

A description, comparison, and contrast of postsecondary developmental mathematics programs in North Dakota
by Laurie Kay Geller

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education in Education
Montana State University
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Abstract:
Postsecondary developmental education is prevalent in higher education. In North Dakota and the rest of the nation, mathematics required remediation more often than any other subject. The literature has identified practices that contribute to successful developmental education, but it was not known if postsecondary developmental educators used these practices.

In response to the above issues, this study did three things: (1) described developmental mathematics education at six of the eleven public postsecondary institutions in North Dakota; (2) compared each institution's policies; organizational and instructional characteristics to "best practice" in developmental education; and (3) contrasted the practices of the programs across institutional types. Data were collected from interviews with instructors and directors of the developmental mathematics programs, observations of developmental mathematics classes, developmental mathematics grade distribution data, and course syllabi.

Findings from the study include the use of mandatory assessment at all institutions but a lack of mandatory placement except at one institution. None of the programs had clearly defined and stated program goals, but most course syllabi included course goals or objectives. None of the programs were regularly and systematically assessed and evaluated. Developmental mathematics instructors were usually adjuncts or lecturers with bachelor's or master's degrees. They had few faculty development opportunities, and some were not included in their department's planning and decision-making activities. All programs used some form of technology but to differing degrees, and most programs intended to align developmental math courses with future courses. Tutoring was the main support service available to students, except at one institution.

This institution had a successful cohort program for underprepared students that included Supplemental Instruction.

As a result of the study, suggestions and recommendations were made for developmental mathematics programs, academic leaders, researchers, and further research.

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by

Laurie Kay Geller

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APPROVAL

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Laurie Kay Geller

This dissertation has been read by each member of the dissertation committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date 7/17/2003

This work is dedicated to my grandmothers, Mary Clifford and Maxine Randolph, two strong, talented, and beautiful women.

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ABSTRACT

Postsecondary developmental education is prevalent in higher education. In North Dakota and the rest of the nation, mathematics required remediation more often than any other subject. The literature has identified practices that contribute to successful developmental education, but it was not known if postsecondary developmental educators used these practices.

In response to the above issues, this study did three things: (1) described developmental mathematics education at six of the eleven public postsecondary institutions in North Dakota; (2) compared each institution's policies, organizational and instructional characteristics to "best practice" in developmental education; and (3) contrasted the practices of the programs across institutional types. Data were collected from interviews with instructors and directors of the developmental mathematics programs, observations of developmental mathematics classes, developmental mathematics grade distribution data, and course syllabi.

Findings from the study include the use of mandatory assessment at all institutions but a lack of mandatory placement except at one institution. None of the programs had clearly defined and stated program goals, but most course syllabi included course goals or objectives. None of the programs were regularly and systematically assessed and evaluated. Developmental mathematics instructors were usually adjuncts or lecturers with bachelor's or master's degrees. They had few faculty development opportunities, and some were not included in their department's planning and decision-making activities. All programs used some form of technology but to differing degrees, and most programs intended to align developmental math courses with future courses. Tutoring was the main support service available to students, except at one institution. This institution had a successful cohort program for underprepared students that included Supplemental Instruction.

As a result of the study, suggestions and recommendations were made for developmental mathematics programs, academic leaders, researchers, and further research.

INTRODUCTION TO THE STUDY

Chapter Introduction

> "If you think the cost of education is high--try ignorance" (Bok, 1979, p. 28). The actual cost of effective remedial education is small compared with the cost of maintaining a society with large numbers of uneducated, unemployed, unemployable, and discontented citizens. Remedial programs can alleviate these ills and offer opportunities for citizens to become taxpayers, workers, and—ultimately—consumers. Critics of remedial programs need data to compare the cost of education and training with the actual cost of alternatives--for example, inmate incarceration. (Roueche & Roueche, 1999b, p. 15)

There was a widespread need for developmental education at colleges and universities across the country. According to the National Center for Education Statistics (1996), 78% of higher education institutions that enrolled freshmen in 1995 offered developmental courses in reading, writing, or mathematics. Adelman (1999) found that 46% of all postsecondary students who earned more than 10 credits took at least one remedial course in English, pre-collegiate math, or basic study skills. Boylan (1999b) estimated that approximately 2.5 million of the nation's almost 13 million undergraduates participated in developmental education during any given year. This estimate was nearly 20% of all undergraduates. The National Center for Education Statistics (1996) found that in 1995, 29% of the nation's 2.1 million first-time freshmen enrolled in at least one developmental reading, writing, or mathematics course. Unlike Boylan's (1999b) estimate, the study by the National Center for Education Statistics did not include: (1) developmental courses in other subjects, (2) developmental services outside of courses, (3) spring developmental enrollments, and (4) non-freshmen participating in

developmental education. In addition, it only reported the percentage of first-year students *enrolled* in developmental education in 1995, not the percentage of students who actually *needed* to take developmental courses. The large numbers of students participating in developmental education raised concerns about its cost.

In 1998, Breneman and Haarlow estimated the annual cost of developmental education to be approximately $1 billion of the $115 billion public higher education budget. This estimate did not include the costs at private institutions or other costs to society and the economy. Merisotis and Phipps (2000) estimated that the figure was probably closer to $2 billion. Saxon and Boylan (1999) said, "Remedial courses seldom cost institutions more than they received in revenues...[and] typically generate more revenue than is spent in their delivery" (para. 36). Others (Astin, 1998; Boylan, Bonham, & White, 1999; Ghazi & Irani, 1997; Institute for Higher Education Policy, 1998; McCabe, 2000a, 2000b; Merisotis & Phipps, 2000; Phipps, 1998; Roueche & Roueche, 1999b; The Economic Importance, 2001) argued that what was spent on developmental education was merely an investment in today's society and economy. This investment would pay for itself by decreasing the likelihood of dependency on social programs and increased tax revenue. McCabe (2000a) stated, "Ten students can have the foundation for their future built through remedial education for the same cost as incarcerating one person for a single year" (p. 40).

Adelman (1995) found that the need to take developmental education reduced the probability of attaining a degree, but effective developmental education "equalizes the opportunity for underprepared students to be successful" (Boylan, 1999b, para. 13).

"With appropriate assistance, underprepared students can be just as successful in higher education as their better prepared colleagues" (Boylan, 1999b, para. 16). Boylan and Bonham (1992) found that community college students who were judged to be underprepared and who participated in developmental education were slightly more likely to obtain a degree than the typical community college student. The situation was similar at the universities. Boylan, Bonham, Claxton, and Bliss (1992), Minnesota State Colleges and Universities (1996), and Boylan and Saxon (1998a) found evidence that suggested passing developmental courses was related to higher grades and to increased student retention. Students who passed developmental courses were also more likely to pass their first college level course in the same subject (Boylan, Bonham, Claxton, & Bliss, 1992; Penny & White, 1998).

From the above, developmental education was a concern of higher education and society. The workplace needed highly educated employees to meet the demands of an increasingly technical and global workplace. Developmental education based on "best practice" helped more students successfully take and pass college level courses, be retained longer, and eventually earn a degree. "Providing effective remedial education is not a mysterious proposition. We know how to do it. We simply do not use what we know" (Boylan & Saxon, 1999, para, 54).

Statement of the Problem

The problem addressed in this comparative study was postsecondary developmental education was prevalent in higher education institutions, and it was not

known whether institutions used the techniques, models and structures described in the literature that contributed to successful developmental education.

Purpose of the Study

The purpose of this comparative study was: (a) to describe public postsecondary developmental mathematics education in North Dakota; (b) to compare each institution's policies, organizational and instructional characteristics to "best practice" in developmental education; and (c) to contrast these programs by institutional type using the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994).

Significance of the Study

Postsecondary developmental education was present at the 11 public institutions in North Dakota. During the fall of 2001, these 11 institutions enrolled 37,596 students, including 7,825 new freshmen (Office of Data Collection and Reporting, 2001). During the 1999-2000 academic year, 3,415 students were enrolled in developmental education, as defined at each institution (North Dakota University System [NDUS], 2000). Each institution might have defined developmental education differently. For example, at the four-year institutions, students who took mathematics courses numbered lower than Math 103 College Algebra did not always receive credit toward graduation for these courses. Other students at some of the two-year institutions received credit toward graduation and their degrees for some of these courses. One institution defined a writing lab as developmental education. Other institutions that required students to attend such labs did

not define their labs as developmental education. In addition, some enrollment data were missing. For example, one institution offered the developmental mathematics course, Math 102 Intermediate Algebra, but these data were not included on the report (NDUS, 2000). Thus, the number of postsecondary developmental students in North Dakota might have been higher than what was accounted for in the study.

Developmental mathematics education in North Dakota had the largest enrollments of all subject areas (NDUS, 2000). In fall 1999, 49% of all developmental enrollments were in developmental mathematics courses, and in spring 2000, 62% were enrolled in developmental mathematics courses (NDUS, 2000). The North Dakota University System (NDUS) (2000) further explored one of the developmental mathematics courses. They examined the 182 first time, first year freshmen in Math 100 Elementary Algebra at one of the doctoral institutions in fall 1999. Math 100 was considered a "refresher math" course and did not satisfy any associate's or bachelor's degree requirements at any of the 11 institutions (NDUS, 2000). The NDUS (2000) stated that 150 of the 182 students (82%) met North Dakota's core admission requirements for baccalaureate and graduate campuses (North Dakota State Board of Higher Education, 2001). This included at least three years of mathematics in high school at the level of algebra I and above. Yet these students still placed into a developmental mathematics course. Fifty-nine percent of the 182 students were 18 to19 years old; thus, they were probably students who had recently graduated from high school. Developmental mathematics was in demand in North Dakota, even by recent graduates who met college preparatory mathematics requirements.

The greatest need for remediation was in mathematics (Boylan & Saxon, 1999; McCabe, 2000a; National Center for Education Statistics, 1996). According to the National Center for Education Statistics (1996), 24% of all 2.1 million entering freshmen enrolled in developmental mathematics courses in 1995, while 13% and 17% enrolled in developmental reading and writing courses, respectively. This percentage was higher than in 1989 when 21% of all entering freshmen enrolled in developmental mathematics courses (National Center for Education Statistics, 1991, 1996). Developmental mathematics courses also had the lowest passing and completion rates of all subjects (Adelman, 1999; Boylan & Bonham, 1992; National Center for Education Statistics, 1991, 1996). In 1989, 67% of students passed developmental mathematics courses while 73% and 77% passed developmental writing and reading courses, respectively (National Center for Education Statistics, 1991). This trend continued in 1995 when 74% passed developmental mathematics courses and 79% and 77% passed developmental writing and reading courses, respectively (National Center for Education Statistics, 1996). These percentages were lower in the public two-year and four-year institutions than in the private two-year and four-year institutions (National Center for Education Statistics, 1991, 1996). Hagedorn, Siadat, Fogel, Nora, and Pascarella (1999) reported Adelman's bleak view of remedial mathematics:

> According to Adelman (1995), the mathematical background of many remedial college students is so deficient that a high failure rate exists even in the remedial classes...Moreover, the major proportion of these students become frustrated with curriculums that include no true or transferable college credit and therefore "drop out" of college without earning a degree (or, in many cases, any transferable college credits). (p. 261)

Mathematics was the greatest obstacle for many students (McCabe, 2000a). However it was so important in the changing workplace, economy, and society.

According to testimony by Greenspan (as cited in The Economic Importance, 2001), "We must strengthen math and science education to address the requirements of the newer technologies we see on the horizon" (para. 16). "Currently, 65% of the nation's workers need the skills of a generalist/technician, including advanced reading, writing, mathematical, critical thinking, and interpersonal group skills. Twenty years ago, that figure was only 15%" (Merisotis & Phipps, 2000, p. 78). According to McCabe (2000a), "Eighty percent of new jobs will require some postsecondary education" (p. vii). McCabe (2000a, 2000b) believed that the workplace would be different in the future. He argued that, in the global economy of the future, jobs would become more complex. America's future would depend more on an educated workforce. McCabe (2000a, 2000b) also noted that demographic changes, such as an aging population, increasing numbers of minorities, and changes in family life, would affect higher education. "Colleges will have the responsibility of raising education attainment for this more diverse and less prepared student population" (McCabe, 2000b, p. 181).

"Providing effective developmental programs that give underprepared students the opportunity to qualify for good jobs is an essential mission for American higher education" (McCabe, 2000b, p. 180). Eliminating developmental education, as critics of developmental education suggested (Healy, 1998; Selingo, 2000), would limit educational opportunities for the poor, who were the majority of those who needed remediation (Boylan, Bonham, & White, 1999; Boylan & Saxon, 1998a; McCabe, 2000a;

McCabe & Day, 1998). It would also limit opportunities for minorities. According to McCabe and Day (1998) and McCabe (2000a, 2000b), minorities were the fastest growing segment of the population, and they would eventually be the majority of the nation's population. Yet, minorities were more likely to have lower incomes, and poverty was the primary cause of educational underpreparation (McCabe, 2000a, 2000b). By eliminating developmental education, the country might only be hurting itself. There was a direct relationship between the amount of education citizens had and the economic prosperity of a state (Lavin & Hyllegard, 1996; McCabe & Day, 1998; Phipps, 1998).

Mathematics required remediation more often than any other subject in North Dakota as well as in the rest of the nation. It was important that developmental students were provided access to developmental programs that were effective as mathematics became more important in a global and technical society. The results of this study included descriptions of six developmental mathematics programs in the NDUS. In addition, the practices of each program were contrasted and compared to "best practice" in an effort to answer the following research questions.

Research Questions

1. What were the policies, organizational, and instructional characteristics of each public postsecondary developmental mathematics program in North Dakota?
2. How did the policies, organizational, and instructional characteristics of each public postsecondary developmental mathematics program in North Dakota compare to "best practice" in developmental education?
3. How did the programs contrast across institutional types?

Definition of Terms

The following terms were defined to clarify their meaning as they were used throughout this paper. Other terms were defined as they were introduced.

1. Developmental education courses: "Courses in reading, writing, or mathematics for college students lacking those skills necessary to perform college level work at the level required by the institution" (National Center for Education Statistics, 1996, p. 2).
2. Developmental support services: services supporting developmental courses that can include orientations, seminars, learning labs, workshops, tutoring, Supplemental Instruction, and counseling.
3. Developmental education: all developmental education courses and support services.
4. Success in a course: obtaining a grade of C or better.
5. Success in developmental education:

   > The success of developmental students is typically measured in three ways: (a) the rate at which they pass developmental courses, (b) the rate at which those who pass developmental courses later pass regular courses in the same subject, and (c) the rate at which developmental students are retained through to graduation. (Boylan & Saxon, 1998b, p. 9)

6. Developmental education students: those students participating in developmental education.
7. Developmental mathematics education: mathematics courses and support services for college students taking mathematics courses numbered below Math 103 College Algebra.
8. College level: defined by the institution to be non-developmental.

9. Institutional type: as defined by the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994).
10. "Best practice": The policies and practices identified in the literature that contribute to student success in developmental education.

Assumptions, Limitations, and Delimitations of the Study

Assumptions

The following assumptions were made with regard to this study:

1. It was assumed that the policies and practices of the developmental mathematics programs could be accessed at each of the institutions in NDUS through the collection of developmental mathematics grade distribution data and course syllabi, interviews with directors and instructors of developmental mathematics programs, and observations of developmental mathematics classrooms. Many of the practices and polices were accessed, but the use of some of the instructional practices, such as the use of learning theories, constructivist or discovery based teaching methods, could not be confidently determined in this study. One of the studied institutions did not send grade data, and another institution did not include dropped students in their data.
2. No one "proved" that what Boylan and Saxon (1999), as well as others like Roueche, identified as "best practice" were actually that. These "best practices" were only related to better programs and student success.

Limitations and Delimitations

A limitation is that which limits the study and is beyond the control of the researcher. A delimitation also limits the study, but is imposed on the study by the researcher. The following were the limitations and delimitations of this study:

1. Interviews were conducted with the directors of the developmental mathematics programs. Depending on his or her position and training, each director had a different amount of information about developmental mathematics education. Depending on the amount of and quality of information, the program descriptions, comparisons to "best practice," and contrasts across institutional types might have been limited.
2. The study was limited by any inability to get interviewees to openly respond to the questions.
3. The study was limited due to the inability to test the "best practices" of developmental education to determine if they really were such.
4. The study was delimited because the researcher was only studying postsecondary developmental mathematics programs at six of the 11 public institutions in one state, North Dakota.
5. The study was delimited by the "best practice" model of developmental education identified by the researcher using the literature. It was the researcher's judgment and the review of the literature that was used to develop this model.
6. The study was delimited because only a few instructors of developmental mathematics courses, not all instructors, were interviewed at each institution. This limited the amount of data collected to describe, compare, and contrast the

instructional practices and policies of each of the institutions and institutional types. As a result, this limited the conclusions that were drawn for each program and for all of the developmental mathematics programs in the study and in the NDUS.

7. The study was delimited by the researcher's data collection methods. Extensive classroom observations would have been another method to collect data regarding instructional practices and policies, but one class meeting of each developmental math course at each of the six institutions was observed only once. If more classes were observed, more information could have been collected that might have allowed broader conclusions to be reached.

Organization of the Remainder of the Study

Postsecondary developmental mathematics education in North Dakota was examined in this study. Postsecondary developmental mathematics programs at six of the 11 institutions were described. The policies, organizational and instructional characteristics of the six programs were compared to "best practice" in developmental education, and the practices of these programs were contrasted across institutional types.

The data were collected using the following methods. First, developmental mathematics grade distribution data were collected from the institutions. Second, developmental mathematics course syllabi were collected and analyzed for evidence of "best practice" and other general items. Third, the researcher visited each campus and observed the instruction used in each developmental mathematics program. Fourth, while visiting the institutions, interviews were conducted with the director of the

developmental mathematics program and with a few developmental mathematics instructors. The methodology and research design are described in more detail in the third chapter, Research Methodology.

"Essentially the research indicates that developmental programs employing sound organizational and teaching strategies have been consistently linked to higher passing and completion rates in courses, better students grades, and higher retention rates" (Boylan, Bonham, & White, 1999, p. 94). The more successful postsecondary developmental programs tended to use more of these practices (Boylan, Bonham, & White, 1999). The next chapter provides a synthesis and evaluation of the literature on developmental education, including those practices considered to be "best."

LITERATURE REVIEW

Chapter Introduction

In this chapter the literature related to developmental education and developmental mathematics education are presented. It is focused on what is considered "best practice" in developmental education. The majority of the chapter includes theme development of the literature regarding the state of and research in developmental education. The criteria for selecting the literature, the context of the problem, and a review of methodologies used for this type of research are also explained. After the presentation of literature, it is summarized and evaluated for weaknesses and strengths, for gaps and saturation points, and for avenues for further inquiry.

Criteria for Selecting the Literature

The majority of the literature was from studies done by the National Center for Education Statistics and the National Center for Developmental Education. More specific, the review includes information from the report, Remedial Education at Higher Education Institutions Fall 1995 (National Center for Education Statistics, 1996; see also Adelman, 1999), and from the many publications that resulted from the National Study of Developmental Education (Boylan, 1999b; Boylan, Bliss, & Bonham, 1993, 1997; Boylan & Bonham, 1992; Boylan, Bonham, & Bliss, 1994a, 1994b; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Boylan, Bonham, Jackson, & Saxon, 1994, 1995) conducted by the National Center for Developmental

Education throughout the 1990s. Most of the other literature that was used included: (a) studies done by J. E. Roueche and his colleagues (Roueche, 1973; Roueche & Kirk, 1973; Roueche & Roueche, 1993, 1999a; Roueche & Snow, 1977); (b) sources identified in Annotated Research Bibliographies in Developmental Education: Developmental Mathematics (Bonham, et al., 2000); (c) sources and information found in the literature review, What Works in Remediation: Lessons from 30 Years of Research by Boylan and Saxon (1999); (d) reports written by McCabe (2000a) and McCabe and Day (1998); and (e) information from the national organizations in developmental education and developmental mathematics, including the National Association for Developmental Education, the National Center for Developmental Education, and the American Mathematical Association for Two-Year Colleges. These sources and studies were chosen and used because they provided the most recent, comprehensive, and accurate information on developmental education.

The research conducted by Roueche and his colleagues (Roueche, 1973; Roueche & Kirk, 1973; Roueche & Roueche, 1993, 1999a; Roueche & Snow, 1997), McCabe (2000a), the National Center for Education Statistics (1991, 1996, 2000; see also Adelman, 1999), and the National Center for Developmental Education (Boylan, 1999b; Boylan, Bliss, & Bonham, 1993, 1997; Boylan & Bonham, 1992; Boylan, Bonham, & Bliss, 1994a, 1994b; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Boylan, Bonham, Jackson, & Saxon, 1994, 1995) were large studies that included all types of institutions across the nation and appeared to have employed sound research methodologies.

The literature review of developmental education that was done by Boylan and Saxon (1999) was also large and comprehensive. It yielded a literature base of approximately 600 books, articles, and technical reports from the last 30 years. These 600 sources were reduced to approximately 200 once each piece was examined and required to meet a set criteria (Boylan & Saxon, 1999). This review (Boylan & Saxon, 1999) was often used for summative information, as a springboard for identifying other sources, and as a guide or reference to many of the "best practices."

The literature did have some weaknesses. Much of the descriptive literature was becoming outdated. The data from the studies by the National Center for Education Statistics (1991, 1996) and the National Center for Developmental Education (Boylan, 1999b; Boylan, Bliss, & Bonham, 1993, 1997; Boylan & Bonham, 1992; Boylan, Bonham, & Bliss, 1994a, 1994b; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Boylan, Bonham, Jackson, & Saxon, 1994, 1995) were between 7 to 12 years old. Funding cuts prevented or delayed studies by the National Center for Education Statistics from being completed and published (H. R. Boylan, personal communication, January, 2002). According to C. Adelman (personal communication, January 3, 2002), new transcript data from the years 1992 to 2000 would be available spring 2002.

The developmental mathematics literature was limited. There were few studies that specifically examined developmental mathematics with large numbers of students at a variety of institutions and areas of the country. Most of the developmental mathematics education research was action research. It was performed at one institution

or with a small number of students. This made it less generalizable than other forms of research. For these reasons, much of the literature on "best practice" in developmental education came from the larger studies that tended to focus on developmental education in general, not applied to one specific subject area like mathematics.

Finally, the literature on "best practice" in developmental education identified practices and policies that were found in successful programs or that were correlated with student success. No one proved that these practices caused student success or why these practices tended to be associated with student success, only that they were related to it.

Context of the Problem

The following sections are intended to provide background and insight into the context of developmental education. Remedial education and developmental education are differentiated so the reader can understand the difference. The history of developmental education is documented to illustrate how it developed into its current form. The different types of developmental students are described to provide insight into who participates in developmental education. Estimates of the costs of developmental education are given, and the opinions of critics of developmental education are explained in order to provide an opposing viewpoint. This section concludes with an explanation of the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994).

Remedial Education Versus Developmental Education

A number of terms were used to describe courses or services that help underprepared college students. The most common terms were "remedial education" and "developmental education." Often the literature did not distinguish between the two terms, but there was a difference. For the purposes of this study, the researcher decided to use the term developmental education.

Remedial education usually was associated with a few things. First, the term "remedial" implied a student had some sort of academic deficiency that needed to be fixed or overcame. This gave remedial education a negative connotation and likened it to a medical model where (a) a diagnosis was made of the student's weaknesses, (b) treatments were prescribed, and (c) the learner was evaluated, much like a patient, to determine if the treatment was successful (Cassaza, 1999). Second, remedial often referred exclusively to pre-college level courses, not other services offered to students (Boylan, Bonham, & White, 1999). Third, the main goal of remedial education was to improve students' academic skills. It wanted to fix or remediate students' academic skills in order to prepare them for college level courses. It was not concerned so much with students' non-cognitive skills.

Developmental educators believed the problem was more complex.

> We began to understand that poor academic performance involved far more complex factors than a student's being unable to solve for *x* in an algebraic equation or write a complete sentence using proper grammar. If such deficiencies were the only problems for students having difficulty in college, simple remediation would be an appropriate solution for everyone. (Boylan & Saxon, 1998b, p. 7)

For these and other reasons, developmental education had a more holistic approach to helping college students. It was concerned not only with cognitive development, but also with affective factors like, locus of control, attitudes toward learning, self-concept, self-esteem, autonomy, and the ability to seek help. It was based on a belief that academic and personal growth were linked (Boylan & Saxon, 1998b). Developmental educators sought to develop the whole student and his or her talents, not just alleviate deficiencies in academic areas.

Developmental education included courses, counseling, tutoring, Supplemental Instruction, orientations, seminars, learning labs, and workshops. According to Cross (1976), developmental education was like an umbrella, under which a variety of services existed that maximized the many talents of students. Boylan, Bonham, and White (1999) described developmental education as a continuum of services with remedial courses on the low end and tutoring or learning assistance centers on the high end. According to the National Association for Developmental Education (2001a):

> Developmental education is a field of practice and research within higher education with a theoretical foundation in developmental psychology and learning theory. It promotes the cognitive and affective growth of all postsecondary learners, at all levels of the learning continuum. Developmental education is sensitive and responsive to the individual differences and special needs among learners.
>
> Developmental education programs and services commonly address academic preparedness, diagnostic assessment and placement, development of general and discipline-specific strategies, and affective barriers to learning.
>
> Developmental education includes, but is not limited to: all forms of learning assistance, such as tutoring, mentoring, and Supplemental Instruction; personal, academic, and career counseling; academic advisement; and coursework. (Definition section, para. 1-3)

The National Association for Developmental Education (2001a) had a list of goals of developmental education.

1. To preserve and make possible educational opportunity for each postsecondary learner.
2. To develop in each learner the skills and attitudes necessary for the attainment of academic, career, and life goals.
3. To ensure proper placement by assessing each learner's level of preparedness for college coursework.
4. To maintain academic standards by enabling learners to acquire competencies needed for success in mainstream college courses.
5. To enhance the retention of students.
6. To promote the continued development and application of cognitive and affective learning theory. (Goals section, para. 1)

These definitions and goals did not provide colleges with a definitive definition of developmental education. Rather, they provided some insight into what developmental education was in general. Each institution or state had to decide what would be considered developmental and how students would be assessed to determine if they required developmental education. Developmental education was arbitrary and relative (Astin, 1998; Merisotis & Phipps, 2000). As Astin (1998) pointed out:

> Most remedial students turn out to be simply those who have the lowest scores on some sort of normative measurement—standardized tests, school grades, and the like. But where we draw the line is completely arbitrary. Second, the "norms" that define a "low" score are highly variable from one setting to another. (para. 12, 13)

In summary, remedial education focused on alleviating deficiencies in students' academic skills and was usually done through coursework. Developmental education was more holistic. It was offered under an umbrella of services and sought to develop the entire student, not just fix their academic inadequacies. Institutions could use these definitions to guide their developmental education programs, but each institution had to

decide which students would participate in developmental education. These decisions often were made in arbitrary and relative ways (Astin, 1998).

History of Developmental Education

Developmental education is not a new phenomenon. It has been a part of American higher education since its beginnings. Its history has paralleled the history of and changes in higher education in general.

Casazza (1995) attributed changes in the educational system to the constant tensions between reformists and traditionalists. The tensions were centered about institutional purpose, students, and curriculum and occurred and recurred throughout the history of higher education. One of these tensions stemmed from the reformists desire for change; while the traditionalists feared that change would bring about a lowering of academic standards (Casazza, 1995). This tension continued with regard to developmental education.

Casazza (1995) divided her historical overview of developmental education into three periods: 1700 to 1862, 1862 to 1960, and 1960 to 2000. For each of these time periods she examined: (a) the purpose of postsecondary education, (b) who should attend college, and (c) what the curriculum should look like. The following paragraphs highlight and summarize what Casazza (1995) wrote.

During the period from 1700 to 1862, there was a "tension associated with founding colleges in a new democracy with only the classical institutions of Europe to use as reference points" (Casazza, 1995, para. 8). During this time period, American institutions of higher education trained and educated male clergy so that they could lead

society as well as help maintain European cultural norms. Higher education was for elite males from certain families. The members of these families had backgrounds in Greek and Latin and were of high moral character. All students had to learn the same curriculum, the classical curriculum, and they had to learn it the same way. There were instances when higher education did reach out to diverse populations, such as the American Indians, but these actions were usually criticized and seen as lowering standards.

Eventually colleges found that they needed students in order to survive financially. They began admitting students that they did not consider to be ready for college. In order to help these students, preparatory departments were formed. The enrollments of these departments often exceeded the regular college enrollments. This typically was due to the lack of secondary schools at that time. Students just did not have the necessary background, especially in Greek and Latin, to begin college fully prepared.

The preparatory departments were much like a high school within the college. These departments offered assistance in spelling, reading, writing, mathematics, classical languages, and other topics. These programs sometimes led to a six-year program for underprepared students. The classic preparatory department at the University of Wisconsin lasted from 1849 until 1880.

Colleges that did not have preparatory departments often offered pre-college courses and tutoring to those in need. Students were admitted "on condition" and had to get extra assistance, enroll in special classes, or receive tutoring to remain a student at the institution.

Proprietary tutoring schools were also available. These were private ventures that tutored students in college and college preparatory coursework. They also helped students prepare for college entrance exams.

In any case, these programs were criticized for lowering academic standards. The Yale Report of 1828 ("The Yale Report," 1997) was evidence of this when it called for an end to admitting underprepared students. Eventually, the traditionalists could not withstand the pressures from the reformists and from those in society who called for a more utilitarian curriculum in which students had a voice in their education.

During the period from 1862 to 1960, the federal government had an enormous impact on higher education. The Morrill Acts of 1862 and 1890, equal opportunity legislation, and the G.I. Bill of Rights expanded and changed the purpose of higher education as well as the type of students who attended college. It also diversified the curriculum and opened doors to a more diverse population of students.

When higher education opened its doors to admit all of these students, it opened its doors to many students who were not prepared for college level work. For example, in 1879, 50% of Harvard applicants failed the entrance exam and were admitted on condition. In 1907, more than half of new students at Harvard, Yale, Princeton, and Columbia did not meet entrance requirements. These schools were forced to add developmental courses to their curricula. Most schools added courses in remedial reading and study skills. In 1909, over 350 colleges offered a "How to Study" course.

During the second half of the nineteenth century, elementary and secondary schools started to become more uniform and abundant. This increase in schools and

uniformity provided colleges with more students in general, as well as more students who were better prepared for college. Even so, there were still many who needed extra assistance. The development of the junior college arose next.

The junior college was initially established within four-year institutions. They offered two years of liberal studies for those who could not complete four years at a college or university. There were also two-year general colleges that helped prepare students who wanted to transfer to four-year institutions. These colleges eventually led to the development of the community college.

In 1900, 1.6% of the college-age population was enrolled in college. In 1960, approximately 22% were. College was no longer just for elite males. Women, blacks, farmers' children, minorities, and veterans entered and eventually flooded, higher education during the first half of the 20th century. These diverse students brought with them diverse needs. Sometimes institutions met these students' needs, but often they did not. This need led to the development of black colleges, women's colleges, and teacher's colleges. These institutions dealt specifically with these particular students' needs. For example, black colleges offered pre-college courses for black high school students who were receiving a high school education that was inadequately preparing them for college.

The developmental programs offered to students prior to 1960 were usually required and often carried credit. They typically took the form of one of the following: (a) special courses, (b) intensified sections of regular courses, (c) tutoring, (d) clinical work, or (e) a reduced schedule of instruction. The most popular approach with the students was the clinical approach. It was also the most expensive approach, but it was

more individualized, and it aimed at improving the whole student, not just fixing or eliminating their academic weaknesses and deficiencies.

For the period from 1960 to 2000, Casazza (1995) reviewed the changes that had to be made at institutions in order to help students succeed. The doors of higher education opened to almost everyone during the 1960s. New types of colleges were designed to serve the needs of these new, often nontraditional, students. The community colleges grew in number. In 1970 there were over 1,000 junior and community colleges serving two million students. Everyone had to offer services to underprepared students, but they still did not know the most effective ways to do this.

Many colleges allowed students to place themselves in courses and create their own academic programs. This freedom led to high failure rates, as well as high dropout rates. It also led to debates about standards and who was considered "college material." Access at the open-door institution was required, but these institutions needed to know how to keep the open door from revolving and pushing the underprepared students right back outside. Access needed to be combined with excellence.

Access contributed to the current state of developmental education. Researchers identified various policies and practices that were associated with "best practice" and student success in developmental education. Accountability requirements and concerns forced institutions to examine their developmental programs. Developmental courses did not have to act as a filter, keeping the underprepared students out of higher education and the increasingly technical workforce. Rather, developmental courses could act as a

pump, fueling institutions, and eventually the workforce and society, with highly trained, skilled workers, taxpayers, and citizens.

To summarize, higher education in America was originally intended for an elite few who had to learn the classical curriculum. Later as colleges were forced to admit more students in order to survive, they had to change to accommodate these new students. These changes included the development and use of preparatory departments, pre-college courses, tutoring, conditional admittance policies, private tutoring schools, developmental courses, junior colleges, two-year general colleges, community colleges, black colleges, women's colleges, and teachers colleges, and today's diverse institutions in which 78% offered developmental courses in reading, writing, or mathematics (National Center for Education Statistics, 1996).

The Developmental Student

Classifications of Developmental Students.

There was no typical developmental student. "The students served in developmental programs come from diverse backgrounds, and the reasons they need developmental courses are as complex as the students themselves" (Hardin, 1998, p. 16). Often they were defined by the institution to be underprepared for college level work, usually based on scores from standardized tests or placement tests. These students were considered to be retention risks and had the least chance of success when this was measured by grades (Boylan & Bonham, 1992).

The Southern Regional Education Board's (SREB) report, prepared by Abraham and Creech (2000), put developmental students into the following categories:

1. A student who graduated from high school years ago and needs a refresher course in mathematics or writing.
2. A recent high school graduate who completed a college preparatory program and may have even received good grades, but whose high school did an inadequate job of preparing him or her.
3. A recent high school graduate who did not take a college preparatory program and was, therefore, not ready for college.
4. A recent high school graduate who completed a college preparatory program but earned low grades.
5. A recent high school graduate who planned to go to college but did not take a college preparatory mathematics class during the senior year.

Hardin's (1988, 1998) classification of developmental students extends the SREB classification to include more categories of students.

Hardin (1988, 1998) classified developmental students into seven categories. These categories were: (1) the poor choser, (2) the adult student, (3) the student with a disability, (4) the ignored, (5) the student with limited English proficiency, (6) the user, and (7) the extreme case.

According to Hardin (1988, 1998), the "poor chooser" was the most common type of developmental student. These students made a decision or decisions that had adverse effects on their academic futures. These decisions usually included not taking a college preparatory curriculum in high school or dropping out of high school (Hardin, 1988, 1998).

The "adult student" was one who had "been away from the academic setting for an extended time" (Hardin, 1998, p. 18). This group of students was one of the fastest growing groups of college students. According to the National Center for Education Statistics (2001c) the population of students 25 years old and older was projected to decrease and then increase again from 1999 to 2011. The traditional college-age population of 18- to 24-year olds was expected to increase 17% during those same years.

The "student with a disability" had a physical or academic weakness (Hardin, 1988, 1998). According to Hardin (1988, 1998), these students might need developmental education for three reasons: (1) their disability prevented them from entering mainstream secondary education; (2) they lacked the necessary social and academic skills to succeed in postsecondary education because their previous education was taught in isolation; or (3) they lost previously learned material due to an injury that resulted in the disability.

The "ignored student" often had academic or physical weaknesses that were not detected while attending high school (Hardin, 1988, 1998). These students tried to remain anonymous and out of the teacher's way to avoid embarrassment, but this avoidance limited what they learned (Hardin, 1998).

The "student with limited English proficiency" obtained his or her elementary and secondary education in a foreign country (Hardin, 1988, 1998). They required help in improving their verbal, reading, and writing skills (Hardin, 1988, 1998).

The "user" attended college for purposes other than obtaining a college education (Hardin, 1988, 1998). They might go to college for the financial benefit of receiving

financial aid or parental support. College might be a place to play sports, to socialize, and to avoid parents' wrath or getting a job. These students did only the minimum in order to get by academically and remain in school (Hardin, 1988, 1998).

The student classified as an "extreme case" had such extreme academic, emotional, and psychological problems that he or she could not succeed in higher education (Hardin, 1998). These students caused problems for their teachers inside and outside of class by causing disruptions and dominating their teacher's time. They needed intervention, but colleges were not the place for this (Hardin, 1998).

Demographics of Developmental Students. The most recent comprehensive study of postsecondary developmental education was conducted by the National Center for Education Statistics and the Department of Education in 1995 (National Center for Education Statistics, 1996). Thus, the following statistics might not accurately reflect current postsecondary students.

The National Center for Education Statistics (1996) found that 29% of all entering first-time freshmen (2.1 million) enrolled in a developmental reading, writing, or mathematics course in fall 1995. The two-year institutions had higher percentages than the four-year institutions, as did the high minority institutions when compared to the low minority institutions (see Table 1). A high minority institution was defined as one in which the total student enrollment of US citizens was less than 50% white non-Hispanic (National Center for Education Statistics, 1996). Adelman (1999) reported that 46% of all students who earned more than 10 credits took at least one developmental course in

English, pre-collegiate math, or basic study skills, where pre-collegiate math was defined to be any course through the level of what high schools call "intermediate algebra."

The National Center for Education Statistics (1996) reported percentages of students in developmental courses by subject area and institutional characteristic. These are provided in Table 1. It did not matter what type of institution students attended, two-year, four-year, public, private, low minority, or high minority, they participated in developmental mathematics courses at a higher rate than in any other subject. These percentages were higher at the public institutions than at the private institutions, at the two-year institutions than at the four-year institutions, and at high minority institutions than at low minority institutions.

Table 1. Freshman Developmental Enrollment During Fall 1995, by Subject Area and Institutional Characteristics.

Institutional Characteristic	Number of first-time freshmen (in thousands)	Percent of all entering freshmen that enrolled in developmental courses in:			
		Reading, writing, or mathematics	Reading	Writing	Mathematics
All institutions	2,128	29	13	17	24
Type					
Public 2-year	943	41	20	25	34
Private 2-year	56	26	11	18	23
Public 4-year	726	22	8	12	18
Private 4-year	403	13	7	8	9
Minority Enrollment					
High	338	43	25	29	35
Low	1,790	26	11	15	21

Note. From Remedial education at higher education institutions in fall 1995 (NCES 97-584), (p. 10), by National Center for Education Statistics, 1996, Washington, DC: U.S. Department of Education & National Center for Education Statistics. Copyright 1996 by National Center for Education Statistics, U.S. Department of Education. Reprinted with permission.

Developmental students also passed mathematics at a lower rate than any other subject regardless of institutional characteristic (see Table 2). These percentages were lower at the public institutions than at the private institutions, at the two-year institutions than at the four-year institutions, and at high minority institutions than at low minority institutions.

Table 2. Mean Percent of Students Generally Passing or Successfully Completing Developmental Courses, by Subject Area and Institutional Characteristics: 1995.

Institutional Characteristic	Reading	Writing	Mathematics
All institutions	77	79	74
Type			
Public 2-year	72	71	66
Private 2-year	(#)	81	80
Public 4-year	82	81	71
Private 4-year	84	88	84
Minority Enrollment			
High	70	71	69
Low	78	80	74

Note. From Remedial education at higher education institutions in fall 1995 (NCES 97-584), (p. 13), by National Center for Education Statistics, 1996, Washington, DC: U.S. Department of Education & National Center for Education Statistics. Copyright 1996 by National Center for Education Statistics, U.S. Department of Education. Reprinted with permission.
(#) Too few cases for a reliable estimate.

Adelman (1999) reported similar results. The top six undergraduate courses with the highest rates of withdrawals, no credit repeats, and incompletes were mathematics courses below the college algebra level (p. 202). Four of the top five undergraduate courses with the highest rates of failure or penalty grades were also mathematics courses below the college algebra level (p. 203).

The National Study of Developmental Education took place from 1989 to 1992. This study was conducted by the National Center for Developmental Education. As part of this study, a random sample of 5,566 students was obtained from 160 two-year and

four-year institutions geographically representative of American postsecondary education (Boylan, Bonham, & Bliss, 1994b). A transcript of each student was obtained as well as other information from program personnel and administrative offices. Boylan, Bonham, and Bliss (1994b) collected demographic and academic information on these students. It is summarized in Table 3 and Table 4 below.

Table 3. Demographic Data of Developmental Students.

Developmental Students in U.S. Colleges and Universities		
	At two-year colleges (n = 2,369)	At four-year colleges (n = 3,287)
Mean age (years)	23	19
Proportion of		
Females	53%	54%
African Americans	23%	30%
American Indians/Alaskan Natives	1%	2%
Asian/Pacific Islander	3%	2%
Latino	6%	7%
White (Non-Latino)	67%	59%
Married students	22%	6%
Special admits	7%	43%
Degree-seeking students	77%	98%
Part-time students	32%	8%
Students receiving financial aid	40%	75%
Resident students	6%	65%

Note. From "Who are the developmental students?" by H. R. Boylan, B. S. Bonham, and L. B. Bliss, 1994b, Research in Developmental Education, 11 (2), p. 1. Copyright 1994 by Appalachian State University. Reprinted with permission.

Table 4. Academic Data of Developmental Students.

Developmental Students in U.S. Colleges and Universities		
	At two-year colleges (n = 2,369)	At four-year colleges (n = 3,287)
Mean H.S. GPA*	2.40	2.58
Mean total SAT	—	674
Mean cumulative GPA*	2.28	2.11
Proportion of		
Students persisting at least one year*	74%	67%
Graduated or still in school*	27%	37%
SAT total score 900 or above*	2%	19%

Note. From "Who are the developmental students?" by H. R. Boylan, B. S. Bonham, and L. B. Bliss, 1994b, Research in Developmental Education, 11 (2), p. 2. Copyright 1994 by Appalachian State University. Reprinted with permission.
*Significantly different at p = 0.01

Like the study by the National Center for Education Statistics (1996), the data collected in the National Study of Developmental Education were becoming outdated, but some of the findings were probably still relevant. For example, according to Boylan, Bonham, and Bliss (1994b), 59-67% of all developmental students were white non-Latino, and 23-30% were African Americans. Yet African Americans were represented at a higher rate than whites (Boylan, Bonham, & Bliss, 1994b). At the time of this study, 9% of those enrolled in higher education institutions were African American, yet African Americans were represented at more than two to three times that rate in developmental programs (Boylan, Bonham, & Bliss, 1994b). Latino students did not appear to be overrepresented. Approximately 6% of all college students were Latino, and about 6% participated in developmental education during that time (Boylan, Bonham, & Bliss,

1994b). McCabe (2000a) found similar, yet more disturbing, numbers in the community colleges.

McCabe (2000a) defined a subpopulation of developmental students called, seriously deficient students. These students were deficient in reading, writing, and mathematics and assigned to a lower-level developmental course in at least one area. In McCabe's (2000a) National Study of Community College Remedial Education, he found that the demographics of seriously deficient students were much different than those of other developmental students. McCabe (2000a) found that 56% of all academically deficient students were white non-Hispanic, 23.4% were African American, and 12.5% were Hispanic. White non-Hispanic students were still the majority of developmental students, as they were of the entire college population, but minorities were heavily represented in the seriously deficient students (McCabe. 2000a). In fact, three quarters of seriously deficient students were minorities—39.8% African American, 21.6% Hispanic, 8.8% Asian/Pacific Islander, 5.8% other—while 23.9% were white non-Hispanic (McCabe, 2000a, p. 36). "The study shows that academic deficiencies affect minorities to a far greater extent than they do white non-Hispanics. For minorities, deficiencies produced through K-12 system inequalities and disproportionate poverty are projected into college" (McCabe, 2000a, p. 36).

Students who participated in developmental education maintained a C average, and they were retained and graduated at rates comparable to those of American college students overall. Jencks and Reisman (1969) and Tinto (1987) estimated attrition rates at four-year institutions to be 66% to 56%, respectively. The 63% attrition rate of

developmental students at four-year institutions was comparable to these figures (Boylan, Bonham, & Bliss, 1994b). A more recent study of American college students, those who enrolled as freshmen in the 1989-90 academic school year, indicated that 37% of all undergraduates graduated from the institution in which they first enrolled within five years, and 50% graduated in five years when transfer students were included (American Council on Education, 2001). At two-year institutions, 22% graduated within five years, and 37% graduated when transfer students were included. At public four-year institutions, private four-year institutions, and for-profit two-year and less than two-year schools, respective pairs of graduation rates with and without transfer students were: 42% and 55%; 58% and 72%; 53% (earned a certificate) and 60%. Another 13% were still working toward their degree five years after enrolling in postsecondary studies (American Council on Education, 2001, p. 3). These last figures were not for developmental students exclusively, but they did compare to the figures Boylan, Bonham, and Bliss (1994b) calculated. If transfers had been included in the study by the National Center for Developmental Education, those percentages would likely have been higher.

In summary, developmental students were quite diverse. They might be an adult, underprepared, physically, emotionally, or psychologically disabled, have limited English skills, or using higher education improperly (Hardin, 1998). Students required developmental education in mathematics more than other subjects (Adelman, 1999; National Center for Education Statistics, 1995), and minorities were overrepresented (Boylan, Bonham, & Bliss, 1994b; McCabe, 2000a). With help, many of these students were retained and graduated at rates comparable to those of all American college students

(Boylan, Bonham, & Bliss, 1994b). The above information on students provided the researcher with additional knowledge that assisted her during the research process and afterwards when writing descriptions of developmental math programs in North Dakota.

Cost of Developmental Education

There were few studies on the cost of developmental education. These studies were difficult to perform due to a number of limitations that were encountered while trying to gain accurate and complete data. These limitations are described below.

First, there was no universal definition for developmental education (Phipps, 1998). The lack of a definition caused problems when collecting and comparing data. English as a second language (ESL) courses might be included in developmental education at one institution but were not included at another institution. The same was true for tutoring, advising, and testing (Saxon & Boylan, 1999).

Second, a universal definition of developmental students did not exist (Phipps, 1998). For example, at one institution developmental mathematics students might be those who received a score of 20 or less on their ACT math tests, while at another institution, even in the same state, it might be those who received scores of 22 or less on the same test. Developmental students might be those students who scored in the bottom third of a standardized test, or they might be those who scored in a certain range on a school-designed placement test. The definition of the developmental student was relative and arbitrary (Astin, 1998). The standards for developmental education varied from state to state and institution to institution.

Third, how costs were distributed varied, and they usually were not separated when reported. For example, institutions did not usually separate the costs of developmental education for nontraditional and traditional age students (Phipps, 1998).

Fourth, instructional issues complicated cost data (Saxon & Boylan, 1999). Often, full-time faculty members taught developmental courses part-time and college level courses as well. The proportion of their salary and benefits were not usually divided to indicate how much they received for each activity. Faculty members also modified their curricula to help students that should have been placed into a developmental course, but who enrolled in a regular college course. The cost of the time and effort spent doing this could not be calculated (Saxon & Boylan, 1999).

Fifth, where developmental education was located within the institution caused problems when collecting cost data (Saxon & Boylan, 1999). It might be easier to collect data that were housed in one centralized department, rather than collecting it from individual departments that offered developmental education (Saxon & Boylan, 1999).

Sixth, it might be beneficial for institutions to understate the cost and extent of developmental education in order to avoid public scrutiny (Saxon & Boylan, 1999; Steinberg, 1998). It might also enhance their reputation and help them recruit students (Merisotis & Phipps, 2000; Steinberg, 1998). Even with all of these limitations, a few researchers and states estimated the cost of developmental education.

Breneman and Haarlow (1998) estimated the annual cost of developmental education to be approximately $1 billion of the $115 billion public higher education budget. This estimate did not include the costs at private institutions or other costs to

society and the economy. Merisotis and Phipps (2000) estimated that the figure was probably closer to $2 billion. In the cost studies Saxon and Boylan (1999, para. 41) reviewed, statewide remediation costs were always in the single digits, always less than 10% of education as a whole, and usually in the one to two percent range. Saxon and Boylan (1999) stated, "Remedial courses seldom cost institutions more than they received in revenues...[and] typically generate more revenue than is spent in their delivery" (para. 39). As Abraham (1998) pointed out, if 30% of developmental students earned a bachelors degree, they would contribute as much as $74 billion in federal taxes and $13 billion in state and local taxes over a lifetime of work. This was $44 billion more than they would be expected to contribute without their degrees. Thus, if Breneman's and Haarlow's (1998) $1 billion estimate was accurate, this would pay for these students' developmental education 44 times over (Abraham, 1998).

Others (Astin, 1998; Boylan, Bonham, & White, 1999; Ghazi & Irani, 1997; Institute for Higher Education Policy, 1998; McCabe, 2000a, 2000b; Merisotis & Phipps, 2000; Phipps, 1998; Roueche & Roueche, 1999b: The Economic Importance, 2001) argued that what was spent on developmental education was merely an investment in today's society and economy. This investment would pay for itself by decreasing the likelihood of dependency on social programs and increased tax revenue. McCabe (2000a) stated, "Ten students can have the foundation for their future built through remedial education for the same cost as incarcerating one person for a single year" (p. 40). Besides decreasing the chances of unemployment, low-wage jobs, welfare participation, and incarceration, successful developmental education programs and going

to college could result in increased tax revenues, greater productivity, increased quality of life, increased consumption, reduced crime rates, increased charitable giving and community service, social cohesion, a greater appreciation of diversity, and an increased workforce flexibility due to individuals with generalizable skills (Phipps, 1998). With all of this in mind, developmental education might be a bargain, especially if it was done well.

In summary, cost studies of developmental education were few in number and were difficult to perform. A few researchers estimated the cost of developmental education to be at least one to two billion dollars, excluding the costs at private institutions and to society and the economy (Breneman & Haarlow, 1998; Merisotis & Phipps, 2000). Critics complained that developmental education was expensive (Steinberg, 1998). Others believed in the long-term benefits developmental education could have on society (Astin, 1998; Boylan, Bonham, & White, 1999; Ghazi & Irani, 1997; Institute for Higher Education Policy, 1998; McCabe, 2000a, 2000b; Merisotis & Phipps, 2000; Phipps, 1998; Roueche & Roueche, 1999b; The Economic Importance, 2001). For the researcher, this section shed light on the problems with and complexity of financing developmental education and the associated policies that might be in place at each of the institutions included in the study.

Critics of Developmental Education

> "What CUNY has done for years," said Guiliani "is feel good rather than educate." Widespread remediation is in Guilliani's view, both costly and damaging to academic standards—and worse, it suffers from a fatal lack of logic. Four-year institutions are not supposed to be in the business of teaching students to read or master high school math. (Schrag, 1999, para. 7)

For years people have complained about developmental education in higher education. The Yale Report of 1828 ("The Yale Report," 1997) called for an end to admitting underprepared students. More recently, various states and institutions tried to eliminate developmental education by (a) moving it outside of four-year institutions to two-year institutions or private learning services (Healy, 1998), or (b) putting limits on the length of time students had to complete developmental coursework (Selingo, 2000). These actions arose from four key complaints about developmental education. These complaints included: (1) the cost of developmental education; (2) high schools are not doing their job; (3) four-year institutions should not provide pre-college material; and (4) developmental education lowers academic standards.

High Cost of Developmental Education. States and institutions complained that developmental education costs too much. For example: Texas spent $172 million on developmental education in 1998-1999; New York spent $90.7 million in 1996; Florida spent $57.5 million in 1995-1996; and Washington spent $30 million in 1995-1996 (Saxon & Boylan, 1999). Breneman and Haarlow (1998) estimated that remedial education cost about $1 billion each year, not including the costs at private institutions or other costs to society and the economy. This figure was less than one percent of all higher education revenue. Merisotis and Phipps (2000) estimated that the figure might be closer to $2 billion.

Steinberg (1998) argued that it was often in an institution's or a state's best interest to underestimate the amount spent on developmental education.

> It is also reasonable to assume that official estimates of the extent and cost of remedial education are deliberately understated. Asking state education departments to estimate the amount of money their postsecondary institutions spend on remedial education is like asking the tobacco industry to estimate how much is spent each year to treat lung cancer. The widespread provision of remedial education at colleges and universities is a well-kept secret that is shared by state education officials, secondary school administrators, postsecondary educators, college students, and the vigorous lobby of remedial educators (who have had to change their moniker to "developmental educators" in order to avoid public wrath).
>
> The practice of systematically underestimating the extent and cost of remedial education has many beneficiaries: state educators profit from it because the weak performance of their elementary and secondary systems remains partially hidden; secondary school administrators get to pass the cost of teaching basic skills on to postsecondary administrators; postsecondary educators can fill their dormitories and classrooms with warm bodies; college students can get course credit for classes that, if labeled remedial, would not count toward graduation; and remedial education instructors get to keep their jobs. From a political and economic perspective, there are few constituencies with a stake in providing accurate data on the prevalence of remediation, and many with considerable incentives to understate the extent of the phenomenon. (para. 7-8)

Steinberg (n.d.) went on to write the following in another piece:

> College professors have long been complaining about the poor preparation of entering undergraduates, but until recently, the insidious practice of providing remedial education to America's semi-literate college freshman has been one of higher education's best-kept secrets. American educators do not want the public to know that colleges and universities are spending substantial amounts of tax dollars teaching undergraduates how to read, write, and add. The public would be understandably upset to learn that despite the vast amounts of money we pour into public elementary and secondary education—more, per capita, than virtually any industrialized country in the world—our public high schools produce millions of graduates whose diplomas are little more than certificates of attendance. (para. 2)

Developmental education could be considered expensive or a bargain. In either case, much of the blame for underprepared students was placed on secondary schools.

High Schools Are Not Doing Their Job. Critics believed that students, taxpayers, and teachers should not have to pay twice for what high schools should have done right the first time. Steinberg (1998) wrote:

> Today's postsecondary remedial education is an embarrassing and costly attempt to compensate for a public education system that is failing miserably; that many, if not most, of the recipients of this instruction are students who have been socially promoted along the pedagogical people-mover we call public education; that the course content of most remedial classes would bore a competent seventh-grader; and that the extent and cost of remediation is knowingly and grossly underestimated by state agencies and post-secondary institutions. (para. 5)

According to McCabe (2000a), 84% of all students who entered ninth grade graduated from high school with a diploma or GED by age 24. Fifty-nine percent of those who entered ninth grade went on to enter postsecondary education, but only 42% of those who entered postsecondary education were prepared for college work. McCabe (2000a) also said, "Eighty percent of new jobs will require some postsecondary education" (p. vii). With only 42% of entering postsecondary students prepared for college level work, many new jobs were unfilled or filled with inadequately skilled employees. Thus, the majority of high school graduates were prepared only for unskilled jobs.

During the 1990s the number of students who took the "new basics" curriculum (National Center for Education Statistics, 2001a, p.276), a set of core academic courses designed to help prepare students for college (sometimes called "college preparatory"), increased from 12.7% to 46.8% (McCabe, 2000a). Even so, "schools systematically place more than half of their students in general and vocational tracks that do not adequately prepare them for an information-rich environment" (McCabe, 2000a, p. 24).

Students who took college preparatory courses and curriculums were more likely to persist in college regardless of risk factors, especially if they completed an intense mathematics and science curriculum (National Center for Education Statistics, 2000), but many students who took a college-preparatory curriculum still placed into developmental courses right out of high school (Hoyt, 2001; Phipps, 1998). This suggests that these courses did not adequately prepare students for college level work and that there was a gap between what high schools and colleges expected from students. Often there was a lack of communication between high schools and colleges. High schools had no way of knowing what their graduates should expect upon entering college.

Another reason for high school students placing into developmental courses was that developmental education was arbitrary from institution to institution and from state to state. What one institution might consider pre-college, another institution might accept as college level. It might also be that college-preparatory curriculums were not rigorous enough. Research has shown that students who participated in a rigorous college-preparatory curriculum while in high school performed better academically in college and took more college credits than less rigorously prepared students (National Center for Education Statistics, 1999). The more years of upper level math students had in high school, the less likely they were to place into developmental math courses in college (Hoyt, 2001). The level of and rigor of high school mathematics courses was important as well as taking a mathematics course during the senior year. Both of these helped reduce the likelihood of being placed in developmental mathematics in college (Hoyt, 2001).

If all developmental students had recently graduated from college, the argument that high schools were not doing their job would be stronger, but this was not always the case. The National Center for Developmental Education (as cited in Breneman & Haarlow, 1998) found that approximately 80% of remedial students were 21 years or younger. Other studies found a greater number of older students took developmental courses. According to the National Center for Education Statistics (as cited in Ignash, 1997), almost half (46%) of all entering freshmen that took a developmental course in 1992-1993 were over 22 years of age, and 31% were 19 years old or younger.

Freshmen were not the only ones who participated in developmental education. Students often delayed taking developmental courses. According to Ignash (1997), the data from the National Center for Education Statistics indicated that 56% of developmental education students were freshmen, 24% were sophomores, 9% were juniors, and 9% were seniors.

Four-Year Institutions Should Not Provide Developmental Education. One of the main issues surrounding developmental education was who should provide it. Some argued that the skills taught through developmental education should have been mastered in high school. If students did not do this, they should gain these skills in the summer or at a two-year institution before enrolling in a four-year institution. This line of reasoning was most often directed at those students who just graduated from high school. It was less applicable to students who returned to college after an extended time away from academics. These students were not expected to have retained the skills and knowledge

necessary to immediately begin school at the college level. They might need to take a few refresher courses.

Some critics contended that having students attend two-year rather than four-year institutions was "a way of diverting poor and minority students from four-year institutions and professional careers and into vocational tracks with limited possibilities" (Schrag, 1999, para. 18). Thus, since minorities were overrepresented in the developmental student population and were more likely to come from lower socioeconomic backgrounds (McCabe, 2000a), they might be more likely to be diverted into vocational tracks.

> Zwerling has argued that students who begin in four-year colleges have a 25 percent better chance of getting their bachelor's degrees, and thus moving into the middle class, than similar students who begin their careers as transfer students from two-year colleges. And in the tracking process, the losers are inevitably the poor and minority students. (Schrag, 1999, para. 18)

According to Breneman and Haarlow (1999), "Research has shown that the vast majority of students who enroll in two-year colleges do not transfer to and graduate from four-year colleges" (p. B7). Students who attended two-year institutions seemed to have limited their academic and career opportunities. In any case, critics believed developmental courses lower academic standards at four-year institutions.

Developmental Education Lowers Academic Standards. For years, people argued that admitting underprepared students lowered the academic standards at an institution. Laurence Steinberg (1998) wrote:

> Providing remedial education in such basic academic skills as reading, writing, and mathematics to entering college students has trivialized the significance of the high school diploma, diminished the meaning of college admission, eroded the

> value of a college degree, and drained resources away from bona fide college-level instruction. (para. 16)

Critics like Steinberg (1998) and Cronholm (1999) believed that the curriculum has been "dumbed down," leading to curricular deflation and grade inflation. Steinberg (1998) cited an example of a statistics course that had to be split into a two-semester course in order for students to master the material that earlier classes had mastered in one semester. On a college transcript it might have appeared as if a student learned twice as much statistics as one who took only one semester, but that was not necessarily the case. Students also received twice as many credits for the same amount of material, and it cost the department time and money to teach the same course in twice the amount of time.

Cronholm (1999) believed that lowering standards and admitting underprepared students imposed heavy costs on students. Cronholm (1999) believed that it was demoralizing for well-prepared students to be in the same class as underprepared students. He also believed that underprepared students were often hurt, rather than benefited, when they enrolled in college level courses at the same time that they enrolled in developmental courses. Students needed to gain college level skills prior to taking college level courses, not while they were taking them, or many were likely to fail.

> When students know that they can make up in college what they slept through in high school—and get college credit for it, to boot—they are that much more likely to nap. Widespread remedial education at the post-secondary level is the price we pay for social promotion in our secondary schools. Eliminating remedial education at CUNY, Temple, and other post-secondary institutions will force secondary schools to make sure that their diplomas actually mean something. Yes, such a step will limit access to higher education for those students who have made it through high school without developing the skills and competencies needed to do college-level work. To many of us, this is good news, not bad. Indeed, for those of us who have been struggling to teach college-level material to

> undergraduates with junior high school skills, the end of remedial education can't come a moment too soon. (Steinberg, n.d., para. 7)

On the other hand, Gleazer (as cited in Casazza, 1995) stated:

> Meet the student where he is. I am increasingly impatient with people who ask whether a student is "college material". We are not building the college with the student. The question we ought to ask is whether the college is of sufficient student material. It is the student we are building, and it is the function of the college to facilitate that process. (para. 64)

To summarize, developmental education was criticized for the following reasons. Some believed developmental education cost too much (Steinberg, 1998; see also Saxon & Boylan, 1999). Others believed that high schools were not doing their job and that four-year institutions of higher education should not have the responsibility of catching up these students (Steinberg, 1998). Finally, critics believed developmental education lowered academic standards in higher education, leading to grade inflation, curricular deflation, and a "dumbing down" of courses (Cronholm, 1999; Steinberg, 1998). For the researcher, the viewpoints of critics provided insight into the attitudes some have about developmental education and into the development of and reasoning behind some of the policies associated with developmental education.

Carnegie Classification of Institutions of Higher Education

The Carnegie Classification system grouped American colleges and universities. It did not group the institutions in a hierarchy. Rather, it grouped colleges and universities together that had similar purposes, programs, and size so that comparisons could be made between institutions within the same group. The Carnegie Classification system underwent four revisions with the most recent revision in 2000. This study used

the 1994 classification (Carnegie Foundation for the Advancement of Teaching, 1994) explained below in Table 5.

Table 5. 1994 Carnegie Classification Categories and Definitions.

Research Universities I (Res I) These institutions offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research. They award 50 or more doctoral degrees[a] each year. In addition, they receive annually $40 million or more in federal support. [b]
Research Universities II (Res II) These institutions offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research. They award 50 or more doctoral degrees[a] each year. In addition, they receive annually between $15.5-million and $40-million in federal support. [b]
Doctoral Universities I (Doc I) In addition to offering a full range of baccalaureate programs, the mission of these institutions includes a commitment to graduate education through the doctorate. They award at least 40 doctoral degrees[a] annually in five or more disciplines. [c]
Doctoral Universities II (Doc II) In addition to offering a full range of baccalaureate programs, the mission of these institutions includes a commitment to graduate education through the doctorate. They award annually at least 10 doctoral degrees--in three or more disciplines[c]--or 20 or more doctoral degrees in one or more disciplines.
Master's (Comprehensive) Universities and Colleges I (MA I) These institutions offer a full range of baccalaureate programs and are committed to graduate education through the master's degree. They award 40 or more master's degrees annually in three or more disciplines. [c]
Master's (Comprehensive) Universities and Colleges II (MA II) These institutions offer a full range of baccalaureate programs and are committed to graduate education through the master's degree. They award 20 or more master's degrees annually in one or more disciplines.
Baccalaureate (Liberal Arts) Colleges I (BA I) These institutions are primarily undergraduate colleges with major emphasis on baccalaureate degree programs. They are selective in admissions and award 40 per cent or more of their baccalaureate degrees in liberal arts fields. [d]
Baccalaureate Colleges II (BA II) These institutions are primarily undergraduate colleges with major emphasis on baccalaureate degree programs. They are less selective in admissions or they award less than 40 per cent of their baccalaureate degrees in liberal arts fields. [d]
Associate of Arts Colleges (AA) These institutions offer associate of arts certificate or degree programs and, with few exceptions, offer no baccalaureate degrees. [e]

Table 5 Continued.

Professional Schools and Specialized Institutions
These institutions offer degrees ranging from the bachelor's to the doctorate. At least 50 percent of the degrees awarded by these institutions are in a specialized field.
Specialized institutions include:
1. Theological seminaries, bible colleges and other institutions offering degrees in religion
2. Medical schools and medical centers
3. Other separate health profession schools
4. Schools of engineering and technology
5. Schools of business and management
6. Schools of art, music, and design
7. Schools of law
8. Teachers colleges
9. Other specialized institutions
10. Tribal colleges

Note. [a]Doctoral degrees include Doctor of Education, Doctor of Juridical Science, Doctor of Public Health, and the Ph.D. in any field. [b]Total federal obligation figures are available from the National Science Foundation's annual report called "Federal Support to Universities, Colleges, and Nonprofit Institutions." The years used in averaging total federal obligations are 1989, 1990, and 1991. [c]Distinct disciplines are determined by the U.S. Department of Education's "Classification of Instructional Programs" 4-digit series. [d]The liberal-arts disciplines include area and ethnic studies, English language and literature, foreign languages, letters, liberal and general studies, life sciences, mathematics, multi- and interdisciplinary studies, philosophy and religion, physical sciences, psychology, social sciences, and the visual and performing arts. The occupational and technical disciplines include agriculture, allied health, architecture, business and management, communications, conservation and natural resources, education, engineering, health sciences, home economics, law and legal studies, library and archival sciences, marketing and distribution, military sciences, protective services, public administration and services, and theology. [e]This group includes community, junior, and technical colleges.

Theme Development

This section includes descriptions of themes in the literature that were relevant to this study. The first few sections are background information about the state of developmental education, including the need for developmental education, the performance of developmental education, and laws and limits affecting developmental education. The following sections include a review of the literature on "best practice" in developmental education and developmental mathematics education. Summaries of what was understood about "best practice" in developmental education as related to policies,

faculty and staff, organization, learning theory, instruction and curriculum, support services, assessment and evaluation, and comprehensiveness, and relevant research findings on these practices are included. The theme development section concludes with ways to reduce and improve developmental education, descriptions of organizations that support developmental education, and a review of methodologies used for this type of research.

The Need for Developmental Education

Patricia Cross (1976) wrote that only 10% of underprepared students who attend college get their degree without some form of intervention. According to Adelman (1999), 46% of all undergraduates who completed at least 10 credits took at least one developmental course. Without intervention like developmental education, few of these students would complete their degrees.

The largest need for developmental education was in mathematics (Adelman, 1999; McCabe, 2000a; National Center for Education Statistics, 1991, 1996). In 1995, 24% of all new entering freshmen enrolled in a remedial mathematics course (National Center for Education Statistics, 1996). During the same year, 13% and 17% enrolled in remedial reading and writing course, respectively (National Center for Education Statistics, 1996). Adelman (1999) found that 32.9% of students earned undergraduate credits in pre-college mathematics, while 25.7% of students did so in remedial English and writing.

Mathematics also had the highest rate of failure and non-completions (Adelman, 1999; National Center for Education Statistics, 1996). The top six undergraduate courses

with the highest rates of withdrawals, no credit repeats, and incompletes were developmental mathematics courses (Adelman, 1999p. 202). Four of the top five undergraduate courses with the highest rates of failure/penalty grades were also developmental mathematics courses (Adelman, 1999, p. 203). These rates were cause for concern. "Eighty percent of new jobs will require some postsecondary education" (McCabe, 2000a, p. vii). Those students who could not complete developmental courses could not move on to college level courses and work toward completing their degree. According to testimony by Greenspan (as cited in The Economic Importance, 2001), "We must strengthen math and science education to address the requirements of the newer technologies we see on the horizon" (para. 16).

McCabe (2000a, 2000b; see also McCabe and Day, 1998) probably wrote the most in recent years about the need for developmental education to support the country's economy and society. McCabe and Day (1998) wrote:

> Rapidly evolving technologies continue to raise the competencies needed in workplaces of the Information Age. For business and industry to remain competitive in a world economy, American workers must develop higher-order skills. At the same time, demographic trends suggest that a growing number of Americans will reach adulthood underprepared for productive employment. Yet, these individuals cannot be written off. America must invest in education to develop the human infrastructure essential to the new world economy. To be successful, the nation must face three great challenges—remaining competitive in a global economy, reversing the growth of a permanent and disenfranchised underclass, and developing a workforce possessing twenty-first century skills. (pp. 4-5)

McCabe and Day (1998) cited a survey of 4,500 companies that revealed high levels of worker deficiencies in three major areas, two of which were the lack of basic

mathematics skills and deficiencies in writing and comprehension skills. Americans entered the workplace and higher education underprepared.

McCabe (2000a, 2000b), and Murdock and Hoque (1999) also described demographic changes, such as a decline in population growth, an aging population, immigration, increasing numbers of minorities, poverty, and changes in family life, and their impact on higher education. The U.S. population was getting older. It was also becoming composed of more minorities such as African Americans, Hispanics, Asian/Pacific Islanders, and others. By the year 2050, minorities were expected to become the majority, with almost 25% of the population composed of Hispanics (McCabe, 2000a; Murdock & Hoque, 1999). From 1990 to 1997, almost 67% of population growth was due to minorities (Murdock & Hoque, 1999). The rate at which minorities attended college was lower than the rate white non-Hispanics did, and the rate at which African Americans and Hispanics completed bachelor's degrees or higher degrees was less than half that of white non-Hispanics (National Center for Education Statistics, 2000). Minorities were less likely to be retained (Boylan, Bliss, & Bonham, 1993) and more likely to be placed in developmental courses as well (McCabe, 2000a; McCrimmon, 1999). "If black and Hispanic students attended college at the same rate as whites, the national economy would grow by $231 billion annually" (Boom, 2000, para. 9).

Much of this growth was due to immigrants. They accounted for 29.8% of population growth from 1990 to 1996, compared to 13.5% in the 1960s and 18.8% in the 1970s (Murdock & Hoque, 1999). Most of the immigrants were from Latin America or

Asia. Many were in the U.S. illegally and lacked the skills that most jobs in the U.S. required (Murdock & Hoque, 1999).

The U.S. population was also getting older. In 1900, one person in 25 was 65 years old or older. By 2040, one person in four will be 65 or older. The median age of the U.S. population was 22.9 years in 1900, 32.9 years in 1990, and was expected to be 38.1 years in 2050 (Murdock & Hoque, 1999).

Family life has changed. More children grew up in single parent homes. Single mothers were more likely to have poor prenatal care, inadequate healthcare, less resources, and spend less time with their children (McCabe, 2000a). All of these factors could impede cognitive growth in a child, place them at risk of school failure, and make them more likely to be underprepared adults (McCabe, 2000a). Even in two-parent homes, both parents usually worked, which often led to less time spent with their children, which could lead to less intellectual stimulation, and thus, less cognitive development (McCabe, 2000a).

As more immigrants entered the U.S., minority populations were expected to grow, and as many children grew up in single parent homes, poverty and educational levels became issues of concern. Minorities typically earned less than white non-Hispanics and graduated from high school and college at lower rates than white non-Hispanics (Dalaker, 2001; McCabe & Day, 1998). The NCES (2000) found that high school graduates from high-income families were considerably more likely to go to college immediately after high school (77%) than high school graduates from low-income families (46%). They were also more likely to go to college right out of high

school if their parents had at least a bachelor's degree (National Center for Education Statistics, 2000). High school graduates from low-income families were less academically qualified than their peers from middle-income and high-income families (National Center for Education Statistics, 2000). They were also less likely to persist once in high school and in college (National Center for Education Statistics, 2000). "Of all factors, poverty correlates most closely with academic deficiency from kindergarten to college...[and] current population trends suggest increased poverty among the growing numbers of underprepared Americans if we cannot meet their educational needs" (McCabe & Day, 1998, p. 6). As the number of minorities is expected to grow, so might the number of poor as well as the number of less educated adults underprepared for the workplace.

All of the above factors could impact the future of higher education and developmental education. As the number of minorities increased in the population, so might the number of them in the college population. By 2050, white non-Hispanic college students were expected to drop from 80% to 58%, while Hispanic and African American college students were expected to increase from 6% to 18% and 10% to 13%, respectively (Murdock & Hoque, 1999). All of the net increase in the college population was expected to be from minority students because the number of white non-Hispanic students was expected to decline (Murdock & Hoque, 1999). When minorities were more likely to come from the lower socioeconomic strata and more likely to be academically underprepared, they were more likely to require developmental education when and if they decided to attend postsecondary institutions. Minorities were already

overrepresented in developmental education (McCabe, 2000a), and as the number of minorities increase in society and thus, in higher education, so may the demand for developmental education in college.

As the population aged, the number of postsecondary students 44 to 54 years of age was expected to increase 573%, and the number 55 years or older was expected to increase 136.9% (Murdock & Hoque, 1999). The number of older adults returning to college might create a demand for developmental education as they brushed up on various skills.

In conclusion, the largest need for developmental education was in mathematics (Adelman, 1999; McCabe, 2000a; National Center for Education Statistics, 1991, 1996). High school graduates entered the workplace and higher education underprepared. Demographic changes, such as an aging population, growing minority populations, changing family life, and poverty levels, might impact higher education, especially developmental education, as it becomes called upon to help educate this diverse population in order to remain globally competitive in the increasingly technical workplace and economy (Boylan, Bonham, & White, 1999; Ghazi & Irani, 1997; Institute for Higher Education Policy, 1998; McCabe, 2000a, 2000b; McCabe & Day, 1998; Merisotis & Phipps, 2000; Phipps, 1998; Roueche & Roueche, 1999a; The Economic Importance, 2001). As Astin (1998) said:

> The education of the "remedial" student is the most important educational problem in America today, more important than educational funding, affirmative action, vouchers, merit pay, teacher education, financial aid, curriculum reform, and the rest. Providing effective "remedial" education would do more to alleviate our most serious social and economic problems than almost any other action we could take. (para. 4-5)

The Performance of Developmental Students

Adelman (1995) found that students who required developmental education courses were less likely to attain a degree, especially if they required developmental reading education. Researchers (Boylan, Bliss, & Bonham, 1993) also found that minority students, especially African Americans, were not retained as well, nor did they perform as well, as white non-Hispanic students in certain situations. Yet, developmental education, when successful, increased retention, the probability of attaining a degree, and grades for all students (Boylan & Bonham, 1992; Boylan & Saxon, 1998a; McCrimmon, 1999). In this way, developmental education was crucial for many students. It "equalizes the opportunity for underprepared students to be successful" (Boylan, 1999, para. 13).

Boylan and Bonham (1992) and McCabe (2000a) found that community college students who were judged to be underprepared and who participated in developmental education were slightly more likely to obtain a degree than the typical community college student. The situation was similar at the universities. Boylan, Bonham, Claxton, and Bliss (1992), Minnesota State Colleges and Universities (1996), and Boylan and Saxon (1998a) found evidence that suggested passing remedial courses was related to higher grades and increased student retention. Students who passed developmental courses were also more likely to pass their first college level course in the same subject (Boylan, Bonham, Claxton, & Bliss, 1992; Penny & White, 1998). The findings of a study conducted by Penny and White (1998) indicated, "A student's performance in his or her last developmental mathematics course is the strongest predictor of success in college algebra. Whatever can be done to ensure the best learning experience for developmental mathematics students should result in their improved performance in college algebra" (p. 10, 12).

McCrimmon (1999) cited long-term studies that suggested success in developmental mathematics was strongly related to the success and retention of college students. A Tennessee study (as cited in McCrimmon, 1999) found that students who completed developmental mathematics courses passed their first college level mathematics course at the same rate (80%) as students who did not need developmental mathematics. A New Jersey study (as cited in McCrimmon, 1999) found that students who completed the developmental mathematics sequence "earned more credits, had the highest cumulative GPA of any remedial group, and were retained at a higher rate than students who did not need algebra remediation" (p. 2). Other studies (as cited in McCrimmon, 1999) indicated that these benefits were true for minorities as well as white non-Hispanics.

The number of minorities was growing in the U.S., but they were disproportionately poor which correlated to underpreparation at every educational level (McCabe, 2000a). Almost 30% of Hispanics, 13% of African Americans, 7% of white non-Hispanics, and almost 4% of Asian/Pacific Islanders dropped out of high school (Kaufman, Alt, & Chapman, 2001). Many minority students entered college underprepared and required developmental education, but minority students were overrepresented and retained less in developmental education (Boylan, Bliss, & Bonham, 1993; Boylan, Bonham, Bliss, & Claxton, 1992; McCrimmon, 1999) as shown in Table 6.

Table 6. Comparative Retention Rates of Developmental Students.

Institution	White Non-Hispanics	African Americans	Latinos
Community Colleges	30.1%	10.0%	22.2%
4-Year Privates	41.0%	46.9%	34.3%
4-Year Publics	32.7%	23.8%	29.1%
2-year Technicals	35.3%	26.9%	23.5%
Research Universities	55.1%	43.6%	31.1%

Note. Retention was defined as having graduated or remained continually enrolled at the end of 3.5 years and 5.5 years for two-year and four-year institutions, respectively. Adapted from "The performance of minority students in developmental education," by H. R. Boylan, L. B. Bliss, and B. S. Bonham, 1993, Research in Developmental Education, 10 (2), p. 2. Copyright 1993 by Appalachian State University. Adapted with permission.

According to Boylan, Bliss, and Bonham (1993) the difference in retention rates of minorities and whites was similar to the national population except for the developmental students at the community colleges. Yet, "there were few statistically significant differences in the admissions credentials of white students and students of color participating in developmental programs at the same type of institution" (Boylan, Bliss, & Bonham, 1993, p. 3). Other factors affected the retention of whites and minorities.

There was no statistically significant difference between the SAT scores of developmental students in community colleges and those in four-year private institutions, yet many more developmental students were retained at four-year private institutions than at community colleges (Boylan, Bliss, & Bonham, 1993). For minorities, especially African Americans, community colleges might not be the most effective way for them to attain a higher education (Boylan, Bliss, & Bonham, 1993).

McCabe's (2000a) study of community colleges found that nearly half of community college developmental education students successfully completed their program, and students who successfully completed developmental education performed well in standard college work. In fact, the academic performance of successful developmental education students was almost identical to that of students who entered community colleges academically prepared. These students passed 88% of standard college English classes and 82% of standard college math classes (McCabe, 2000a). Further, most successful developmental education students gravitated toward occupational programs or direct employment and became productively employed. In fact, 98.5% of these individuals were employed and nearly 90% worked at jobs above the unskilled level (McCabe, 2000a).

Developmental education increased retention, grades, and the probability of attaining a degree (Boylan, Bonham, Claxton, & Bliss, 1992; Boylan & Saxon, 1998a; Minnesota State Colleges and Universities, 1996). Students who passed developmental courses were also more likely to pass their first college level course in the same subject (Boylan, Bonham, Claxton, & Bliss, 1992; Penny & White, 1998). Developmental mathematics education had the same positive results (McCrimmon, 1999; Penny & White, 1998). With effective developmental education, many students went on to earn degrees and became productive members of society. These results emphasized the importance of effective developmental education and validated this study's collection of grade distribution data and comparisons to "best practice."

Law and Limits Affecting Developmental Education

The National Center for Education Statistics (1996) reported that there were laws that affected the developmental education offerings in about one-third of institutions offering developmental courses. Below is a summary of their findings. State policies affected public institutions more often than the private institutions. At public two-year and public four-year institutions offering developmental courses, 57% and 40%, respectively, reported that state laws or policies affected their developmental offerings, while only 3% and 7% of private two-year and private four-year institutions, respectively, reported this. The effect reported most often was that institutions were encouraged or required to offer developmental education. Public two-year institutions were encouraged to offer developmental courses twice as often as public four-year institutions. Public four-year institutions more often were discouraged or restricted from providing developmental courses than public two-year institutions.

Some institutions and states placed limits on the amount of time a student could take developmental courses (National Center for Education Statistics, 1996). Approximately one quarter of all institutions had limits on the length of time students could participate in developmental coursework. Percentages ranged from 23-29% across institutional types. Of those institutions offering developmental courses and having time limits, 75% reported that limits were set by institutional policy and 21% reported that limits were set by state policy. State policy was a factor at 53% of public two-year institutions, while institutional policy set time limits at almost all public and private four-year institutions (National Center for Education Statistics, 1996).

Boylan, Saxon, and Boylan (1999) gathered data via a telephone survey of state higher education offices in the United States and through documents, follow-up calls and e-mail conversations. Of the 45 responding states, 38 of them permitted developmental courses to be provided by community colleges and universities. Eleven of these states had written policies stating that four-year institutions were free to offer developmental education, but two-year institutions were considered the primary providers of it. Ten of these states placed restrictions on developmental education. These restrictions might include limits on the number of courses students could take, additional fees, or restricting developmental education to less selective state institutions. Seven states demoted or planned to demote developmental courses to two-year institutions. Five of these states strictly prohibited universities from offering developmental courses.

Thus, state and institutional policies directly and indirectly affected who offered developmental education and how long students participated (National Center for Education Statistics, 1996). Two-year institutions were usually considered the primary providers of developmental education and were encouraged to offer it more often than four-year institutions (Boylan, Saxon, & Boylan, 1999). In addition, this information informed the researcher about possible differences in policies between institutional types.

Policies in Developmental Education

The following sections summarize those policies considered to be the "best" policies regarding developmental education. These sections contain descriptive information as well as research findings.

Mandatory Assessment and Placement. When students enter college they are often assessed to determine their levels in reading, writing, and mathematics. The assessment system used by an institution or department varies. Assessment tools often included scores on standardized tests, like the ACT or SAT, as well as student grades and scores on placement tests given by the institution. Institutions that used placement tests might use tests that were locally developed or externally developed. If students placed "too low" they were often advised or mandated to take one or more developmental courses. The cutoffs for placement at certain levels were usually determined by the institution or department and might be different from state to state and institution to institution. In any case, McDonald (1989) suggested that the goals of the institution or department should match the goals of the assessment system as well as the institution's priorities. Tests should also be validated to ensure accurate decision scores for placement.

Morante (1989), Boylan, Bliss, and Bonham (1997), and Roueche and Roueche (1999a, 1999b) advocated mandatory assessment and placement of developmental students. They suggested that developmental programs that mandate assessment and placement were most effective. Roueche and Roueche (1999a) indicated that retention rates and success levels were higher when institutions required and enforced assessment and placement. Common sense suggests that if assessment and placement were not practiced, then there was no way to know which students needed to enroll in developmental courses nor was there any way to ensure that those who needed it actually enrolled and participated in it. "It is inappropriate and misguided to permit students into

college-level courses when they lack the necessary cognitive skills" (Roueche & Roueche, 1999b, p. 16).

According to the National Center for Education Statistics (1996), placement tests given to all entering students were the most frequently used approach to determine the need for developmental courses. About 60% of all institutions used this approach in reading, writing, and mathematics. About 25% of all institutions gave placement tests to entering students who met various criteria to determine their need. Approximately 10% required or encouraged entering students who met various criteria to enroll in developmental courses. The remaining percentage of institutions used other selection approaches. Placement tests in mathematics were given more often than in reading and writing. They were also used more often in two-year institutions than in four-year institutions. Regardless of subject area, four-year institutions required or encouraged students meeting various criteria to enroll in developmental courses more often than did two-year institutions (National Center for Education Statistics, 1996). Thus, four-year institutions used mandatory placement practices more than two-year institutions, and two-year institutions gave placement tests more often than four-year institutions.

In the National Study of Developmental Education, Boylan, Bliss, and Bonham (1994a) found that 76% of the nation's developmental programs required incoming students be assessed, and the remaining 24% used voluntary assessment. Mandatory assessment was more common in four-year institutions (91%) than two-year institutions (68%). Of those who assessed, placement was mandatory at 69% of four-year institutions and at 35% of two-year institutions where students demonstrated a need for

developmental courses. In 1999, Boylan, Saxon, and Boylan found that almost all states required or encouraged assessment of incoming students, but only half made placement mandatory based on the assessment.

Boylan, Bliss, and Bonham (1997) later found that mandatory assessment had little impact on student grades or retention, but was related to student success in developmental courses. There were no statistical differences in first-term GPA, cumulative GPA, or retention rates of students in programs with voluntary or mandatory assessment, but those who participated in programs with mandatory assessment were significantly more likely to pass their first developmental English or mathematics courses than their counterparts in programs with voluntary assessment. Boylan, Bliss, and Bonham (1997) found mandatory placement was positively related to retention at four-year institutions and negatively related to retention at two-year institutions.

Boylan, Bliss, and Bonham (1997) explained the negative relationship between mandatory placement and retention by saying that when placement was mandatory, many of the weakest students were forced to take courses they would otherwise have avoided. This could drive down grade point averages and retention data. Many of these students would not be retained in the long run, but unless they participated in developmental education they would not get counted in the data collected for it; thus, keeping the retention data and grade point averages for developmental programs higher than if these students were included (Boylan, Bliss, & Bonham, 1997).

Mandatory placement was also related to success in developmental courses. At two-year institutions, students who took developmental mathematics or English courses

were more likely to pass these courses when placement was mandatory rather than voluntary. This was true for developmental mathematics students at four-year institutions as well (Boylan, Bliss, and Bonham, 1997).

In conclusion, assessment and placement of developmental students should be mandatory according to Morante (1989), Boylan, Bliss, and Bonham (1997), and Roueche and Roueche (1999a, 1999b). Placement tests were the most commonly used instrument to determine student need for developmental coursework, especially in mathematics. Four-year institutions used mandatory assessment less often than two-year institutions, but mandated or encouraged placement in the assessed course more often than two-year institutions (National Center for Education Statistics, 1996). Only half of states made placement mandatory based on assessment results (Boylan, Saxon, & Boylan, 1999). Mandatory assessment and placement were positively related to student success in developmental courses (Boylan, Bliss, & Bonham, 1997). In addition, these findings provided information about the use of assessment and placement and how and where it might be used in North Dakota. They also influenced the researcher to include mandatory assessment and placement on the list of "best practices" used in this study.

Credit and Financial Aid for Developmental Courses. Over the last few decades there was a trend toward eliminating academic credit for developmental courses (Boylan, Saxon, & Boylan, 1999; National Center for Education Statistics, 1996). The National Center for Education Statistics (1996) published data indicating a decrease in institutions awarding degree credit for developmental reading, writing, and mathematics courses and an increase in those institutions awarding institutional credit for these courses.

Under Title IV of the Higher Education Act, federal guidelines allowed financial aid to be used for developmental courses for one year if students met certain requirements (Goldstein, 1997). Roueche and Roueche (1999a, 1999b) advocated providing more comprehensive financial aid programs. "Student loan programs must be redesigned and implemented in the context of today's social and economic realities" (Roueche & Roueche, 1999b, p. 16).

> There is ample evidence that recipients have higher retention rates than do students who have similar financial needs with limited or no support (Leaning & Beal 1980; Jackson 1988). Financial difficulties are among the three most frequently reported reasons for dropping out (Astin 1985). (Roueche & Roueche, 1999b, p. 16)

Roueche and Roueche (1999b) further added that work-study programs should be connected to students' academic lives since Tinto's (1987) research has shown that students who worked were more academically and socially involved in their institutions, and thus, more likely to persist. Therefore, financial aid programs directed toward involving developmental students in academic and social activities might be beneficial.

In this study, the existence of financial aid credit was one of the policies examined by the researcher during the interviews. This information was then used to compare and contrast the policies of institutions.

Institutional Commitment to Developmental Education. It was important for institutions to make a strong commitment to their developmental education programs (Boylan & Saxon, 1998a; Roueche & Roueche, 1999a). They could do this through public administrative support for developmental education, appropriate allocation of resources for developmental education, and institutional acceptance of developmental

education (Boylan & Saxon, 1999). This commitment lets students, faculty, administration, staff and others know that developmental education is important and valued.

Roueche and Roueche (1993) stated:

> Yet, a 1973 study of successful programs for such students concluded: "Administrative leadership may well be the most important factor in the design of programs for nontraditional students" (Roueche and Kirk, p. 75), that a common feature of all successful developmental programs committed to serving the at-risk student was institutional commitment. (p. 72)

Moreover, resources were more often devoted to developmental education when presidents became involved in writing goals and objectives for developmental programs and could sell their ideas to other administrators. Yet, it was important for the president to have buy-in from the faculty and across as many disciplines and barriers as possible, or else risk having the programs fail (Roueche & Roueche, 1993).

Boylan and Saxon (1998a) found that students had higher pass rates in developmental courses and higher retention rates in developmental programs that were included in the academic mainstream of the institution rather than those that were not integrated. If institutions were committed to developmental education, then they would be more likely to do the things necessary to help make it effective.

Knowledge of the positive influence of institutional support influenced the researcher to try to determine the level of institutional support for developmental mathematics at the studied institutions. Strong institutional support also was included as a "best practice."

Other policies. Roueche and Roueche (1999b) suggested that institutions abolish late registration, eliminate dual/simultaneous enrollment in skill and regular academic courses, and encourage working students to take a reduced number of credit hours. Allowing students to enter a class late already put them at risk since they might have missed crucial information in those first few days of a course. Allowing students to take regular college courses while they took developmental courses, especially in reading or multiple areas, could create problems for the student. If the student's reading skills were poor, taking courses that required a lot of reading before or while the student was enrolled in the developmental course did not make sense. It would place the student at risk of failing or doing poorly in the regular college level courses. Students who worked or who had families carried an extra burden. They should be encouraged to and allowed to reduce their course loads in order to help increase their chances of success (Roueche & Roueche, 1999a).

Ignash (1997) provided five policy recommendations for all institutions offering developmental education:

1. Institutions should keep track of the types of students (directly from high school, out of school for a number of years, transfer students) that need developmental education as well as local or regional demographic and academic data.
2. Institutions should research the types of teaching methods and strategies that are most effective for developmental students in different age groups, and develop effective feedback systems with the high schools to help reduce the need for developmental education in younger students.

3. Institutions should track their developmental programs' effectiveness with disadvantaged minority students by measuring persistence and achievement.
4. Institutions should evaluate how much developmental education they can realistically provide.
5. State coordinating agencies should review developmental education to ensure its effectiveness and standards as well as ensuring access and equality for minorities.

Organization of Developmental Education

There were two types of developmental program structures. One was a centralized program where all courses and services were provided by one administrative unit. The other type was a decentralized program where individual academic departments offered courses and support services (Boylan & Saxon, 1999). According to Boylan, Bonham, and Bliss (1994a), approximately 52% of all institutions had centralized programs. This percentage was the same at two-year and four-year institutions. The National Center for Education Statistics (1996) found that 30%, 22%, and 21% of institutions provided a separate division for developmental reading, writing, and mathematics, respectively. Another 55%, 67%, and 70% of institutions provided developmental reading, writing, and mathematics, respectively, through traditional academic departments (National Center for Education Statistics, 1996). Approximately 7-12% of institutions provided developmental reading, writing, and mathematics using learning centers (National Center for Education Statistics, 1996). Also, more public two-year institutions offered developmental writing and mathematics courses in a separate developmental division than did four-year institutions or private two-year institutions.

Roueche and his colleagues (Roueche & Kirk, 1973; Roueche & Snow, 1977; Roueche & Roueche, 1993) as well as Boylan, Bonham, Claxton, and Bliss (1992) advocated teaching developmental education from a separate centralized program rather than from individual academic departments. "Some of the stronger remedial programs are housed in departments responsible for all student support services and initiative" (Roueche & Roueche, 1999a, pp. 24-25). Boylan, Bonham, Claxton, and Bliss (1992) found that students who participated in centralized developmental programs were more likely to pass their developmental courses and more likely to be retained for longer periods of time than their counterparts in decentralized programs. Later analysis by Boylan, Bliss, and Bonham (1997) found that students who participated in centralized developmental programs at two-year institutions were more likely to be retained and to pass developmental courses in English than students in non-centralized developmental programs. At four-year institutions, students participating in centralized developmental programs had higher first-term GPAs, higher cumulative GPAs, and were more likely to pass developmental courses in mathematics than their counterparts in decentralized developmental programs (Boylan, Bliss, & Bonham, 1997).

In the discussion of their findings, Boylan, Bliss, and Bonham (1997) noted that the level of coordination of programs might be what was related to student success, not program centralization. This idea was supported by their finding that many highly coordinated decentralized programs also had higher student first-term and cumulative GPAs than uncoordinated programs (Boylan, Bonham, & Bliss, 1992). Centralized programs were typically more coordinated than those taught in individual academic

departments where it often was harder to communicate and coordinate efforts. Thus, developmental education courses and services required coordination and communication to be successful, which usually occurred in a centralized developmental program.

To summarize, centralized or highly coordinated developmental programs were related to increased retention, passing developmental courses, and higher GPAs (Boylan, Bliss, & Bonham, 1997). The majority of institutions offered developmental reading, writing, and mathematics education through traditional departments, not through a centralized developmental program. Centralized programs were found more often at two-year institutions than four-year institutions (National Center for Education Statistics, 1996). In this study the location and level of coordination were investigated. Having a centralized or highly coordinated developmental program was considered "best practice."

Developmental Faculty and Staff

According to Roueche and Kirk (1973) and Cross (1976), staff members who worked with developmental students should be selected based on their interest, commitment, and knowledge about learning problems. Roueche and Roueche (1993, 1999a) also advocated this, but noted that this was not always practiced. Many times the faculty with the least seniority or least amount of education and training were assigned to teach developmental courses (Boylan, Bonham, Jackson, & Saxon,1994). This finding did not mean that these faculty were inadequate teachers, but as Roueche and Roueche (1993) wrote, "It is not possible to spend too much money or time seeking out and hiring the very best faculty; moreover, once hired, it is not possible to spend too much time or

money orienting them to this special environment and developing their teaching and interpersonal skills" (p. 120).

Roueche and Snow (1977), Casazza and Silverman (1996), Maxwell (1997), and Boylan, Bonham, and White (1999) addressed the importance of training for those who worked with developmental students, and research validated this (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Claxton, & Bliss, 1992). Students who participated in developmental programs that emphasized professional development for faculty and staff were more likely to pass remedial courses, to earn higher grades, and to be retained longer (Boylan, Bonham, Claxton, & Bliss, 1992). Boylan, Bliss, and Bonham (1997) later found that training and development of staff not only increased a program's overall effectiveness, but it also increased the effectiveness of instruction, counseling, and tutoring. It seemed to make sense that the more training and motivation staff had to work with developmental students, the more successful they would be at what they did. Yet, it was not always the case that the most highly trained, educated, and motivated staff were hired.

J. N. Gardner said, "No matter what we do, being involved with the beginning college experience is always going to be lower status, less sexy, and less respectable than working with more advanced, upper division students" (see Spann, 2000a, p. 22). Working in developmental education was not always very attractive to faculty members; thus, it tended to have more part-time, under credentialed staff. Boylan, Bonham, Jackson, and Saxon (1994) found that 72% of developmental faculty were part-time. At

two-year and four-year institutions, 79% and 66% of developmental faculty, respectively, were part-time.

Math was the one subject area where instructors were least likely to be full-time at two-year institutions. The master's degree was the most common credential of developmental faculty at all institutions. Approximately 62% of faculty held this degree. Another 17% of faculty had bachelor's degrees, 6% had specialist degrees, and 15% had doctoral degrees. Fewer two-year developmental faculty had doctorates than did four-year developmental faculty (Boylan, Bonham, Jackson, & Saxon, 1994). When part-time developmental faculty were identified, full-time faculty who taught developmental education courses on a part-time basis were included. Thus, more faculty might actually have been full-time, but it was important to note that only 28% of developmental faculty were strictly devoted to developmental education on a full-time basis.

About the same percentage of developmental faculty had bachelor's degrees at two-year and four-year institutions, but faculty teaching mathematics at two-year institutions were the largest group of developmental faculty whose highest level of education was the bachelor's degree (21%). They were also the least likely to hold a specialist degrees or doctorates. At four-year institutions, 19% of mathematics faculty held only bachelor's degrees (Boylan, Bonham, Jackson, & Saxon, 1994). "Those least likely to be on a tenure track teach developmental mathematics at four-year institutions. Only 29% of these faculty are on a tenure track" (Boylan, Bonham, Jackson, & Saxon, 1995, p. 2).

The high incidence of mathematics faculty with only a bachelor's degree suggests that there was a shortage of developmental math personnel or a lack of interest in teaching it (Boylan, Bonham, Jackson, & Saxon, 1994). Yet, math was the most often taken developmental course as well as the one in which students were least successful (Adelman, 1999; National Center for Education Statistics, 1996). Penny and White (1998) found that "students tend to perform better in college algebra when their last developmental mathematics course was taught by a full-time instructor" (p. 10). Based on this finding, it might be wise for developmental mathematics programs to recruit more full-time faculty, or to provide faculty training and development for part-time faculty to help improve their skills and knowledge (Penny & White, 1998). The American Mathematical Association for Two-Year Colleges (2002) cautioned mathematics departments not to overuse adjuncts and part-time faculty to teach mathematics courses.

"For whatever reasons, there are disparities in the degree credentials of developmental faculty as opposed to American college faculty in general" (Boylan, Bonham, Jackson, & Saxon, 1994, p. 3). Developmental courses were most often taught by part-time less well credentialed faculty than were non-developmental courses. Overall in higher education, 70% of faculty were full-time and 30% were part-time, yet in developmental education, these numbers were reversed (Boylan, Bonham, Jackson, & Saxon, 1994). In higher education, about 55% of all college faculty held doctorates and 2.2% held bachelor's degrees, while in developmental education only 18% held doctorates at the four-year institutions and 17% held bachelor's degrees (Boylan, Bonham, Jackson, & Saxon, 1994).

Part-time less-well credentialed faculty typically had fewer development opportunities and fewer resources than full-time more credentialed faculty. They were also less likely to know and understand the goals of the institution as well as the department and its programs because they were less likely to be a part of meetings and planning at the institutional and departmental level. This lack of involvement could hamper instructors' efforts and effectiveness in the classroom, which could then hurt their students' chances of success. Penny and White (1998) recommended involving part-time faculty in these activities as part of an effort to help improve their teaching and advising abilities. "The quality of student learning is directly, although not exclusively, related to the quality of teaching. Therefore, one of the most promising ways to improve learning is to improve teaching" (Angelo & Cross, 1993, p. 7), and what better way to do this than through faculty development in a well-coordinated developmental program.

> Our contention is that many students who fail developmental courses might be successful if they had appropriate instruction. They [sic] key to reducing failure rates in developmental courses is to improve the quality of instruction by investing more heavily in the training of the part-time and adjunct faculty who teach these courses. (Boylan, Bonham, & White, 1999, p. 99)

Tomlinson (1989) made the following recommendations for faculty and staff of developmental education. First, involuntary placement of faculty in developmental education should be discouraged. Faculty who were unhappy with what they were teaching might bring negative attitudes to their teaching environment, which might make them less effective as teachers. Second, developmental education faculty should maintain contact with faculty teaching college level courses and should also teach college level courses when possible. Doing this might keep them informed about the goals and

objectives of the department and of other courses, so that they were aware of what students needed to know and to be able to do upon entering college level courses.

Roueche and Roueche (1999a) wrote:

> Instructors who thoroughly understand a college's goals and the complexity of the at-risk population, who have significant classroom experience and a broad repertoire of teaching techniques that lets them match learning needs to instruction, who want to work collaboratively with other faculty, who want to be involved in strong faculty development activities, who *want to teach remedial courses,* and who *believe that at-risk students can learn* and be successful—these are the right instructors for the job, whether they are full-time or part-time. Faculty attitude and competence are the keys to student success. (p. 26)

To summarize, developmental faculty and staff tended to have less education and training, were more likely to be part-time, and had little involvement with decision-making and planning in their departments. This was especially true in mathematics. With training, developmental faculty could increase the effectiveness of instruction, but first, faculty must be interested and want to teach developmental courses.

The findings regarding faculty education levels, training, and involvement influenced the researcher to investigate the education levels, training, and amount of involvement faculty included in this study had. Faculty training, development, and departmental participation were also included as "best practices."

Learning Theory

If instructors taught using what they knew about how people learn and what they knew about good teaching and learning, their teaching should be more effective. Researchers (Boylan & Saxon, 1998b; Casazza & Silverman, 1996; Roueche, 1973; Roueche & Kirk, 1973; Stahl, Simpson, & Hayes, 1992) found evidence that

developmental courses were more effective when they were designed and taught using sound cognitive, teaching, and learning theories. The following sections provide descriptions of various learning theories and studies that have shown promise in helping developmental students learn.

Strategic Learning. Sometimes developmental students did not know how to gain and process information. They could not monitor their own understanding and learning processes (Boylan & Saxon, 1999). This inability could create problems for these students in college unless they were taught how do to this. Claire E. Weinstein (Weinstein et al., 1997; Weinstein, Dierking, Husman, Roska, & Powdrill, 1998) was credited with developing the theory of strategic learning. The basic idea behind her theory was that the key to learning was to know how to do it. She developed a course based on her model that taught students how to be strategic learners (Weinstein et al., 1997). The course focused on: (a) skill—using learning strategies and identifying important information, note-taking, listening; (b) will—motivation, using and setting goals; (c) self-regulation—time management, avoiding procrastination, concentration, reflecting, monitoring comprehension; and (d) the learning context—teacher expectations, characteristics of tasks (Weinstein, Dierking, et al, 1998; Weinstein, Hanson, et al., 1997). Students were taught how to learn as well as how to monitor their own learning.

Weinstein, Hanson, et al. (1997) and Weinstein, Dierking, et al (1998) reported positive results with the strategic learning course at the University of Texas-Austin. Approximately 71% of students who successfully completed the course as entering

students in 1990 graduated after five years compared to approximately 55% of students who did not take the course as entering students in 1990. It is important to note that the students who took the course had significantly lower SAT scores than those who did not. According to Weinstein et al. (1997), this finding "supports the long term retention effects of intervention in learning strategies" (para. 6). The data also supported the positive effect developmental education had on students who were at-risk of failing or who entered college underprepared. Students could take a specific course on strategic learning, but instructors could also incorporate some of Weinstein's theory and techniques in their own classes to help students learn. Once students have these skills, they could use them in other classes throughout their college careers as well as throughout their lives.

Critical Thinking. Critical thinking was defined many ways, but its definition usually included the ability to solve problems, analyze, use logic, reason analytically, use evidence to support a view, generalize, evaluate ideas, synthesize information, or to make connections between concepts (Chaffee, 1992). Developmental students often lacked critical thinking skills and needed to be taught these skills.

John Chaffee (1992, 1997), at LaGuardia Community College, created a course to help students think critically as well as a model to help integrate critical thinking into the college curriculum. His model helped students learn how to: (a) solve difficult problems; (b) analyze issues and information to arrive at informed and reasoned solutions; (c) create goals and plan; (d) communicate effectively; and (e) critique information (Chaffee, 1997). Chaffee (1992) provided guidelines for integrating critical thinking into the

curriculum: (a) build critical thinking into the course structure; (b) stimulate active learning; (c) encourage cogent reasoning and well-supported conclusions; (d) encourage perspective taking; (e) stimulate thinking and language use at all cognitive levels; and (f) build from students' experiences (Chaffee, 1992, p. 8).

In their literature review, Boylan and Saxon (1999) reported that when students participated in critical thinking activities, they had improved performance in reading, writing, and research assignments, improved attitudes toward learning, and higher grades and retention levels. Chaffee (1992) reported similar findings such as improved language, thinking, and problem solving skills.

Metacognition. Metacognition was described as thinking about thinking and included actively monitoring one's own thinking and cognition (Gray, 1995). It helped students become aware of how they thought and solved problems, and then helped them actively direct, reflect, and structure their thinking so that it was most effective. In this way it was like strategic learning. Instructors taught strategies and also trained students to transfer strategies to other situations and contexts (Stahl, Simpson, and Hayes, 1992). By doing this, students' thinking skills developed so that they were more flexible and more critical.

Metacognition could be used to help mathematics students solve problems. By making students aware of their thinking and by helping them plan, monitor, and control their thinking strategies, they could become better mathematical problem solvers. By focusing on awareness and controlling thinking, students used less memorization, and instead, became better thinkers and logical problem solvers (Gray, 1995).

Gray (1995) listed metacognitive goals for mathematics students. These goals were: (a) active involvement in mathematics; (b) awareness and control of thinking; (c) expressing thinking and ideas about mathematics; (d) awareness of effective learning behaviors; (e) the ability to self-assess and develop behaviors and beliefs that help the learning of mathematics (Gray, 1995). These goals were reached through the regular practice of verbalizing, recording, comparing, and analyzing strategies, and through writing assignments that forced students to reflect, self-assess, and develop as mathematical learners (Gray, 1995).

Gray (1995) said, "Experience with metacognition in the mathematics classroom can help developmental students increase awareness and control of their thinking while promoting more effective learning beliefs and behaviors" (p. 28). Gray (1995) observed a number of positive benefits from the use of metacognition. Students experienced increased motivation and willingness to try more complex problems. They became more flexible in their thinking, had a higher level of awareness, and used more strategies. They improved their ability to communicate what they were thinking, and they took more time considering a problem and a strategy before starting a solution. They could also use these skills in other courses, in life, and in the workplace.

Other Theories and Research. Casazza (1998) constructed a theoretical framework for how developmental education students learned using theories from psychology, linguistics, cognitive science, reading, and adult education. Her framework considered how intelligence was defined, ways of knowing, constructivism, the strategic process of learning, metacognition, and culture in an attempt to serve as a reference for

training new developmental educators as well as easing decision making in the field (Casazza, 1998). Casazza (1998) hoped that by better understanding the process of learning and development, developmental education could more effectively help students. Her framework was a first step toward developing a theory for how developmental education students learn but the framework needed to be tested.

Casazza and Silverman (1996) connected learning theory to practice. They believed that no one theory was broad enough, and they suggested using principles from at least the areas of behaviorism, cognitivism, social learning theory, motivational theory, and adult learning theory. These theories could be combined to create an effective theory or plan to help developmental students.

In conclusion, developmental courses that were based on sound cognitive, teaching, and learning theories had positive results with developmental students. Some of the benefits of strategic learning, critical thinking, and metacognition included increased retention and grades, and improved thinking skills, problem-solving skills, attitudes toward learning, and communication skills. Others (Casazza, 1998; Casazza & Silverman, 1996) have proposed other developmental theories. The use of these theories was considered "best practice," and in this study, the researcher tried to determine instructors' use of these theories in developmental mathematics education.

Developmental Instruction and Curriculum

"Essentially the research indicates the developmental programs employing sound organizational and teaching strategies have been consistently linked to higher passing and completion rates in courses, better student grades, and higher rates of retention" (Boylan,

Bonham, & White, 1999, p. 94). The following sections provide the current understanding of and research on "best practices" in instructional methods and curriculum for developmental students. These methods include mastery learning, learning communities and paired courses, lab integration, technology, diversity in instructional methods, structure, constructivism, seamless alignment of courses, having a written statement of goals and objectives, and other methods and research findings. These practices were considered "best practices," and the researcher tried to determine the extent of their use at the institutions included in this study.

Mastery Learning. Mastery learning is based on the principle that all students can learn, but that it may take some longer than others to do this. Content is divided into units that must be mastered before proceeding to the next unit. Frequent tests requiring a certain score are used to determine if students have mastered the material in a unit. Students who do not master the material must restudy the material and then retest. This method of learning helps guarantee that the student has learned prerequisite material before beginning new material which can be very beneficial in sequential courses, like mathematics, where knowing the prerequisite material is essential for success in the latter material.

According to Boylan and Saxon (1999), studies by Cross (1976) and Kulik and Kulik (1991) supported the use of mastery learning in developmental courses. Boylan, Bonham, Claxton, and Bliss (1992) found that developmental students in courses that used mastery learning techniques were more likely to pass those courses, earn higher grades, and be retained, than developmental students who were enrolled in courses using

other more traditional teaching techniques. Boylan and Saxon (1998a) found that students who took developmental courses that utilized mastery learning methods at Texas community colleges were more likely to pass a statewide achievement test in that developmental subject area than students who took developmental courses that did not utilize mastery learning methods.

Learning Communities and Paired Courses. Learning communities connect groups of students and courses. A group, or cohort, of students enrolls in the same cluster of courses that are connected by a theme. The instructors of these courses collaborate to ensure that the courses are connected and support each other. Tinto (1998) said that learning communities benefited students through "shared knowledge" and "shared knowing." The same students worked together all term to learn a coherent single body of knowledge. It connected the academic and social lives of students, eased the transition to college, and helped students integrate into campus culture (Tinto, 1998). These factors were all important to increasing retention (Tinto, 1987).

Tinto (1998) suggested ways of adapting the learning communities model specifically for developmental students. This adaptation might be done by mirroring the linked courses to the level of the developmental students enrolled in the courses. In the case where students needed a great deal of developmental coursework, all of the linked courses could be developmental. Communities could also be created with one developmental course included in the group of courses for groups of students requiring a single developmental course.

Tinto (1998) and others (Hunter College, Sacramento City College, the University of Minnesota Twin Cities, Skagit Valley College, Spokane Falls Community College, and Seattle Central Community College; see Tinto, 1998 for more) found that learning communities had positive results with developmental students. These communities increased students' level of involvement academically and socially, which was important for retention (Tinto, 1987, 1998). The results of studies indicated that developmental students who participated in learning communities had better attitudes toward learning, higher pass rates, higher persistence rates, higher grades, and higher completion rates than students who did not participate in learning communities (Tinto, 1998).

Paired courses are similar to learning communities. Two courses are paired, and instructors work together to align these courses so that the material taught in one course is related to material taught in the other course. According to Commander, Stratton, Callahan, and Smith (1996), students in paired courses reported higher levels of satisfaction as well as improved performance.

Lab Integration. Learning laboratories are sometimes used in developmental courses as supplements to or aids for a course. These learning labs might be computer labs, labs with instructional videos, tutoring labs, instructional labs, or any other type of learning lab used to supplement or aid a course. Integration of classroom and laboratory instruction was found to be associated with student success (Boylan, Bliss, & Bonham, 1997). Boylan and Saxon (as cited in Boylan & Saxon, 1999) found that lab and classroom integration was related to student success on a mandated achievement test in Texas. It might be that the level of integration and coordination was what made this form

of assistance and instruction effective. If laboratory activities were not well integrated with instructional activities, they were not as effective as those that were integrated (Boylan, Bonham, & White, 1999). If labs were used for tutoring, it was important that the tutors be trained in order to be effective (Boylan, Bonham, Bliss, & Saxon, 1995).

Technology. In mathematics, technology often took the form of hand-held calculators or computers. In developmental mathematics, educators usually took one of two stances regarding technology. Some believed developmental students should not be allowed to use technology since they should be learning basic skills that needed to be mastered without the help of a calculator. Others, including the American Mathematical Association of Two-Year Colleges (AMATYC) (1995, 2002) and the National Council of Teachers of Mathematics (2000), believed that technology should infuse the curriculum of all mathematics classes to enhance mathematical thinking, learning, and problem solving. In fact, the National Council of Teachers of Mathematics (1998) and the American Mathematics Association of Two-Year Colleges (1995) included statements regarding technology use in their published standards. One of the principles included in the AMATYC's (1995) Crossroads in Mathematics was, "The use of technology is an essential part of an up-to-date curriculum. Faculty and students will make effective use of appropriate technology." Standard 1-6: Using Technology states, "Students will use appropriate technology to enhance their mathematical thinking and understanding and to solve mathematical problems and judge the reasonableness of their results" (AMATYC, 1995). AMATYC (2002) also published a position statement regarding the use of technology in mathematics.

Vásquez's (2000) review of calculator usage in developmental mathematics reported that there were few research studies on calculator usage specifically in developmental mathematics. Most of the studies that were completed were usually action research. They were done for the purpose of improving the program at that particular institution or in that course. The studies Vásquez (2000) reviewed provided evidence that calculator usage did not hinder students. In fact, students using calculators performed as well or better than those who did not use calculators, and the use of calculators also seemed to enhance problem solving, to improve students' attitudes toward learning math, and to make learning more real-world based (Vásquez, 2000).

Roueche and Roueche (1999a) found most colleges used instructional technology in developmental courses, usually for mathematical problem solving and writing assignments. Boylan and Saxon (1999) reported on the effects of computer-based instruction in developmental education. Kulik and Kulik (as cited in Boylan & Saxon, 1999) analyzed computer-based instruction at 123 colleges and universities and found that when the computer was used as a tutor to supplement regular instruction, students learned more in less time, had slightly higher grades on post-tests, and had improved attitudes toward learning. Kulik and Kulik (1991) later found that with underprepared students, achievement was raised with computer-based instruction. Further, computer-based instruction was most successful when it was used as a supplement to the regular developmental class, rather than as the primary delivery method (Boylan and Saxon, 1999). Maxwell (1997), Boylan and Saxon (1998a), and Bonham (1992) (as cited in Boylan & Saxon, 1999) found that students whose computer-based instruction was

provided this way earned higher grades and were more likely to finish their developmental courses. This finding seemed to be in line with the previously stated finding that integration of classroom and laboratory instruction was associated with student success (Boylan, Bliss, & Bonham, 1997).

Diversity of Instructional Methods. Various instructional strategies have been tried over the years. Some were found to improve student performance (active learning), some worked momentarily (text-book-programmed instruction), and others, like lecture, were generally ineffective but still persisted (Roueche & Roueche, 1993). In any case, it might be best for instructors to use a variety of instructional methods, such as cooperative learning, discussion, lecture, technology, hands-on, audio-visual, etc., to effectively teach the diverse body of students encountered in higher education today (Boylan & Saxon, 1999; Chickering & Gamson, 1991; Davis, 1993; Roueche & Roueche, 1993).

Researchers (Casazza & Silverman, 1996; Cross, 1976; Kulik & Kulik, 1991) found that developmental students were more likely to be successful when a variety of instructional methods were used. Chickering and Gamson (1991) found that undergraduate students learned best when instructors used diversity in their teaching. Students are diverse and learn in diverse ways; thus, instructors' methods of teaching also must be diverse.

According to Boylan and Saxon (1999), there was some research that indicated developmental students learned in ways that traditional instruction did not typically address. Boylan and Saxon (1999) cited studies since the 1970s that indicated developmental students tended to be more visually oriented and more hands-on oriented.

They tended to learn best by direct experience and by doing (Boylan & Saxon, 1999). This might be why lecture, a common college teaching method, has not worked well for these students in the past. It might also explain why students in classes where the instructor utilized a variety of instructional methods were more successful since these students were more likely to experience the teaching methods that worked best for them.

Davis (1993) cautioned that instructors should not try to match teaching methods to students' learning preferences since there was no consensus in the research that matching teaching methods to learning preferences or styles actually increased learning. Rather, Davis (1993) suggested that students observe their own learning preference(s) and try to better understand how they learn most effectively so that they can use this information to help them succeed in their courses. Davis (1993) also suggested that students should be encouraged to value different learning styles and orientations and should work with students who have a different learning preference. Doing this could enrich their learning experiences and possibly help develop their less preferred learning styles. By doing this, they could learn effectively in more ways because not every instructor will teach with diversity nor will each instructor match the learning preference of each student. Therefore, it is important that students take responsibility for their own learning and try to make it as diverse and flexible as possible.

Educators do not know what works best for which students, but they do know that variety offers the best chance for all students to succeed. Cross (1976) might have said it best:

> It now seems clear that we are not going to improve instruction by finding *the* method or methods that are good for all people. The research on teaching

> effectiveness has been inconclusive and disappointing...When we ask whether discussion is better than lecture, whether television is as good as a live teacher, whether programmed instruction is an improvement over more traditional methods, we find that for that mythical statistical *average* student it seems to make little difference how we teach. But when we look at the data student by student, it is clear that some students improve, some remain unaffected, and a few actually regress under various teaching conditions. (p. 112)

Degree of Structure. Roueche (1973) and Cross (1976) emphasized the use of structure with underprepared students. They thought that developmental students did not have the ability to organize their thoughts and concepts. They needed to be shown how to do this in order to understand concepts. This can be done by modeling appropriate behavior and by structuring students' learning activities and environments in such a way that they learn appropriate ways to organize information. Cronbach and Snow, Kulik and Kulik, and Boylan, Bonham, Saxon, and Bliss (as cited in Boylan & Saxon, 1999) found that structured learning environments were most beneficial to the weakest students. Further, learning theories, like strategic learning and metacognition, provided students with skills that could be generalized to all situations, not just those situations where the environment was structured.

Constructivism. The American Mathematical Association of Two-Year Colleges advocated the use of constructivism in their standards for pedagogy. Also, their standards for pedagogy were written to be compatible with the constructivist point of view (American Mathematical Association of Two-Year College, 1995).

Different educators have interpreted constructivism differently. Lochhead (as cited in Blais, 1988) described constructivism in the following way:

> What I see as critical to the new cognitive science is the recognition that knowledge is not an entity which can be simply transferred from those who have it to those who don't...Knowledge is something which each individual learner must construct for and by himself. This view of knowledge as an individual construction...is usually referred to as constructivism. (p. 2)

Education was then the process that transformed a novice into an expert, and experts saw the "essence" in a problem or concept, while the novices sought information to use for algorithmic activity, according to Blais (1988).

In mathematics this was often the case. Students had a shallow understanding of concepts because they only learned rules or algorithms, not the essence or complete understanding of what happened in problems. Too often math focused on drill and kill activities and rote learning, and did not spend enough time on discovery, reinvention, and reconstruction, all of which would help students construct and reconstruct their own knowledge of mathematics (Blais, 1988).

According to Blais (1988), explanations only facilitated students to seek algorithmic activities, and this created a reliance on memorization and often caused students to believe math was something that was memorized, a series of steps, and had only one right answer. It also created the listener-follower roles for students that led to dependence, a lack of independent thinking, and learned helplessness, which kept the novice a novice and learning shallow (Blais, 1988). Piaget (as cited in Blais, 1988) said, "The teaching of mathematics and science is 'psychologically archaic insofar as it rests on the simple transmission of knowledge'" (p. 6). Maybe by incorporating more constructivist or discovery based techniques in the mathematics curriculum and classroom, students would gain more understanding, not more superficial skills.

Seamless Alignment of Courses. In order for developmental education courses to be effective, they must prepare students for the next course that must be taken in a specific subject area. This is especially true in subjects like mathematics, where concepts are sequential and build upon one another. Prerequisite knowledge is essential for success in latter courses. For example, intermediate algebra needs to help students gain the necessary skills and knowledge they will need to succeed in college algebra. If this is not done, the student will most likely struggle in college algebra. If the intermediate algebra course teaches students how to do everything using a calculator, but the college algebra course expects students to do all algebraic manipulation without the use of a calculator, students will probably struggle. The more closely aligned these courses are, it seems to follow that, the more likely students are to succeed in them.

Boylan, Bonham, Claxton, and Bliss (1992) found that when consistency was ensured between exit standards in developmental courses and entry standards in regular college courses, the developmental courses were more effective. Students who passed developmental courses were more likely to pass later courses in the same subject area when this consistency was ensured (Boylan & Bonham, 1992; Boylan & Saxon, 1999). According to Boylan and Saxon (1999), a study done in Texas in the mid-1990s found that very few institutions made an effort to determine if what was taught in developmental courses was necessary for student success in college level courses.

In order for programs and institutions to know if this alignment of courses is occurring, they must assess and evaluate themselves. Abraham (as cited in Spann & McCrimmon, 1998) recommended developmental programs be reviewed and evaluated

yearly to ensure academic integrity and to ensure that students who completed developmental courses had the necessary skills and knowledge to enter regular college level courses. This alignment cannot happen unless people talk and work together; therefore, a high level of communication and coordination must be maintained within the program to ensure a seamless transition between courses. It may also mean that program and course goals and objectives need to be explicitly stated so that everyone knows and understands the purposes of the program and courses. Roueche and Roueche (1999a) also recommended creating a "more seamless web," not only between courses, but also between high schools and colleges, and elementary schools and high schools. "Collaboration and strong linking mechanisms are critical to successful transition" (Roueche & Roueche, 1999a, p. 51).

Written Statement of Program Goals and Objectives. Roueche and Snow (1977), Roueche and Roueche (1993), Casazza and Silverman (1996), Maxwell (1997), and Boylan and Saxon (1998a) all suggested that successful developmental programs have clearly defined philosophies, goals, and objectives. These programs have stated what they valued, what they were going to do about what they valued, and what was expected from those who participated and worked in the program. When these goals and objectives were measurable, it also made assessment of them easier.

The rationale for defining and writing goals was: If the objectives and goals of programs and courses were clearly defined, then they were carefully considered and thought through. Goals and objectives should be linked to the mission of the department or the institution or both, as well as to future college level courses. In these ways the

goals would reinforce the larger purposes and mission of the institution and might increase the chances of the courses and program being successful. Finally, writing out and sharing the goals and objectives made them known and demonstrated a commitment to the goals and to student learning (Roueche & Roueche, 1993).

According to Boylan and Saxon (1999), "Studies by Donovan (1974), Cross (1976), Kulik and Kulik (1991), and Boylan, Bonham, Claxton, and Bliss (1992) also found that remedial instruction based on carefully defined goals and objectives was associated with improved student performance" (para. 10). By linking the goals and objectives to the actual teaching process, students knew exactly what was expected of them. Then they could take the necessary actions to meet these expectations. Teachers were also guided by the goals in the teaching of the courses. This provided structure for both parties in the learning process and connected them on the same path.

Other Instructional Methods. Starks (1998) identified eight pedagogical elements that contribute to successful developmental education: (1) use of cooperative or collaborative learning, (2) use of electronic media to support learning, (3) a focus on metacognition or learning strategies, (4) small classes, (5) frequent student-faculty contact in the classroom, (6) attention to students' personal learning styles, (7) frequent evaluation of students with continuous feedback, and (8) evaluation of teaching (p. 22). These elements were similar to the seven principles of undergraduate education that Chickering and Gamson (1991) advocated.

The previous sections included the current understanding of and research on "best practices" in instructional methods and curriculum for developmental students, including

mastery learning, learning communities and paired courses, lab integration, technology, diversity in instructional methods, structure, constructivism, seamless alignment of courses, having a written statement of goals and objectives, and other methods and research findings. These instructional methods have had various positive benefits, including increased retention and pass rates, higher grades, better attitudes toward learning, and increasing the chances of passing regular college courses.

Developmental Support Services

The following sections provide descriptions of how support services can positively contribute to developmental education. Orientation and freshmen seminar, counseling, tutoring, and Supplemental Instruction are described. These services were included in the list of "best practices," and the researcher tried to determine which services were used at each of the studied institutions.

Orientation and Freshman Seminar. Many developmental students were first-generation college students who were often unaware of the rules, regulations, procedures, environment, expectations, demands, and rewards of college. College orientations, especially those that were comprehensive and ongoing, might help developmental students adjust to college life. These orientations should last for the first quarter, first semester, or first year. Students might be provided mentors to help them through the first year as well as be required to participate in certain events or services (Boylan & Saxon, 1999; Roueche & Roueche, 1999a).

One step beyond orientation was the freshman seminar, a college course that had students examine various issues surrounding college life (Upcraft & Gardner, 1989). It helped students integrate into the college environment by providing them with knowledge about college culture and by helping them develop the skills necessary to be successful in college. Gardner (1998) reported that underprepared students who participated in ongoing orientation courses, like the freshman seminar, were more likely to be retained than students who did not participate in these courses. It could also enable students to get college credit while taking developmental courses that should help prepare them for college level courses (Boylan, 1999a).

Counseling. "When teachers are trained in counseling, and when special in-service staff development is provided, the high-risk student does better" (Roueche & Snow, 1977, p. 36). Counseling offered another way for students to receive help, support, and instruction from specially trained professionals. Roueche and Snow (1977) advocated counseling for developmental students and found that programs with a strong counseling component were more likely to have successful developmental education programs. The use of counselors as consultants in community colleges was significantly related to increased student success, while the use of counselors as instructors was significantly related to student success at senior colleges (Roueche & Snow, 1977).

Boylan, Bonham, and Bliss (1994a) found that 71% of all institutions had an advising or counseling component in their developmental programs, and only 30% of these evaluated their advising/counseling component. According to Boylan and Saxon (1999, para. 34, 35), later research by Keimig (1983), Kulik, Kulik, and Schwalb (1983),

Boylan, Bonham, Claxton, and Bliss (1992), the Higher Education Extension Service (1992), and Casazza and Silverman (1996) validated the relationship between student success and counseling, but only when counseling was: (a) integrated into the overall structure of a developmental program (Kiemig, 1983); (b) based on the goals and objectives of the program (Casazza & Silverman, 1996); (c) carried out early in the semester (Kulik, Kulik, & Schwalb, 1983); (d) based on student development theory (Higher Education Extension Service, 1992); and (e) performed by counselors trained specifically to work with developmental students (Boylan, Bliss, & Bonham, 1997).

Boylan, Bliss, and Bonham (1997) found that advising/counseling had a significant positive relationship to first-term GPA and pass rates in developmental English courses at four-year institutions, and to pass rates in developmental mathematics courses at two-year and four-year institutions.

Tutoring. Tutoring has long been used as a way to help struggling students learn or as a supplement to a course. For courses in which tutoring was received, it was positively linked to persistence rates, graduation rates, final grades, completion rates, and student attitudes toward instruction (Boylan, Bonham, Bliss, & Saxon, 1995). The majority of tutors worked part-time, got paid for their services, and were undergraduate peer tutors (Boylan, Bonham, Bliss, & Saxon, 1995). Sometimes graduate students were used as tutors, but this usually only occurred at four-year institutions where graduate students were also enrolled.

In developmental education, tutoring was used at most institutions, but tutoring programs with trained tutors were significantly more successful than those programs in

which tutors were not trained (Boylan, Bonham, Bliss, & Saxon, 1995). Boylan, Bonham, Bliss, and Saxon (1995) reported that approximately 75% of four-year institutions and 71% of two-year institutions offered tutoring programs (73% overall). About 80% and 55% of four-year and two-year institutions with tutoring programs, respectively, provided tutor training. Overall, about 70% of all institutions provided this training (Boylan, Bonham, Bliss, & Saxon, 1995). In 1997, Boylan, Bliss, and Bonham went on to show that tutoring programs without a training component had no relationship to student GPA or retention. Yet, tutoring programs with a training component were found to have a significant positive relationship with first-term GPA at two-year and four-year institutions, cumulative GPA and retention at four-year institutions, and higher pass rates in developmental English courses at two-year and four-year institutions. Tutoring had no significant effect on pass rates in developmental mathematics courses at either type of institution (Boylan, Bonham, Bliss, & Saxon, 1995).

One further thing to note, tutoring programs that underwent regular and systematic evaluation were more successful than those programs that did not (Boylan, Bonham, Bliss, & Saxon, 1995). Yet, only 39% of all institutions evaluated their tutoring programs (25% of two-year institutions and 48% of four-year institutions) (Boylan, Bonham, & Bliss, 1994a). This finding suggests that those programs that are aware of what they are doing well, as well as what they need to do to improve, should be more successful than those programs that do not know how effective their programs are. Only by asking tough questions about what is being done and what needs to be done, can

programs know what needs to be improved, continued, and eliminated. Then, they must take the necessary actions to make the appropriate changes.

In mathematics, affective issues, such as anxiety, attitude, self-esteem, self-concept, and motivation, have often been an issue. Gourgey (1992) described a model for tutoring developmental mathematics students that aims to help them "overcome their anxiety, improve their self-concept of their math ability, and develop capacities for independent learning" (p. 10). The model included dialogue, analysis of error, response to affective needs, reeducation about the learning process, and the use of real-life applications (Gourgey, 1992, p. 10). The goal of the model was to teach mathematics as well as "to develop skills for self-directed learning in which students actively seek and construct their own understanding" (Gourgey, 1992, p. 14). In this way, it was a more comprehensive tutoring model than just a model that described how to teach content. It aimed to develop the entire student so that they could be successful throughout their college career, much like the goals of developmental education.

Supplemental Instruction. Supplemental Instruction is a voluntary academic assistance program that targets high-risk courses, those with a 30% or higher rates of D, F, and W (withdrawals) grades. These programs provide regularly scheduled small-group sessions outside of class led by a student or peer leader. The leader should be someone who previously took the course. The leader attends the course, takes notes, and meets with students to help teach them how to be successful in the course. The leader provides advice and help with course materials, study skills, and note-taking and test-taking strategies in an attempt to help students in the course succeed. The leader may

also give quizzes or listen to recitation (Boylan & Saxon, 1999; Martin, Arendale, & Blanc, 1997).

According to Martin, Arendale, and Blanc (1997), the U.S. Department of Education validated three research findings regarding Supplemental Instruction. In summary, these findings stated that students who participated in Supplemental Instruction earned higher mean final course grades, succeeded at a higher rate (i.e., withdrew at a lower rate and received a lower percentage of D or F final course grades), and persisted (reenrolled and graduated) at higher rates than those who did not participate in Supplemental Instruction (Martin, Arendale, & Blanc, 1997). Martin, Arendale, and Blanc (1997) also reported that video-based Supplemental Instruction (VSI) was particularly effective with underprepared students. Underprepared students who participated in VSI earned significantly higher percentages of A and B final course grades, significantly lower percentages of D and F final course grades, and significantly higher mean final course grades than the more prepared students enrolled in a non-VSI course taught by a live instructor (Boylan & Saxon, 1999; Martin, Arendale, & Blanc, 1997).

Supplemental Instruction has been linked to developmental students' success (Commander, Stratton, Callahan, & Smith, 1996; Hodges & White, 2001; Ramirez, 1997). According to Ramirez (1997), students who participated in Supplemental Instruction during their early years of college were retained longer than those who did not participate in Supplemental Instruction. This suggests that some students in

developmental courses might be successful in college level courses that used Supplemental Instruction.

Hodges and White (2001) found that developmental students who attended Supplemental Instruction sessions had significantly higher GPAs than non-attendees, while tutoring had no effect on the GPAs of students in the same course. This could be because Supplemental Instruction sessions addressed learning and study strategies for a course as well as content, whereas tutoring usually only addressed content.

Developmental support services like orientation, freshman seminar, counseling, tutoring that uses trained tutors, and Supplemental Instruction can help developmental students succeed. The studies described above indicated that these support services increased retention, student success, GPA, pass rates, and course completion rates.

Assessment and Evaluation of Developmental Programs

"Evaluation is one, if not the single most, critical issue not yet resolved as colleges respond to at-risk students" (Roueche & Roueche, 1999b, p. 18). In order for any program to be and to remain effective and successful, it needs to know what it is doing, how well it is doing it, and what it needs to do to improve. Researchers (Boylan, 1999; Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, & White, 1999; Boylan & Saxon, 1999; Casazza & Silverman, 1997; Maxwell, 1997; McCabe, 2000a; Roueche & Roueche, 1999a) recommended regular, systematic program evaluation that was both formative and summative and was used to revise and to improve the program. Roueche and Roueche (1999a) suggested that this information be actively disseminated to staff and faculty.

Weisman, Bulakowski, and Jumisko (1997) stated:

> Evaluation of a developmental education program is critical because it will reveal if the program is accomplishing its purpose, if the students are succeeding, and if the policies the institution has put in place are facilitating student success. Without evaluation, it is impossible to tell which components of a program are working and what needs to be changed. Evaluation should go beyond determining if the courses are effective. It should also examine the policies the college has established to govern the developmental education program. (p. 74)

Weisman, Bulakowski, and Jumisko (1997, p. 74) also suggested that to assess the effectiveness of a program, four outcomes must be examined.

1. Are students successfully completing developmental education?
2. Are students moving from developmental education to college level courses?
3. Are students who have taken developmental education successfully completing college level courses?
4. Are students persisting in completion of their academic goals?

Boylan and Saxon (1998b) stated that the success of developmental students was usually measured by: (a) the rate at which students passed developmental courses; (b) the rate these same students later passed college level courses in the same subject; and (c) the rate at which these students were retained until graduation. In both cases, the success and the retention of the students were used to measure the effectiveness of the program.

Donovan (1974), Roueche and Snow (1977), and Boylan, Bonham, Claxton, and Bliss (1992) all found that regularly and systematically evaluating programs was related to program success. The National Study of Developmental Education (Boylan, Bonham, Claxton, & Bliss, 1992) revealed that program evaluation had a positive relationship with long-term retention of developmental students as well as their grades in developmental

courses. Boylan, Bliss, and Bonham (1997) demonstrated that program evaluation was positively related to student retention and success in developmental math and English courses at all institutions. The relationship between program evaluation and student success depended on how the information gathered in the evaluation was used. The more effective programs with higher rates of student success used a combination of formative and summative evaluation methods in which the formative data were used to improve the program (Boylan & Saxon, 1999). Similar findings were reported in Boylan and Saxon (1998a).

"Program evaluation has been and remains the weakest component of the remedial effort. Most colleges have never defined, described, or evaluated their remediation efforts very well" (Roueche & Roueche, 1999a, p. 16). Only 14% of developmental programs at two-year institutions and 25% of these programs at four-year institutions regularly and systematically evaluated themselves and their activities (Boylan, Bonham, & Bliss, 1994a). In 1989, 40% of all institutions offering developmental education were not doing anything to decrease the need for it (National Center for Education Statistics, 1991). Without assessment and evaluation, programs cannot know how effective they are at improving student learning, retention, and success in developmental courses. Weissman, Bulakowski, and Jumisko (1997) wrote:

> Continual monitoring and evaluation of developmental education programs are critical. Without evaluation, it is impossible to tell what is working and what is not. Evaluation must lead to decision making about changes that can be made to raise levels of student performance. Expanding assessment to include policy issues will provide further information for decision-making. (p. 79)

To summarize, regular, systematic program evaluation that is both formative and summative should be used to revise and to improve developmental programs. Yet, few developmental programs did this regularly. This type of evaluation has been related to program success, higher retention rates, higher grades, and success in developmental mathematics and English courses. The positive findings associated with program assessment and evaluation influenced the researcher to include it on the list of "best practices" and to try to determine if the studied programs were regularly and systematically assessed.

Comprehensiveness

All of the above practices and policies were beneficial for developmental students, but they were most beneficial when many of these practices were used together, rather than when only one or a few practices and policies were used. Boylan, Bonham, and Bliss (1994a) stated:

> The literature in the field of developmental education (Boylan, 1983; Keimig, 1983; Kulik, Kulik, & Schwalb, 1983; Maxwell, 1985; Roueche & Snow, 1977) has consistently suggested that the more comprehensive the services of a developmental program, the greater its likelihood of promoting student success. Remedial courses alone, tutoring alone, counseling alone, or academic advising alone are less effective than a combination of these services. The most effective developmental education, therefore, is comprehensive. (p. 1)

McCabe and Day (1998) echoed their sentiments, "Extensive study of developmental education programs has documented a correlation between the comprehensiveness of the program and the impact on student learning. Isolated basic skills courses have been found to be least likely to have a long term effect on student achievement and persistence" (p. 20).

Boylan, Bliss, and Bonham (1997) found evidence to say, "There are definite relationships between the presence of certain program components and various measures of success among developmental students" (para. 44). These program components included: centralized or well-coordinated administrative structures, mandatory assessment and placement, tutoring with tutor training, commitment to faculty and staff development, advising and counseling, and ongoing systematic evaluation (Boylan, Bliss, and Bonham, 1997). These components were the only ones tested, and all of them were found to be related to student success, with centralized structure, tutoring with tutor training, and ongoing and systematic evaluation related to the most success variables (Boylan, Bliss, & Bonham, 1997). Thus, program comprehensiveness was studied and listed as a "best practice."

Summary of "Best Practices" in Developmental Education

The literature on developmental education described and detailed in the above sections presented a number of practices that contributed to successful developmental education. Various policies, the organization and location of developmental education, faculty and staff characteristics, learning theories, instruction and curriculum, support services, and assessment and evaluation were all discussed. Table 7 includes a summary of many of these "best practices," specifically those "best practices" that guided the study.

Table 7. "Best Practices" in Developmental Education.

"Best Practices"
1. Mandatory assessment and placement of developmental mathematics students.
2. Strong institutional commitment to developmental mathematics.
3. Centralized or highly coordinated developmental program.
4. Training and professional development and for the staff and faculty who work with developmental mathematics students. These staff and faculty should also be involved in departmental planning and decision-making processes. Adjuncts and part-time faculty should not be overused.
5. Developmental courses should be designed and taught using sound cognitive, teaching, and learning theories. This includes integrating strategic learning, critical thinking, and metacognition into the curriculum.
6. Successful instructional and curricular methods include: a. mastery learning techniques; b. learning communities and/or paired courses; c. the integration of classroom and laboratory instruction; d. the supplemental use of technology; e. the use of a variety of instructional methods; f. a high degree of course structure; g. constructivist or discovery based techniques; h. the alignment of exit skills and knowledge in developmental courses with those required to enter regular courses; and i. clearly defining, linking, and sharing with others the philosophies, goals, and objectives of the developmental program and its courses.
7. The provision of various support services, including ongoing student orientation, freshmen seminars, the use of trained tutors, and Supplemental Instruction;
8. Regular, systematic assessment that is both summative and formative and is used to revise and improve the program and its courses.
9. Comprehensiveness, or the use of many "best practices," rather than a few.

Reducing and Improving Developmental Education

Reducing Developmental Education.

Suggestions for reducing developmental education include:

1. Collaboration between institutions (Abraham & Creech, 2000; Astin, 1998; Boylan, Bonham, & White, 1999; Ignash, 1997; Institute for Higher Education Policy, 1998; McCabe, 2000a; Merisotis & Phipps, 2000; Roueche & Roueche, 1999a; Spann, 2000b; Spann & McCrimmon, 1998). A more seamless web needs to be created between all schools from elementary school through college, between two-year and four-year institutions, between states and institutions, and between business and educational institutions. Articulation and collaboration between institutions and people is critical to success. If high schools and colleges do not know what each other are doing, they cannot effectively help prepare students.
2. Aligning high school requirements and content with college content and expectations (Institute for Higher Education Policy, 1998; McCabe, 2000a; Merisotis & Phipps, 2000; Roueche & Roueche, 1999a). Feedback systems can be developed between high schools and colleges so students exit high school with the necessary skills to enter college prepared. The success of this will likely depend upon the first recommendation, collaboration.
3. Early intervention and financial aid programs (Institute for Higher Education Policy, 1998; Merisotis & Phipps, 2000). These programs can be implemented to correct student academic deficiencies before students reach college.

4. Improved teacher preparation (Institute for Higher Education Policy, 1998; Merisotis & Phipps, 2000) and developmental instruction (Boylan, Bonham, & White, 1999; Spann & McCrimmon, 1998). Improving future and current teachers' skills should help students get the best education possible. It should also help students successfully complete developmental courses on their first attempt.
5. Establish faculty:student and staff:student ratios that are appropriate for effective and efficient developmental education (Spann, 2000b).
6. "States should increase the number of required mathematics courses beyond Algebra I for high school graduation and should look at ways to increase the rigor of the high school curriculum" (Abraham & Creech, 2000, p. 18). Evidence suggests that students were less likely to need developmental courses if they completed a core of challenging courses in high school and took an upper-level math course their senior year (Abraham & Creech, 2000; Adelman, 1999; National Center for Education Statistics, 2000).
7. "Use more noncognitive assessment to determine who may participate in non-course-based developmental education" (Boylan, Bonham, & White, 1999, p. 97). Assessing characteristics like motivation, attitude toward learning, or learning preferences, could help institutions determine if they really need to offer developmental courses or if they could just add more tutoring or workshops to help students (Boylan, Bonham, & White, 1999).
8. "Provide more alternatives to traditional remedial courses" (Boylan, Bonham, & White, 1999, p. 98). Alternatives like Supplemental Instruction, strategic learning,

and freshmen seminars can help students who may not need an entire developmental course.

9. "Require that minimum standards and procedures for placement and assessment be consistent statewide for all public institutions of higher education" (Spann & McCrimmon, 1998, p. 44). This would help guarantee that students who transfer from two-year institutions to four-year institutions do so with the same skills and knowledge, and thus, do not require developmental education in a course previously taken.
10. Provide adequate funding for developmental programs since these can require greater efforts and costs (McCabe, 2000a; Spann & McCrimmon, 1998). If programs are not adequately supported, they cannot operate effectively.
11. Developmental education must be included in all long-term educational plans (McCabe, 2000a). When developmental education is addressed and planned for, more efforts can be directed at reducing it and making it as effective as possible.
12. "The continued and substantial lag in educational progress for minorities demands massive reform" (McCabe, 2000a, p. 49). Society needs to find a way to improve the education of minorities since they are overrepresented in developmental education and underrepresented in degree completion.
13. A national guide should be instituted to assist institutions in developing appropriate and effective developmental education programs (McCabe, 2000a). McCabe (2000a) suggested involving business and industry representatives in the development of the guide.

Improving Developmental Education. Besides using methods and policies of "best practice," other suggestions have been made for improving developmental education.

1. Interinstitutional collaboration (Astin, 1998; Institute for Higher Education Policy, 1998; Merisotis & Phipps, 2000). Colleges should work together to help all students achieve at all levels of education because it is important to the educational system, the state, and society.
2. Help all students do better rather than specifically targeting developmental students (Spann, 2000a). In this way developmental students can be helped without the criticism and lack of support many developmental programs receive.
3. Examine other institutions' successful developmental courses and programs (McCabe, 2000a; Roueche & Roueche, 1999a).
4. Employ a more collaborative effort to learn from each other (McCabe, 2000a; Roueche & Roueche, 1999a).
5. Assess, evaluate and take action on what is found (Roueche & Roueche, 1999a; Spann & McCrimmon, 1998). Only by doing this can institutions and programs know what is happening in developmental education, and by knowing this, they can make decisions and create plans to improve practice and to maintain what is already promoting success.
6. States should monitor whether students needing developmental education are recent high school graduates or adults who have been out of high school or higher education

for one or more years (Abraham & Creech, 2000). These two groups of students may have different needs.

7. Educational institutions need to make better use of information that exists on how high school graduates perform as college freshmen. This information can help instructors improve courses at both the high school and college level (Abraham & Creech, 2000).
8. Developmental education must be included in all long-term educational plans (McCabe, 2000a). When developmental education is addressed and planned for, more efforts can be made to improve and direct it in an attempt to help students.
9. Institutions must give developmental education higher priority and greater support.

> Successful remediation occurs in direct proportion to priority given to the program by the college. Most important is a caring staff who believe in the students and in the importance of their work. Presidential leadership, in word and deed, is critical to success. (McCabe, 2000a, p. 49)

Organizations Supporting Developmental Education

The opinions and recommendations of three organizations regarding developmental education and developmental mathematics education are presented below. These organizations include the National Center for Developmental Education (NCDE), the National Association for Developmental Education (NADE), and the American Mathematical Association of Two-Year Colleges (AMATYC).

National Center for Developmental Education. The mission of the NCDE was to improve the quality of practice in the field of developmental education (National Center for Developmental Education, 2002). In order to do this the NCDE: (a) provided

instruction and training in developmental education; (b) published journals and provided other literature in the field; (c) conducted research; (d) co-sponsored an annual national conference on research in developmental education; (e) disseminated resources in developmental education; and (f) provided a Web page with access to readings and other information in developmental education (National Center for Developmental Education, 2002).

According to Boylan (1999b), NCDE and NADE supported the following concepts and stood willing to work with other groups to promote these concepts:

1. Underprepared students have every right to the opportunity for higher education at the institution of their choice.
2. Underprepared students are not second-class citizens in academe. They pay the same amount of tuition, attend the same courses, participate in the same activities, and share the same aspirations as any other college student.
3. Those who serve underprepared students as faculty, staff, or administrators are professionals. They deserve and demand the same respect, the same salary, and the same benefits as any other academic professional.
4. Developmental education supports the mission, goals, and objectives of American higher education. It is, therefore, an integral part of the academic endeavor in higher education.
5. Developmental education is based on sound theory and research. It should be supported and practiced accordingly.
6. Developmental education is necessary at all levels of higher education. The specific courses, services, and activities undertaken in support of it may vary depending upon the mission and characteristics of the institution in which it is housed.
7. Developmental education is necessary in a variety of business, industry, community, and government settings. Its philosophy and methods are applicable whenever and wherever the development of human talent is a goal. (para. 43)

National Association for Developmental Education. "NADE seeks to improve the theory and practice of developmental education at all levels of the educational spectrum, the professional capabilities of developmental educators, and the design of programs to

prepare developmental educators" (National Association for Developmental Education [NADE], 2002). The purpose of NADE included: (a) providing professional development; (b) supporting student learning; (c) providing public leadership; (d) disseminating exemplary models of practice; (e) coordinating efforts with other organizations; (f) facilitating communication among other developmental education professionals; and (g) anticipating trends.

NADE (2001b) had 10 official resolutions as well as position statements on topics of developmental education. These 10 resolutions were:

1. The need to encourage and to support ongoing professional development for developmental education professionals so that knowledge can be increased and thus, practice improved. NADE has developed a set of standards for practice in its Self-Evaluation Guides (NADE, 2001b).
2. "Need for institutions to support certification of developmental programs" (NADE, 2001b, para. 1).
3. "Need for systematic ongoing evaluation in developmental education programs"(NADE, 2001b, para. 1). Institutions must provide the necessary support so that developmental education programs can do this.
4. The need to promote a seamless system of education for all learners across all levels of education and communities and workplace (NADE, 2001b).
5. "Need for professional leadership including faculty and staff to reflect the diversity of the student population in postsecondary education" (NADE, 2001b, para. 1).

6. Need for developmental education at all types of postsecondary institutions regardless of institutional size or type (NADE, 2001b).
7. "Need for mandatory academic testing and placement of students in appropriate college classes" (NADE, 2001b, para. 1).
8. "Investing in developmental education is not paying for it twice" (NADE, 2001b, para. 1), and NADE encourages policy makers to increase the investment in developmental education programs (NADE, 2001b).
9. "Opposition to college students paying higher tuition or fees for developmental education courses" (NADE, 2001b. para. 1).
10. "Establishment of a federally-funded national center for research and dissemination of effective practices in developmental education" (NADE, 2001b, para. 1).

American Mathematical Association of Two-Year Colleges. AMATYC is an organization committed to developing and implementing curricular, pedagogical, assessment, and professional standards for mathematics in the first two years of college (AMATYC, 1995). In 1995, AMATYC published standards for introductory college mathematics before calculus in Crossroads in Mathematics (AMATYC, 1995). These standards were being revisited in light of current issues. According to AMATYC (1995):

> The following principles form the philosophical underpinnings of this document:
> 1. All students should grow in their knowledge of mathematics while attending college.
> 2. The mathematics that students study should be meaningful and relevant.
> 3. Mathematics must be taught as a laboratory discipline.
> 4. The use of technology is an essential part of an up-to-date curriculum.
> 5. Students will acquire mathematics through a carefully balanced educational program that emphasizes the content and instructional strategies

recommended in the standards along with the viable components of traditional instruction.

6. Introductory college mathematics should significantly increase students' options in educational and career choices.
7. Increased participation by all students in mathematics and in careers in mathematics is a critical goal in our heterogeneous society. (Introduction, para. 8)

Three sets of standards in Crossroads in Mathematics (AMATYC, 1995) included: (1) standards for intellectual development, (2) standards for content, and (3) standards for pedagogy. These standards were addressed in terms of different mathematical programs. The program most applicable to this study was the "Foundation." The Foundation included topics traditionally taught in developmental mathematics as well as topics that all students should be able to use and learn. The goal of the Foundation was to expand the educational and career options for all underprepared students (AMATYC, 1995).

The standards for intellectual development included: problem solving, communicating, modeling, using technology, reasoning, developing mathematical power, connecting with other disciplines (AMATYC, 1995). The standards for content included: number sense, discrete mathematics, symbolism and algebra, probability and statistics, geometry, deductive proof, and function (AMATYC, 1995). The standards for pedagogy were compatible with the constructivist point of view and included: teaching with technology, multiple approaches, interactive and collaborative learning, experiencing mathematics, and connecting with other experiences (AMATYC, 1995). Chapter three of Crossroads in Mathematics (AMATYC, 1995) provided guidelines for interpreting and

achieving the standards and included suggestions for where attention should be increased and decreased in each type of program.

Chapter four of Crossroads in Mathematics (AMATYC, 1995) summarized AMATYC's recommendations in various areas. AMATYC (1995) advocated:

1. Faculty training and development and discouraged overuse of adjunct and part-time faculty;
2. Advising and placing of students;
3. The use of mathematics laboratories and technology to teach mathematics;
4. Assessment of student outcomes that supported student learning and instruction and was integrated into the instructional process so it was part of the learning process, not an end product of it;
5. Program evaluation that made recommendations for improvement while maintaining the effective aspects of the program; and
6. Articulation with high schools, with other postsecondary institutions, and with employers in an effort to improve mathematics education.

AMATYC (2002) published guidelines for academic preparation and internships for two-year college mathematics faculty and for mathematics departments at two-year colleges. AMATYC (2002) also published position statements on various topics relevant to introductory college mathematics. Those statements especially relevant to developmental mathematics education were those that addressed the following topics: (a) adjunct faculty; (b) faculty development; (c) the use of technology in mathematics; (d) the minimum mathematics requirement for an Associate of Arts (A.A.) and an Associate

of Science (A.S.) degree; and (e) academic assessment of mathematical programs. AMATYC (2002) made the following recommendations:

1. Adjunct faculty should not be overused and should be adequately supported and trained when they are used.
2. All faculty should receive and be encouraged to participate in training and professional development.
3. All students should have access to and learn how to use technology, and that teachers should incorporate technology in their instructional methods and curriculum.
4. Requirements of both an A.A and an A.S. degree should include at least one college level mathematics course of three semester hours or more that is above the Foundation level.
5. Each college assess their mathematical programs with the goal of improving instruction and student learning, and that institutions recognize that this takes time and resources and then provide faculty with these in order to make the assessment process possible.

To summarize, there were organizations that supported, advocated, researched, and disseminated knowledge of developmental education. The three main organizations that were involved in these processes were the National Center for Developmental Education, the National Association for Developmental Education, and the American Mathematics Association of Two-Year Colleges. Their contributions have helped to improve and educate others about developmental education.

Review of Methodologies

A variety of methods were used in studies of developmental education. These methods usually included surveys, interviews, transcript analyses, and literature reviews. In the late 1960s and early 1970s, Roueche (1968, 1973) conducted the earliest studies that attempted to identify effective techniques for providing developmental education. "Initially, their research was based on reviews of the literature to identify components of learning theory most applicable to remedial courses" (Boylan & Saxon, 1999, para. 9). Later research validated much of what Roueche found in his reviews of the literature.

The National Center for Education Statistics (1996) collected information using a survey and the Postsecondary Education Quick Information System (PEQIS). The sample institutions were selected using a random sample that was stratified by three variables with each strata sorted by another three variables (for more information, see National Center for Education Statistics, 1996, pp. 39-40). Each institution identified a campus representative to serve as a survey coordinator and facilitator. A database was created, and descriptive information was obtained and analyzed.

The National Study of Developmental Education (Boylan, 1999b; Boylan, Bliss, & Bonham, 1993, 1997; Boylan & Bonham, 1992; Boylan, Bonham, & Bliss, 1994a, 1994b; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Boylan, Bonham, Jackson, & Saxon, 1994, 1995) collected data on developmental education using a circular systematic random sampling process that insured that institutional types in the sample would be representative of those in American higher education. Students in the programs at these institutions were then randomly selected.

The data collection methods included collection of admissions data, financial aid data, and transcripts of those randomly selected students from over eight-year and four-year periods for four-year and two-year institutions, respectively. Surveys were also used to collect information from developmental programs. An individual was chosen to act as a project liaison at each institution to help facilitate the data collection process and to clarify and answer any questions. Databases, created from the transcript data and survey data, were statistically analyzed to determine various relationships between variables.

The studies by Roueche and his colleagues (Roueche & Kirk, 1973; Roueche & Roueche, 1993, 1999a; Roueche & Snow, 1977) and McCabe (2000a) have used similar methods. Usually surveys and interviews were performed, and then a database was created and analyzed to determine if there were significant relationships between variables or to provide descriptive information about programs and institutions.

Other studies included in the literature review have used similar data collection methods, including interviews, surveys, transcript data, grade data (pretest and posttest), and literature reviews. Their data analysis methods were usually similar as well. They often created a database to be analyzed for relationships between variables or to provide descriptive statistics.

One final note, it made a difference how developmental education was defined in each study or at each institution. In the studies of remedial education done by the National Center for Education Statistics (1991, 1996), remedial education was defined by each institution and only included courses in mathematics, reading, and writing. Broader definitions of developmental education existed and included other services such as

writing labs or tutoring. Adelman (1999) used the term "pre-collegiate math" to describe developmental math courses and collected information on the total numbers of students taking pre-collegiate math courses.

Evaluation of the Literature

Summary of the Review of the Literature

Research and literature on "best practices" in developmental education and developmental mathematics education were identified and summarized within the context of the problem of developmental education in the nation. Literature and studies by the National Center for Developmental Education, the National Center for Education Statistics, and other professional organizations, including the American Mathematical Association for Two-Year Colleges and the National Association for Developmental Education, were used to guide and inform this review.

Background information and topics informing the context of the problem were described in early sections of the literature review. Remedial education and developmental education were considered, explained, and differentiated. The history of developmental education, the developmental student, and the Carnegie Classification of Institutions of Higher Education (1994) were described. Estimates and studies of the cost of postsecondary developmental education were summarized, and the views of critics of developmental education were explained.

The theme development section of the literature review documented the need for developmental education, the performance of developmental students, and laws and

limits affecting developmental education prior to summarizing the literature on "best practices" in developmental education. The developmental subject with the largest need was mathematics (Boylan and Saxon, 1999; McCabe, 2000a; National Center for Education Statistics, 1996), and demographic changes raised concerns about higher education and an increased need for effective developmental education (McCabe, 2000a; McCabe & Day, 1998; Murdock & Hoque, 1999). Yet, when developmental education was effective, it increased retention, the probability of attaining a degree, grades, and the likelihood of passing the next course in the same subject.

The remaining sections of the literature review provided descriptions of what was known and what was researched about "best practices" in developmental education, including policies, organization, faculty and staff, learning theory, instruction and curriculum, support services, assessment and evaluation, and comprehensiveness. These sections were followed by ways to reduce and improve developmental education, organizations that supported developmental education, and a review of the methodologies used in developmental studies.

The literature and findings on "best" policies and organizational structure indicated that mandatory assessment and placement, a centralized or highly coordinated program, and institutional commitment were all related to positive student outcomes (Boylan, Bliss, & Bonham, 1997). The research on faculty indicated that faculty needed to be committed to developmental education, full-time, trained, and involved in departmental decisions and faculty development, but in reality, developmental faculty were often part-time, had lower levels of education, and were not committed to

developmental education (Boylan, Bonham, Jackson, & Saxon, 1994). Learning theories, like metacognition, strategic learning, and critical thinking, were identified as positively contributing to developmental students' success (Chaffee, 1992; Gray, 1995; Weinstein, Hanson, et al., 1997).

Instructional methods and curriculum that were associated with positive student outcomes included diversity in instructional methods (Boylan & Saxon, 1999), technology used as a supplement to a course (Boylan & Saxon, 1999), lab integration (Boylan, Bliss, & Bonham, 1997), learning communities and paired courses (Commander, Stratton, Callahan, & Smith, 1996; Tinto, 1998), written statement of goals and objectives (Boylan & Saxon, 1999), and alignment of courses (Boylan, Bonham, Claxton, & Bliss, 1992). Support services, like tutoring with tutor training (Boylan, Bonham, Bliss, & Saxon, 1995), counseling (Boylan, Bliss, & Bonham, 1997), orientation and freshmen seminar (Gardner, 1998), and Supplemental Instruction (Martin, Arendale, & Blanc, 1997), also were related to student success in developmental education.

Assessment and evaluation of developmental programs was not widely performed, even though it was positively related to program success, retention, and student success (Boylan, Bonham, & Bliss, 1997; Boylan, Bonham, Claxton, & Bliss, 1992). Roueche and Roueche (1999b) described it as "the single most, critical issue not yet resolved as colleges respond to at-risk students" (p. 18). The last "best practice" described above was comprehensiveness. The more comprehensive developmental programs were, the more success they tended to have (Boylan, Bonham, & Bliss, 1994a;

McCabe & Day, 1998). The theme development section concluded with sections that described ways to improve and reduce developmental education, professional organizations that supported developmental education, and a review of methodologies used to study developmental education.

Weaknesses and Strengths in the Literature

There were a number of weaknesses in the literature on developmental education. First, there were no recent national studies currently available. The available data were becoming dated as the college population continued to grow and change. Second, in the studies it was hard to collect information due to definition problems. How institutions, states, and programs defined developmental (or remedial) varied. Some institutions only considered courses and others considered courses and support services as developmental. Definitions of developmental courses varied as well. Intermediate algebra might be different at one institution than at another, or at two-year institutions and at four-year institutions. Third, suggestions were made on how to improve developmental education, but there was little to no information on whether or not these suggestions were actually effective. There was no information on how to execute these suggestions either. A practical guide was needed, and one appeared to be on the way (see Boylan, 2002).

One of the strengths of the literature on developmental education was that it was growing. More associations were becoming involved and were in the early stages of creating and using evaluation, self-study, and "best practice" guides for programs and institutions (Boylan, 2002; NADE, 2002). Studies by the National Center for Developmental Education (Boylan, 1999b; Boylan, Bliss, & Bonham, 1993, 1997;

Boylan & Bonham, 1992; Boylan, Bonham, & Bliss, 1994a, 1994b; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Boylan, Bonham, Jackson, & Saxon, 1994, 1995) and the National Center for Education Statistics (1991; 1996; see also Adelman, 1999) offered a wealth of information. These studies were done on random samples of institutions and students throughout the country so they appeared to be representative of developmental education across the nation. Second, "best practices" were identified with more reliable methods than by only using literature reviews. Now more studies were needed to determine the impact of the use of these "best practices."

To summarize, much of the literature was dated. Definitions of developmental education varied between institutions, states, faculty, and administration. More guidance in implementing "best practices" was needed. The literature base appeared to be growing as national organizations continued to grow and develop.

Gaps and Saturation Points in the Literature

The literature on developmental education grew due to the studies by the National Center for Education Statistics (1991, 1996; see also Adelman, 1999) and the National Center for Developmental Education (Boylan, 1999b; Boylan, Bliss, & Bonham, 1993, 1997; Boylan & Bonham, 1992; Boylan, Bonham, & Bliss, 1994a, 1994b; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Boylan, Bonham, Jackson, & Saxon, 1994, 1995), but it still was not the subject of serious research for most of the past century (Boylan & Saxon, 1999). Norton Grubb (as cited in Boylan & Saxon, 1999) said, "Because remedial education has developed as a solution to

a particular problem—the lack of education progress of many students—almost no one views it as valuable in its own right" (para. 2). For this reason and others, research was lacking in some areas of developmental education.

First, research indicated that developmental minority students were not retained at the same rate as non-minorities and they placed in developmental education at a higher rate than non-minorities (Boylan, Bliss, & Bonham, 1993). More research was needed to understand why this was true for minorities, and models need to be developed to address and correct these situations, especially in light of the growing number of minorities (Murdock & Hoque, 1999). Second, there was general knowledge of what works "best" in developmental education, but nothing that was specific to each discipline. Math was the largest developmental subject. More information is needed regarding how to specifically address the policies and practices of developmental mathematics instruction and curriculum as well as the needs of these students. Third, there was a lack of research that addressed the connections between all educational levels. If researchers and practitioners better understood why students who completed three or four years of high school mathematics and still placed in developmental mathematics right out of high school, they could address how to correct this problem. This would require articulation between all educational levels. Finally, experimental and quasi-experimental studies were lacking and needed to be performed to investigate the effects of "best practice" techniques in general and in specific programs (Boylan, Bliss, & Bonham, 1997).

The literature was saturated with descriptive statistics and findings that demonstrated relationships between various variables and academic success and

persistence of students in developmental education. For example, Boylan, Bliss, and Bonham (1997) found definite positive relationships between centralized and well coordinated administrative structures, mandatory assessment and placement, advising and counseling, tutoring with tutor training, commitment to faculty training and development, ongoing and systematic program evaluation and developmental student success on various measures.

In conclusion, developmental education research was saturated with descriptive studies. More research needed to be done on minorities, on "best practices" that were discipline specific, and on establishing connections at all educational levels. Experimental studies were need as well.

Avenues for Further Inquiry

There were a number of avenues that required further research in developmental education. Boylan, Saxon, Bonham, and Parks (1993) specified 10 general areas. Some of their ideas and others are listed below.

1. Faculty issues: More research needs to be done to better understand developmental faculty's status and credentials and their relationship to student success.
2. Developmental instruction: More research still needs to be done to identify effective instructional techniques with developmental students.
3. Assessment and placement: There is quite a bit of research on this topic, but more information is needed regarding the best placement instruments and their validity. There has been an interest in creating a compendium of instruments used in developmental education.

4. Affective factors: Research on how affective or non-cognitive factors, like motivation, self-concept, and self-esteem, impact developmental students' success could still be done. There is quite a bit of research on affective factors with the general college population, but little research in relation to developmental students specifically.
5. Student characteristics: More information is needed about the characteristics of developmental students.
6. Retention: There is a great deal of literature on the retention of the general college population, but very little of this research has dealt specifically with developmental students. Tinto (1998) began to address this, as did Boylan and Bonham (1992), but more information is needed to address why certain factors increase or decrease student retention.
7. Minority students: As mentioned earlier, more research is needed on developmental education and minority students. As the number of minorities increases in the overall population and in higher education (Murdock & Hoque, 1999), it will become more and more important to understand how to contribute positively to their success and retention. This is especially important since minorities did not participate in higher education in as great of numbers and were not retained as well as non-minorities, and were overrepresented in developmental education. The success and participation of minorities could become crucial for the country's economy (McCabe, 2000a).
8. Professional standards: NADE (2002) and others (AMATYC, 1995; Boylan, 2002) have begun to create or have already created standards or models for "best practice"

in developmental education. These will need to be updated as new research findings inform practice. Once implemented, research needs to be done to determine their impact on developmental student success.

9. The high school connection: Research needs to be done in high schools and earlier educational levels to help determine ways to reduce developmental education in college, especially in mathematics.
10. Experimental and quasi-experimental research studies should also be pursued to investigate the effects of best practice variables on students' outcomes in general and in specific programs, like developmental mathematics (Boylan, Bliss, & Bonham, 1997).

Chapter Summary

The literature review shed light on the state of developmental education in the United States and on what practices were most effective at promoting developmental students' success. Developmental education has been present since higher education's beginnings, and recently, almost half of all students took at least one developmental course in college (Adelman, 1999). More students took developmental mathematics courses than any other developmental subjects (Adelman, 1999; McCabe, 2000a; National Center for Developmental Education, 1991, 1996), but the developmental math courses had the lowest completion rates and passing rates of all subjects (Adelman, 1999; Boylan & Bonham, 1992; National Center for Education Statistic, 1991, 1996).

Critics, like Steinberg (1998), argued that developmental education cost too much, lowered academic standards, had no place in college, and high schools were to blame. Yet, others (Astin, 1998; McCabe, 2000a; Merisotis & Phipps, 2000) argued that developmental education was a bargain because of the benefits it might have on society, the economy, and individuals' lives.

Researchers (Boylan & Bonham, 1992; Boylan, Bonham, Claxton, and Bliss, 1992; Minnesota State Colleges and Universities, 1996; Penny & White, 1998) found evidence that students who successfully participated in developmental education experienced positive outcomes such as increased retention rates, improved grades, and success in college level courses. The literature on developmental education revealed practices that were most effective at helping developmental students succeed. The types of policies, organization, and faculty and staff that were used influenced the effectiveness of programs and success of students. Various forms of learning theories, instructional methods, curriculum, and support services were related to student success in developmental education (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan & Saxon, 1999; Commander, Stratton, Callahan, & Smith, 1996; Gardner, 1998; Hodges & White, 2001; Martin, Arendale, & Blanc, 1997; Ramirez, 1997; Roueche & Snow, 1977). Assessment and evaluation were underperformed but also critical to program and student success (Boylan, Bonham, Claxton, & Bliss, 1992; Donovan, 1974; Roueche & Roueche, 1999a; Roueche & Snow, 1977). In addition, researchers identified ways to help reduce and improve developmental education, but the degree to which this was done was unknown. Organizations like AMATYC, NCDE, and

NADE were helping lead the way in supporting, advocating, and researching developmental education.

The literature was saturated with descriptive statistics, but these were becoming outdated. More current research and statistics needed to be published and appeared to be on their way according to Adelman (personal communication, January 3, 2002). Other research still needed to be done, especially with minorities as they were quickly growing in the population, but continued to be behind in higher education and overrepresented in developmental education.

The findings of this study contributed to the knowledge of developmental mathematics education at six public postsecondary institutions in North Dakota. The details of the study's methodology are presented in the next chapter.

RESEARCH METHODOLOGY

Chapter Introduction

Included in this chapter are descriptions of the research methodologies used: (a) to describe public postsecondary developmental mathematics education at six institutions in North Dakota; (b) to compare each institution's policies, organizational and instructional characteristics to "best practice" in developmental education; and (c) to contrast these programs by institutional type using the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994). For the purposes of this study, developmental mathematics education at the postsecondary level was defined as any course numbered lower than Math 103 College Algebra.

There were four primary elements to the study. The first element was the collection of developmental mathematics grade distribution data. These data included the number of students who participated in developmental mathematics education at each of six institutions as well as the distribution of grades for each developmental mathematics course. The second element of the study was the collection of developmental mathematics course syllabi. The course syllabi were reviewed for evidence of "best practice" and for further descriptions of the developmental mathematics programs at each institution. The third and fourth elements of the study were the classroom observations and interviews with developmental mathematics instructors and with the director of the developmental mathematics program at each institution. The observations and interviews were used to obtain descriptive information about each program, to provide insight into

the practices of the developmental mathematics programs, and to determine whether or not these practices were in accordance with those considered "best practice" in the literature. All four elements of the study provided information that allowed the programs, and thus the institutional types, to be contrasted.

Descriptions of the participants and the instruments used in the study are presented in the next sections of this chapter. These descriptions are followed by an explanation of the research design, including its rationale, data collection processes, data analysis, reliability and validity. The assumptions, limitations, and delimitations of the study, the timeframe of the study, and the chapter summary are explained in the final sections of the chapter.

Programs and Participants

Programs and Participants

The developmental mathematics programs at each of the 11 institutions in the North Dakota University System were the population. For the purposes of the following descriptions, the 11 institutions were labeled Institution A through Institution K.

After reviewing each institution's Web page, the researcher determined that each institution offered at least one developmental mathematics course. In order to access these programs, the director of the developmental mathematics program was the main contact person used to gather information about the programs at each of the selected institutions. Grade distribution data, developmental mathematics instructors, classroom

observations, and course syllabi were used to gather information on these programs as well.

Method of Selection of Programs and Participants

All 11 institutions were not studied due to time constraints and the large size of a study that involved that many institutions. Six of the 11 institutions in the NDUS were chosen for the study. These six institutions included two AA institutions, two BA institutions, one Master's institution, and one Doctoral institution. These six institutions were named: AA I, AA II, BA I, BA II, the Master's Institution, and the Doctoral Institution. Each institutional type was represented in the sample so that programs could be contrasted across institutional types and so that each type of institution in the population was represented.

The two largest AA institutions and the two largest BA institutions were chosen because the researcher believed that the larger enrollments of these institutions would provide more consistency each semester in the programs and because these institutions were expected to serve the largest numbers of developmental math students in these institutional types. The Master's Institution was chosen because it was the only Master's institution in the NDUS. The Doctoral Institution included in the study was randomly chosen from the two Doctoral institutions in the NDUS. During the course of the study, the developmental mathematics instructor at the largest BA institution refused to participate in the study. The Director and instructor at the remaining BA institution were asked to participate, and they agreed to do so.

The researcher contacted and interviewed the director of the developmental mathematics program at each of the six institutions because she believed this person would have the most information regarding the program. This person was usually the Chair of the Mathematics Department or a similar department (Mathematics and Computer Science Department or Science and Mathematics Department). Sometimes there was more than one person who oversaw the developmental mathematics courses. Other times the person who oversaw the developmental mathematics courses was the director of another department, such as Academic Services. For the purposes of this study, the person (or persons) who oversaw these courses was referred to as the Director of the developmental mathematics program.

Developmental mathematics instructors were also contacted for more specific instructional information. This information was collected during interviews and observations of the instructors' developmental mathematics classes. When instructors or directors did not provide enough information about support services, other people were contacted by phone or e-mail. These people were usually directors of support services who were contacted for more information about these services.

Demographic Characteristics of the Institutions

Descriptions of the 11 postsecondary institutions in the NDUS are provided below. The information included in these descriptions was gathered from various NDUS documents (NDUS, 2001, 2002b; Office of Data Collection and Reporting, 2001) and from the Carnegie Foundation for the Advancement for Teaching (1994). The following items are described for each institution: institutional type, admission policies, enrollment

figures, types of degrees offered, and the number of programs offered and completed at each institution. Some of this information is summarized below in Table 8 and Table 9. Summary information about each institution's institutional type, fall 2001 total enrollment and new freshmen enrollment is given in Table 8. The number of programs offered and completed at each institution is provided in Table 9 for the 2000-2001 school year.

Table 8. Institutional Type and Fall 2001 Enrollment.

Institution	Institutional Type	Enrollment Fall 2001	New Freshmen Fall 2001
Institution A	AA	3,044	972
Institution B	AA	1,308	520
Institution C	AA	526	212
Institution D	AA	2,292	747
Institution E	AA	748	267
Institution F	BA II	2,101	417
Institution G	BA II	755	144
Institution H	BA II	1,005	158
Institution I	MA I	3,515	506
Institution J	DOC II	10,538	1,935
Institution K	DOC II	11,764	1,947
Total		37,596	7,345

Note. The data in Table 8 are from University of North Dakota Electronic Fact Book (2001), by the Office of Data Collection and Reporting, Grand Forks, ND: University of North Dakota.

Table 9. Program Types, Number Offered, and Number Completed at Each Institution During 2000-2001.

Program Type and Number Offered and Completed	Institution										
	A	B	C	D	E	F	G	H	I	J	K
Certificate											
Offered	19	12	1	114	6	1	1		5		
Completed	93	4	0	135	1	0	0		0		
Diploma											
Offered	16	4	6	9	3						
Completed	8	8	4	46	6						
Associate											
Offered	24	14	19	37	13	5	3		1		
Completed	552	115	151	682	195	59	9		2		
Bachelors											
Offered						33	22	32	60	99	95
Completed						250	107	175	534	1,361	1,602
Masters											
Offered									9	46	49
Completed									73	193	381
Doctorate											
Offered										19	19
Completed										23	44
Specialist											
Offered									1	1	1
Completed									4	3	3
Professional											
Offered										1	2
Completed										54	114

Note. A completed program was one in which a student met all of the requirements to obtain a degree or certificate (16 or more credit hours at the undergraduate level or nine or more credit hours at the graduate level) in that field of study. Thus, the numbers in the table above might differ slightly from other sources that reported degrees granted since one person might have completed two programs, yet received only one degree. The data in Table 9 are from Programs Offered and Programs Completed at North Dakota Institutions of Postsecondary Education July 1, 2000–June 30, 2001 (2001), by North Dakota University System, Bismarck, North Dakota: North Dakota University System.

Institutions A-E. Institutions A-E were classified as Associate of Arts (AA) institutions according to the Carnegie Foundation for the Advancement for Teaching (1994). Each of these institutions had an open admissions policy with limited restrictions. All students who completed high school, or the received an equivalency

diploma, could enroll at these institutions (NDUS, 2002b). These institutions offered vocational-technical programs, as well as transfer curricula for those planning to continue their education at another institution. These schools had small class sizes and an average student-to-faculty ratio ranging from 13 to 1 to 22 to 1 (NDUS, 2002b).

In fall 2001, Institution A enrolled over 3,000 students. Almost one third of these students were new freshmen (Office of Data Collection and Reporting, 2001). Institution A offered almost 50 different one- or two-year programs. During the 2000-2001 academic year, 93 certificates, eight diplomas, and 552 associate programs were completed (NDUS, 2001).

Institution B enrolled over 1,300 students during fall 2001. More than 500 of these students were new freshmen (Office of Data Collection and Reporting, 2001). It offered 30 one- or two-year programs. During the 2000-2001 academic year, four certificates, eight diplomas, and 115 associate programs were completed (NDUS, 2001).

Institution C enrolled over 500 students in fall 2001. More than 200 of these students were new freshmen (Office of Data Collection and Reporting, 2001). It offered 26 one- or two-year programs during the 2000-2001 academic year. During the academic year, four diploma programs and 151 associate programs were completed (NDUS, 2001).

Institution D enrolled almost 2,300 students in fall 2001. Almost 750 of these students were new freshmen (Office of Data Collection and Reporting, 2001). During the 2000-2001 academic year, Institution D offered more than 60 programs at the one- or two-year level, and 135 certificates, 46 diplomas, and 682 associate programs were completed (NDUS, 2001).

During fall 2001, Institution E enrolled approximately 750 students. Almost 270 of these students were new freshmen (Office of Data Collection and Reporting, 2001). During 2000-2001, Institution E offered 22 one- or two-year programs. That same year one certificate, six diplomas, and 195 associate programs were completed (NDUS, 2001).

Institutions F-H. Institutions F-H were classified as Baccalaureate Colleges II (BA II) according to the Carnegie Foundation for the Advancement for Teaching (1994). Institutions F-H offered one- or two-year programs, four-year degree programs, and pre-professional programs that led to a certificate, diploma, associate degree, or bachelor's degree. Institution H was an exception. It did not offer one- or two-year programs but offered the other programs. To enroll at one of these institutions, a student had to be a high school graduate (or completed the equivalent) and had to take the ACT. To be admitted into a baccalaureate program, students that completed high school after 1993 were required to have completed the high school college preparatory course core curriculum defined by the NDUS (NDUS, 2002b, p. 3). Some exceptions were made to these admission policies (NDUS, 2002b).

Institution F enrolled approximately 2,100 students in fall 2001. Almost 220 of these students were new freshmen (Office of Data Collection and Reporting, 2001). During the 2000-2001 school year, this institution offered 6 one- or two-year programs which were completed by 59 students. Institution F also offered 33 bachelor degree programs and had 250 bachelor program completions (NDUS, 2001).

During fall 2001, Institution G enrolled 755 students, of which 144 students were new freshmen (Office of Data Collection and Reporting, 2001). During the 2000-2001

school year, Institution G offered 4 one- or two-year programs that yielded nine associate program completions by students. It also offered 22 bachelor programs with 107 bachelor program completions (NDUS, 2001).

Institution H enrolled 1,005 students in fall 2001, and 158 of these students were new freshmen (Office of Data Collection and Reporting, 2001). During 2000-2001, Institution H offered 32 bachelor programs and had 175 of these programs completed by students.

Institution I. Institution I was a Master's University I (MA I) according to the Carnegie Foundation for the Advancement for Teaching (1994). During 2000-2001, this institution offered 6 one- or two-year programs that granted a certificate or an associate degree, 60 different undergraduate programs, and nine graduate programs (NDUS, 2001). The student-to-faculty ratio was 15 to 1. Institution I accepted qualified high school graduates, or those who successfully completed the GED examination. Entering students were required to complete the high school college preparatory curriculum (NDUS, 2002b, p. 3). Some exceptions were granted, and other admission requirements, like the ACT exam, were usually required (NDUS, 2002b).

Institution I enrolled 3,515 students during fall 2001. Approximately 500 of these students were new freshmen (Office of Data Collection and Reporting, 2001). It offered 6 one- or two-year programs, 60 bachelor's programs, and 10 graduate (nine masters and one specialist) programs during 2000-2001. During 2001-2002, two associate programs, 534 bachelor's programs, 73 master's programs, and four specialist programs were completed (NDUS, 2001).

Institutions J and K. Institutions J and K were classified as Doctoral Universities II (Doc II) (Carnegie Foundation for the Advancement for Teaching, 1994). Both institutions offered undergraduate education and graduate education through the doctorate. Both institutions offered more than 150 programs of study from the undergraduate degree through the master's, doctoral, specialist, and professional degrees. To be admitted to these institutions, students had to complete the college preparatory, high school curriculum (NDUS, 2002b, p. 3). They also needed a minimum high school grade point average and a minimum ACT or SAT score (NDUS, 2002b).

During fall 2001, Institution J enrolled 10,538 students. Almost 2,000 of these students were new freshmen (Office of Data Collection and Reporting, 2001). During 2000-2001, it offered 99 bachelor's programs and 67 graduate programs. The graduate program included 46 master's programs, 19 doctoral programs, one specialist program, and one professional program. During the 2000-2001 academic year, 1,361 bachelor's programs, 193 master's programs, 23 doctoral programs, three specialist programs, and 54 professional programs were completed (NDUS, 2001).

Institution K enrolled 11,764 students. Almost 2,000 of these students were new freshmen (Office of Data Collection and Reporting, 2001). During 2000-2001, Institution K offered 95 bachelor's programs and 71 graduate programs. The graduate programs included 49 master's programs, 19 doctoral programs, one specialist program, and two professional programs. During that school year, 1,602 bachelor's programs, 381 master's programs, 44 doctoral programs, three specialist programs, and 114 professional programs were completed (NDUS, 2001).

Developmental Mathematics Programs

The developmental mathematics departments, courses, and instructors at each institution are described below. This information was collected from each institution's Web site during July 2002.

Institution A had a Department of Mathematics. It employed four assistant professors, each with a master's degree, and six adjunct instructors. During fall 2002, an associate professor from another department taught two sections of Math 092 along with an adjunct instructor and a mathematics professor. Adjunct instructors and mathematics professors taught Math 102. Academic Support Services was a department located on campus that offered tutoring and workshops, and employed a mathematics learning assistant.

Institution B did not have a separate department of mathematics or developmental education. It had four individuals who taught mathematics, two of whom taught both mathematics and science courses. The education levels of the faculty were not provided.

Similarly, Institution C did not have a separate department of mathematics. It had two individuals who taught mathematics. The highest degree held by one individual was a master's degree, and the other individual had a bachelor's degree. Both institutions had an Academic Skills Center that provided services to students. The Academic Skills Center at Institution C employed a mathematics tutor.

Institution D had a Mathematics and Science Department with nine members, including an assistant professor, three associate professors, one professor, two instructors, and two lecturers. Their education levels were not listed. Approximately four of these

members taught mathematics courses. Institution D also had an Academic Services Center with nine employees, two of whom specialized in math and science and ran a math and science lab that also employed a math tutor. The Academic Skills Center provided trained peer tutors to students. Instructors from both the Mathematics and Science Department and the Academic Services Center taught developmental mathematics courses. During fall 2002, the instructors and a tutor from the Academic Services Center taught ASC 090, ASC 091, ASC 092, ASC 093, and Math 102, and one instructor in the Mathematics and Science Department also taught Math 102.

Like Institutions B and C, Institution E did not have a separate mathematics department. There were four people listed who taught mathematics courses or other courses like science or computer science. The highest level of education of one of these individuals was a bachelor's degree. The highest level of two others was a master's degree. During fall 2002, an instructor with a bachelor's degree taught all developmental mathematics courses. The fall 2002 class schedule also listed two other instructors who taught Math 103 College Algebra. These instructors were from local high schools.

Institution F had a Mathematics and Computer Science Department. There were six faculty members and eight adjunct instructors in the Department. Two of the faculty members had doctorates, and the highest education levels of the others were bachelor's degrees and master's degrees. Two of the adjunct instructors taught the developmental mathematics courses fall 2002.

Institution G had a Science and Mathematics Department that included two assistant professors, three associate professors, two instructors, and two lecturers. Three

of the departmental members taught mathematics courses. The highest level of education obtained by each of these three math faculty members was a master's degree. The individual who taught the developmental mathematics courses was an employee who worked in the Health and Physical Education Department as an instructor and as a basketball coach. He was classified as an instructor of physical education and mathematics.

Institution H had a Mathematics and Science Department that included eight faculty members. Three of them were math professors and five were science professors. All but one of the eight faculty members had doctoral degrees. During fall semester 2002, a faculty member from the education department and a math faculty member taught the developmental mathematics courses. A master's degree was the highest level of education of both of these instructors.

Institution I had a Department of Mathematics and Computer Science that included 15 faculty members. Four members had doctoral degrees, and all others had master's degrees, with the exception of one who had a bachelor's degree. Two of those with master's degrees were completing doctoral degrees. All faculty members in the Department, except three, taught mathematics part-time or full-time. In addition, there were at least two local middle school and high school mathematics teachers who taught some of the developmental mathematics courses at a local U.S. Air Force Base. During fall 2002, one professor, one instructor, one lecturer, and two middle school teachers taught the developmental mathematics courses. Institution I had a drop-in math clinic where undergraduate mathematics majors provided tutoring assistance to students.

Institution J had a Department of Mathematics. There were 16 professors of various rank, 18 lecturers, approximately 17 graduate teaching assistants, and four undergraduate teaching assistants. All of the professors had doctorates, and most of the lecturers had master's degrees. The names of the instructors that taught the developmental mathematics courses during fall 2002 were not listed, but it appeared that teaching assistants or lecturers or both taught these courses. Institution J had a drop-in tutorial center run by graduate teaching assistants and a tutoring program ran by Orientation and Student Success. Other programs that assisted students with developmental mathematics review and placement were available through the Department of Distance and Continuing Education.

Institution K had a Mathematics Department that included 15 professors, 14 of whom had doctorates, six lecturers, and approximately nine graduate teaching assistants. One of the lecturers taught the developmental mathematics courses offered during fall 2002. This Department also had a drop-in math learning center in which instructors, graduate students, and knowledgeable undergraduate students provided tutoring on a drop-in basis.

Developmental Mathematics Courses

Each institution in the NDUS offered at least one developmental mathematics course. Students received institutional credit for some of these courses, but it depended on the course and the policies of the institution and the NDUS. For the purposes of this study, all mathematics courses numbered lower than Math 103 were defined as developmental. The NDUS established common general education requirements for all

institutions in their "General Education Requirements Transfer Agreement" (GERTA) (NDUS, 2002a). These requirements applied to all Associate of Arts, Associate of Science, and Bachelor's degrees. The Agreement allowed accepted courses taken at one NDUS institution to be transferred to all other institutions in the NDUS.

In mathematics, no institution in the NDUS provided credit toward the General Education Requirements, as specified in GERTA, for mathematics courses that were numbered lower than Math 103 College Algebra (NDUS, 2002a). At some institutions, students still received program, institutional, or financial aid credit for mathematics courses numbered lower than Math 103, but they could not use these courses to meet the General Education Requirements.

The titles, course prefixes, and course numbers of the developmental mathematics courses offered in the NDUS included: ASC 090 Mathematics Prep, ASC 091 Pre-Algebra, ASC 092 Beginning Algebra, ASC 093 Pre-Trigonometry, Math 099 Beginning Algebra, Math 100 Applied Mathematics, and Math 102 Intermediate Algebra. ASC was the abbreviation for an Academic Skills (or Services) Center course. Math was the abbreviation for a mathematics course. Table 10 lists the developmental mathematics courses offered at each institution during fall semester 2002.

Common Course Numbering. All institutions in the NDUS agreed on Common Course Numbers (CCNs) for many of the courses they had in common. When students transferred between institutions in the NDUS, the CCN courses transferred easily. This system was not yet perfect. Sometimes the same course had different prefixes. For example, Beginning Algebra was sometimes ASC 092 or Math 099.

Table 10. Fall Semester 2002 Developmental Mathematics Courses By Institution.

Institution	Developmental Mathematics Courses
Institution A	ASC 092 Beginning Algebra Math 102 Intermediate Algebra Math 102 Intermediate Algebra (Slower Paced) & Math 102L Intermediate Algebra Lab (concurrent enrollment)
Institution B	ASC 091 Pre-Algebra ASC 092 Beginning Algebra Math 100 Applied Mathematics Math 102 Intermediate Algebra
Institution C	Math 100 Applied Mathematics Math 102 Intermediate Algebra
Institution D	ASC 090 Mathematics Prep ASC 091 Pre-Algebra ASC 092 Beginning Algebra ASC 093 Pre-Trigonometry Math 102 Intermediate Algebra
Institution E	ASC 092/Math 092 Beginning Algebra Math 100 Applied Mathematics Math 102 Intermediate Algebra
Institution F	Math 090 Introductory Algebra Math 102 Intermediate Algebra
Institution G	Math 102 Intermediate Algebra
Institution H	Math 099 Beginning Algebra Math 102 Intermediate Algebra
Institution I	Math 099 Beginning Algebra Math 102 Intermediate Algebra
Institution J	Math 099 Beginning Algebra Math 102 Intermediate Algebra
Institution K	Math 102 Intermediate Algebra

Instrumentation

The instruments that were used in the study are described in this section. These instruments included: (1) the grade distribution report that was used to gather grade distribution data from the registrars of the institutions; (2) the "Best Practices" Checklist that was used when reviewing developmental mathematics course syllabi for evidence of "best practice;" (3) the General Syllabus Checklist that was used when reviewing developmental mathematics course syllabi for the inclusion of various syllabus items; (4) the Interview Protocol for Directors of Developmental Mathematics Programs that was used when the directors were interviewed; and (5) the Interview Protocol for Developmental Mathematics Instructors that was used when the instructors were interviewed. Copies of each of these instruments are provided in Appendix A.

Grade Distribution Report

The grade distribution data were collected for fall 1999, 2000, and 2001. Rather than creating a specific instrument to collect these data, the researcher worked with the Director of Records at the researcher's institution to collect these data. After each semester, all NDUS institutions were required to submit grade distribution reports for all courses. These reports were generated in the same manner and using the same software program at all NDUS institutions. The institutions' use of the same software program provided consistency for comparisons. The researcher requested copies of grade distribution reports of all developmental math courses at all 11 NDUS institutions for the above indicated fall semesters.

"Best Practices" Checklist

The "Best Practices" Checklist (see Appendix A) was used to analyze each developmental mathematics course syllabus for evidence of "best practice" in developmental education. The Summary of "Best Practices" in Developmental Education (see Table 7) was used to develop the "Best Practices" Checklist. Each practice that was on the Summary was put on the "Best Practices" Checklist. No practices were excluded because it was not known what might be found on the syllabi until they were reviewed. Since some of the practices on the Summary grouped more than one practice together, these practices were split up and listed as individual practices on the "Best Practices" Checklist.

When analyzing each syllabus for evidence of "best practices," the researcher placed an "X" in one of four boxes to indicate the presence and the extent of a particular "best practice." The four boxes were labeled "direct evidence," "indirect evidence," "no evidence," and "not clear." Direct evidence meant the practice was described on the syllabus. Indirect evidence meant the practice was implied on the syllabus. No evidence meant there was neither of the above. Unclear evidence meant the researcher thought that the practice might have been implied, but it was not clear. If there was direct evidence, indirect evidence, no evidence, or unclear evidence of a practice, the corresponding box was marked. Also, there was space provided for comments regarding each practice. These comments were used to clarify any evidence of "best practice," especially in the case of indirect or unclear evidence.

It is important to note that prior to the analysis of syllabi, the researcher only speculated about where she expected to find evidence of each practice. During the course of actually analyzing the syllabi, the predicted sources of evidence sometimes changed. Also, syllabi included descriptions of the intended curriculum and practices of a course. Description of a practice on a syllabus did not necessarily mean the practice was actually used in the classroom.

A list of the practices included on the "Best Practices" Checklist are given below and accompanied by explanations of characteristics that constituted evidence of these practices.

1. Mandatory assessment of developmental mathematics students: Evidence of mandatory assessment was found on syllabi as course prerequisites or as placement policies, such as requiring students to take a placement exam or other standardized test.
2. Mandatory placement of developmental mathematics students: Evidence of mandatory placement was found on syllabi in the form of a required minimum score on a placement exam or other standardized test before enrolling. It also might have been a prerequisite course that had to be successfully completed before taking the course. Some syllabi listed placement scores or prerequisites, but these sometimes were just recommended, not mandatory; thus, the interviews were used to determine if placement was mandatory or not.
3. Strong institutional commitment to developmental mathematics: This practice usually was not evident on course syllabi and had to be determined during the interviews.

4. Centralized or highly coordinated developmental program: Evidence of a centralized or highly coordinated program was not on syllabi. Some courses had the prefix ASC or Math but were offered in different departments so centralization and coordination were determined during the interviews.
5. Training and professional development for the staff and faculty: Training and professional development of staff and faculty were not evident on syllabi.
6. Developmental courses are designed and taught using sound cognitive, teaching, and learning theories. This includes integrating strategic learning, critical thinking, and metacognition into the curriculum: Indications of sound theory were found infrequently, but usually in the objectives or outcomes of a course. For example, critical thinking was a listed as a measured outcome on one syllabus.
7. Mastery learning techniques: These techniques were evident on syllabi with testing policies.
8. Learning communities and/or paired courses: If a course was part of a learning community or was being paired with another course, this should have been stated on the course syllabus. This was not the case. Math 102 was part of a cohort program at one institution, but no mention of this was on the course syllabus. This fact was discovered during the interviews.
9. The integration of classroom and laboratory instruction: Descriptions of the use of a lab or laboratory activities was on syllabi. The level of integration was determined during the observations and interviews.

10. The supplemental use of technology: The use of technology was indicated on course syllabi as a specific calculator or software package requirement or in a statement that explained how computers or labs were used in the course. Evidence of the use of technology was sometimes found in course descriptions, in the course objectives, in a list of student outcomes, or in the course assignments that were described on syllabi.
11. The use of a variety of instructional methods: Evidence of intended use of a variety of instructional methods was sometimes found in a teaching philosophy section or in the descriptions of activities and assignments.
12. A high degree of course structure: Whether or not a course was taught with a high degree of structure could not be determined from the syllabi.
13. Constructivist or discovery based techniques: Evidence of constructivist or discovery based techniques could not usually be determined from syllabi. One syllabus indicated such techniques in a description of the format of the course, and the use of these techniques was verified during one observation of this instructor's course.
14. The alignment of exit skills and knowledge in developmental courses with those required to enter regular courses: Evidence of intent to align developmental courses with regular courses was sometimes found in the course objectives or description or in a list of student outcomes. This usually was a statement that said the current course would prepare students for other succeeding courses. Actual alignment of courses could not be determined using syllabi.
15. Clearly defining, linking, and sharing with others the philosophies, goals, and objectives of the developmental program and its courses: Evidence that the

philosophies, the goals, and the objectives of the developmental program and its courses were defined, linked and shared with students were evident by having those things listed on syllabi.

16. Ongoing student orientation: This practice was not evidenced on syllabi.
17. Freshmen seminar: Like ongoing student orientation, freshmen seminar was not evidenced on syllabi.
18. The use of trained tutors: The use of or availability of tutors (or a tutoring service or center) for developmental mathematics courses was listed on syllabi with other services available to students. It was not evident from the syllabi if the tutors were trained.
19. Supplemental Instruction: Supplemental Instruction was not listed on syllabi as a service available to students even though it was available to students in one course at one institution.
20. Regular, systematic assessment that is both summative and formative and is used to revise and improve the program and its courses: Evidence of the use of assessment to revise and improve a course was not stated on course syllabi.

General Syllabus Checklist

The General Syllabus Checklist (see Appendix A) was used to analyze each developmental mathematics course syllabus for inclusion of 20 different items that were recommended by B. G. Davis (1993) in her book, Tools for Teaching. When analyzing each syllabus for each of the items, the researcher placed an "X" in boxes that represented one of four choices to indicate the presence of the item. The choices

included "Yes," "No," "N/A," or "Not Clear." If an item was present on the syllabus, "Yes" was marked. If an item was not present on the syllabus, "No" was marked. If an item did not apply to the syllabus and course, "N/A" was marked. If it was not clear if an item was included, "Not Clear" was marked. There also was space for comments regarding each item. These comments were used to clarify an item that was not clear.

Each of the items included on the General Syllabus Checklist is explained below and based on those created and recommended by Davis (1993).

1. Basic course information: This information included the course title and number, time, location, credit hours, and any other basic information about the course.
2. Instructor information: Instructor information included the instructor's name, office address and phone number, e-mail address, Web page address, office hours and any other instructor information.
3. Prerequisites: Prerequisites were courses, abilities, or placement scores students needed to complete before they took a course.
4. Course description: A course description was simply that, a description of the course. It usually gave a list of content but sometimes explained more about the course. Often it was the course description provided in the institution's catalog but was sometimes more than this depending on the instructor.
5. Course purpose: The course purpose was an introduction to the subject matter and explained how the course fit in the college or department curriculum. It explained what the course was about and why students should learn the material (Davis, 1993).

This was more than the course description because it included an explanation for the course, not just a list of content.

6. State the general learning goals or objectives: A list of the major objectives for a course or its students or both should be provided. These goals or objectives often were answers to the question: What will students know and be able to do after completing this course? (Davis, 1993).
7. Clarify the conceptual structure used to organize the course: The structure of the course should be explained to students so that they understood why the topics were arranged in a given order and why they were selected (Davis, 1993).
8. Description of the activities and format of the course: This description should explain to students what the course involved and in what format it would be taught.
9. Textbooks, readings, and materials: A section of the syllabus should indicate what materials were required for the course. Explanations of why these materials were chosen and how they related to the course objectives might also be provided.
10. List assignments, papers, and exams: A list of assignments, papers, and exams should be included on the syllabus. Davis (1993) recommended that each of these be explained and related to the course objectives.
11. Evaluation and grading policies: A section of the syllabus should explain the grading procedures and policies.
12. Other course requirements: If there are other course requirements, they should be stated and explained on the syllabus.

13. Discuss course policies: All course policies should be clearly stated and explained, including class attendance, late work, missing assignments, tests, make-ups, cheating, illness, plagiarism, and any other policies enforced by the instructor.
14. Disability statement: All syllabi should include a statement for those with any type of learning or physical disability. This statement should refer students to Disability Student Services and encourage students to contact the instructor regarding this matter.
15. Course calendar: The course calendar should include the sequence of course topics, the preparations or readings, due dates, and exam dates (Davis, 1993).
16. Schedule fast feedback: Davis (1993) recommended setting a time midway through the term when feedback could be solicited from students and their reactions to the course.
17. List important dates: Important dates, such as the last day to drop a course, should be included on the course calendar.
18. Estimate student workload: The instructor should give students a sense of how much time, work, and preparation were involved in the course. Estimates of the amount of time students should spend on homework, readings, and other assignments might be given (Davis, 1993).
19. Include supplementary material: Any supplementary material, such as hints on how to study, a glossary, supplemental readings, past exams, etc., should be included or referenced on the syllabus.

20. Provide space for names and telephone numbers of two or three classmates: Davis (1993) recommended instructors provide this space on their syllabi so students had someone to contact if they missed a class or if they wanted to study together.

Interview Protocols

Director Protocol.

The Interview Protocol for Directors of the Developmental Mathematics Programs (see Appendix A) was constructed with the literature and the Summary of "Best Practices" in Developmental Education (see Table 7) in mind. Explanations of the intent or rationale for the director protocol questions are given below.

Prior to asking the specific interview questions, basic information about the interviewee's experience and education were gathered. This information provided background about the person's role in the developmental mathematics program and the person's professional characteristics and experience.

First, the director was asked to define developmental mathematics at the institution. The intent of this question was to allow the director to define developmental mathematics in his or her own words. His or her definition sometimes varied from the definition being used in the study and provided further description of each program.

Second, the director was asked to describe the students who took developmental mathematics courses at the institution. The intent of this question was to gather descriptive information about the types of students (students right out of high school, non-traditional students, students with or without college prep in high school, minorities, etc.) who took developmental mathematics courses at the institution.

Third, the director was asked if he or she taught any of the developmental mathematics courses. If the director did not teach any developmental math courses, he or she was asked to describe the effective practices and policies of the developmental mathematics program and its courses. If he or she taught developmental math courses, he or she was asked to describe a few effective lessons from the developmental mathematics course(s) he or she taught and to describe the effective practices and policies of the developmental mathematics program. In both cases, these questions were used to gather information about the practices and policies of the program and its courses. If the director taught developmental mathematics courses, he or she had insight into the actual classroom practices, but if the director did not teach these courses, he or she still had information about many of the policies and practices of the program and its instructors.

The descriptions of the lessons and/or programs were probed for evidence of "best practice" using other questions. Questions 5-14 on the director's protocol were aimed at obtaining this kind of information and were used to help probe the director's descriptions. The focus of these questions was on the following: (a) defined, stated, and shared philosophies, goals, desired outcomes, or objectives of the program and its courses; (b) the organizational structure of the program and its level of coordination; (c) the alignment of developmental math courses with the next required math courses; (d) the level of support the courses and the program received from others; (e) the policies and the practices used to promote student success (mandatory assessment and placement of students, assessment and evaluation of the program and its courses); (f) the professional characteristics of faculty, faculty development opportunities, and the level of

participation developmental mathematics faculty had in the department; (g) the types of instructional methods used in the developmental mathematics classroom (technology, constructivism or discovery based techniques, labs, paired courses, mastery learning, critical thinking, strategic learning, metacognition, structure, assessment and evaluation, lecture, groups); and (h) the types of support services available to students (orientation, Supplemental Instruction, tutoring, counseling, freshmen seminar).

Questions 15 and 16 of the director protocol were more administrative in nature. The director was asked about the cost of developmental mathematics education at the institution. The answers to this question provided information about how the programs were offered and the priority that these programs received. The director was also asked about the number and success of students who participated in developmental mathematics education each semester or each year. This question was used to determine if the developmental mathematics courses were successful independently. It was also used to determine if the developmental mathematics courses were successful at preparing the students for the regular mathematics coursework that followed the developmental mathematics courses.

In the final questions of the director protocol, the director was asked to describe any changes he or she wanted to see occur in the developmental mathematics program. He or she was invited to discuss anything else regarding developmental mathematics that he or she wanted the interviewer to know. This question gave the interviewer an opportunity to receive any other information that might be important. It gave the director a chance to add anything he or she forgot to mention earlier in the interview.

Instructor Protocol. The Interview Protocol for Developmental Mathematics Instructors (see Appendix A) was constructed with the literature and the Summary of "Best Practices" in Developmental Education (see Table 7) in mind. Explanations of the intent or rationale for the instructor protocol questions are given below.

Introductory questions were asked to familiarize the interviewer with the courses taught by the interviewee and to determine the experience and educational levels of the interviewee. Once that was completed, the instructor was asked to describe a few effective lessons from the developmental mathematics course(s) he or she taught. The responses to this question provided descriptions of the practices and policies used by the instructor in the developmental mathematics classroom. These responses were probed for the use of those "best practices" described in the literature and in the Summary of "Best Practices" in Developmental Education (see Table 7).

Next, the instructor was asked to describe the students who took developmental mathematics courses. The intent of this question was to gather descriptive information about the types of students (students right out of high school, non-traditional students, students with or without college prep in high school, minorities, etc.) who took developmental mathematics courses at the institution.

The instructor was asked what goals, desired outcomes, objectives, or expectations he or she had for the developmental mathematics course and students. The intent of this question was to determine what goals the instructor had as well as if the instructor had considered, defined, stated, and shared these goals, desired outcomes, objectives, or expectations with others. Question 4 was related to Question 3 and had the

instructor describe how the developmental mathematics courses and curriculum were developed and who was responsible for this development. The intent of this question was (a) to determine if there was coordination when planning and preparing courses, (b) to determine if the goals, desired outcomes, objectives, or expectations helped guide the planning and preparation processes, and (c) to determine if the courses were developed and aligned with succeeding courses.

The intent of question 5 was to determine if the developmental mathematics courses were aligned with the succeeding developmental and regular mathematics courses and to determine how this alignment was achieved. Alignment could not be determined, but the responses to this question indicated the interviewees' intent to align courses. The responses also provided insight into the level of coordination of the program.

The intent of questions 6-8 was to determine the type of and the level of support developmental mathematics instructors received from others. The instructor was asked to describe the level of support others had for the developmental mathematics courses. The response to this question provided insight into the perceived support of developmental mathematics education on campus. The instructor was asked what types of faculty development opportunities were available. The responses to this question provided insight on the level of support developmental mathematics instructors received. It also indicated the priority placed on faculty development for developmental mathematics instructors. The instructor was asked about his or her level of involvement in the planning and decision-making processes in the program, the department, and the

institution. The responses to this question shed light upon the developmental mathematics instructor's roles, contributions, and inclusion in his or her institution and department.

The final two questions were the same as the last two questions in the director protocol. The instructor was asked to describe any changes he or she wanted to see occur in the developmental mathematics program and courses. These questions gave the interviewer an opportunity to receive any other information that might be important. It also gave the instructor a chance to add anything he or she forgot to mention earlier in the interview.

Research Design

Rationale

All elements of the study, gathering grade distribution data, classroom observations, interviews, and the collection of course syllabi, were done for three main purposes. First, the data were used to describe six NDUS developmental mathematics programs and their practices. Second, the data were used to compare each program's practices to "best practices" in developmental education as described in the literature. Third, the data were collected to contrast the programs by institutional type in light of "best practice."

Grade Distribution Data. Grade distribution data were collected to determine how many students were enrolled in developmental mathematics education and their success rates during fall 1999, 2000, and 2001. These data were used for comparisons to national

data on developmental education and for contrasts between the institutions and institutional types. The grade distribution data were used to provide insight into the number of and success of the developmental mathematics students.

Course Syllabi. The developmental mathematics course syllabi were collected and analyzed for descriptive information regarding developmental mathematics courses at each of the institutions. The course syllabi were analyzed for information regarding the intended use of "best practice" in these courses at each institution and for the inclusion of various items. This analysis was done using the "Best Practice" Checklist and the General Syllabus Checklist. The content of the course syllabi provided insight into the grading policies, assignments, exams, and objectives of the course. This information was not always obtained during the interviews or the observations. The course syllabi review and analysis provided another source of information that was used to describe, compare, and contrast the developmental math programs in light of "best practice."

Classroom Observations. The classroom observations were used to collect data that would help describe, compare, and contrast the programs. The information obtained during the observations helped describe the developmental mathematics programs and sometimes provided insight into the instructional methods used in the classroom. It gave the researcher a chance to watch the students interact with the instructor. The information obtained during the observations could also be compared to what the instructors said during their interviews. If the instructors actually taught class in the way

that they described, it lent credibility to this finding. All information obtained during the observations provided additional information for the comparisons and contrasts that were conducted in light of "best practice."

Interviews. The interviews with developmental mathematics instructors and with the director of the developmental mathematics program provided the most information to help describe, compare, and contrast the developmental mathematics programs. The purpose of the interviews with the instructors and with the director was to gather information that could be used to describe each institution's developmental mathematics program and to compare these described practices to the "best practices" in the developmental education literature. The questions in the interview protocols were focused on determining the general state of the developmental mathematics program. More specifically, they were used to determine what components of "best practice" the program and its instructors utilized. Once the practices were determined, they were compared to "best practice" and contrasted across institutions.

Data Collection Processes

From the review of the literature on "best practices" in developmental education, interviews of faculty, surveys, classroom observations, and the collection of transcript and enrollment data were the most common data sources used in developmental education research. Classroom observations, interviews with instructors and the directors of developmental mathematics programs, grade distribution data, and course syllabi

appeared to be the best data sources for conducting this study. The data collection processes are described below.

Grade Distribution Data. The grade distribution data were collected from the Records Office or the Registrar of each institution. Working with the Director of Records at the researcher's institution, the Director of Records at each of the 11 institutions in the NDUS was asked to send fall semester 1999, 2000, and 2001 grade distribution reports for each developmental mathematics course. Each Director of Records was given the option to decline participation or to send the requested data reports. Grade distribution reports were received from eight of the 11 institutions. The letter that was given to the Directors of Records is included in Appendix A.

The collection of these data helped provide a picture of the level of success of the students participating in each of these developmental mathematics courses at each institution. These data shed light upon the success of students at different institutions and in different courses.

Course Syllabi. Developmental mathematics course syllabi were collected from the interviewed developmental mathematics instructors at each of the six studied institutions. During the interviews, the researcher asked each of the interviewees for a copy of their developmental mathematics course syllabus. Sometimes the same syllabus was used for all instructors, but instructors sometimes created their own syllabus for the course.

After the course syllabi were received, they were used to gather descriptive information on the developmental mathematics courses, and they were analyzed using the General Syllabus Checklist (see Appendix A). They were also analyzed for evidence of "best practice" using the "Best Practice" Checklist (see Appendix A).

Classroom Observations and Interviews. Visits were made to the campus of each of the six institutions. During these visits, the director and a few of the instructors in the developmental mathematics program were interviewed. One class of each developmental mathematics course was observed except at AA II. At AA II, only two of the five offered developmental mathematics courses were observed. The two observed classes were the same as those offered at the other studied institutions. The three unobserved courses were not usually offered at the other studied institutions and were also taught using individualized instruction rather than classroom instruction.

The director of the developmental mathematics program at each institution was sent a letter to introduce the study. After receiving the letter, the director was contacted by phone to get permission to perform the interviews and the observations. During the phone conversation, the date for the visit was set, and the researcher determined which instructors to contact. The researcher contacted the developmental mathematics instructors by phone, by e-mail, or with the help of the director. They were asked to do an interview and to have their class observed. When they agreed, a time was determined for the interview and the observation. The initial contacts occurred during fall semester of 2002, and the interviews and observations occurred later that same semester.

All interviews followed the protocols (see Appendix A). Prior to the interview, each interviewee was e-mailed a copy of the appropriate protocol. Most of the interviews were recorded with the interviewee's approval, and notes were taken as well. During the classroom observations, detailed notes were taken to record what happened in each classroom observation. The notes and recordings that were made during the observations and the interviews were reviewed and analyzed afterwards. This was done using the methods described in the Data Analysis section of this chapter. Sometimes a follow up question was asked or a response needed to be clarified. When this occurred, the appropriate person was e-mailed. Other people were e-mailed or called for more information regarding the support services at each institution.

The classroom observations and interviews provided opportunities to determine if and how the programs implemented "best practice" in developmental education as specified in the literature. The observations and interviews also were ways to gather descriptive information about each developmental mathematics program. This information later was used to contrast the programs.

Data Analysis

Grade Distribution Data. After receiving the developmental mathematics grade distribution data, the researcher entered them into a spreadsheet. This enabled the grade data to be summarized, compared, and contrasted by course and institution. The average grade point averages for each course and semester were provided on each report. Drop rates were calculated for each course at each institution during each semester. In

addition, the drop rates were calculated for each course at each institution during all three combined fall semesters. Success rates were calculated two different ways: (1) with the students who dropped as part of the total number of students enrolled in the courses, and (2) without the students who dropped as part of the total number of students enrolled in the courses. A success was defined as an A, B, C, S, or P grade. These data were used to describe and contrast the developmental math programs at the six institutions.

Course Syllabi. All of the developmental mathematics course syllabi were analyzed using the "Best Practice" Checklist (see Appendix A). Each syllabus was reviewed for evidence of each "best practice" on the "Best Practices" Checklist and for the extent that the practice was reflected on the syllabus. If there was direct evidence or no evidence of a practice, this was indicated. If there was indirect evidence of a practice, or if it was not clear that a practice was evidenced, this was indicated as well. Notes were taken at the time to clarify any of the evidence of "best practice," especially in the cases of indirect or unclear evidence. The information obtained from the "Best Practices" Checklists later were used and combined with the results of the interviews to provide a more complete description of each developmental mathematics program and its use of "best practices."

All of the developmental mathematics course syllabi were analyzed using the General Syllabus Checklist (see Appendix A). Each syllabus was reviewed to determine which 20 items were included. If an item was or was not included, this was indicated on the General Syllabus Checklist. If use of an item was not applicable or not clear, this was indicated. Notes were taken at the time to clarify or add additional notes to any items.

The information from the General Syllabus Checklists later was used and combined with the results of the interviews and observations to provide a more complete description of each developmental mathematics program.

Classroom Observations and Interviews. After the observations and the interviews, all notes and tapes were reviewed and recorded. The interview responses and observations were typed and summarized for each director and each instructor at each institution. For the member checking process, the notes from each interview or observation or both were sent to the interviewee to allow him or her to check for errors of fact and to make corrections or additional comments. The data from the observations and the interviews were used to describe each institution's developmental mathematics program. These descriptions then allowed the findings to be compared to "best practices" in developmental education.

Descriptions. Using the data collected from the grade distributions, syllabi, observations, and interviews, descriptive summaries were written for each institution. These data were themed and described according to the following topics: background information; definition and location of developmental mathematics education; developmental mathematics faculty; curriculum development; policies; goals, objectives, and desired outcomes; students; instruction; preparation for success in future math courses; support services; program and course assessment; perception of support; desired changes; other comments; grade distribution data; and summary. Due to their length, complete narrative descriptions of the programs at the six studied institutions are included

in Appendices B-G. More concise descriptions of each program are included in the next chapter, Research Findings.

Comparisons to "Best Practice". The practices of each institution were compared to the list of nine "best practices" in the Summary of "Best Practices" in Developmental Education (see Table 7). These findings were summarized according to the following eight practices:

1. mandatory assessment and placement,
2. strong institutional commitment,
3. centralized or highly coordinated developmental program,
4. developmental mathematics faculty,
5. instruction and curriculum,
6. support services,
7. assessment, and
8. comprehensiveness.

Due to the data collection methods of this study, it was not possible to determine the following: (a) if cognitive, teaching, and learning theories were used; (b) if the exit skills and knowledge in developmental courses were aligned with those required to enter regular courses; and (c) if constructivist or discovery based teaching techniques were used. It is important to note that the "best practice," alignment of exit skills and knowledge in developmental courses with those required to enter regular courses, was changed to: *intent to align* exit skills and knowledge in developmental courses with those required to enter regular courses.

Contrasts Across Institutional Types. Once the descriptions and comparisons to "best practice" were completed for each institution, the practices needed to be contrasted across institutional types in light of "best practice." Rather than directly contrasting the programs across institutional types, the researcher contrasted the practices of the programs at the six studied institutions. This was done for two reasons. First, the six studied institutions were not chosen to be representative of all NDUS institutions and of all institutions within the institutional types. Second, there were distinct differences in the practices of the studied institutions within the institutional types. Due to these differences, each program needed to be treated individually. Therefore, because the chosen institutions reflected membership in each institutional type, the contrasts of the programs at the six institutions were done as a proxy for the contrasts by institutional type. The program contrasts between institutions might provide some indication of differences by institutional type. These possible differences between and patterns across institutional types are discussed in the final chapter.

Validity and Reliability in the Study

Grade Distribution Data. A letter (see Appendix A), that included an explanation and an example of the requested grade distribution data, was sent to the Director of Records at all 11 NDUS institutions. Once the grade distribution data were sent to the researcher, they were checked for missing or out of place data. All of the institutions in the NDUS operated on the same calendar year and used the same statewide computer system. Enrollment reports were generated the same way except at the Doctoral

Institution. At the Doctoral Institution, the grade distribution report was generated using a different program, and it lacked the number of students who dropped each course. The consistency in most reports prevented definitional problems. Each institution used Common Course Numbering (CCN). This prevented problems when identifying those courses for which to collect data. This also made it easier to summarize, compare, and contrast the data for each developmental course, program, and institution. When discrepancies were found, like with the Doctoral Institution, comparisons were not made or were made only for the data that did not include students who dropped.

Course Syllabi. Each of the interviewed instructors was contacted and asked to provide a syllabus for each developmental mathematics course at their institution. These syllabi were collected from each department for the same academic semester. These syllabi were analyzed using the "Best Practice" Checklist and the General Syllabus Checklist. Notes were made of any other important findings in the syllabi. The same Checklists were used for all syllabi to provide consistency. All findings were judgments made by the researcher, and thus, they were subject to her interpretations and biases.

At some institutions, different instructors used different syllabi for the same course. This meant that there might be differences on the syllabi of instructors of the same course at the same institution.

Classroom Observations and Interviews. After initial construction, two university educators reviewed the director and instructor interview protocols (see Appendix A). After these reviews, changes to the protocols were made based on the suggestions of the

educators. Like the analysis of the syllabi, the visits and interviews were subject to researcher bias since the researcher was the data collection and data analysis instrument. In order to minimize this bias, the researcher did a number of things. The researcher described her self in relation to the study in the Delimitations section of this chapter. While visiting each campus and its developmental mathematics facilities, detailed, rich, thick descriptive notes were kept of all observations and interviews. To help elicit honest, complete responses during the interviews, the interviewees were told that their responses would be kept confidential and any quotes would remain anonymous. Notes were taken during all of the interviews, and most interviews were tape-recorded. The interviews followed the structured interview protocols (see Appendix A), and probing questions were used to follow up on relevant areas.

The written and recorded responses of the interviewees and the observation notes were reviewed and summarized for each interviewee and observation. Any necessary follow up conversations and clarifications of the interviewees' responses, including member checking, was done by e-mail and phone calls.

Trustworthiness. To develop a trustworthy study, it was necessary to establish credibility, transferability, and confirmability of the data, the data interpretations, and the conclusions (Lincoln & Guba, 1985). To ensure credibility, data collection methods were triangulated because "no single method ever adequately solves the problem of rival cause factors. Because each method reveals different aspects of empirical reality, multiple methods of observation must be employed" (Denzin, 1978, p.28). Triangulation was established using the observations, interviews, syllabi, and grade distribution reports.

Credibility was also established with member checks (Lincoln & Guba, 1985). During the member checking process, interviewees verified the summarized interviews and observations. Transferability was established by providing thick descriptions of the findings, especially the descriptions included in Appendices B-G, for determination of their appropriateness in other settings (Lincoln & Guba, 1985). An auditor was used to ensure confirmability (Lincoln & Guba, 1985). After the researcher completed the analysis, an auditor was used to help confirm the findings and conclusions of the researcher. The auditor was a sociology professor at the researcher's institution. The auditor reviewed the study's proposal so that he had an understanding of its problem, purpose, research questions, literature, "best practices," and methodology. After this, the auditor reviewed the researcher's data, findings, and conclusions to determine if they were supported by the data. When the auditor found inconsistencies or a lack of data to support a conclusion, this was noted and discussed with the researcher. The researcher considered the auditor's finding and made changes based on the findings and suggestions of the auditor.

Limitations and Delimitations

Limitations

1. Syllabi were collected for each course, but because a syllabus included a statement that a certain practice would occur, did not necessarily mean that it did.

2. Even though Common Course Numbering was used in the NDUS, the information taught in the same courses at different institutions might not be the same. Any differences made the comparisons less valid.
3. The findings of this study could not be generalized to all developmental mathematics programs, nor could they confidently be generalized to all 11 institutions in the NDUS. The findings were only relevant to the six institutions included in the study. Any generalization beyond these institutions is the responsibility of the reader.

Delimitations

1. This study was delimited due to the short amount of time spent on each campus, the lack of extensive observations of developmental mathematics classrooms, and the small number of people being asked to describe the program at each institution. Because of this delimitation, the amount of data that was gathered about some instructional practices and policies was limited, and thus, so were the conclusions. Use of the following practices could not be determined: cognitive, teaching, and learning theories; course alignment; and constructivist or discovery based teaching methods.
2. The variability of each instructor's methods limited the conclusions that could be made for each course and institution. For example, the variety of instructional methods differed by instructor. Therefore, without interviewing and observing all developmental math instructors at an institution, conclusions could not be drawn for all instructors at that institution.

3. As mentioned earlier, the qualitative methods used in this study made the researcher the instrument for data collection and data analysis. This delimitation made the data and its subsequent analysis susceptible to the researcher's biases. The researcher's relationship to the study was that she was a mathematics instructor at one of the institutions included in the study. She was not teaching developmental mathematics courses during the time of the study, but she was interested in the improvement of these courses and programs. Her educational background was in mathematics, statistics, and mathematics education, as well as higher education teaching and academics.

Timeframe for the Study

Table 11. Timeframe for the Study.

Date	Event
September, 2002	Requests for grade distribution sent out.
October, 2002	Letter sent to directors.
Early November, 2002	Directors and instructors contacted to schedule visit.
November 13, 2002	Interviews and observations conducted at AA II.
November 19, 2002	Interviews and observations conducted at BA II.
November 21, 2002	Interviews and observations conducted at Doctoral Institution.
December 3, 2002	Interviews and observations conducted at AA I.
December 9, 2002	Interviews and observations conducted at BA I.
December, 2002	Interviews and observations conducted at Master's Institution over a two-week period.
December, 2002	Data analysis and writing of Chapters Four and Five begins.
July, 2003	Writing of Chapters Four and Five completed.

Chapter Summary

Included in this chapter were detailed explanations of the research methodologies used in this study. The researcher explained how grade distribution data, course syllabi, classroom observations, and interviews with directors and instructors of six postsecondary developmental mathematics programs in North Dakota enabled the following to be accomplished: (1) descriptions of the programs; (2) comparisons of the programs' practices to "best practice" in developmental education as described in the literature; and (3) contrasts of the practices across institutional types. The next chapter includes the findings from the study.

RESEARCH FINDINGS

Chapter Introduction

The research findings of this study were used to: (a) describe public postsecondary developmental mathematics education at six institutions in North Dakota; (b) compare each institution's policies, organizational and instructional characteristics to "best practice" in developmental education; and (c) contrast practices of the programs across institutional types.

Data were collected from a sample of public postsecondary institutions in North Dakota using the following methods. First, developmental mathematics grade distribution data were collected from the institutions. Second, developmental mathematics course syllabi were collected and analyzed for evidence of "best practice" and other items. Third, the researcher visited each campus once and observed the instruction used in each developmental mathematics program. These observations were limited to one class session of each developmental math course. Fourth, while visiting the institutions, interviews were conducted with the director of the developmental mathematics program and with one instructor of each developmental mathematics course.

Included in this chapter are the results of the data analysis. These results are organized in the following way. First, background information and a summary of the program descriptions from the six institutions are presented. The detailed program descriptions for each institution, which include all of the general findings from the interviews, observations, syllabi, and grade data, are included in Appendices B-G.

Second, the results of the comparisons of each program to "best practice" are presented. Third, the researcher highlights the differences between the six programs. These sections are followed by a discussion of the meaning of the results, including relationships to prior research, findings not supported by the literature, findings supported by the literature, weaknesses, uncontrolled factors, and incongruities in the study.

Summary of the Data

Introduction

The sampled developmental mathematics programs were given names based on their institution's Carnegie Classification (Carnegie Foundation for the Advancement for Teaching, 1994). The two Associate of Arts institutions are referred to as AA I and AA II. The two Baccalaureate Colleges II institutions are referred to as BA I and BA II. The Master's University I institution is referred to as the Master's Institution, and the Doctoral University II institution is referred to as the Doctoral Institution.

The researcher was not able to observe all sections of developmental mathematics courses at each institution, nor was she able to interview all of the instructors who taught these courses. During fall 2002, each developmental mathematics course at each institution was observed once, with three exceptions. These three exceptions were at AA II. AA II offered five developmental courses, three of which were taught using individualized instruction. These three individualized courses, ASC 090 Math Preparation, ASC 091 Pre-Algebra, and ASC 093 Pre-Trigonometry, were not observed, and the other two courses, ASC 092 Beginning Algebra and Math 102 Intermediate

Algebra, were observed. Notes were taken during the classroom observations. These were reviewed and typed afterwards.

All interviews with instructors and directors followed the appropriate interview protocols. The researcher took notes during all of the interviews and tape-recorded most interviews. Those interviews not recorded were done so at the request of the interviewee or due to the circumstances surrounding the interview. The researcher reviewed and supplemented her interview notes with the tapes of the interviews. Complete transcriptions of the taped interviews were not produced.

The researcher collected the developmental mathematics syllabi. These syllabi were analyzed by means of the General Syllabus Checklist (see Appendix A). This Checklist was based on the work of Davis (1993). These syllabi were also analyzed by means of the "Best Practices" Checklist (see Appendix A). This Checklist was based on the literature of developmental education.

Eight of the 11 NDUS institutions sent grade distribution reports for the developmental mathematics courses offered during fall semesters 1999, 2000, and 2001. The researcher entered these data into spreadsheets. The researcher used these data to further describe the level of success of students who took developmental mathematics courses.

The results of the data analysis are described in the following sections. These results are organized by program descriptions, comparisons of each program to "best practice," and program contrasts.

Program Descriptions

The program descriptions were used to describe each of the six programs and to compare each program's practices to "best practice." In the sections below, Tables 12-17 include summaries of the descriptive information for each of the six institutions. Detailed, narrative descriptions were written for each of the six chosen developmental mathematics programs, but due to the length of these descriptions and the focus of this study on "best practice," these descriptions are presented in Appendices B-G. The descriptions in Appendices B-G are organized according to the following sections: Background; Definition and Location of Developmental Mathematics Education; Developmental Mathematics Faculty; Curriculum Development; Policies; Goals, Objectives, and Desired Outcomes; Students; Instruction; Preparation for Success in Future Math Courses; Support Services; Program and Course Assessment; Perception of Support; Desired Changes; Other Comments; Grade Distribution Data; and Summary. Tables 12-17 are organized in a similar manner.

Besides the previously described summary tables, the following sections include background information regarding who was interviewed and which developmental mathematics courses were offered and observed at each of the six chosen institutions during the semester of study. Again, complete and detailed descriptive information for each of the six institutions can be found in Appendices B-G.

Table 12. AA I: Program Description.

Subject	Description
Courses	ASC 092 Beginning Algebra and Math 102 Intermediate Algebra (three credit version and four credit version that was described as slower paced and included a one credit lab component)
Definition and Location	Developmental mathematics at AA I was defined by the Director as, "All [mathematics] courses below Math 103, College Algebra, especially ASC 092 Beginning Algebra." Courses were offered by the Mathematics Department and taught by mathematics instructors.
Developmental Mathematics Faculty	The majority of instructors were adjunct faculty. A few full-time professors taught one or two sections of these courses each semester. The instructors had bachelor's degrees or master's degrees and no developmental training. Faculty development opportunities depended on funding, and full-time faculty, not adjuncts, received priority for these funds. Adjuncts did not participate in the planning and decision-making processes of the Department.
Curriculum Development	Full-time mathematics faculty developed the curriculum. There was a common outline of content and common textbooks for each course. Instructors taught using their own methods, but the Director tried to coordinate the courses.
Policies	There was mandatory assessment (ACT math scores or COMPASS placement exam scores), but placement was not mandatory. Students signed a waiver if they enrolled against the advise of their advisor or placement score.
Goals, Objectives, and Desired Outcomes	The program did not have stated goals, objectives, or desired outcomes, but the course syllabi did. These goals and objectives were usually focused on content and skills. Other goals mentioned by the interviewees were: improving students' organizational skills; preparing students for their next math course; and eliminating or reducing students' fear and anxiety of math.
Students	Developmental mathematics students varied. They were traditional age and nontraditional age, often with poor experiences or backgrounds in math. Many students worked full-time and had families while trying to go to school full-time.
Instruction	Instruction varied by instructor. The observed and interviewed instructors used the following methods: lectures, board work, group work, student-teacher interaction, labs, examples, tests, quizzes, and homework. The interviewees thought that the following were important and effective when teaching developmental math courses: practice, repetition, hands-on activities, active engagement of students, small class size, and positive student-teacher interaction. A basic or scientific calculator was used in both courses, and Gateway Tests were used in four-credit Math 102 to prevent students from moving on to new material without mastering current material.
Preparation for Success in Future Math Courses	The interviewees prepared students for future math courses by: building students' skills; emphasizing topics needed in the next course; eliminating fear; using Gateway Tests; in theory, using assessment and placement, but this depended on students and advisors; and by providing a review sheet at the end of Math 092 to help students determine if they were ready for Math 102. Students who earned A and B grades were most likely to be successful in their next math course.
Support Services	Tutoring by trained tutors, study skills seminars, Disability Student Services, programmed learning materials, audiovisual materials, and computer-assisted materials were available.
Program and Course Assessment	The developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations in each class each semester. An instructor also voluntarily tracked students' performance in math courses based on their performance in previous math courses. The evaluations and tracking were not part of a formal assessment process.
Perception of Support	The interviewees thought the Mathematics Department supported the developmental mathematics courses. They were unsure about the level of institutional support. They cited the following as indicators of a lack of support: large class size, initial lack of support for the four-credit Math 102 course, and how support sometimes depended on the person and the department. The courses were funded like other courses at AA I.
Desired Changes	The interviewees desired the following changes: teaching two levels of Math 102; adding an arithmetic course; having a two semester transition course for ASC 092 and Math 102 without the repetition that was in these courses; smaller classes; more involvement with tutoring services; making all sections of Math 102 four credits; and having ASC 092 meet during three 50 minute class sessions instead of during two 75 minute class sessions each week.
Grade Distribution Data	During fall 1999, 2000, and 2001, student GPAs in developmental courses were between 2.09 and 2.48. About one-fifth to one-third of students dropped developmental math courses. Success rates were between 71% and 81% when dropped students were not included in the calculations and were between 46% and 61% when dropped students were included.

Table 13. AA II: Program Description.

Subject	Description
Courses	ASC 090 Math Preparation, ASC 091 Pre-Algebra, ASC 092 Beginning Algebra, ASC 093 Pre-Trigonometry, and Math 102 Intermediate Algebra
Definition and Location	According to the ASC Director, developmental mathematics education at AA II was "the skill building or preparatory courses that are the foundation for many of the higher level math courses," including Beginning Algebra, Intermediate Algebra, and Basic Mathematics. Courses were offered by the Academic Services Center and the Mathematics and Science Department.
Developmental Mathematics Faculty	Academic Services faculty taught the ASC math courses. Academic Services faculty and Mathematics faculty taught Math 102. These instructors had bachelor's degrees or master's degrees. Academic Services Center faculty members were required to have education degrees and vocational training. Faculty development opportunities were available, and the instructors of these courses participated in the planning and decision-making processes of their departments.
Curriculum Development	Developmental mathematics instructors from the Math and Science Department and the Academic Services Center developed the curriculum together. They chose the textbooks and content for the courses. Some of the ASC math instructors attended Math and Science meetings to keep abreast of the Math and Science Department's discussions, planning, and activities.
Policies	There was mandatory assessment (ACT math scores or COMPASS placement exam scores), but placement was not mandatory.
Goals, Objectives, and Desired Outcomes	The program did not have stated goals, objectives, or desired outcomes, but the course syllabi did. These goals and objectives were usually focused on content and skills. Other goals mentioned by the interviewees were: helping students overcome their fears of math; improving students' skills, self-esteem, and confidence in math; and preparing students for their next math course.
Students	Developmental mathematics students varied. They were traditional age, nontraditional age, from farms and inner cities. They often had negative experiences with math, and most feared it or lacked confidence in their abilities. Many had little or no background in math.
Instruction	Instruction varied by instructor. The observed and interviewed instructors used the following methods: lecture, board work, group work, student-teacher interaction, integrated technology, labs, examples, journaling, tests, retests, quizzes, and homework. The interviewees thought that the following were important and effective teaching methods: having a good rapport with students; reducing students' fears of math; a non-threatening learning environment; individualized instruction; practice; active engagement of students; small class size; patience; focusing on skills; and teaching in a way students understand. A graphing calculator was used in both courses.
Preparation for Success in Future Math Courses	The interviewees prepared students for future math courses by: knowing what was taught in the next math course; offering peer led study groups; allowing students to retake quizzes or tests; offering a summer college prep program; having extensive hours in the Academic Services Center; using the results of a pretest in ASC 092 to help place students appropriately and to adjust instruction; and using the results of a posttest in ASC 092 to help adjust instruction.
Support Services	Tutoring by instructors and trained peer tutors, courses, study services, texts, workshops, videos, Disability Student Services, computers, software, summer programs, and labs were available.
Program and Course Assessment	The developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations in all classes. There was: some tracking of students that took ASC math courses; a pretest and posttest in ASC 092; and informal assessment activities completed by the ASC Director.
Perception of Support	The interviewees thought the Institution and their departments were supportive. There were extensive hours in the Academic Services Center, and the focus of the Institution and both departments was on student learning. The Math and Science Department and the Academic Services Center supported each other with referrals and coordinated efforts and planning.
Desired Changes	The interviewees desired the following changes to the developmental program: mandatory placement; smaller class size; more real-life curriculum; more complete student understanding; more involvement of math faculty with developmental math courses; a tutoring room for Math and Science; recognition that courses like Math 102 took more time; to learn more about working with and motivating different students; and tracking Math 102 students.
Grade Distribution Data	During fall 1999, 2000, and 2001: student GPAs in Math 102 were between 1.70 and 2.23; 4-15% of students dropped ASC 092; and about 15-19% of students dropped Math 102. In all developmental math courses, success rates were between 59% and 71% without dropped students in the calculations and were between 50% and 68% with dropped students.

Table 14. BA I: Program Description.

Subject	Description
Course	Math 102 Intermediate Algebra
Definition and Location	Developmental mathematics at BA I was essentially the one developmental math course, Math 102. There was a cohort program for underprepared students that included Math 102 as one of its courses. Math 102 was offered by the Division of Science and Mathematics and taught by an instructor who was a faculty member of the Health and Physical Education Department.
Developmental Mathematics Faculty	As mentioned above, there was only one developmental math course and only one developmental math instructor. The Math 102 instructor had a bachelor's degree in mathematics, a master's degree in physical education, and no developmental training. He had not pursued any faculty development opportunities so he did not know if any existed. He did not participate in the planning and decision-making processes of the Division of Science and Mathematics.
Curriculum Development	The Math 102 instructor developed the curriculum. He chose the textbook, content, and all instructional methods. He did speak with Math 103 College Algebra students and instructors to help him determine what was taught in Math 103. He used this information to create a Math 102 curriculum that would prepare students for Math 103.
Policies	There was mandatory assessment, but placement was not mandatory. Students were advised based on their ACT math scores.
Goals, Objectives, and Desired Outcomes	The program did not have stated goals, objectives, or desired outcomes, but the course syllabi did. During the course of the interview with the Math 102 instructor, the researcher determined that two of the three stated goals were not met. Other goals mentioned by the interviewees were to get students ready for Math 103 and to alleviate students' anxiety, fear, and dislike of math.
Students	Developmental mathematics students varied. They were traditional and nontraditional age, often with weak backgrounds in math. Many were scared of math. The Director classified the students into two groups: those who were underprepared and took little math in high school, and those who self-selected to take Math 102. Many of those who self-selected were older than average students.
Instruction	The Math 102 instructor used the following methods: lecture, examples, tests, quizzes, and homework. He said he taught the course like a high school math course. The interviewees thought that the following were important and effective when teaching developmental math courses: being personable; working individually with students; small class size; attendance; and helping students get over their fears of mathematics. A calculator with fraction mode was used.
Preparation for Success in Future Math Courses	The interviewees prepared students for future math courses by: speaking with Math 103 instructors and students to find out what was taught in Math 103; looking at Math 103 exams; making sure students got the basic information to take Math 103; advising; allowing students to move between Math 102 and Math 103 so that they were in the appropriate course; and having the cohort program for underprepared students.
Support Services	Tutoring, Supplemental Instruction, counseling, advising, Disability Student Services, a study skills course, freshmen seminar, and the cohort program were available.
Program and Course Assessment	The developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations in each class each semester. The Director said that a little bit of monitoring of student success in subsequent courses took place, but not formally and on a regular basis.
Perception of Support	The Director thought the institution supported Math 102 since it was part of the associate program and the cohort program. The Math 102 instructor said that he had no support and did not need any, but he thought that he would get support if he asked for it. The course was paid for like any other course. Funds went for the instructor's salary and for the tutoring and Supplemental Instruction budget.
Desired Changes	The Director wished Math 102 were more individualized. The instructor wished Math 099 were offered for those students who were not quite ready for Math 102.
Grade Distribution Data	BA I did not send the requested grade distribution data.

Table 15. BA II: Program Description.

Subject	Description
Courses	Math 099 Beginning Algebra and Math 102 Intermediate Algebra
Definition and Location	The Director would not define developmental mathematics at BA II, and noted that BA II was a small institution that really did not have a formal developmental mathematics program. The courses were offered by the Mathematics and Computer Science Department.
Developmental Mathematics Faculty	Faculty of the Mathematics and Computer Science Department taught the developmental math courses. These instructors had master's degrees or doctorates, but they did not have training in developmental education. Faculty development opportunities were available, but funding was limited. On campus workshops and seminars were available. Since the developmental math instructors were full-time faculty members, they participated in the planning and decision-making processes of the Department. The Math 102 instructor said that he did not like teaching Math 102, and he did it to fill his schedule.
Curriculum Development	Department faculty developed the curriculum. They decided on a textbook, and the content was partly determined by the University System's Common Course Numbering.
Policies	There was mandatory assessment, but placement was not mandatory. Students took a test on the first day of class in Math 102 and Math 103 and were advised based on their scores and sometimes their ACT math scores.
Goals, Objectives, and Desired Outcomes	The program did not have stated goals, objectives, or desired outcomes, but the course syllabi did. These goals, objectives, and desired outcomes were focused on content, skills, and the goals of the instructor. Other goals mentioned by the interviewees were to try to get students to learn mathematics and to develop students' formal thinking skills.
Students	Developmental mathematics students varied. Some had been away from math for a long time, and others were right out of high school. Other students had no background or courses in math or were not strong in math.
Instruction	Instruction varied by instructor. The observed and interviewed instructors used the following methods: lecture, a small amount of group work, examples, tests, homework, and in class activities. The Math 102 instructor allowed students to use a basic calculator, but described himself as anti-technology. The Director sometimes used Maple mathematical software when he taught the course. According to the course description, other forms of technology, such as Excel, were used when teaching Math 099.
Preparation for Success in Future Math Courses	The Director said that he had no idea if students were prepared for their next math course. The Math 102 instructor said that he tried to develop students' algebraic skills, symbolic manipulation, and formal thinking, but he did not think of the students as going on to another math course.
Support Services	According to the Director, tutoring was available on campus for students. It could not be determined what other services were available due to no response by the Director of Academic Services and no information on the Institution's Web site.
Program and Course Assessment	The developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations in each class each semester.
Perception of Support	The interviewees refused to comment about the support for developmental math courses at the Institution. The costs of the courses were no different than other courses and included instructor salaries and computer software licensing fees.
Desired Changes	The interviewees did not indicate any desired changes to the developmental program. The Director said that there would be summer advertising for Math 102. The Math 102 instructor said that he did not want anything changed. He wanted the least amount of work as possible and acknowledged that this was not in the best interest of students.
Grade Distribution Data	During fall 1999, 2000, and 2001, student GPAs in Math 099 were between 1.25 and 2.86, and in Math 102 were between 2.03 and 2.30. Approximately 25-60% and 35-51% of students dropped Math 099 and Math 102, respectively. In Math 099, success rates were between 25% and 100% when dropped students were not included in the calculations and were between 10% and 75% when dropped students were included. In Math 102, the success rates were 65-83% without dropped students in the calculations and 40-43% with dropped students in the calculations.

Table 16. Master's Institution: Program Description.

Subject	Description
Courses	Math 099 Beginning Algebra and Math 102 Intermediate Algebra
Definition and Location	Developmental mathematics at the Master's Institution was defined by the Director as, "What you do in courses that are nominal prerequisites for College Algebra." Courses were offered by the Department of Mathematics and Computer Science and were taught on campus, by correspondence, at a nearby U.S. Air Force Base, or sometimes at a two-year coordinate campus.
Developmental Mathematics Faculty	The majority of campus instructors were classified as instructors or lecturers. One full-time professor taught one or two sections of Math 102 at the Base each semester and a section by correspondence. The other Base instructors were usually local junior high and high school teachers. The instructors had bachelor's degrees or master's degrees, except for the professor, who had a doctorate. No one had developmental training. Faculty development opportunities were available, but not emphasized for these instructors. The campus instructors participated in the planning and decision-making processes of the Department.
Curriculum Development	The curriculum development process involved the selection of a text and an agreement on course content with the consensus of the campus course instructors and other concerned faculty.
Policies	There was mandatory assessment (ACT math scores or COMPASS placement exam scores), but placement was not mandatory.
Goals, Objectives, and Desired Outcomes	The program did not have stated goals, objectives, or desired outcomes; but the course syllabi did. These goals and objectives were usually focused on content, skills, and the goals of the instructor. Other goals mentioned by the interviewees were: preparing students for their next math course; dispelling students' fears of math; and improving students' views of math and themselves.
Students	Developmental mathematics students varied. They were traditional age and nontraditional age. Some students had little experience with math and others had four years of high school math.
Instruction	Instruction varied by instructor. The observed and interviewed instructors used the following methods: lecture, board work, manipulatives, group work, student-teacher interaction, real life and abstract examples, integrated technology, help sessions, a teaching assistant, tests, retests, and homework. The interviewees thought that the following were important and effective when teaching developmental math courses: being an approachable instructor; positive student-teacher relationships; using multiple methods for teaching and solving problems; group work; retesting; technology; correct mathematical vocabulary and notation; small class size; help sessions; active student involvement; attendance; a teaching assistant; individual attention; lots of homework; dispelling fear; and providing success. Graphing calculators were used in both courses.
Preparation for Success in Future Math Courses	The interviewees prepared students for future math courses by: using effective instructional techniques; appropriate placement; having help sessions; using retests; using teaching assistants; and giving the students a good introduction and exposure to the topics they would need in Math 103.
Support Services	Peer tutoring by trained tutors, a math clinic run by undergraduate math students, Disability Student Services, Veteran's Upward Bound, TRIO Student Success Services, a critical thinking course, and a study skills course were available.
Program and Course Assessment	The developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations in each class each semester. According to the Director, more assessment eventually might come down from administration.
Perception of Support	The Director did not think developmental math was fully supported. The following were indicators of this: Math 099 was not part of regular teaching loads; student numbers did not count toward student credit hours so there was a disincentive to spend money on Math 099; and courses were not needs based. The instructors thought their department was supportive of the courses, and administration might have understood the need for the courses but was not necessarily in full support of them.
Desired Changes	The interviewees desired the following changes to the developmental program: someone to examine and decide how to deal with remediation across the State; mandatory placement; changes in content to include more practical applications; and smaller class sizes.
Grade Distribution Data	During fall 1999, 2000, and 2001, student GPAs in Math 102 were between 1.69 and 1.81, and approximately 25-32% of students dropped the course. In Math 099, success rates were between 61% and 81% not including dropped students and were between 50% and 79% including dropped students. The success rates in Math 102 were between 48% and 57% not including dropped students and were between 36% and 40% not including dropped students.

Table 17. Doctoral Institution: Program Description.

Subject	Description
Courses	Math 099 Beginning Algebra and Math 102 Intermediate Algebra
Definition and Location	Developmental mathematics at the Doctoral Institution was defined as Math 099 and Math 102 and was designed to help students get back into the swing of things. Courses were offered and funded by Continuing Education since state dollars could not be spent on these courses.
Developmental Mathematics Faculty	There was a Math 099 supervisor, Math 102 supervisor, and the Remedial Program Director of the Department of Mathematics. The instructors were lecturers in the Mathematics Department and had bachelor's degrees or master's degrees and no developmental training. Faculty development opportunities were available, but full-time faculty, not lecturers, received priority for these funds. The lecturers did not participate in the planning and decision-making processes of the Department.
Curriculum Development	The Remedial Math Director and developmental math instructors developed the curriculum. The courses had common syllabi, common content, and common exams.
Policies	There was mandatory assessment and placement. Students were placed based on their scores on a battery of placement exams. Students paid a flat fee for these courses in addition to their regular tuition. These fees funded the courses and paid for instructors' salaries and tutoring.
Goals, Objectives, and Desired Outcomes	The program and course syllabi did not have stated goals, objectives, or desired outcomes. The interviewees wanted to help students: gain conceptual understanding of the material; be successful at the next level and eventually get their math credit; get rid of their fears of math; build confidence; become proficient in the necessary areas; become more familiar with the calculator so they could be successful in Math 103 or Math 104; and improve their organizational skills.
Students	Developmental mathematics students varied. Some were traditional age students who did not place out of developmental math, and others were nontraditional age students returning to school.
Instruction	Instruction varied by instructor. The observed and interviewed instructors used the following methods: lecture, board work, group work, examples, student-teacher interaction, integrated technology, in class assignments, teaching the course like a high school class, homework, quizzes, tests, and retests. The interviewees thought that the following were important and effective when teaching developmental math courses: student involvement; technology; relaxing students; using humor; making it fun; doing a little at a time with a lot of repetition; building the students' confidence; using groups; partnering students to help each other; retaking quizzes and tests; application problems; and teaching students how to be organized and neat. Graphing calculators and a supplemental online computer program were used in both courses. One online section of each course was offered in addition to the traditional classroom sections.
Preparation for Success in Future Math Courses	The interviewees prepared students for future math courses by: asking conceptual questions; having mandatory assessment and placement; retesting; testing the students on appropriate material; advising; providing the students with success to build their confidence; and having instructors use one office hour per week to do tutoring in a lab.
Support Services	Tutoring by trained tutors or instructors, freshmen seminar, counseling, advising, and Disability Student Services were available. Three of the interviewees complained that the tutors often were ineffective because they did not know how to teach the material using the methods of the courses.
Program and Course Assessment	The developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations each semester. Course supervisors observed all developmental instructors and met with them regarding this observation. Informal assessment took place through discussion.
Perception of Support	Both directors said that money was an issue with the developmental courses. Another interviewee thought that there were those in administration who viewed the developmental courses in a negative light and wanted fewer students in them. Students were charged additional fees for these courses and did not receive graduation credit for them. The courses were offered through Continuing Education, not as part of regular course offerings. There was support within the group of developmental instructors, but these instructors could not participate in departmental meetings.
Desired Changes	The interviewees desired the following changes to the developmental program: less students in the developmental courses; two levels of Math 102, a year long course and a semester course; a tutoring center just for developmental math; smaller classes; and technology in all classrooms.
Grade Distribution Data	Success rates were calculated without dropped students since the grade distribution data did not include the number of dropped students. During fall 1999, 2000, and 2001, student GPAs in Math 099 and Math 102 were between 1.78 and 2.22 and 1.81 and 2.15, respectively. The success rates in Math 099 and Math 102 were between 57% and 75% and 57% and 68%, respectively.

AA I. AA I offered two developmental mathematics courses, ASC 092 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (three or four credits). During the visit to AA I, the researcher observed each of these courses. The observed Math 102 section was one of two sections offered four days a week, instead of three days a week. It was described as slower paced and having a lab component. Students who took this course enrolled in a special three-credit section of Math 102 and a concurrent one-credit section of Math 102L, the lab component. The majority of Math 102 sections met three days a week.

The researcher interviewed the contact person in the Mathematics Department. As the contact person, the researcher assumed that this person would have the most knowledge about the Department. For this reason, the contact person was chosen as and referred to as the Director. The researcher interviewed two instructors who taught developmental mathematics courses. The researcher chose these instructors according to the scheduled times of the classes and according to the times when faculty were available for interviews on the scheduled day of the visit.

Table 12 is a summary of the descriptive findings for the developmental mathematics program at AA I. A complete and detailed narrative of these findings is in Appendix B.

AA II. AA II offered many developmental mathematics courses, including ASC 090 Math Preparation (one credit), ASC 091 Pre-Algebra (one to two credits), ASC 092 Beginning Algebra (two credits), ASC 093 Pre-Trigonometry (one credit), and Math 102 Intermediate Algebra (three credits). During the process of conducting the interviews,

the researcher discovered other courses (Basic Mathematics sequence) at AA II that, based on their content, could be considered developmental mathematics courses. These courses were not developmental according to this study's definition of developmental mathematics education. Developmental mathematics education was defined as: mathematics courses and support services for college students taking mathematics courses numbered below Math 103 College Algebra.

During the day of the visit to AA II, the researcher could not observe all developmental math courses. Thus, ASC 092 Beginning Algebra and Math 102 Intermediate Algebra were observed. The reason for observing these two courses was their being offered by most other studied institutions. In addition, they were taught in a classroom setting. The other three unobserved developmental math courses were taught with individualized instruction.

Faculty of the Math and Science Department and the Academic Services Center taught the developmental mathematics courses at AA II; therefore, the researcher interviewed directors and instructors from both departments. These interviewees included the Director of the Academic Services Center (referred to as ASC Director), the Chair of the Math and Science Department (referred to as Math and Science Chair), the ASC 092 instructor, and a professor in the Math and Science Department (referred to as Math 102 instructor). The interview with the Math 102 instructor was conducted over the phone prior to the visit. This was done because the instructor had to leave for a conference shortly after the researcher arrived on campus.

Table 13 is a summary of the descriptive findings for the developmental mathematics program at AA II. A complete and detailed narrative of these findings is in Appendix C.

BA I. BA I offered one developmental mathematics course, Math 102 Intermediate Algebra (three credits). During the visit to BA I, the researcher observed this class and interviewed its instructor. The Math 102 instructor was chosen as an interviewee because he was the only person who taught a developmental math course at BA I. The researcher also interviewed the Chair of the Division of Science and Mathematics. This person is referred to as the program's Director.

Table 14 is a summary of the descriptive findings for the developmental mathematics program at BA I. A complete and detailed narrative of these findings is in Appendix D.

BA II. BA II offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 College Algebra (four credits). One section of Math 102 was being taught during the campus visit, and due to low enrollment, Math 099 was canceled that semester. Thus, the researcher observed the one Math 102 class and interviewed its instructor. The researcher chose this person for the interview because he was the only instructor teaching the course that semester. The researcher interviewed the Chair of the Mathematics and Computer Science Department. He taught one of the developmental math courses, Math 102, but not during the semester in which the visit was conducted. He is referred to as the program's Director.

Table 15 is a summary of the descriptive findings for the developmental mathematics program at BA II. A complete and detailed narrative of these findings is in Appendix E.

Master's Institution. The Master's Institution offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (four credits). The researcher observed one section of Math 099 and two sections of Math 102. The same instructor taught both observed sections of Math 102. One section of Math 102 had a teaching assistant, and the other section did not. The researcher interviewed the instructors of these observed classes as well as the Chair of the Department of Mathematics and Computer Science. The Chair was an associate professor of computer science. He is referred to as the program's Director.

The Math 099 instructor was a part-time lecturer who taught both developmental mathematics courses. The researcher chose the Math 099 instructor because she was the only person teaching Math 099 on campus at the Master's Institution. Also, she taught Math 102 when the Department needed her to do so. Thus, she had information about both developmental math courses. The Math 102 instructor was a full-time instructor of mathematics. The researcher chose the Math 102 instructor because he taught two sections of Math 102 every semester. Other instructors of the course did not teach as many sections of the course or did not teach it as frequently.

Table 16 is a summary of the descriptive findings for the developmental mathematics program at the Master's Institution. A complete and detailed narrative of these findings is in Appendix F.

Doctoral Institution. During the visit to the Doctoral Institution, the researcher observed two developmental mathematics classes, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (four credits). In addition, the researcher interviewed four people: the Director of Distance and Continuing Education, the Remedial Program Director of the Department of Mathematics, and two instructors, both of whom taught Math 099 and Math 102. In order to distinguish between the two Directors, the Director of Distance and Continuing Education is referred to as the Continuing Education Director, and the Remedial Program Director of the Department of Mathematics is referred to as the Remedial Math Director. To distinguish between the instructors, the person who supervised Math 102 and whose Math 102 class was observed is referred to as the Math 102 instructor. The other interviewed instructor is referred to as the Math 099 instructor.

The researcher interviewed the Continuing Education Director because developmental mathematics courses were offered through Continuing Education. The Remedial Math Director was interviewed because he was in charge of the developmental mathematics courses and instructors. He also was the University Mathematics Placement Director. The Math 099 instructor was not selected for any specific reason other than he taught Math 099. He also taught Math 102, but his interview was mainly about Math 099. During an initial phone call with the researcher, the Remedial Math Director suggested an interview the Math 102 instructor, and thus, the researcher arranged the interview. This person was also the Math 102 supervisor. The interviewed Math 099 instructor was different than the Math 099 instructor that was observed. This difference

was due to scheduling difficulties during the time of the visit; yet, it provided the researcher with an additional source of information regarding the developmental mathematics program at the Doctoral Institution.

Table 17 is a summary of the descriptive findings for the developmental mathematics program at the Doctoral Institution. A complete and detailed narrative of these findings is in Appendix G.

Data Analysis

Comparisons to "Best Practice": Introduction

The findings from the interviews, observations, syllabi, and grade distribution data at each of the six institutions were compared to "best practice" in developmental education. The "best practices" included in Table 18 were used for these comparisons. The results of the comparisons to "best practice" are below.

"Best Practice": AA I

Mandatory Assessment and Placement. At AA I, assessment of students' mathematical skills and knowledge was mandatory, but placement was not. Students were assessed using the COMPASS placement exam or ACT math scores. According to the Director, "We do have recommended (not mandatory) cut scores for placements into our math classes. If students and advisors follow these, they are accurate and to the students' benefit." She added, "There is a waiver that students sign if they enroll against the advise of their advisor or placement score," but according to the interviewees, there

was nothing that prevented students from enrolling in inappropriate courses. Students were advised and placed in the four-credit Math 102 course because they were thought to be at risk of failure due to their low ACT scores, low placement scores, or having to repeat the course.

Table 18. "Best Practices" Used for Comparison Analysis.

"Best Practices"
1. Mandatory assessment and placement of developmental mathematics students.
2. Strong institutional commitment to developmental mathematics.
3. Centralized or highly coordinated developmental program.
4. Training and professional development and for the staff and faculty who work with developmental mathematics students. These staff and faculty should also be involved in departmental planning and decision-making processes. Adjuncts and part-time faculty should not be overused.
5. Successful instructional and curricular methods include: a. mastery learning techniques; b. learning communities and/or paired courses; c. the integration of classroom and laboratory instruction; d. the supplemental use of technology; e. the use of a variety of instructional methods; f. a high degree of course structure, defined as: helping students' organize their thoughts and concepts by modeling appropriate behavior and by structuring students' learning activities and environments in such a way that they learn appropriate ways to organize information (Cross, 1976; Roueche, 1973); g. intent to align exit skills and knowledge in developmental courses with those required to enter regular courses; and h. clearly defining, linking, and sharing with others the philosophies, goals, and objectives of the developmental program and its courses.
6. The provision of various support services, including ongoing student orientation, freshmen seminars, the use of trained tutors, and Supplemental Instruction.
7. Regular, systematic assessment that is both summative and formative and is used to revise and improve the program and its courses.
8. Comprehensiveness, or the use of many "best practices," rather than a few.

Strong Institutional Commitment. There were indications of institutional commitment and indications of a lack of this commitment. All interviewees said that the Mathematics Department strongly supported the developmental mathematics courses, but there was some question about institutional support of the developmental math courses. One interviewee said, "Within the Department, the developmental math courses are a high priority. People understand that students in [ASC] 092, [Math] 102, and [Math] 103 need more attention and more one-on-one time as opposed to upper level students."

There were some indications of a lack of institutional support. Two of the interviewees explained how they had trouble gaining administrative support for the four-credit Math 102 course. The Director said, "It took a long time to convince administration that the four-day [Math 102] class would be a good idea. It took longer to get paid for [teaching] the extra day." According to two of the interviewees, they had to "fight to keep the course" at one point. Since then, the course had become fairly well established. The Math 102 instructor was unsure about the level of institutional support.

The Director said that support depended on the person and the department on campus. Those departments that used math in their disciplines more accurately advised students about which math courses to take than those departments that did not use math in their disciplines.

Other indications of a lack of institutional support were the use of adjuncts and the interviewees' complaints about class size. All interviewees thought that smaller class sizes would improve the developmental math classes. During the three fall semesters in which grade data were collected, ASC 092 and four-credit Math 102 had about 35

students in each section, and three-credit Math 102 had about 50 students in each section. The ASC 092 instructor described the importance of small class size and the student-teacher relationship in developmental mathematics classes:

> I am glad that I don't have 40 [students]...I don't think the comfort would be what it is for most of those people because now I think they are pretty comfortable as a group and they know their neighbors. I can't imagine having [Math] 102 classes that have like 35-40 people in them. How can you get the student to feel that the teacher knows who you are, and knows your specific difficulties and have a relationship. It is almost like it is a lecture bowl...I think that is really helpful in these lower level math classes if there is somewhat of a relationship between the teacher and the student, even if it is just visiting after class or whatever.

Adjuncts usually taught the developmental math courses. Faculty development opportunities usually were not available and emphasized for developmental math instructors. The Director wrote, "Funds for adjuncts for major conferences are iffy. State conference, no problem." All mathematics faculty members, including adjuncts, were encouraged to attend the NDMATYC (North Dakota Mathematical Association of Two-Year Colleges) conferences. Thus, developmental math instructors did not receive priority for funding of major faculty development opportunities, but they could attend local or state opportunities.

There were some indications of support for developmental mathematics. There was a large support services center on campus. It provided math learning assistants, trained tutors, and numerous other materials. Administration finally did fund four-credit Math 102. Also, it did not enroll as many students in those sections as it did in the three-credit Math 102 sections. The funding of the developmental math courses was the same as other courses but was probably less than what was spent on upper level math courses. This is because adjuncts were paid to teach the courses rather than full-time professors.

There were a few full-time faculty members involved with the developmental math courses but only on a part-time basis. The Director and another former full-time math professor (who was retired and working as an adjunct professor) developed and taught the two sections of four-credit Math 102. Again, this course was started to help students who were at risk of failing the course or who needed more time to learn the material. They did not get paid more for this work, and it took a while to gain administrative support for the course. Yet, full-time faculty were concerned about students' success in Math 102.

To summarize, there were indications of institutional commitment to developmental mathematics and indications of a lack of this commitment. Therefore, no conclusions could be made about institutional commitment to developmental mathematics education at AA I.

Centralized or Highly Coordinated Developmental Program. All developmental mathematics courses were taught from the same department, the Mathematics Department, but not all developmental courses were taught from one department. Thus, the developmental mathematics program was centralized, but the entire developmental program was not. According to two of the interviewees, there had been talk of establishing a developmental college of core English and math courses, but it had not gone any farther than discussion.

There was coordination within the Mathematics Department when developing and maintaining the developmental mathematics curriculum. For each developmental math course, there was a common text and a common outline of content for instructors to

follow. In addition, there was a common syllabus format. Faculty were supposed to follow this format when creating their syllabi, but they could supplement this format if they desired. Full-time math faculty members chose the textbooks and developed the content outlines. The adjunct instructors who taught the majority of the sections of these courses did not participate in this process. According to one interviewee, "The adjuncts realize that it is not expected of them to try to change the textbook or to go out on their own and do something different."

The level of coordination within a course depended partly on the instructors of the course. Some of the instructors, especially the four-credit Math 102 instructors, worked closely together. The Director began coordinating each developmental math course after noticing differences in the depth of content taught by different instructors and in the varying amounts of success of students in different sections of the same course.

Developmental Mathematics Faculty. At AA I, the majority of the instructors were adjunct faculty. Some of the full-time faculty members taught one or two sections of the developmental courses each semester. One of these people was the Director. She was an assistant professor of mathematics. Most semesters she taught two or three sections of Math 102. Another assistant professor of mathematics taught two sections of ASC 092 during fall 2002. He usually taught just one evening section of the course each semester.

According to the Director, the instructors of developmental mathematics courses were required to have bachelor's degrees or master's degrees. They did not receive special training in developmental mathematics education. As stated earlier, "Faculty

development opportunities depend on the availability of funds," wrote the Director. All interviewees said that adjuncts did not receive the same priority in funding opportunities. The Director wrote, "Funds for adjuncts for major conferences are iffy. State conference, no problem." The Director also noted that there were not many faculty development opportunities on campus.

Full-time faculty members participated in the decision-making and planning processes in the Department and on campus, but adjunct faculty did not. One interviewee said, "It is not expected of adjuncts to do this."

In summary, developmental math instructors at AA I were usually adjuncts. Sometimes full-time math faculty members taught a few sections of the developmental math courses. The highest level of education of these instructors was the bachelor's degree or the master's degree. The adjunct instructors did not participate in the decision-making and planning processes of their departments, and faculty development opportunities were usually limited to local or in-state opportunities.

Mastery Learning. Mastery learning was practiced in four-credit Math 102, but it was not practiced in the other developmental math courses, ASC 092 and three-credit Math 102. In the four-credit Math 102 course, students took three Gateway Tests. These tests covered topics important to student success in current and future math courses. The Gateway Tests were mentioned by the interviewees and were described on the four-credit Math 102 syllabus. Students had to pass the Gateway Tests with at least an 80% or else they had to retake them. They could retake each Gateway Test twice within a given time period until they earned at least an 80%. Each time a student did not earn at least an

80%, they were given practice problems like the ones they missed, and they retook a similar test. The Math 102 instructor said, "This is a way to make sure all students are up to task to move on with new material." Not all developmental math courses and instructors used mastery learning techniques. Thus, the researcher could not conclude that this was a "best practice" used in the developmental math program at AA I.

Classroom and Lab Integration. The one credit lab component of the four-credit Math 102 course was integrated with the three-credit classroom portion of the course. Students worked in groups in class to complete the lab. The lab was application based and involved real life problems. These problems were related to the material being studied in class and were not of a rote form. In order to solve the problems, students had to think, reason, problem solve, discuss using mathematical language, and use what they knew from class. While the students worked, the instructor continually walked around the room. He observed and helped students as he did this.

Supplemental Use of Technology. In both developmental math courses, students used a scientific calculator for calculations. The ASC 092 instructor said that he tried to restrict students' use of the calculator by having them demonstrate two or more steps of a problem on tests and quizzes. On the Math 102 syllabus, the instructor required students to have a calculator and said that students might want to buy a graphing calculator if they planned to go on to College Algebra.

Variety of Instructional Methods. Using a variety of instructional methods was an instructional "best practice." During the observation of the ASC 092 class, the ASC 092

instructor used the following instructional activities: used lecture; used examples to illustrate concepts; explained concepts, examples, thought processes, and mathematical methods used to solve examples; had students solve problems at their desks individually or with their neighbors while he observed, answered questions, and made comments to students about their work. Assignments were homework problems from the book. The instructor gave 10 quizzes, four tests, and a comprehensive final exam.

The ASC 092 instructor said that in the evening ASC 092 class, he could do more things in groups since it was a smaller class. He had not done this with his afternoon class. He also said, "The night class is such a different group. By the second week they are all talking to each other; they know each other's names; they have their phone numbers; they work together; whatever. A lot different than the day class."

Thus, the observed and interviewed ASC 092 instructor used a larger variety of instructional methods, including board work and group work, in the evening section of ASC 092 than in the afternoon section of the course. This was due to the difference in students and the smaller size of the evening class. Otherwise, the ASC 092 instructor taught the course with lecture, answering questions, doing examples, and having students do examples and homework problems. Since only one instructor was observed and interviewed, no conclusions could be reached about the variety used by all ASC 092 instructors.

During the observation of the four-credit Math 102 class, the Math 102 instructor began class by making students aware of the upcoming topics, assignments, and quizzes and by taking questions from the homework lesson. At the board, he worked the

problems about which students asked questions. He solved these problems with the students' help. After taking questions, the instructor reviewed topics, and a lab was handed out.

The students worked in groups to complete the lab. The lab was application based. It involved real life problems that were related to the material being studied in class. As said above, the problems on the lab were not of a rote form. In order to solve the problems, students had to think, reason, problem solve, discuss using mathematical language, and use what they knew from class. While the students worked, the instructor continually walked around the room. He observed, answered questions, and helped students as he did this.

Assignments in the four-credit Math 102 course were homework problems from the text as well as handouts called lessons. Assessment methods were described in detail in the four-credit Math 102 syllabus. These methods included four unit tests, a comprehensive final exam, three Gateway Tests, daily work, 10 short quizzes covering only one or two topics, and three or four graded collaborative activities.

The Director described the most effective lessons as "anything that actively engages the students and causes them to interact with each other." She listed examples of a measuring lab, a box lab, and board work. When said that when students sat at two person tables, rather than individual desks, it helped promote interaction and conversations between students as well. The Math 102 instructor said that "anything hands-on" was effective. The Director said that you had to love the students, get to know

them, and establish a relationship with them. The Director said that most of the instructors used a lecture format, but she and the Math 102 instructor used board work.

Thus, a variety of instructional methods were used in the four-credit Math 102 course. These methods included lecture, board work, group work, hands-on activities, and labs. According to the director, it was harder to do some of these things in the three-credit Math 102 course so a more traditional lecture format often was used.

Overall, the amount of variety in instructional methods depended on the instructor. Not all developmental instructors were observed and interviewed to determine the overall level of variety used in teaching the developmental math courses. Thus, the researcher could not draw any conclusions about the use of instructional variety in the developmental math courses at AA I.

Course Structure. Structure was defined as helping students' organize their thoughts and concepts by modeling appropriate behavior and by structuring students' learning activities and environments in such a way that they learn appropriate ways to organize information (Cross, 1976; Roueche, 1973). There was some evidence of structure in the observed developmental math courses. The observed and interviewed instructors presented detailed explanations of concepts and examples using accurate mathematical vocabulary. The four-credit Math 102 instructors developed additional handouts for each lesson. These handouts provided additional information, were completed by students, and graded by instructors. Both developmental math courses had detailed course syllabi. These syllabi had explanations of course policies, assignments, grades, and outlines of the course material. The four-credit Math 102 labs guided

students with questions. These questions helped them learn how to do, organize, and write mathematics. The labs and lessons were graded; thus, students received feedback about the appropriate ways to solve or write mathematics problems.

In ASC 092, the interviewed and observed ASC 092 instructor used in-class exercises and frequent quizzes to provide students with feedback. He said, "I use quizzes a lot to gauge, and in-class exercises, to try to get a gauge of how they are handling different topics." He did not have time to grade homework. He said, "They need TLC, yet I don't want to get in a situation where it is like ninth grade math and I am collecting papers and turning them back. With [teaching] 20 some credits it is hard to do something like that."

Like instructional variety, the observed and interviewed developmental math instructors provided students with some structure. The amount of structure depended on the instructor. Not all developmental instructors were observed and interviewed, and thus, no conclusions could be drawn about the degree of structure used in the developmental mathematics program at AA I.

Intent to Align Courses. The instructors and the Director had intent to align the developmental math courses with other math courses in order to prepare students for their next math course. This intent to align courses was evidenced in the interviewees' responses. The instructors said that they taught with the goal of preparing students for the next math course. "I treat the course solely as preparation for Intermediate Algebra," said the ASC 092 instructor. At the end of ASC 092, the instructor gave students a review sheet. Completing this sheet required the skills and abilities of entry-level Math

102 students. The ASC 092 instructor said that students could use this sheet to review for the ASC 092 final exam and to gauge their readiness for Math 102. He added, "If they are able to work through this without any big hang-ups, then they are pretty comfortable with what was done in ASC 092." It was not known how many students could successfully complete this review sheet.

Statement of Goals, Objectives, or Desired Outcomes. The developmental mathematics program at AA I did not have stated program goals, objectives, or desired outcomes. Course objectives were on the syllabus of each developmental course (see Appendix B). The Director said that these were "roughly defined together," but instructors could add their own goals and objectives for the course and the students. During the interviews, the interviewees mentioned other personal goals that they had for the courses and the students. These goals are included in the Goals, Objectives, and Desired Outcomes section of Appendix B and in Table 12.

Support Services. Academic Support Services at AA I offered small group tutoring from degreed learning assistants and peer learning assistants. The Director said, "Those who have a documented disability qualify for more extensive help—special tutors, note takers, special testing arrangements." According to the Director of Academic Support Services, the tutoring program was certified by the College Reading and Learning Association; thus, the peer tutors were required to participate in 10 hours of training. Four of these hours were given prior to the first tutoring experience. Further training, with an ongoing evaluation process, was conducted throughout the remainder of

the semester. Some of the tutor training topics included: definition of tutoring and tutor responsibilities; basic tutoring guidelines; techniques for successfully beginning and ending a tutor session; some basic tutoring dos and don'ts; communication skills; active listening and paraphrasing; study skills; and compliance with the ethics and philosophy of the tutor program.

Academic Student Services also provided programmed learning materials, audio-visual material, and computer assisted instruction to students. Study skills seminars were held each semester to help student success and to increase student retention (Academic Support Services, 2003). These services were free and available to students in all programs. Disability services were available for those with documented needs. There was an orientation, but it was not ongoing. Supplemental Instruction and freshmen seminar were not available.

Assessment. AA I did not regularly and systematically assess its developmental mathematics program, but some assessment of courses and instructors occurred. Student evaluations of the courses and instructors were done in all classes each semester. The Math 102 instructor calculated the success rates of students in each math course according to grades in previous math courses. For example, 64% of students who got an A grade in ASC 092 passed Math 102. The collection of this information was not required, but the Math 102 instructor had done it for a number of years. The Director said that there was talk on campus of assessing the developmental courses, but this had not yet occurred.

Comprehensiveness. The following "best practices" were used at AA I. The institution had mandatory assessment. There was coordination within the developmental mathematics program evidenced by the common text, content, and Director's coordination of the instructors. The labs in four-credit Math 102 were integrated with the classroom instruction. Technology, in the form of a basic calculator, was used in both courses. There was intent to align the courses. Trained tutors and other support services were available to students. Course syllabi included stated objectives.

The following practices occurred at AA I but were not in agreement with those of "best practice." Placement of students in appropriate math classes was not mandatory. Adjuncts, whose highest level of education was a bachelor's degree or master's degree, taught the majority of developmental math courses. They did not have developmental training, were not involved in the departmental planning and decision-making processes, and had less priority in faculty development opportunities. Developmental math program goals, objectives, or desired outcomes were not stated in writing, and the program was not regularly and systematically assessed. AA I lacked a freshmen seminar, ongoing orientation, paired courses or learning communities, and Supplemental Instruction.

"Best Practice": AA II

Mandatory Assessment and Placement. At AA II, assessment of mathematical skills and knowledge was mandatory, but placement was not. Students with ACT math scores below 20, or no ACT math scores, were required to take the COMPASS placement test (Assessment, 2001; Course descriptions: Mathematics, 2001). Students then were

advised to take certain math courses based on their placement scores and their program of study, but there was nothing to prevent students from enrolling in non-advised math courses. As the ASC Director said, they did not "have any teeth behind it [mandatory assessment]" since placement was not mandatory

The Math and Science Chair said that, within the Math and Science Department, they tried to place students by telling them what courses they should take based on their placement scores, ACT math scores, or both, but there was no guarantee that students heeded the advice. All of the interviewees mentioned the placement exam. The exam was listed as a prerequisite on the Math 102 course syllabus as well. In addition to the placement exam, a pretest was given in ASC 092. Students with high scores could drop ASC 092 and enroll in Math 102.

Two interviewees said that the placement test often was not accurate at predicting what a student could do in math. The Math and Science Chair and the Math 102 instructor thought the ACT math score was the best indicator for student placement in math courses. Faculty conducted research was the basis of their judgment.

Strong Institutional Commitment. All interviewees said that the Institution, the Mathematics Department, and the Academic Services Center strongly supported the developmental mathematics courses. The Math and Science Chair said, "The two-year school is a stepping-stone for those individuals wanting to go on to the four-year institutions, and they may be better off starting here in Intermediate Algebra and College Algebra and not getting in large classrooms." The ASC Director said that AA II was very focused on student learning and supported the developmental mathematics courses.

She said that there were "extensive hours" in the Math and Science Lab, and "it is an extremely busy lab." She thought that their Academic Service Center was probably the most extensive one in North Dakota. The ASC 092 instructor said, "ASC is obviously supportive. Both Intermediate and College Algebra instructors are very supportive in keeping us informed, telling their students about us, and using our services for making up tests and correcting tests."

Most of the developmental math instructors were from the Academic Services Center. They were hired specifically to teach and tutor developmental mathematics. Some of the math faculty members taught a section of Math 102 during a semester, but they did not do this full-time. Faculty development funds and opportunities were available for faculty of both departments according to the interviewees. These opportunities were usually conference attendance.

The Academic Services Center coordinated its efforts with the Mathematics Department. These departments developed the developmental math curriculum together. They also supported each other. Math and Science referred students to the Academic Services Center and informed those in the Academic Services Center of what they did. Some of the math faculty members volunteered their time in the Math and Science Lab in Academic Services, but due to a lack of pay and recognition, they eventually stopped doing this, according to the Math 102 instructor. Math instructors from Academic Services Center attended the Math and Science meetings.

There were some indications of a lack of support. There were comments about large class sizes, budget cuts, and not having enough space or faculty, but many of the

interviewees seemed to believe these problems occurred at many institutions in North Dakota. The Chair of the Math and Science Department said that he could use more staff to decrease class size. He said, "Money's not an issue because it's not there to ask for." The Math 102 instructor said that the Math 102 sections often started with about 30 students but usually dropped down to about 20 students. During the three fall semesters in which grade data were collected, the ASC developmental math courses had no more than 20 students in each section, and Math 102 had no more than 30 students in each section. The Math 102 instructor also said, "There should be more recognition that a course like Math 102 takes more time."

To summarize, the interviewees thought AA II was committed to developmental mathematics education. The institution's focus on student learning and its large and comprehensive Academic Services Center were indications of this support and commitment. The high degree of coordination and communication between the Math and Science Department and the Academic Services Center were further indications of support.

Centralized or Highly Coordinated Developmental Program. Almost all developmental math courses were taught in the Academic Services Center. Math 102 was the only developmental math course offered outside of Academic Services. It was offered by the Math and Science Department. Thus, the institution's developmental program and the developmental mathematics program were centralized with the exception of one course, Math 102.

The level of coordination within Academic Services and between Academic Services and the Math and Science Department was high. The ASC Director said, "There is a good relationship with the Math Department because it is student focused." As stated earlier, math instructors from Academic Services attended the Math and Science Department meetings. Instructors in the Math and Science Department sometimes volunteered their time helping students in the Academic Services Center. They also referred students to the Academic Services Center so that the students could "get more structure and more one-on-one attention," said the Math and Science Chair.

Together faculty from both departments developed the curriculum of the developmental math courses. Instructors agreed on textbooks and almost all of the content for the courses. The ASC 092 instructor said that the teachers who taught Beginning Algebra, Intermediate Algebra, and College Algebra sat down and made a flowchart of the content in these courses. They then divided the content into each of the appropriate courses (Beginning Algebra, Intermediate Algebra, and College Algebra). They later tweaked the content whenever necessary. The Math and Science Chair said that the Math and Science Department and the Academic Services Center had the "same basic philosophy regarding the developmental courses."

Developmental Mathematics Faculty. Developmental mathematics faculty at AA II needed to have bachelor's degrees or master's degrees. According to the ASC Director, those that worked in the Academic Services Center had to have an education degree and be vocationally certified. Instructors in the Academic Services Center had to take additional coursework to receive this certification. The ASC Director said that some

of this coursework dealt with the philosophy of vocational education, working with special population students, and other areas of importance in vocational education. The ASC Director also said, "Developmental instructors need empathy for student learning."

In the Academic Services Center, three staff members were specifically hired to teach and tutor developmental mathematics. In the Math and Science Department, full-time faculty members sometimes taught a section of Math 102. The math tutor from Academic Services also taught Math 102. None of the developmental mathematics instructors had training in developmental education.

Faculty members in both Departments took part in the planning and decision-making processes of their departments. They usually did this by attending their respective departmental meetings. In addition, some of the developmental mathematics instructors from the Academic Services Center attended the Math and Science Departmental meetings. All math faculty members were encouraged to participate in departmental activities. The Math 102 instructor said that he took part in the planning and decision-making processes of the Department and the Institution through committee work, curriculum development, and departmental meetings. The ASC 092 instructor said that she had complete control over what was taught in ASC 092; thus, she had a big part in the planning and decision-making of that course.

Both departments provided some type of professional development opportunities for their instructors. The ASC 092 instructor said that faculty development funds were available, and she usually attended the Midwinter Special Needs Conference. The Math 102 instructor said that he had picked up skills as he went along by working with

colleagues, through experiences, and through conferences. Other faculty development opportunities, usually in the form of conference attendance, were available to him,.

In summary, developmental math instructors at AA II were ASC instructors specifically hired to teach developmental math courses or full-time math faculty members who taught Math 102 part-time. The highest level of education of these instructors was the bachelor's degree or the master's degree. Faculty participated in the decision-making and planning processes of their departments and had faculty development opportunities.

Mastery Learning. None of the observed and interviewed instructors used mastery learning in developmental math courses. The Basic Mathematics Courses used mastery learning (see the Instruction section of Appendix C for further description), but these courses were not defined to be developmental in this study even though their content might be considered developmental. Some of the developmental mathematics instructors allowed students to retake exams or quizzes, but this was not true mastery learning where students could not move on to the next topics until they demonstrated competency in the current topics. Thus, it could not be concluded that mastery learning was a practice used in the developmental mathematics program at AA II.

Classroom and Lab Integration. AA II had a Math and Science Lab that usually was the classroom for all developmental math courses except Math 102. Thus, lab and classroom instruction were integrated for those developmental math courses taught in the Math and Science Lab. The developmental math instructors' offices were located in the Lab, and math tutors were also available in the Lab at various times. Therefore, trained

tutors who taught the developmental math courses, classroom instruction, and additional materials were available together in the Lab. The Math 102 instructors in the Math and Science Department also utilized the Lab and referred their students to this Lab.

Supplemental Use of Technology. In both studied developmental math courses, students used a graphing calculator. The graphing calculator was introduced in ASC 092. In Math 102, a graphing calculator was required and used a great deal. The calculator use was supplemental and integrated into the curriculum of the courses.

The ASC 092 instructor had started using the TI-83 calculator. She said that she introduced it in the course so that students got comfortable with it and could use it in Math 102. She also said that those in Academic Services had talked about an evening calculator workshop or mini class. In this workshop or mini class students would learn how to use the calculator, and thus, decrease the amount of class time instructors would have to spend doing this. These workshops had not occurred yet. The Math 102 instructor also used and required a graphing calculator. The TI-83 was recommended on the syllabus. During the observation of this instructor's Math 102 class, he used the calculator not only for calculations. He also used it as a discovery and exploratory tool to help students develop, understand, and visualize concepts.

Variety of Instructional Methods. During the observation of the ASC 092 class, the class began with what was called the Daily Dozen Quiz. Following the quiz, the ASC 092 instructor went over the solutions and answered questions about the problems. In a similar manner, the instructor stated the answers to each section of homework problems,

asked, and answered questions. Next, the instructor presented a new concept at the chalkboard using lecture and examples. Finally, she had the students complete similar problems at their seats while she walked around and helped them.

The ASC 092 instructor said that a lot of quizzes were given in ASC 092, and students had the opportunity to retake these quizzes. She explained:

> We do a lot of quizzes. I call them quizzes because [the students] don't get as panicky over quizzes than they do if you say it's a test. We do a lot of them partly because I want the feedback right away and partly because they will forget, and partly because I want to get rid of some of this test anxiety because there are a million of these that have test anxiety too.

Also, the ASC instructor said that she gave the students a journal question everyday. They were not graded as such, but she definitely read them and made comments on them before they were handed back. In an e-mail response, she wrote:

> It's more of a dialogue, I suppose. I'm constantly changing the questions from one semester to another! Some of them are opinion questions, some of them are more for assessment, and some of them are directly related to things we've done in class. Some students don't do them and they aren't penalized for that, but they don't know that! I get some very good answers sometimes, and some very humorous ways of saying "I don't know" sometimes!

Thus, the ASC 092 instructor used quizzes, journals, lecture, examples, homework, and seatwork when teaching ASC 092. Like the ASC Director said, "The [ASC] instructors taught in a more traditional manner with the instructor giving some lecture and then the students working on things with the instructor walking around and facilitating the [students'] learning."

During the observation of the Math 102 class, the Math 102 instructor had students discover a property of logarithms through the use of examples and patterns, through students' previous knowledge of logarithms and exponential functions, and

through the use of the calculator. Once the students developed the property and were convinced that it was true, the instructor wrote the property on the board and gave it a name. After this, the instructor completed a few examples at the board using the new property. He then had all of the students go to the board in groups of two or three.

While at the board, the instructor gave the students a problem to solve. This problem was read orally to the students. This forced students to determine how to write down the mathematical concepts they heard. Once written on the board, the groups of students attempted to solve the problem. The instructor helped some groups, but most of the time he let them work together. The instructor eventually provided the correct solution and discussed it with the students. This process was repeated for the remainder of the class session.

During the interview, the Math 102 instructor basically described his teaching method like what was observed in class. He also said, "You have to put them to work or you lose them."

The Math 102 course assignments were homework problems and projects from the text. The instructor said that he allowed time in class to answer questions about the homework. He also said that the students' motivation for homework was low. Thus, when there was time, homework problems were done in class. There were eight homework quizzes (one for each chapter), a cumulative midterm exam, and a cumulative final exam.

To summarize, a variety of instructional methods were used in the observed Math 102 class. These methods included lecture, board work, group work, hands-on activities,

and integrated technology. In all developmental math courses, the amount of variety in instructional methods depended on the instructor. Not all developmental instructors were observed and interviewed, and thus, it was not possible to determine the overall level of instructional variety in the developmental math courses. Therefore, no conclusions could be made about the use of instructional variety in the developmental math program at AA II.

Course Structure. There was some evidence of structure in the observed developmental math courses. The observed and interviewed instructors presented detailed explanations of concepts and examples using accurate mathematical vocabulary and notation. The ASC 092 instructor reviewed the answers to the homework at the beginning of each class. She also used the rules and properties of algebra (i.e., no "shortcuts" were used). The observed and interviewed instructors frequently gave quizzes in both courses. Doing this provided students with feedback about what was and was not correct. The ASC 092 instructor also said, "You also have to teach in a way that they understand. I know that a lot of people start on too high of a level, and you have to remember that these students are complete novices. They do not know anything about math."

Like variety, the observed and interviewed developmental math instructors used some structure, but the amount of structure depended on the instructor. Not all developmental instructors were observed and interviewed, and thus, no conclusions could be made about the degree of structure in the developmental math program at AA II.

Intent to Align Courses. There was some evidence of intent to align developmental math courses with other math courses at AA II. Together the math instructors in the Academic Services Center and in the Math and Science Department developed the content for the ASC math courses, Math 102, and Math 103. At one time, they created a flowchart of content that was then divided by course. The math instructors in Academic Services attended Math and Science Departmental meetings. This helped them stay involved with and informed of all math courses at AA II.

The ASC 092 instructor said that she prepared students for success in future courses by knowing what was taught in those courses (Math 102 and Math 103). By doing this, preparatory material could be covered in ASC 092. She said, "I know what is taught in [Math] 102 and [Math] 103 because we have those students come in for help, and I try to cover all the background material." The ASC 092 instructor also said that her main goal was to get students ready for Intermediate Algebra so "that they will have the necessary background and skills necessary to successfully take Intermediate Algebra." The ASC Director said that the ASC 092 instructor set up ASC 092 like Math 102 and Math 103 in order to better prepare students for those courses. The Math 102 instructor said that, when teaching Math 102, they made the assumption that Math 103 College Algebra, Math 104 Finite Math, or Math 210 Elementary Statistics would be the student's next course.

Statement of Goals, Objectives, or Desired Outcomes. The developmental mathematics program did not have stated program goals, objectives, or desired outcomes. The Academic Services Center did have a mission statement: "The Academic Services

Center (ASC) works cooperatively with other college departments, high schools, and funding agencies to provide a broad spectrum of educational courses, activities, and services to improve academic achievement and increase retention of students" (Academic Services Center, 2003). Course goals or objectives were on the collected developmental mathematics course syllabi (see Appendix C). During the interviews, the interviewees mentioned other unwritten goals for the courses and the students. These goals are included in the Goals, Objectives, and Desired Outcomes section of Appendix C and in Table 13.

Support Services. The Academic Services Center offered support services to developmental mathematics students and other students at AA II. These services included: courses; study services; workshops; Disability Support Services; study groups led by trained peer tutors; tutoring provided by the Academic Services Center faculty; supplemental materials, like video tapes, texts, and computer software; summer college-prep programs and workshops; a tutoring program for refugees; and various labs where students worked and got walk-in help from tutors. The labs included the Math and Science Lab, a Writing Lab, a Reading Lab, and a FLEXtime lab. There was also an open center. It offered credit courses, provided walk-in help and other services like proctored testing, taped texts, videotapes, Internet, and e-mail (North Dakota State College of Science, 2002). The ASC Director said that they referred students to academic counselors. There was a freshmen orientation during the summer before the semester started, and placement tests were given during this. The orientation was not ongoing, but the ASC Director said that a retention, enrollment, and orientation

committee was considering doing more with orientation. Supplemental Instruction and freshmen seminar were not available.

The Math and Science Chair credited the work of the Academic Services Center. He said, "Academic Services Center is the place for support services on campus."

Assessment. The developmental mathematics program at AA II did not have a regular and systematic assessment process. Student evaluations of the courses and instructors were done in all classes each semester. The ASC 092 instructor gave students a survey to gather comments about the course. She also used students' journals, informal feedback from conversations with students, and a pretest and a posttest to inform and improve her teaching and student learning. Math 102 was assessed as part of general education, but not as part of the developmental mathematics program.

The ASC Director mentioned the tracking of ASC math students to determine how they did in their next math course(s) and if they were retained. She also said that she used personal interviews with students in which she very informally asked students how it was going. She said that students' views were not always the same as the faculty's views. These student interviews gave her a bigger picture. She said, "I listen to my instructors and observe a lot. If the lab is full all of the time, it lets me know that I may need more room or need to extend hours." The Academic Services Center kept a record of the number of students who logged in to use the labs each month.

According to the Math and Science Chair, Assessment Week was held on campus each semester. Departments could use this time for assessment activities. The Math and Science Chair said that the results of Assessment Week were used to improve the Math

and Science Department and its courses, but these assessment efforts were not usually targeted at the developmental mathematics program and its courses.

Comprehensiveness. The following "best practices" were used at AA II. The institution had mandatory assessment. The developmental program was centralized except for one math course, Math 102. There was a high degree of coordination between the Mathematics and Science Department and the Academic Services Center. Most developmental mathematics faculty members: were not considered adjuncts; had faculty development opportunities; and participated in the planning and decision-making processes of their departments, other departments, and sometimes the Institution. The Academic Services Center instructors were vocationally certified. Instructors of both courses supplemented the courses with a graphing calculator. There was intent to align the courses. Trained tutors were available to students. Course syllabi included stated objectives.

The following practices occurred at AA II but were not in agreement with those of "best practice." Placement of students in appropriate math classes was not mandatory. The highest level of education of the instructors was a bachelor's degree or a master's degree, and none of these instructors had training in developmental education. Developmental math program goals, objectives, or desired outcomes were not stated in writing, and the program was not regularly and systematically assessed. AA II lacked a freshmen seminar, ongoing orientation, paired courses or learning communities, and Supplemental Instruction for developmental math students.

"Best Practice": BA I

Mandatory Assessment and Placement. At BA I, assessment was mandatory, but placement was not. At one time students took a placement exam to determine what mathematics course they should take, but that was no longer done. Students were assessed using ACT math scores. The Director said, "As far as determining those underprepared students, my predecessor correlated ACT scores and performance. And so anyone who gets less than a 16 on the math component of their ACT is recommended that they take Intermediate Algebra." According to the Director, the ACT math score was as effective at placing students as the placement test. As a result, the placement test was no longer used. Placement was not mandatory, just recommended by advisors. The Director said that if students were incorrectly placed in Math 102 or Math 103, they could easily switch courses at the beginning of the semester. This was especially true for those who needed to drop down to Math 102 from Math 103. Students who were away from math for a while usually took Math 102. No other developmental math course was offered for these students to take.

Strong Institutional Commitment. The Director thought that there was institutional support for the developmental mathematics course, Math 102. The Director said that BA I being allowed to accept underprepared students, and Math 102 being "part of that associate program, that cohort program" were all indications of the institutional, administrative, and state's support of Math 102 at BA I. The Director described the cohort program:

> We don't really have a program to deal with that other than we've got, um, and I don't know how familiar you are, [BA I] is approved by the Board [of Higher Education] to accept students that are underprepared...Everyone else has a limit about how many students they take that don't meet all the college prep requirements. And so we're approved to do that. So what we've done in the last, probably, four years is kind of develop a program for those students. It is kind of a cohort program. We try and get them all to take the same classes, and so we set up a section of Intermediate Algebra for those students. There's a section of basic English for those students that they all kind of get in together and kind of build that cohort. That's really the program. If you are just looking at the math, it's just the one course. And then there's Supplemental Instruction in all those [cohort] classes.

Students in the cohort took four courses together, Math 102 Intermediate Algebra, a basic English course, a study skills course, and freshmen seminar. Supplemental Instruction was a part of all of these courses. The courses were funded like other campus courses. Instructor salaries were paid, and there was a budget for tutoring and Supplemental Instruction.

The Math 102 instructor did not indicate the same level of support. He said that he had no support and did not need any, but if he asked, he could get the support he needed. He also noted how he was not really part of the Division of Math and Science. He said:

> People in the Math Department who then teach the [Math] 103 realize the importance of the class, and part of it is too that I am mostly in the HPE [Health and Physical Education] Department teaching a math class. I think that if I was in the Math Department more they might be more, concerned is not the word, but more interested in it.

The Math 102 instructor did not participate in any faculty development opportunities to improve the developmental course or his instruction of it. He did not participate in the meetings of the Division of Math and Science either.

In summary, there were indications of institutional commitment to developmental mathematics and indications of a lack of this commitment. Math 102 being included in the cohort program, associate program, and receiving additional support through Supplemental Instruction were all indications of support. The instructor being a member of another department, his lack of participation in the Division of Math and Science planning, and his lack of knowledge regarding faculty development opportunities were possible indicators of a lack of support for the developmental math course. Therefore, no conclusions could be made about the institutional commitment to developmental mathematics as BA I.

Centralized or Highly Coordinated Developmental Program. The developmental program at BA I was not centralized. The Division of Science and Mathematics offered the only developmental mathematics course, Math 102. Individual departments offered other developmental courses at the Institution. As stated earlier, this course was part of a cohort program for underprepared students.

The Director said that the development of the Math 102 curriculum was "left up to the instructor." The instructor chose the Math 102 text, the course content, and the teaching methods. The Math 102 instructor said that he spoke with Math 103 students and instructors. These discussions helped him to better prepare Math 102 students for Math 103. The Math 102 instructor did not attend the meetings in the Division of Science and Mathematics. His office was not located near the other math instructors' offices. It was in the Health and Physical Education Department in a different building. Thus, the Math 102 instructor was isolated from the activities and planning of the

Division of Math and Science. He did try to coordinate the Math 102 curriculum with the Math 103 curriculum by speaking with Math 103 instructors, but course planning was not done with other math instructors. Being the only developmental math instructor and being in a different department appeared to make this difficult.

Developmental Mathematics Faculty. At BA I there was only one developmental mathematics instructor, the Math 102 instructor. He had a bachelor's degree in mathematics education and a master's degree in the physical education field. He was an instructor in the Health and Physical Education Department and taught Math 102 for the Division of Science and Mathematics. He did not have training in developmental education. Also, he had not participated in faculty development opportunities and was not aware of any such opportunities. He determined the curriculum for Math 102, but he did not participate in the decision-making and planning processes of the Division of Science and Mathematics. The Director did say, "If there is something that he [the Math 102 instructor] needs to be here for, we would make sure he is included."

Mastery Learning. The Math 102 instructor did not use mastery learning. The instructor said that students sometimes got to correct problems for partial points on a test. This was done for a test on which most students did poorly.

Learning Communities or Paired Courses. Math 102 was part of a cohort program or learning community for underprepared students (for a description of the cohort program, see Strong Institutional Commitment above or Appendix D). According to the Director, the cohort program was very successful. He said, "The retention has

improved significantly for those underprepared students. It used to be like 30% and now it is closer to what the regular freshmen class is, which is 55% or 60%."

Supplemental Use of Technology. Each student was required to have a scientific calculator with fraction mode. This requirement was on the course syllabus and mentioned by the Math 102 instructor. The Math 102 instructor said the following about calculator use in Math 102:

> I want them to use it for anytime that they want to use it. Calculators are so accessible right now and I think it is more important that they know how to use the calculator and how to find the right answer, than that they know how to add two fifths plus one seventh. I'd rather have them know how to do it on the calculator than know how to find it otherwise.

Variety of Instructional Methods. During the observation of the Math 102 class, the Math 102 instructor reviewed material for a future test. Therefore, the researcher was not able to observe the Math 102 instructor's presentation of new material, but the researcher did observe the instructor's interaction with students and his explanations of problems.

At the start of class, the Math 102 instructor: took attendance; read aloud the answers to the homework problems; took questions on the homework; and proceeded to answer these questions by completing problems at the chalkboard. He explained what he did and had students help him with the explanations. Following this, the Math 102 instructor gave students three problems from the text to complete at their desks. This was done as review for the upcoming test. The students worked quietly and individually while the instructor walked around. After about five to 10 minutes, he went over the

solutions on the board. Like the homework explanations, the Math 102 instructor prompted students with questions in order to solve the problems. The students did this twice more before the end of class.

The Director and the Math 102 instructor were asked to describe effective lessons, policies, and practices used in Math 102. The Director described the instruction in Math 102 as primarily lecture. He added:

> [The Math 102 instructor] is very personable and relates well with students and that is important in that classroom....[He] spends a lot of time working individually with the students, as much time as he can, because in [Math] 102 there really is a range of ability that I can't imagine beginning to deal with....It goes from the underprepared, really unprepared, to those who are in there just because they self-selected, really probably have the ability, they just don't have the confidence in themselves.

The Director also commented on the importance of class size. He said, "We try to keep the classes small so we can get as much one-on-one as we can." According to the Director, this was easier to do in the spring and summer. During these semesters, the course was capped at 20 students.

During the interview with the Math 102 instructor, he said that he taught the course somewhat like a high school Algebra I course. He said, "What I find is most effective is kind of relaxing their fears about math, giving them a lot of shortcuts or at least telling them, 'Here's a shortcut to get to the answer,' but let them try and relax their fears a little bit about math and let them realize that they are going to get through it." He said that he wanted to get the students ready for Math 103 College Algebra. He did not use cooperative learning or groups, except maybe "twice a semester at the most." When this was done, students solved problems together in groups as review for a test.

Homework assignments came from the text and were assigned after each class. The Math 102 instructor said that he graded five of the homework assignments throughout the semester. He said, "They could choose not to do it, but then they just better hope that's not one we turn in." The Math 102 instructor had a mandatory attendance policy. Attendance was included in students' grades. Quizzes, five tests, and a final exam were given during the semester.

In summary, lecture, examples, and teaching the course like a high school math course were the methods used in the course. According to the Math 102 instructor, groups were rarely used. With one developmental math instructor who used lecture as the primary instructional method, the developmental math course at BA I lacked a variety of instructional methods.

Course Structure. The amount of course structure in Math 102 was difficult to determine. The instructor presented explanations of concepts and examples, but often did not model important behaviors and details that other instructors might deem important. For example, during the observation, the Math 102 instructor did not label points and axes on his graphs. He did not label key items, like the slope of a line, with appropriate symbols and notation. Problems were solved in a rote manner by following a set of rules or steps. There was no further explanation of the meaning of the solutions. As he said, his use of a lot of shortcuts, or at least telling them, "Here's a shortcut to get to the answer," may have helped relax their fears, but it did not necessarily model appropriate mathematics. The Math 102 instructor graded homework five times during the semester, and thus, students did not gain much feedback about their work. Since there were

indications of structure and a lack of structure, no definitive conclusions could be made about the amount of structure in Math 102 at BA I.

Intent to Align Courses. The interviewees had intent to align the developmental math course with other college courses. The Math 102 instructor said that he spoke with Math 103 instructors and students. He looked at some of the Math 103 exams. Doing this helped him to develop the Math 102 curriculum as preparation for Math 103. The Math 102 instructor said, "My main goal really in there is just get them ready for [Math] 103." In addition, part of the course description on the syllabus was: "The course is designed to prepare students mathematically for successful entry into college level courses such as College Algebra, Finite Mathematics, Trigonometry, Chemistry, Biology, and the Physical Sciences." The Director said that there was some monitoring of student success in subsequent courses. For example, grades of students who took Math 102 and then took Math 103 were monitored. There still was a small number of unsuccessful Math 103 students, but "[the instructor] seems to be pretty successful at it because if they made it through his class [Math 102] there hasn't been a lot of issues on being successful in College Algebra," said the Director.

Statement of Goals, Objectives, or Desired Outcomes. The developmental mathematics program did not have stated program goals, objectives, or desired outcomes. The Math 102 syllabus included objectives (see Appendix D), but two of the three objectives, "the ability to work in groups to enhance academic achievement" and "competency in each of the prescribed units of instruction," were not practiced. The

instructor said that he only used groups twice a semester at the most, and students could pass the course even if they did not demonstrate competency and failed one or more exams. During the interviews, the interviewees mentioned other unwritten course goals. These goals are included in the Goals, Objectives, and Desired Outcomes section of Appendix D or Table 14. It was not determined if the cohort program had stated program goals, objectives, or desired outcomes.

Support Services. The Academic Support Center provided a variety of support services to developmental mathematics students at BA I. There was the cohort program for underprepared students. This program would be considered a learning community. In addition, there was a one-day orientation, freshmen seminar, a study skills course, counseling services, academic advising, tutoring, Supplemental Instruction, and Disability Student Services (Academic Support Center, 2002). According to the Math 102 instructor, "There was a [Supplemental Instruction] tutor that sits in the class, and she can be reached at any time if the students are needing extra help. And then usually the day before a test she'll set up one or two study sessions for them to go to." He said about 12 of his 50 students attended the study session prior to the previous test.

Tutors and Supplemental Instruction leaders received minimal training. The Director of the Academic Support Center said:

> Our tutors are students, paid at minimum wage for their services by Student Services (some on federal work study, others by regular student employment). They must be recommended by the instructor for whom they are tutoring, and in the math field, really don't receive any additional training other than the mechanics of the program (time sheets, how to handle overly dependent students, etc.). The instructors continue to mentor them and assist them if they need more in-depth knowledge.

Assessment. BA I did not regularly and systematically assess its developmental mathematics course. Student evaluations of the course and the instructor were completed each semester as in all classes. According to the Director, there was some monitoring of student success in subsequent math courses. For example, the grades of students who took Math 102 and then took Math 103 were monitored, but this was informal and not reported. The Director did not provide specifics about the number of or percentage of students who were successful in each course.

Comprehensiveness. The following "best practices" were used at BA I. There was mandatory assessment of mathematical skills. The developmental instructor participated in institutional planning. A basic calculator with fraction mode was used. There was intent by the instructor to align the courses with future courses, and according to the Director, Math 102 students were usually successful in Math 103. Trained tutors and Supplemental Instruction leaders were available to students. Underprepared students were part of a cohort program that included Math 102, a study skills course, a basic English course, and a freshmen seminar course. The course syllabus included stated objectives (but most of these objectives were not met).

The following practices occurred at BA I but were not in agreement with those of "best practice." Placement of students in appropriate math classes was not mandatory. Math instructors did not plan and coordinate the developmental math courses and curriculum together. Mastery learning was not used. The developmental math instructor did not use a variety of instructional methods. The developmental math program was not part of a centralized developmental program. A faculty member outside of the Division

of Science and Mathematics taught the developmental math course. This person: had a bachelor's degree in math; was not involved in the departmental planning and decision-making of the Division of Science and Mathematics; and did not participate in faculty development. The course was not regularly and systematically assessed. BA I lacked ongoing orientation.

"Best Practice": BA II

Mandatory Assessment and Placement. According to the Director at BA II, assessment of mathematical skills and knowledge was mandatory, but placement was not. According to the Director, a test was given in Math 103 College Algebra and in Math 102 Intermediate Algebra on the first day of classes. Those students who did poorly on these tests were advised to drop and take the next math course numbered lower than the current course in which they were enrolled. Sometimes ACT math scores were used to advise students on placement into mathematics courses. Students did not have to heed the advice and the results of the exams because placement was not mandatory.

Strong Institutional Commitment. No conclusions could be made about institutional commitment to developmental mathematics at BA II. Both interviewees did not want to comment about the level of support for developmental math courses. The Director said, "I have no feeling about this one way or the other," and he would not elaborate further. The Math 102 instructor said that he was neutral and did not feel one way or the other about this. He said that faculty members were inherently

unmanageable, and as long as there were no impediments in his way, he was happy. He liked to be left alone to do his thing.

There were some indications of support. Full-time math and computer science faculty members taught the developmental math courses. Teaching was emphasized on campus and in the Division of Mathematics and Science. According to the Math 102 instructor, teaching workshops and seminars were held on campus for faculty. There were other faculty development opportunities, but these were limited by available funds. The courses were funded like other campus courses. Instructor salaries and software fees were paid.

The interviewees did not mention the size of classes. During the three fall semesters in which grade data were collected: Beginning Algebra had no more than 20 students in each section, and Intermediate Algebra had no more than 46 students in each section.

To summarize, there were indications of institutional commitment to developmental mathematics and indications of a lack of this commitment. Therefore, no conclusions could be made about institutional commitment to developmental mathematics education at BA II.

Centralized or Highly Coordinated Developmental Program. All developmental mathematics courses were taught from the same department, the Mathematics Department, but not all developmental courses were organized and taught by one department. Thus, the developmental mathematics program was centralized, but the entire developmental program was not.

There was some coordination among faculty. They decided on course content and textbooks, but beyond that, there was little coordination among faculty who taught the developmental math courses. The Director said that faculty together decided on a common text every three or four years or as needed for the developmental math courses. Sometimes there was coordination between instructors, but usually there was just one instructor who taught each course each semester. According to the Director, each instructor decided how to teach the material, but the content was partly determined by the Common Course Numbering system of the NDUS. Like the Director, the Math 102 instructor said that the mathematics faculty agreed on course textbooks. He said, "No one is really gung-ho about the course," and added that faculty did not formally meet to discuss the course. The instructors were basically given the text and told to teach through a certain chapter.

Different instructors of the same course used different syllabi and thus, had different goals and objectives for the same course. Instructors did not coordinate their efforts and ideas when they wrote these.

Math 099 and Math 102 were supplemented with technology. The type and amount of technology varied according to the instructor of each course section. According to the Math 099 course description (Connect, 2002, p. 97), Excel computer software was used as a tool for teaching the course. The use of technology in Math 102 varied. The Math 102 instructor described himself as "anti-technology." The Director said that he sometimes used Maple software. This helped Math 102 students to visualize

concepts. Thus, the use of technology differed by course and instructor and was not coordinated across the developmental math courses.

Developmental Mathematics Faculty. Developmental mathematics faculty at BA II had master's degrees or doctoral degrees. None of the developmental instructors had training in developmental education. The instructors were full-time faculty members of the Mathematics and Computer Science Department. The Math 102 instructor said that he taught Math 102 to fill his teaching load. He said that he did not like teaching the course. He also told his students on the first day of class that they both did not want to be there, and so they should just get through the class. He said that his biggest challenge was generating enough of his own enthusiasm for teaching the course.

According to the Math 102 instructor, faculty development opportunities were available for the instructors, but funding was limited. The Math 102 instructor said that teaching was emphasized at BA II. Campus workshops and seminars were available for faculty to attend. In addition, the Division Chair reserved time for discussion of teaching and classroom issues during Division meetings.

Mathematics faculty members, including developmental math instructors, participated in developmental mathematics, institutional, and departmental decision-making and planning. The Math 102 instructor said that he liked to let mathematics faculty make decisions regarding math because he was a computer science faculty member. He also said that the department was pretty inclusive overall.

To summarize, developmental math instructors at BA II were full-time math and computer science faculty. The highest level of education of these instructors was the

master's degree or the doctoral degree. Faculty participated in the decision-making and planning processes of their departments and had faculty development opportunities.

Supplemental Use of Technology. As stated above, the use of technology in Math 102 varied according to instructor. The Director sometimes used Maple mathematical software in Math 102. The Math 102 instructor described himself as "anti-technology." He did allow use of a simple calculator for calculations, but he did not want a device that he said "did all of the steps for them." Excel software was used for teaching concepts in Math 099 (Connect, 2002, p. 97). Thus, the developmental math courses used technology. The type of technology and the extent to which it was used depended on the instructor of the course.

Variety of Instructional Methods. The observed and interviewed Math 102 instructor taught the course primarily by lecture. During the observation, he took questions from the homework and then worked the solutions on the board. After this, he presented a new topic, the rules of exponents, at the chalkboard. The Math 102 instructor stated the rules and wrote them on the chalkboard. He did not explain why these rules were true. After this, the instructor completed examples to demonstrate the stated rules of exponents, and he announced the homework assignment. This is exactly how he described his instruction during the interview. He added that he sometimes did group work at the end of class. This usually consisted of equations and word problems on worksheets for the students to solve in their groups.

The Director sometimes taught Math 102, and thus, he was questioned about his methods for teaching the course. He said that he presented the material and then had the students work some problems. While they did this, he walked around to see how they were doing. This was a laptop university. All students were required to have a laptop computer. Because of this, the Director sometimes used Maple mathematical software in Math 102 to help with the visualization of material. Sometimes students solved problems in groups during class. He said that this was done with challenging problems. Both interviewees assessed students using homework, tests, and in class exercises.

Thus, both interviewees primarily used lecture, examples, and answering questions to teach Math 102. Sometimes students worked in groups or technology was used to enhance instruction of concepts. The amount of variety in instructional methods depended on the instructor. Since Math 099 was not offered during the semester of study and not all developmental instructors were observed and interviewed, no conclusions could be made about the use of instructional variety in developmental math courses at BA II.

Course Structure. There was some evidence of structure and a lack of structure in Math 102. Tests were given after each chapter. This meant: students only had to master one chapter of information for each test, and they received feedback more often by having many chapter tests rather than a few. The Math 102 instructor said that he collected homework to force students to do it, but he did not grade it. Thus, students did not receive feedback about their homework prior to being tested on it. During the observation, the instructor often skipped steps when solving problems, but the students

never questioned what he did. They either understood or just did not ask. The amount of structure depended on the instructor. Not all developmental math instructors were observed and interviewed, and thus, no conclusions could be drawn about the degree of course structure in the developmental math program at BA II.

Intent to Align Courses. It was not clear if there was intent to align the developmental math courses with other math courses at BA II. The Director said that he did not know if, after taking Math 102, students were prepared for their next math course. He said that there was an overlap of content in Math 102 and Math 103. The Math 102 instructor said that he did not teach Math 102 as if students were planning to take another math course. The course outline indicated that Math 102 "provides a basis for Mathematics 131 and other courses that require an understanding of algebra." The Math 102 instructor did not write the course outline. He wrote his own syllabus, but made the course outline available to students. Thus, there might or might not have been intent to align developmental math course with other courses.

Statement of Goals, Objectives, or Desired Outcomes. The developmental mathematics program did not have stated program goals, objectives, or desired outcomes. Course objectives were on the Math 102 syllabus and course outline, but the objectives were different on each document (see Appendix E). During the interviews, the interviewees mentioned other unwritten course goals. These goals are included in the Goals, Objectives, and Desired Outcomes section of Appendix E and in Table 15.

Support Services. The researcher could not determine all of the support services available to students. The Director said that tutoring was available for students through Student Academic Services. He also thought that the more poorly students were doing in a course, the more likely they were to get a tutor. The Director of Student Academic Services was contacted more than once for details regarding student services, but she never responded. The researcher found nothing on the Institution's Web site that described these services either.

Assessment. BA II did not regularly and systematically assess its developmental mathematics program. Student evaluations of the courses and instructors were completed in all classes each semester. The Director said that he used informal methods of assessment. For example, in Math 102 he watched students attempt problems and informally assessed how they were doing in class. These activities did not assess the program or the courses, but they might have informed instructors about their teaching practices.

Comprehensiveness. The following "best practices" were used at BA II. The institution had mandatory assessment. The developmental math faculty members were full-time tenure or tenure-track faculty. They participated in departmental and institutional planning and decision-making and held master's degrees or doctoral degrees. They had some opportunities for faculty development, but funding was limited. Technology was used in both developmental math courses, but its use was not consistent across courses. Tutors were available to students, but it could not be determined if they

were trained. Course syllabi included stated objectives, but these were different on each instructor's syllabus, even for the same course.

The following practices occurred at BA II but were not in agreement with those of "best practice." Placement of students in appropriate math classes was not mandatory. The developmental program was not centralized, and the degree of program and course coordination was not high. One of the Math 102 instructors admitted that he did not like to teach the course. Developmental math program goals, objectives, or desired outcomes were not stated in writing, and the program was not regularly and systematically assessed. BA II lacked a freshmen seminar, ongoing orientation, paired courses or learning communities, and Supplemental Instruction.

"Best Practice": Master's Institution

Mandatory Assessment and Placement. At the Master's Institution, students were assessed using their ACT math scores. Those without ACT math scores or who were older than age 25 took the COMPASS placement test. ACT math scores or placement test scores were used to advise students of appropriate math course, but placement in these courses was not mandatory.

The Director said that advising was important. He said, "You want to get them slotted in as appropriately as possible based on things like ACT." Sometimes he would give a student typical course problems to complete. The Director said that he knew by watching the student if he or she could do the problems and thus, succeed in a certain course.

The Director said that he was not sure if mandatory placement would make a difference, but added, "I can't see why it would make things worse. That's a pretty weak statement. I can't see how it would hurt. I think you'd want to talk about an option." He thought that the option to challenge a course should always be available to students.

The Director added that some type of mandatory placement would be good bureaucratically, but he said, "There is this notion that we don't want to do anything that might make the prospective student go someplace else. It is the balance thing again of free choice and more structure. I think it would work for a lot of freshmen." The Math 099 instructor was in favor of mandatory placement. The Math 102 instructor was in favor of more strict guidelines on placement, but like the Director, he thought that students should be able to challenge courses.

Strong Institutional Commitment. There were indications of institutional commitment to developmental mathematics, and there were indications of a lack of this commitment. The Director thought the developmental mathematics courses were not fully supported. He said that there was a lot of "pious talk about remediation...Math 099 is not part of the regular load so the University System does not really think this is something the University System ought to be doing." In addition, the courses were not based on student and instructor needs. According to the Director, when Math 099 should have 10 students, it had 25, but administration was happy because they did not have to pay another instructor.

Math 099 was offered through Continuing Education and was funded differently. The Master's Institution was not allowed to spend state dollars on remedial or

developmental education. The Director said that the number of students in developmental mathematics courses did not count for student credit hour production. Thus, there was actually kind of a "disincentive to spend money on these courses."

Large class size and use of instructors were other possible indicators of a lack of institutional support. Both instructors and the Director thought that classes were too large and could not be taught as effectively as smaller classes. During the three fall semesters in which grade data were collected, Math 099 had no more than 20 students in each section, and Math 102 had as many as 55 students in each section. Instructors, not full-time professors, taught the developmental math courses. On the other hand, the instructors on campus did have some faculty development opportunities and were included in the departmental planning and decision-making activities.

The Math 102 instructor thought the institution was fairly supportive of Math 102. He said that he got the feeling that administration was not as comfortable with remedial classes, but from visits with administrators up to the vice president's level, "they seemed to understand the need for the courses."

For the most part, the developmental mathematics instructors thought that other faculty members in the Department of Mathematics and Computer Science were supportive of the developmental math courses. The Math 102 instructor said:

> The Department understands and has a pretty consistent feeling that [Math] 102 is an essential course. And we have a fairly large number of students who should be taking it who aren't. And I think most of the department is comfortable with the kinds of things we are doing in [Math] 102, getting students ready for movement to the other class. If they leave a 102 class with a C, a B, or an A, I think we're fairly comfortable that they are going to get into a [Math] 103 class and survive. If they have a D, that's a little more frightening....No one in the Department belittles those courses.

To summarize, there were indications of support and indications of a lack of institutional support for developmental mathematics. Thus, no conclusion could be made about the institutional commitment to developmental mathematics at the Master's Institution.

Centralized or Highly Coordinated Developmental Program. The developmental mathematics program at the Master's Institution was not completely centralized, and it did not belong to a centralized developmental program. According to the Director, the developmental math courses were taught on campus, at a U.S. Air Force Base, by correspondence, and sometimes at a coordinate campus. The Director had some kind of connection to all of these.

The developmental mathematics program appeared to be coordinated. Math 102 instructors followed an agreed upon outline of content and used the same text and calculator. The Director and Math 102 instructor said that the curriculum development process involved the selection of a text with the consensus of the course instructors and other concerned faculty members. It also involved an agreement on the course's content. The Director said that the Math 099 instructor did her own thing. The Math 099 instructor said that, since she taught Math 102, she knew what students needed to be able to do when leaving Math 099 and entering Math 102. At the Base, the instructors followed a syllabus or outline of content that they received from the Department of Mathematics and Computer Science at the Master's Institution. The syllabus provided consistency because it outlined the same course content as was covered on campus. The same texts and calculator were used at the Base and on campus as well. One professor

was responsible for the Math 102 correspondence course. He followed the same outline of content as the classroom sections. Within each course, the level of coordination depended partly on the instructors of the course. Most instructors worked independently and helped each other when they had questions or problems.

Developmental Mathematics Faculty. Faculty members, who were instructors or lecturers of mathematics, taught the developmental mathematics classes at the Master's Institution. Local high school and junior high school math teachers and one math professor from the Master's Institution taught the developmental math courses which were offered at the Base. This same professor also taught the correspondence section of Math 102.

The Director said that the instructors of developmental mathematics courses were required to have bachelor's degrees, but even those who had a higher degree could teach the developmental courses if that was what they did best. Some of the instructors had been high school math teachers. The Director said that these instructors still needed to "enjoy being in the classroom" and "have the fire to teach with some expectation of longevity." The Director said, "Here it is has been a little bit of serendipity having high school teachers, teachers with experience at that level. I think that is the way you do it, that's not the only way, but it's the most effective way." He continued, "Those courses obviously are more about pedagogy, than content." According to the Director, the instructors of these courses needed to have good relationships with students. He said, "A lot of it is your social perspective. There are people that really enjoy working directly with students. Some people just eat that up and others don't."

The Director invited all campus developmental mathematics faculty members to all departmental meetings. Any faculty member on special contract, like the Math 099 instructor, was not officially obligated to attend the meetings, but these faculty members usually did. The Director said that he told those instructors that he valued their opinions and they had a right to be included in departmental discussions. He added:

> There are several veteran instructors in this Department who are on special contract. The implication is they're here to teach. They've been doing it a while and they're doing a good job....I cannot afford not to have these people involved in decisions because they are in the classroom everyday, much more so than I am, dealing with students from all over campus. They know the problems. They know what works. They know what the options are. How dumb would it be for me to say, "Well, I'm sorry, I don't care what you think." That just makes no sense to me.

Some faculty development opportunities were available to developmental math instructors. The Math 099 instructor said that she had been to some workshops and conferences and had taken some graduate courses. She was invited to and attended departmental meetings, and was involved in the planning of Math 102. She was not invited to some of the campus events at the Master's Institution because she was on special contract. The Math 102 instructor said that he had attended calculator workshops that developed his calculator skills. In the summer he taught in the Master of Arts in Teaching: Mathematics program and had interaction with high school math teachers who participated in this program. He had given presentations at meetings of the North Dakota Council of Teachers of Mathematics (NDCTM) and had received Bush Grant funding for the use of teaching assistants in his Intermediate Algebra classes. He said that he took part in the planning and decision-making processes of the Department, especially with Math 102 and Math 103. He was invited to and attended departmental meetings and said

that he was listened to in the same way as other faculty members in the Department. He served on the Bush Grant Committee and the Math 103 Committee.

To summarize, the majority of those teaching developmental mathematics were instructors or lecturers. Each semester, one full-time professor taught one or two sections of Math 102 at the Base and one section by correspondence. The other Base instructors were usually local junior high and high school teachers. The instructors had bachelor's degrees or master's degrees, except for the professor, who had a doctorate. No one had developmental training. Faculty development opportunities were available but not emphasized for these instructors. The campus instructors participated in the planning and decision-making processes of the Department.

Mastery Learning. Mastery learning was not practiced at the Master's Institution. Some instructors, including those that were interviewed and observed, allowed students to retake exams. This was not true mastery learning in which students could not move on to new topics until demonstrating competency in the current topics. The Math 102 instructor considered his retesting and other policies a form of mastery learning:

> I have a little bit of the mastery learning theory because of the things I do with the retesting and because one of my other philosophies from mastery learning is that a student should receive partial credit at all times for attempting problems so generally my students get half credit on homework problems, just for attempting them. I also, from the mastery learning philosophy, again buy into the retesting plan because it fit right into what I was doing.

For further description of each instructor's use of retests, see the Instruction section of Appendix F.

Supplemental Use of Technology. In both developmental math courses, students used a graphing calculator. The amount of use depended on the instructor, but all instructors were expected to use it. The Math 102 instructors integrated the calculator into the entire Math 102 curriculum and used it as another method of demonstrating and solving problems. Its use was supplemental, and students were still required to show all work or to explain how the calculator was used to determine solutions. Regarding technology, the Director said, "Anymore, I don't know that there is an alternative." The problem was not, should technology be used, but how to use it and to what extent.

In Math 099, students were told to buy the TI-83 calculator because the instructor used that model and because it was the calculator they would need in future math courses. The Math 099 instructor said that students used the calculator to check equations, to check the order of operations, for factoring, for graphing, for fraction operations, and to check their work. All work still had to be shown so that students did not become dependent on their calculators. She said, "They get excited when I hand them calculator materials." She showed students how to use it for factoring. "Once they saw that, then they became convinced about buying one if they had not bought one yet." Students sometimes used the calculator for basic arithmetic. The Math 099 instructor did not have time to re-teach arithmetic facts, and she thought that students probably would not learn them now if they had not already mastered them. During the observation of Math 099, the Math 099 instructor used the graphing calculator to illustrate graphing. This occurred after teaching students how to graph by hand.

The Math 102 instructor used technology a TI-83 graphing calculator. The researcher asked the instructor about his philosophy regarding technology, and he said:

> After all of my experience at the high school level, if a student hasn't developed some fundamental concepts by the time they are about 16 or 17 [years old], then if you are going to study any mathematics that has decent math content, there has to be some alternative approach to those areas where they are having fundamental problems. And so by using the math frac portion on the calculator we get away from some things that cause phobias. Graphing certainly allows us to look at a visual approach to a lot of problems where prior to that they did not have that option. Graphing was too tedious. And the other thing is we can look at patterns now because we can do so many problems so quickly that they can begin to see patterns, whereas before it would have taken you a month to do enough problems for them to see patterns.

During the observation of the Math 102 classes, the Math 102 instructor extensively used the graphing calculator to illustrate concepts, to graph, to solve problems, and to check solutions to problems.

Variety of Instructional Methods. The observed and interviewed Math 099 instructor and Math 102 instructor used a variety of instructional methods. During the observation of the Math 099 class, the Math 099 instructor did the following instructional activities: used lecture; explained concepts; used examples, including real-life situations, to illustrate concepts; explained terms, examples, thought processes, and mathematical methods used to solve the examples; had the students solve problems at their desks individually or with their neighbors while she observed, answered questions, and made comments to students about their work; provided the students with mnemonic devices to remember concepts; used a graphing calculator; told the students the historical development of a concept; and answered students' questions individually. Many

examples connected mathematical concepts to things in life. She solved problems with the help of the students.

During the interview, the Math 099 instructor gave the interviewer many handouts that she considered effective lessons. There was a handout in which students had to convert ladies' shoe sizes in different countries. This demonstrated functions and compositions of functions. There was a handout that used white and black beans as negative and positive charges, like electrons and protons. This helped demonstrate and explain addition, subtraction, and multiplication of positive and negative numbers. Another handout was an article that explained how to use black and white beans and paper cups to demonstrate and explain how to solve simple algebraic equations. Another handout was a practical application. It related an electrician's job time and a customer's job cost. On this worksheet, students graphed the relationship between job time and cost, and then answered questions about it. The Math 099 instructor gave this worksheet to students to complete in groups. She said that she hardly said a word while they worked on it. She let them explore and discover as she wandered the classroom and observed them. The last handout included graphing calculator instructions for students to use when factoring mathematical expressions.

The Math 099 instructor said that she used manipulatives to explain many concepts in Math 099. These were hands on and visual and took the students from the "concrete to the representative to the abstract." She said that she used the correct mathematical terminology with the manipulatives too. Small class size, less than 20 students, was important. She said that this allowed her to do more with manipulatives

and to give students more individualized attention. The size of the class was not always less than 20 students, and thus, she was hoping to get a previous Math 099 student to help her in the classroom. This way she could do more with manipulatives.

Math 099 met three days a week. On a fourth day the Math 099 instructor held a voluntary help session for students. Homework usually came from the text. On the syllabus the instructor told students "to do as many problems as you need to do to learn the material." The homework was not graded. Exams and quizzes were given. On all exams except the last exam, students got a chance to retake a similar exam. The second score was the one that counted; hence, students could not "blow off" the retake option.

To summarize, the observed campus Math 099 instructor used a variety of instructional methods. Since all Math 099 instructors were not observed, the researcher could not draw any conclusions about the amount of instructional variety in Math 099 at the Master's Institution.

Like the observed campus Math 099 instructor, the observed Math 102 instructor used a variety of instructional methods. Math 102 was taught using: a very interactive lecture; consulting the text; doing problems with multiple methods; student participation in their seats and at the board; group work; and with graphing calculator technology.

The observed class sessions were very active. All students were awake and paid attention. Students participated in the lecture from their seats and at the board. The Math 102 instructor demonstrated, explained, and used multiple methods to solve problems. He encouraged students to work in groups. He called students to the board to do problems. They were given the choice of going to the board alone or with their group or

with a partner. The Math 102 instructor used technology extensively—sometimes to solve a problem and other times to verify answers. During the entire class period, one student ran the graphing calculator that was attached to the overhead projector. This freed the instructor of this task. The Math 102 instructor explained each problem and concept and what students should be thinking as they solved the problems. He was very enthusiastic and knowledgeable. Students were made aware of his expectations.

In one of the observed Math 102 sections, there was an undergraduate teaching assistant. The teaching assistant did the following: handed back papers; wrote material on the board; interacted with the students; called on students to answer questions or do board work; and led the help sessions. The course met four days a week, and help sessions were held on the fifth day of the week. During these sessions, students could ask questions and receive help.

During the interview, the Math 102 instructor described his effective teaching methods for Math 102: "The most effective lessons are the ones where I get my students involved either in groups or individually. I can accomplish that sometimes by moving them to the board. That gets them involved. Straight lecture does not work in those classes generally." The students also stayed actively involved taking notes. The instructor said, "Because of my philosophy about letting students use notes on exams, they value their notes so they take lots of notes. They are very busy writing things down."

The Math 102 also said that he used a little bit of cooperative or group philosophy.

> I also have a tendency to agree a little bit with Johnson and Johnson, the group philosophy. I try to do as much grouping as I can, however the class size and our facility isn't really conducive to grouping. It doesn't work real well, but we do still have it. You could even see that when you were in there. We have informal groups and they do use their groups. And some of those groups carry outside of class. They meet at the library. They meet in the mornings. There's a lot of that going on.

As described above, the Math 102 instructor extensively used the TI-83 graphing calculator. He believed in giving students a "lengthy" amount of homework problems from the text and grading all of it.

> I do grade homework almost everyday. And so they get my grade comments back. They know what they've done wrong. Those problems aren't the problems that have the answers in the back of the book or in the student solutions manual. I assign evens. And I make homework about 20% of their daily grade. And then their homework papers become part of their notes and they can use those on exams.

Tests were given after each chapter, and a comprehensive final exam was given at the end of the course. Students could use their notes and homework on their exams. Retests were given for all exams except the last one and the final. The retests were similar to the original exams, but students were given twice as much time to complete them. The instructor said:

> Retesting is a lifesaver for those students because sometimes in the learning process they don't do well on the first exam. A lot of them have test phobia. A lot of them are crunched by time. So my retesting in the morning and in the afternoon where I extend the time limit to two hours really helps those students.
>
> My retesting has been part of my philosophy since before retesting was used by anyone, really, way before mastery learning. I've retested in my geometries, my advanced algebra. I have found that students generally improve on retests, even though the retest may be a little harder or a little longer than the original test. And as long as they have learned the material, that's what matters.

In summary, the observed and interviewed Math 099 instructor and Math 102 instructor used a variety of instructional methods, but overall, variety depended on the

instructor. Since not all developmental math instructors were observed and interviewed, no conclusions could be drawn about the use of instructional variety in the developmental mathematics program at the Master's Institution.

Course Structure. The two observed developmental math instructors at the Master's Institution used some structure in their teaching. For example: The Math 099 instructor provided students with a very structured method for graphing the equation of a line. She used the correct mathematical vocabulary and notation when completing examples, and she explained her grading and work expectations.

The Math 102 instructor explained each problem, concept, and what students should be thinking as they solved problems. This was done using correct mathematical notation and vocabulary. He referred students to new theorems or concepts in the book, and then he carefully walked students through these new theorems and concepts. This appeared to help the students learn how to read, write, and understand mathematical language and notation. It might have helped with their organizational skills as well. At the end of class, the instructor provided students with tips and clarifications for the homework assignment. The instructor graded homework almost everyday. Therefore, students received constant feedback about their work and doing mathematics correctly.

To summarize, the observed and interviewed Math 099 instructor and Math 102 instructor used structure in their developmental math courses, but overall, use of structure depended on the instructor. Since not all developmental instructors were observed and interviewed, no conclusions could be drawn about use of course structure in the developmental mathematics program at the Master's Institution.

Intent to Align Courses. There was evidence of intent to align developmental math courses with other math courses. The Director said, "The current general objective is that the student will leave the program equipped with the mathematical skills necessary to pass college algebra (i.e., Math 103) successfully." The Math 099 instructor said that one of her goals in Math 099 was "to plant a firm foundation that they can build on for success in [Math] 102." The Math 102 instructor said:

> My main objective, and I give this to them immediately, is that when they leave my course they're ready to take their College Algebra course, which is their required course for graduation. And we try to tie as much of our course as possible to that course. And emphasize when we are in a topic how that is going to be used in [Math] 103, how important it is going to be in [Math] 103.

The Math 102 instructor also said that he helped prepare students for their next math course "through a good exposure to and at least an introduction to topics that will meld well into the [Math] 103 [course]."

Another indication of intent to align the developmental math courses with other math courses was the cooperation of Math 099, Math 102, Math 103, and other course instructors when selecting a text or deciding on changes for these courses. The Math 099 instructor also taught Math 102, and many of the Math 102 instructors also taught Math 103 or other non-developmental math courses. Thus, these instructors knew what was taught in each of these courses and might have been better able to teach each course with the knowledge of what students needed to know for their next math course.

Statement of Goals, Objectives, or Desired Outcomes. The developmental mathematics program did not have formally stated program goals, objectives, or desired outcomes. The Director said that it would be nice to all come together and say, "After

taking this course, students will be able to...and will know..." When asked, the Director provided objectives for the program, but these objectives were not written down anywhere.

> The current general objective is that the student will leave the program equipped with the mathematical skills necessary to pass college algebra (i.e., Math 103) successfully. "Pass successfully" may seem redundant, but there is a difference between simply passing and mastering the Math 103 material well enough to use it in other courses (e.g., Math 277/377). This implies that intermediate algebra (Math 102) is part of the developmental mathematics program.
>
> Specific objectives (skills) include, for example, being able to analyze linear and quadratic relationships (implying familiarity with elementary coordinate geometry) and to develop simple mathematical models from verbal descriptions of problems.
>
> These objectives are implicitly defined in the prerequisites for Math 103 and, more explicitly, in the pretest for Math 103. They are part of the "tribal knowledge" of the math department.

Course objectives were listed in the course description on the Math 099 syllabus (see Appendix F). The Math 102 instructor's syllabus did not include course goals or objectives, but course goals and desired student outcomes were on a general Math 102 syllabus that administration required. Instructors did not necessarily use this formal syllabus. Most instructors created their own syllabi for their courses. Administration did not require a syllabus for Math 099. During the interviews, the interviewees mentioned other unwritten course goals. These goals are included in the Goals, Objectives, and Desired Outcomes section of Appendix F and in Table 16.

Support Services. Support services were available to developmental mathematics students at the Master's Institution. These services included peer tutoring, a drop-in math clinic, teaching assistants (for more, see Appendix F), Disability Student Services,

orientation, a critical thinking course, learning communities, Veteran's Upward Bound instruction, study skills development, and a study skills course.

The tutors used in the Math Clinic did not receive training in tutoring. They were undergraduate students with strong math skills who often were mathematics majors or mathematics education majors. The orientation held on campus was not ongoing. The peer tutors from the Student Development Center received training. According to the Director of Student Development, there was a monthly in-service training for tutors. It included conflict management, working with others, classroom techniques, and behavior management. The Director of Student Development relied on faculty recommendations to ensure tutors knew the content.

According to one interviewee, TRIO Student Success Services handled some developmental students, but they were having "birthing pains." They advised, placed, monitored, and tracked their students.

Learning communities existed on campus, but they were being discontinued due to a lack of interest and success. The ones that did exist were not directed at underprepared or developmental students. Developmental mathematics courses were not included as one of the three courses in the learning communities program (L. Eriksmoen, personal communication, February 3, 2003).

Assessment. The Master's Institution did not regularly and systematically assess its developmental mathematics program. Student evaluations of the courses and instructors were done in all classes each semester. According to the Director, "More assessment may be coming down from administration."

Developmental math instructors sometimes used individual assessment techniques to inform their teaching but not to assess and evaluate the program. The Math 099 instructor said:

> I have in the past sometimes asked students to write for me a list of suggestions that I could share with the next class. It's really not an evaluation of myself. I ask them, "If you could give advice to the incoming students, what would you tell them?" And then I've typed that all up sometimes and said, "Okay, here is some advise from previous students."

In the Math 102 sections that had a teaching assistant, students assessed the Math 102 teaching assistants by means of a survey. This was done because the teaching assistant project was originally part of a Bush Grant and had to be assessed. The Bush Foundation Grant no longer funded the teaching assistant project, but the instructor continued the assessment of the teaching assistant. He said that this gave him "another measure of the students' perceptions of what's going on [in the course]." It also provided the teaching assistants with feedback that could be used for their improvement.

The help sessions also provided the Math 102 instructor with valuable student feedback. He said, "I get a lot of student comments, though, because of my help sessions, and I get a lot of interaction with students there, almost one-on-one....It's a really valuable tool for assessment and finding out where you're at."

Comprehensiveness. The following "best practices" were used at the Master's Institution. Assessment was mandatory. There was coordination within the Mathematics Department evidenced by the common text, common outline of content, use of the same graphing calculator, and coordinated curriculum development. Moreover, the campus developmental math faculty participated in the planning and decision-making processes

of the Department and sometimes the Institution. Some faculty development opportunities were available for developmental math instructors. A graphing calculator was used to supplement the content and instruction of both courses. The courses were developed with the intent that the content and skills of each course were aligned with the content and skills needed in the next course. Trained and untrained tutors and sometimes teaching assistants were available to help students. Developmental math course syllabi included stated objectives.

The following practices occurred at the Master's Institution but were not in agreement with those of "best practice." Placement of students in appropriate math classes was not mandatory. A centralized developmental program did not exist. Instructors and lecturers taught the majority of developmental math courses, and local high school and junior high school instructors usually taught these courses at the Base. The highest level of education of most instructors was a bachelor's degree or a master's degree, and none had training in developmental education. Developmental math program goals, objectives, or desired outcomes were not stated in writing, and the program was not regularly and systematically assessed. The Master's Institution lacked a freshmen seminar, ongoing orientation, paired courses or learning communities, and Supplemental Instruction for developmental math students.

"Best Practice": Doctoral Institution

Mandatory Assessment and Placement. Assessment and placement were mandatory at the Doctoral Institution. The Remedial Math Director said that a "battery

of tests" was given to students to place them in appropriate courses. He said, "This has been done for years." There was an algebra experience exam that was used to determine students' knowledge of algebra. A precalculus experience exam was used to determine if students were ready for calculus. The Remedial Math Director said that ACT math scores were used until about three years ago, but many students had not taken the ACT for many years. Hence, the placement exams were adopted to deal with that problem. At the end of Math 099, students were offered another placement exam, the Math 102 final exam. If they passed the Math 102 final, they could skip Math 102. The Remedial Math Director said that the final was "somewhat successful." Some students took the Math 102 final exam and realized their need to take Math 102.

The Remedial Math Director said that students often took Math 099 and then wanted to take the algebra experience placement exam again. This was not allowed because, according to the Remedial Math Director:

> The placement test is a simplistic view of algebra, and a [Math] 099 student could probably pass it and not have to take Math 102, but probably would not be successful in Math 103 or Math 104. Like in high school, right after they take a course, they can do well, and a month later they don't remember anything. And that is the piece that we need. The kinds of things that we need from them are the things that they should never lose. They should not lose the idea that $2x + 1 = 7$ is a linear equation. That they can recognize that, or they have got an idea of how to do the graph or something about it instead of just staring blankly....Maybe when first asked you may not be able to answer, but you'd be able to start, and then say, "oh yeah," and start to recognize it, and then you can explain how to do the problem.

Strong Institutional Commitment. There were indicators of institutional commitment to developmental mathematics and indicators of a lack of this commitment

at the Doctoral Institution. The interviewees cited financial issues and administrator's views of developmental education as the main reasons for a lack of support.

Both Directors said that money was always an issue. The developmental math courses had to be offered through Continuing Education because the Institution could not spend state dollars on remedial or developmental courses. The course tuition funded all developmental math courses. It paid for instructor salaries, tutoring wages, and other costs associated with the courses. All students, including out of state students, paid a special fee for these courses. The special tuition fee was: in addition to regular tuition costs; 70% of the normal in-state tuition; and the same for all students regardless of other factors, such as program and residency. Since the courses did not satisfy any requirements for graduation, the tuition was discounted, and student fees were not charged for these courses as well. Yet, the cost of these courses was additional to other tuition costs. The revenue from the developmental mathematics courses was split between Continuing Education and the Mathematics Department.

The Remedial Math Director explained his thoughts on how some at the Doctoral Institution perceived the developmental math courses:

> The University would like that course, the population of the course, to be much, much smaller. It is being perceived as a negative for incoming. I don't know if freshmen perceive it that way, but the administration, I think, does. That it's saying that you can come here, but you're scum. You know, I don't think it ever said that anywhere, and no one is probably ever going to say it that way, but you, you know, "All right, come on down and play, but your chances of success are being diminished."

The Remedial Math Director also mentioned financial and managerial issues regarding the developmental math courses:

> Now we get this issue of additional fees because this is supported by the fee structure. And so they pounded it as being full-time equivalent and all that sort of stuff, but it does not receive credit for graduation. Eighty percent of the students or 75% of the students who take these courses go right into a college level course. They may not meet the general ed [requirement] that they need, but maybe it's College Algebra moving on toward their general ed course or whatever, but it's not one of these. So it is kind of hard to support.
>
> This is where the Math Department at one time asked and kind of threw this out and said, "We're not going to fund this course anymore because it is a drain on the Department." Well then it became under control of somebody else, and the [Math] Department in a short period of time was not happy with what was being done. And now they have control over the content of instruction, and how it is being delivered, and so they just took it back. So okay, they just want to be in charge of this, they just don't want to have to pay for it. So classes are created as to the numbers of students that are there.

There were some indications of institutional support. The Continuing Education Director said that administration had not yet siphoned any of the developmental mathematics money, and according to her, this was an indication of their support. There was a Remedial Program Director of the Department of Mathematics. He was responsible for the developmental math courses. This person was also the University Mathematics Placement Director. These responsibilities were included as part of his teaching or faculty load. There were numerous tutoring services available for students as well.

On the other hand, there were still other indications of a lack of institutional support. There were supervisors for each developmental math course, but they had to have more students in their developmental math classes in order to pay their higher supervisor salaries. Adjuncts or lecturers, rather than professors, taught the courses. Even the Remedial Math Director was a senior lecturer, who, according to one interviewee, did not have the same rights as the professors in the Math Department. The

developmental math instructors did have some faculty development opportunities, but these usually were only local, in state, or campus opportunities. The professors, not the developmental math lecturers, received funding for major conferences or other opportunities.

Both of the interviewed instructors felt support from others in the developmental mathematics program and from some of the other members of the Mathematics Department. The Math 102 instructor said that the Department Chair was "very supportive," and "it is great having [the Remedial Math Director] as our leader." One of the instructors said that the professors did not know what the developmental math instructors did and probably thought it was less important. "They have what they do and we have what we do....There definitely is a break. We're the lecturers. They're the professors. We have no voting rights. We have nothing. They tell us what to do, and we do it." Even the senior lecturers, like the Remedial Math Director, "They don't have votes like the faculty," according to one instructor. An instructor said that the lecturers had no say in what happened in other courses outside of the developmental courses. The lecturers were separate from the professors, but the instructor said, "That's okay, I like what I do. But I'm not certain that makes what we do less important."

To summarize, there were indications of support and indications of a lack of institutional support for developmental mathematics. Thus, no conclusion could be made about the institutional commitment to developmental mathematics at the Doctoral Institution.

Centralized or Highly Coordinated Developmental Program. Continuing Education offered all developmental mathematics courses, and instructors in the Mathematics Department taught these courses. According to the Continuing Education Director, Continuing Education handled the administrative details, as well as performing some student advising and counseling. The Mathematics Department handled the instructional and curricular responsibilities. Again, Continuing Education offered the courses because of how the courses had to be funded. Thus, the instructional and curricular responsibilities of the developmental mathematics program were centralized in the Mathematics Department, but one centralized developmental program did not exist for all developmental courses on campus.

The developmental mathematics program at the Doctoral Institution was extremely coordinated. There was a Remedial Program Director of the Department of Mathematics. He was in charge of the developmental mathematics courses. There were course supervisors as well, one for Math 099 and one for Math 102. According to the interviewees, the same syllabus, text, outline of material, exams, and online computer program were used for each developmental math course. The Remedial Math Director said that planning for a Web based course resulted in this coordination and helped align the content of the developmental and other courses. The Remedial Math Director said, "[The planning] forced people to talk. It forced people to make sure they were on the same page. That priorities got set in general, instead of specifically to the instructor." He continued:

> We have an outline of day by day or whatever for the course so that when we get to the end we are fairly assured that students have had the experience that is

> comparable to someone else's experience. This mushroomed into other courses. We now do this in [Math] 103, [Math] 104, [Math] 105, [Math] 146, stuff, like common syllabi, common tests, common content.

Beyond this, instructors were free to teach using their own styles. Course supervisors did observe Math 099 and Math 102 instructors each semester. A report regarding this observation was placed in each instructor's file following a meeting between the instructor and the supervisor. This added another level of coordination to the program.

Developmental Mathematics Faculty. Developmental mathematics instructors at the Doctoral Institution were lecturers with bachelor's degrees or master's degrees. The Remedial Math Director said:

> The majority of the instructors are lecturers. They probably are teaching something in the Department. If not that, they are very experienced instructors that are perhaps working on their degrees, their advanced degrees, with years of high school experience and have bought into the idea that students that are in [Math] 099 and [Math] 102 need to have not have been there...And then there is a few that are undergraduates, especially math major types, that have gone through and are close to being done....We try to use the best possible candidates we have available to teach these courses.

According to the Remedial Math Director, the undergraduates who taught were allowed to teach developmental mathematics courses in order to gain teaching experience without the worries of disciplining students that occurred in high schools.

One of the instructors said that in order to teach a credit course (Math 103 or higher), an instructor needed a master's degree, except for courses taught after 3:00 p.m. The Math 102 instructor said, "We use a lot of teachers from the community." Quite often, experienced local high school teachers were recruited to teach the developmental math courses. The Math 102 instructor said that this worked because the local instructors

saw what was done at the college level and took it back to the high school to use or help with their curriculum.

The full-time mathematics faculty did the departmental and developmental mathematics decision-making and planning. Lecturers were not included in these processes or in the Mathematics Departmental meetings, but they participated in and had input into the developmental mathematics courses and developmental mathematics meetings. The Director said that instructors had a "nonvoting voice." Different instructors had impacted the course over the years through their input and concerns. "They are listened to if they voice their opinions and change can start to happen," he said. The interviewed Math 099 instructor thought that he had a voice in anything that went on and that he would be listened to and considered. He felt as if he was as important as anyone else. The Math 102 instructor said that the developmental mathematics instructors had no voting rights or say in other courses. They were not included in departmental meetings, but they were included in the developmental mathematics course meetings.

The Math 102 instructor said that faculty development opportunities were available to her. She was currently participating in a peer review program with another mathematics instructor. She said the program was beneficial. She was revising her course syllabi and incorporating cooperative learning as a result of it. The Math 102 instructor said that other faculty development opportunities were available on campus. Some of these opportunities were various workshops on computers, personal response systems, and problem-based learning. The Math 099 instructor said that he really had not

participated in any faculty development opportunities. He said, "Because I am a veteran of teaching they kind of trust me, but if I ever feel that I have a problem, I have no problem talking to anybody about it." He added:

> We don't have per say, "Okay, we'll go for the afternoon and have a seminar on it." My seminar is when I walk in their office and say, "Hey, I can't get this to work." Or this morning I walk in [the Math 102 supervisor's office] and I said, "We have our test in [Math] 102 on Monday and tomorrow in class I want to do a practice test. Do you have one for me?" [She said,] "Just a minute I'll print one up for you."

He later said that he had been to state conferences on mathematics education and that the Department encouraged and paid for this.

Like at other institutions, many faculty development opportunities depended on the availability of funds. Developmental mathematics instructors, because they were lecturers, graduate students, or undergraduate students, did not receive the same priority in funding of faculty development opportunities as professors.

To summarize, the majority those teaching developmental mathematics were lecturers and a few undergraduate math students. There were supervisors for each course, and there was the Remedial Program Director of the Department of Mathematics. The instructors had bachelor's degrees or master's degrees, but none had developmental training. Local, state, or campus faculty development opportunities were available and encouraged, but major opportunities were usually reserved for professors. The instructors did not participate in the planning and decision-making processes of the Department, but they did have some input in the development of the developmental math courses.

Mastery Learning. Mastery learning was not practiced in Math 099 and Math 102. In all developmental math courses, students could retake quizzes, sometimes many times. In addition, they could retake exams once each to improve the exam scores to a maximum of 75%, but students did not need to receive a certain score to move on to the next unit of material, as they would need to do with mastery learning.

Classroom and Lab Integration. At the Doctoral Institution, the Math 102 instructors provided students additional help for an online computer program called MyMathLab. This program was used to supplement the developmental math courses. Instructors of the developmental math courses provided assistance with MyMathLab in a computer lab. In this way, students had access to MyMathLab and instructors of the courses who used it. These instructors should have been familiar with MyMathLab and the content of the developmental math courses. The Math 102 instructor said:

> What we also have done this year is, my teachers have been really good about doing this. Many of the graduate students find it hard to tutor a student at this level. So when we see a [Math] 103 student coming back with a calculus answer to a 103 problem, we know they didn't do it. The students get frustrated and so do the graduate students...So my teachers have agreed to give up one or to take one of their office hours a week in the tutoring lab that we have. So that they sit there for an hour and help the students that come in. And this time we did it in the computer lab so that they could help them with MyMathLab.

Thus, the use of the computer lab was integrated with the content and instruction of the developmental math course.

Supplemental Use of Technology. In both developmental math courses, the instructors used a graphing calculator. On each course's syllabus, the instructor recommended students have either a scientific or graphing calculator. Each course had

an online computer component called MyMathLab. It was used to supplement and support both courses. Students could do homework, read the text, and take quizzes using MyMathLab. In Math 099 and Math 102, students were required to have an e-mail address and access to a computer with Internet access and an Internet browser. This was made clear on the course syllabi. The Math 102 instructor said that she pushed for more use of the graphing calculator in order to better prepare students for its use in Math 103 and other courses. One section of each course was offered completely online each semester.

Variety of Instructional Methods. During the observation of the Math 099 class, the instructor reviewed material for a future test. Therefore, the researcher was not able to observe the instructor's presentation of new material, but the researcher did observe the instructor's interaction with students and his explanations of problems.

At the beginning of class, the instructor told the students that there was a practice exam on MyMathLab for students to use to review. To help the students review, the instructor gave the students problems to solve at their seats. While the students worked on problems, the instructor walked around and checked on the students and their work. After giving the students time to work on a problem, the instructor asked the students about the solution to the problem. Together, the students and the instructor went over the solution.

During the interview with the Math 099 instructor, which was not the same instructor that was observed teaching Math 099, he described how he effectively taught the course:

> There's a lot of interaction. You introduce what you are going to do that day, and then you'll do an example problem, and then you'll have them do an example problem, and then you'll try to get some interaction that way. Because [Math] 099 is basically algebra one from high school and [Math] 102 is algebra two from high school, and those are the things that I taught in high school for many, many years. It hasn't changed much, just the book.

Later he added, "It's not much different than teaching a high school class except that they [the students] don't have to be there." He said that he liked algebra and teaching the developmental math courses, but a lot of people did not. He was a high school math teacher so he was used to teaching at that level. He said:

> To me it's like teaching high school, and I don't mind that. I like, I like algebra. That's my, and when I was in high school I taught algebra one and algebra two for many, many years and then the last 10 years I taught algebra two, precalc, trig, and AP calculus. And I've been everywhere on that, and I don't mind this. It's fun. And you try to make games out of it. And you try to have...I have to use a lot of humor because of my size because I can intimidate the hell out of anybody, so then you try to use a lot of humor with it. You try to get them relaxed. You know, and I don't want a fear factor in there because their fear right now is the word, math. What you are trying to do is get rid of that and the anxiety part of it. Hopefully we can build them up...You don't try to do things in big chucks. You try to do things in little pieces and then you take the little pieces and try to build it up...Again this is a kid who...no confidence. "I don't like math."

The Math 099 instructor tried to do some type of assignment everyday in class. He had students grab a partner or group. They did one problem in their group and handed in one solution for the entire group. He said, "Of course they all get a 10 out of 10. Which is good and that's the whole idea there." These assignments also did two other things. They acted as an attendance check and made students do problems. He sometimes intentionally partnered certain students together.

> I think in [Math 099] more, I partner them up. And what I'll do is kind of go okay, "Well, Mary you go with Johnny today." Well, Mary's your number one student. Johnny's your lowest student, and your hoping that Mary works with

> Johnny and helps him that way because that's a different voice trying to do the same thing that you do.

Assignments were problems from the textbook or from the text and MyMathLab. The Math 099 instructor said that he liked the way the text was set up. He said, "The book does a nice job of doing a little one thing and teaching that and then a lot of repetition in the problems. And that's what I like to see. Lots and lots of homework."

As stated earlier, Math 099 was supplemented by technology, including the graphing calculator and MyMathLab. The Math 099 instructor gave quizzes using the online MyMathLab computer program. He said that there were 10 online quizzes created by the instructor. Students did them on their own and had to complete them by a certain date. The computer program graded the quizzes immediately, and thus, students received instant feedback. Students could take the first quiz as many times as they wanted. After that, the instructor restricted the number of times to five per quiz. The instructor could put a time limit on quizzes, but the Math 099 instructor did not do this. He said, "At this level the most important thing you are looking for is success. If a kid gets in there and he has eight problems done and he runs out of time it could ruin their psyche." Exams were given in class. On all exams, students who scored below 75% could retake the exam once and earn a maximum of 75%.

Thus, the interviewed Math 099 instructors used a variety of instructional methods, including: lecture, technology, group work, lots of homework, retests, examples, interaction, in class assignments, and humor. No conclusions could be reached about the instructional variety used by all Math 099 instructors at the Doctoral Institution since only a few instructors were included in the study.

During the observation of the Math 102 class, the Math 102 instructor began class by placing the answers to the homework assignment on the overhead projector. The students checked their work, and the instructor walked around to see how the students did. After allowing sufficient time for the students to check their work, the instructor asked for questions on the homework. The students asked about some of the problems. The instructor did those problems on the board while she explained them with the help of the students. After the Math 102 instructor answered all of the homework questions, she presented new concepts and reviewed old concepts at the board. As she presented new concepts, she connected them to previous concepts. The Math 102 instructor did some examples that involved the new concepts.

After the Math 102 instructor finished presenting the new concepts and examples, she placed some problems on the board. Students got into their groups to work on the problems. Each student had to complete the problems, but they did not have to work alone. They could get help from their group members. After the Math 102 instructor checked to ensure that every group members' problems were complete, the group picked one problem not already completed by another group. They wrote the problem's solution on the board. The students worked on these problems until the end of class. After class, the Math 102 instructor helped a few students who stayed to ask questions.

The Math 102 instructor described effective teaching methods in her Math 102 classes. She said that she tried to get students to be "more active in class and in their learning." She was trying to incorporate cooperative learning in her classes. She had

students sit together in groups, work on problems, and do board work. The researcher observed these activities during the observation of this instructor's Math 102 class.

The Math 102 instructor said that technology was used in Math 099 and Math 102. This included a graphing calculator and the MyMathLab Internet program that accompanied the course's textbook. She described her experiences with MyMathLab and how she used it for the students' homework assignments:

> I have a number of students that like it—they use it all the time—and some that just really fight it. What I have finally done, I did have homework where they did part on MyMathLab and part on paper, and I finally, because of the fact that MyMathLab was not as reliable as it should be because, they told me, they expected a 12% increase and they had an over 25% increase in usage, and so I think they are just struggling to keep up with it. And so I did, and because the students, some of them disliked it so much that they were just struggling in class. I said, "Okay you have a choice. Either turn your work into me everyday so I see that you've done the odd ones because the odd ones go out on MyMathLab, or you can do it on MyMathLab, in which case you don't have to have it done that day. You can have a little extra time that you can go out and work it there." And then sometimes I just take in all the even ones and we correct the even ones. So that they have a choice in how they do it. And that has been a real help.

The assignments were problems from the text or a combination of problems from the text and MyMathLab. She graded the even problems from the text. Students had to keep all their assignments neatly organized in a notebook. As mentioned earlier, when students did problems on MyMathLab, the program immediately corrected the problems so students got fast feedback. She said:

> And I do try with their assignments to make sure they get application problems and some challenging ones that they sometimes do. Like we have one today, they won't have the answer for it. And I'm not giving them the answer and they are going to work in their groups and turn it in. To get that one done, I will give them a hint today.

In Math 102, the instructors gave retests on two of the three major exams. If students showed that they had studied the material, those who scored below 75% could retake the test once for a maximum of 75%.

The Math 102 instructor also taught one online section of Math 102. She required local students to stop in once a week. They showed her their work and handed in their homework assignments. She provided the answer keys outside her office so that students could check their work before meeting with her. She said that together they went through the ones about which the students' had questions.

To summarize, the observed and interviewed Math 102 instructor used a variety of instructional methods when teaching Math 102. These methods were: group work, lecture, examples, calculator and online technology, a notebook, and retests. Thus, since all Math 102 instructors were not interviewed and observed, no conclusions could be made about the use of instructional variety in Math 102 at the Doctoral Institution. Overall, no conclusions could be made about the use of instructional variety in either developmental math course at the Doctoral Institution.

Course Structure. There was some indication of course structure in the developmental math courses. For example, the observed Math 099 instructor had students use correct mathematical language when they spoke. He forced students to explain the concepts, the problems, and their solutions. He also modeled correct mathematical language, notation, and solution processes. The Math 099 instructor conceptually explained a solution process before actually writing anything down. For example, there was a word problem in which the students had to derive the correct

equation before they could solve it. The instructor talked about the thought processes needed to derive and write the necessary equation to be solved. He explained how to think about the problem and how to pull out the key parts as well as why he used certain formulas and numbers. This may have helped students organize solution processes.

According to the interviewed Math 099 instructor, students' critical thinking skills were weak. The Math 099 instructor said that the students got good at solving equations, but he had break down and talk students through story problems. He said, "It's easy to teach a kid how to solve an equation, but the next step is taking the words and making it into an equation. So you break down, break down, and talk them through it." This was a way to help students organize and complete the mathematics and was another example of structure.

As the Math 102 instructor worked the problems she said, "Think about this as you are working problem number..." She talked the students through the solution processes and prompted them with. This helped them think about and organize the mathematics. She also modeled correct mathematics language, notation, and solution processes.

The Math 102 instructor had students keep all of their work in a notebook of work. This was done to ensure that students did the work and to help students "do it in a more organized fashion to make them better math students." The researcher previously mentioned this as one of the instructor's goals for the course. She told the other Math 102 teachers:

> I want you to model this, and I want you to say, "This is what makes you a better math student because you are more organized. If you have it written all over the

> page, it's not going to work. And I want you to comment about those things when you look at their work."

She described how keeping the notebook and being more neat and organized helped one student:

> And I know the one, she brought her work up to me the other day and I said, "This is really nicely done. It's organized. I know exactly what you've done. You can go back and check it." And I said, "So, tell me, is this what you did at the beginning of the semester?" because I couldn't remember exactly. And she said, "No. It has gotten better." So they can see that it makes a difference....Part of the time that's why they're there because they are so disorganized with what they're doing.

To summarize, the observed and interviewed instructors used structure in their teaching of developmental mathematics, but only a few instructors were observed and interviewed. Due to this, no conclusions could be made about the use of structure at the Doctoral Institution.

Intent to Align Courses. There was some evidence of intent to align developmental math courses with other math courses. According to the Remedial Math Director, past development of a Web version of one of the courses forced them to address the content of both developmental courses and to make sure these courses were aligned and supported one another. This led to the development of common content, course syllabus, and exams in each developmental course and other math courses. In addition, the instructors said that they taught with the goal of preparing students for their next math course. The Math 099 instructor said that his goal in Math 099 was:

> [The students] be successful at the next level is all. Just that they, when they get out of [Math] 099 they can go to [Math] 102 and do [Math] 102, and when they get out of [Math] 102, they can go to [Math] 103 or [Math] 104 and they can get

> their credit...Because the whole idea here is, we've talked about, is that success thing. So we can get all these kids so that they can get through here.

The Remedial Math Director said:

> We did, not for a couple of years probably, did studies about, where did these students come from and so on...and some of the better students that we have in those classes are the kids that are coming out of these classes. And this is across the board. You know whatever class that you want to pick on, according to our past Chair, the best students that we have are the ones that were in a previous course in our system.

Statement of Goals, Objectives, or Desired Outcomes. According to the Remedial Math Director, the developmental mathematics program did not have stated program goals, objectives, or desired outcomes. In addition, course goals, objectives, or desired outcomes were not stated on the developmental math syllabi. The Math 102 instructor said, that, as part of a peer review process, she was working on improving her syllabus and including course goals or objectives. During the interviews, the interviewees mentioned other unwritten course goals. These goals are included in the Goals, Objectives, and Desired Outcomes section of Appendix G or in Table 17.

Support Services. A number of support services were available to developmental mathematics students at the Doctoral Institution. According to the Continuing Education Director, counseling and advising were available from Continuing Education. Disability Student Services were available as well. There was orientation for new students, but this was not ongoing. Also, all new freshmen and students who transferred less than 24 credit hours were required to take a one-credit course called First-Year Experience Course.

This course was comparable to a freshmen seminar (NDSU Bulletin, 2002). Tutoring was available from many sources.

In the Math Department, graduate students and upper level undergraduate students usually were the tutors. Mathematics teaching assistants ran a drop-in tutorial center in the Mathematics Department (Department of Mathematics, n.d.). Regarding tutor training, the Remedial Math Director said, "We try to do some on site (tutor room) observations [of the tutors] with directions on how to improve their contact with the students. We also have done some workshop time with the use of calculators."

The tutoring program provided by Orientation and Student Success held tutoring sessions at various times and locations on campus, including evenings and in residence halls (Orientation and Student Success, 2003). Their Assistant Director said:

> We hire current students for our Super Tutor program. Students who have successfully (grade of A or B) completed that course(s) are able to tutor other students. We have a minimum cumulative GPA that they must also meet. As for training, I must admit, this is something I would like to further develop. In the past we have trained them on the ins/outs of the program itself, different learning styles, specific high-tech calculator usage, and study/test taking tips.

The Math 102 instructor mentioned the use of developmental mathematics instructors as tutors in the Math Department. This was previously discussed in the Classroom and Lab Integration section above. TRIO and the Veterans Upward Bound Program also offered tutoring through the Student Support Services Office (TRIO: Student Support Services, 1999).

All three interviewees from the Mathematics Department made comments about the math tutors. The Math 099 instructor said that there was tutoring every hour of the

day somewhere on campus, but the tutoring was hard for the graduate teaching assistants to do.

> The TAs can get down to that level, but the way that they do it is a little bit over some of these kids' heads. You can't blame the TAs. They've never done this. Most of them were probably doing it in the sixth grade when they took algebra one or whatever, you know, eighth grade at the latest. It's hard for them to realize they have a love of math, and it's their chosen field, and these other ones, it's an obstacle to get through to graduate. Some of them will never use it again, the algebra part.

The Math 102 instructor made similar comments about the teaching assistants who tutored. She said that this was one of the reasons for asking her instructors to give up one office hour each week to tutor in the lab.

The Remedial Math Director mentioned the tutoring done in the Mathematics Department and across campus by Orientation and Student Success:

> We tutor in an area that's not within this Department which is always unhandy for me and uncomfortable for me because you can't kind of watch them or walk in on them and see what in the world is going on unless you walk up two blocks over there, and you might not do that. And the same thing that we have Super Tutor on campus where they are there all over and all different times of the day and night and so on, and then you might not see them either, but the main thing with both is that they haven't taken this class [Math 099 or Math 102]. They haven't done any of this. They've never taken a class like this. They've never taught a class like this. They're not sure what is in there. They attempt to help at a level that isn't appropriate to the student.

The Remedial Math Director said that he was uncomfortable making some of these comments, but he was told that the tutors were not able to assist in how to do a certain function on the calculator. "They went to the tutor, asked the tutor how to do it so they could find out how to do it themselves. The tutor did not know, and in one case said, 'Look it up in your manual.' Which wasn't really a very helpful, caring answer." He said that even some of the instructors were not helpful because they did things differently

than another instructor; thus, "their help is not helpful." All this did, according to the Remedial Math Director, was create a negative tutoring experience. Students did not like receiving help from others because they often got incorrect information.

Due to the issues with the tutors, the Remedial Math Director scheduled tutor time with him. He had all of the tutors come in and fill out a sheet that indicated what they were and were not comfortable doing as tutors. Next he set up a time when all of the tutors were available, but hardly anyone showed up during the scheduled training time. He was quite disappointed.

Assessment. According to both directors, the developmental mathematics program was not regularly and systematically assessed. Students completed course and instructor evaluations at the end of each semester in all classes. The Remedial Math Director said that informal assessment took place through discussion. He said, "Is there a set way of assessing? No. Is there discussion? Yes....The step between formal and informal assessment is a big one." He also said that some of the things that were done over the past 10 years were common things—common exams, common syllabi, common content. He thought that formal assessment would burden others with high expectations and little pay each semester.

The Math 102 instructor used an online formative assessment tool to gain feedback about her classes. The results of some of these assessments resulted in positive course changes. The Math 102 instructor described this process:

> We have used something called a formative assessment. Students can go into, we have a site where they can go in, and they evaluate us. They evaluate me. I can look at what their comments are. It only goes to me. But then I can look at some

> things that I can do. And that was one of the things that I did as a result of those, was giving them some options [on their homework assignments]. I got good comments about that....You put [a formative evaluation question] out once, but what I could do, is go take it off and have them put another one out. We do have them evaluate as part of the University. I can go in and say, "Okay, this is something I have received from a number of you and that makes sense to me. Let's do this." And a lot of them have appreciated that part of it. Other changes I have made, that was another reason why I really had them sit in groups. Some said, "You know it really helps if I can sit in that group and talk to them." And so I did make that more of an everyday type thing.

One final assessment method was the observations of all developmental math instructors by the developmental math course supervisors each semester. A meeting between the supervisor and the observed instructor followed each observation. A report was also placed in each instructor's file. This activity assessed each instructor and their methods, but it was not used to assess the entire program.

Comprehensiveness. The following "best practices" were used at the Doctoral Institution. The institution had mandatory assessment and placement. There was a great deal of coordination within the Mathematics Department evidenced by the common text, content, calendar, and exams for each developmental math course. In addition, there was a director of all developmental math courses and a supervisor for each developmental math course. Some faculty development opportunities were available for developmental math instructors. Supplemental use of a graphing calculator and an online computer program occurred in both courses. There was intent to align the content and skills of each course with subsequent math courses. Trained and untrained tutors were available, and students had to take a freshmen seminar type course called the First-Year Experience Course.

The following practices occurred at the Doctoral Institution but were not in agreement with those of "best practice." The developmental program was not centralized. Lecturers, whose highest level of education was a bachelor's degree or a master's degree, taught the majority of developmental math courses. They did not have training in developmental education, and they were not involved in the planning and decision-making of their department and institution. Mastery learning was not practiced. Developmental math program and course goals or objectives were not stated in writing, and the program was not regularly and systematically assessed. The Doctoral Institution lacked an ongoing orientation, paired courses or learning communities, and Supplemental Instruction for developmental math students.

Program Contrasts

In this section are contrasts of the six studied developmental mathematics programs. As explained in the third chapter, these program contrasts are a proxy for the program contrasts across institutional types. They were determined by comparing the descriptions and "best practices" of each developmental math program at each institution. Since the six studied institutions were not chosen to be representative of all NDUS institutions, the following contrasts only apply to the six studied institutions, not to all NDUS institutions or all institutions within an institutional type.

Course Offerings. Beginning Algebra was offered least at the two studied BA institutions. BA I did not offer the course at all. BA II only offered it once a year and

sometimes canceled it due to low student enrollment. All other studied institutions offered the course during fall, spring, and sometimes summer semesters.

Coordination and Centralization. The developmental math programs at the two studied BA institutions had the least coordinated developmental mathematics programs. Individual developmental math faculty members often worked in isolation or in one case, did not enjoy teaching the courses.

At BA I, the developmental faculty member was isolated from other mathematics faculty members in another department. He did not participate in the Division of Science and Mathematics meetings, and he alone was responsible for developing the curriculum for the developmental math course.

The developmental mathematics curriculum at BA II appeared to involve the least amount of planning and coordination of all studied institutions. As mentioned above, the Math 102 instructor said there was no discussion about the course. He did not want to participate in decisions about math courses since he was primarily a computer science instructor. He said that he was given a text and told to teach through a certain chapter without thinking about whether or not students needed the content of the course for future math courses. The Math 102 instructor at BA II said that his dislike of teaching the course affected his instruction of the course. He said that he put as little time and effort as possible into the course and that his biggest challenge was maintaining enthusiasm to teach the course. He was the only interviewed instructor to mention this dislike of teaching the developmental math courses.

All of the other studied institutions had coordinated developmental mathematics programs. For the most part, developmental math faculty at these institutions followed the same outline of content and spent time discussing, preparing, and trying to align the curriculum.

The Doctoral Institution and AA II had the most coordinated developmental math programs of all six studied programs. At AA II, faculty of different departments worked together to coordinate the developmental math curriculum and to improve student learning. The developmental math courses at the Doctoral Institution used common syllabi, exams, and outlines of content. In addition, the Doctoral Institution and AA II had directors who were responsible for the developmental courses in their departments. Developmental math course supervisors also were used at the Doctoral Institution. At all other studied institutions, a department chair or representative, who did not necessarily have an interest in developmental math education, was in charge of these courses along with all other math, and sometimes non-math, courses.

AA II had the only centralized developmental program, with the exception of one course. All ASC developmental courses were organized and taught by instructors of the Academic Services Center. An instructor from the Academic Services Center usually taught some of the Math 102 sections each semester. In addition, there was a high degree of coordination between the Academic Services Department and the Math and Science Department that offered Math 102. Thus, AA II had a highly coordinated and almost centralized developmental program.

To summarize, the developmental math programs at the two BA institutions had the least amount of coordination, and the developmental math programs at AA II and the Doctoral Institution had the most coordination. The developmental program at AA II was centralized except for Math 102, which was offered in the Math and Science Department. AA II's program was the only centralized program included in the study.

Developmental Mathematics Faculty. At three of the institutions, AA I, BA I, and the Doctoral Institution, developmental math faculty did not participate in the planning and decision-making processes of their departments or the department which included the developmental math program. Developmental math instructors of these three institutions were more isolated from regular faculty members than at other institutions, and they were more often called "adjuncts." For example: At BA I, the developmental math instructor participated in the planning and decision-making processes of the Health and Physical Education Department but not in the planning and decision-making processes of the Division of Science and Mathematics which offered the developmental math course.

The Master's Institution and AA II involved developmental math faculty in the departmental planning and decision-making processes more than the other studied institutions. At AA II, developmental math instructors in the Academic Services Center even participated in the meetings of the Math and Science Department.

Policies. The Doctoral Institution was the only institution in which Math 102 did not satisfy any requirements for graduation. At all other institutions, credit for Math 102

depended on the program of study, but it was not completely eliminated as graduation credit.

The Doctoral Institution was the only institution that had mandatory placement. It was also the only studied institution that did not use ACT math scores as part of the assessment process. It used a series of placement exams to test every new student.

Courses that could not be used for any graduation requirements were funded differently at the Master's Institution and the Doctoral Institution. These institutions were not allowed to use state money to pay for these courses, and thus, other funds had to be used to support them. At the Doctoral Institution the developmental math courses were offered through Continuing Education. Students paid a special fee that completely funded these courses. At the Master's Institution, Math 099 was offered through Continuing Education. It did not require a special fee, but the number of students who took this course did not count toward total credit hour production in the Department of Mathematics and Computer Science.

Goals, Objectives, and Desired Outcomes. None of the studied developmental math programs had written program goals or objectives. Most of the collected developmental math course syllabi included course objectives or goals. The inclusion of goals or objectives sometimes depended on individual instructors. Different instructors often created their own syllabi that did not necessarily include the same course objectives, goals, or desired outcomes as other instructors' syllabi. An example of this was described above for the Master's Institution. Goals, objectives, or desired outcomes were not included on the common developmental math syllabi at the Doctoral Institution.

Instruction. Of all the studied programs and courses, only the four-credit Math 102 course at AA I used mastery learning. Its use of Gateway Tests was described above. Some of the interviewed instructors had test/retest policies, but retests without minimum grade requirements were not considered mastery learning.

AA I, AA II, and the Doctoral Institution integrated classroom and lab instruction. Descriptions of this integration were provided above in the Classroom and Lab Integration sections. The programs at the two BA institutions and the Master's Institution did not mention the use of any labs.

Technology was used in all six studied programs. The developmental math instructors at AA II, the Master's Institution, and the Doctoral Institution used graphing calculators to supplement the developmental math courses. The other three institutions used scientific calculators and sometimes a computer software program. The program at the Doctoral Institution was the only one that used an online computer program to supplement the developmental math courses. It was also the only institution to offer the developmental math courses completely online.

Instructors at the Master's Institution sometimes used teaching assistants in the developmental math courses. The use of teaching assistants began when someone wrote a grant proposal for this. This was not observed at any of the other studied programs.

Support Services. All six of the studied institutions had some kind of support services for students. Tutoring was offered at all institutions, but the Doctoral Institution was the only institution that required all new students take a freshmen seminar. BA I

offered a freshmen seminar course as part of its cohort program, but it did not require it for all students.

Institutional Support. The interviewees of AA I, the Master's Institution, and the Doctoral Institution perceived the least amount of institutional support. The interviewees cited money, policy, and administration's views of developmental education as a lack of support. The interviewees at AA II perceived the most support for developmental mathematics. They cited a large Academic Services Center and the institution's focus on student learning as two examples of institutional support for developmental mathematics. For further descriptions and examples of perceived support, see the Strong Institutional Commitment sections above.

Grade Distribution Data. Of the six studied institutions that sent grade data, the Master's Institution consistently had the lowest Math 102 GPAs and success rates. These GPAs ranged from 1.69 to 1.81 during fall 1999, 2000, and 2001. The success rates were between 48% and 57% when students who dropped the course were not included in the calculations. These rates decreased to 36-40% when students who dropped the developmental math courses were included in the calculations. The lowest corresponding success rates in Math 102 at other institutions were the highest Math 102 success rates at the Master's Institution.

Data were received for only one of the studied BA institutions, but the developmental courses at this institution had the highest student drop rates of all institutions, especially in Math 102. Approximately 35-51% of Math 102 students at BA

II dropped the course during fall 1999, 2000, and 2001. The highest drop rates at the other institutions were the lowest drop rates at BA II.

It is also interesting to note that AA II had the lowest drop rates in Beginning Algebra and Intermediate Algebra. In Math 102 these were often one half, and sometimes one-third, of the drop rates at the other studied institutions. The above rates can be found in Tables 21-31 of Appendices B-G.

"Best Practice" and Comprehensiveness. Table 19 provides a comparison of each institution by their use of "best practice." If a program used a "best practice," a "+" was placed in the blank. If a program did not use a practice, a "–" was placed in the blank. If the use of a practice could not be determined, "N/D" was placed in the blank. The total number of "best practices" for each institution is in the final row of Table 19. This was calculated by adding the number or + signs for each institution.

AA II, which had the only centralized program, used the most "best practices." The highly coordinated program at the Doctoral Institution used the second most "best practices." The cohort program and its inclusion of freshmen seminar and Supplemental Instruction contributed to the number of "best practices" used in the program at BA I. The programs at the Master's Institution and AA I each used seven "best practices," and the program at BA II used five.

Table 19. Use of "Best Practice" by Each Institution.

Best Practice	AA I	AA II	BA I	BA II	Master's Institution	Doctoral Institution
Mandatory assessment	+	+	+	+	+	+
Mandatory placement	–	–	–	–	–	+
Strong institutional commitment to developmental mathematics	N/D	+	N/D	N/D	N/D	N/D
Centralized developmental program	–	+	–	–	–	–
Highly coordinated developmental math program	–	+	–	–	–	+
Faculty development opportunities for developmental math faculty	+	+	–	+	+	+
Developmental math faculty participation in departmental planning and decision-making	–	+	–	+	+	–
Mastery learning	+	–	–	–	–	–
Learning communities or paired courses for developmental students	–	–	+	–	–	–
Integration of classroom and lab instruction	+	+	N/D	N/D	N/D	+
Supplemental use of technology	+[a]	+[b]	+[a]	+[a,c]	+[b]	+[b,d]
Variety of instructional methods	N/D	N/D	–	N/D	N/D	N/D
High degree of course structure	N/D	N/D	N/D	N/D	N/D	N/D
Intent to align exit skills and knowledge of developmental math courses with those of future courses	+	+	+	N/D	+	+
Written statement of program goals or objectives	–	–	–	–	–	–
Course goals or objectives on syllabi	+	+	+	+	+	–
Support Services						
Ongoing student orientation	–	–	–	–	–	–
Freshmen seminar	–	–	+	–	–	+
Trained tutors	+	+	+	–	+	+
Supplemental Instruction	–	–	+	–	–	–
Program assessment	–	–	–	–	–	–
Total number of "best practices"	7	11	8	5	7	9

Note. + Indicates evidence of a practice. – Indicates that a practice was not used. N/D Indicates the practice could not be determined. [a]Scientific calculator. [b]Graphing calculator. [c]Computer software. [d]Online computer program.

Summary. After the six developmental math programs were contrasted, the researcher found the following differences.

1. Beginning Algebra was offered least at the two BA institutions.
2. AA II and the Doctoral Institution were the most highly coordinated programs.
3. The Doctoral Institution had a director and course supervisors who were responsible for the developmental mathematics curriculum and instructors.
4. AA II and the Master's Institution involved developmental math faculty in the departmental planning and decision-making processes more than other institutions involved faculty in these processes.
5. The Doctoral Institution was the only institution in which Math 102 did not satisfy any graduation requirements.
6. The Doctoral Institution was the only institution that had mandatory placement.
7. At the Master's Institution and the Doctoral Institution, courses that did not satisfy any graduation requirements were offered through Continuing Education and were funded differently.
8. Syllabi at all studied institutions, except the Doctoral Institution, had stated course goals, objectives, or desired outcomes.
9. BA I was the only studied institution that had a cohort program for underprepared students. Math 102 was included as one of the four courses students in the cohort program.

10. The developmental math program at the Doctoral Institution was the only one to supplement the developmental math courses with an online computer program and to teach one section of each developmental math course solely online.
11. The Master's Institution was the only institution that sometimes used teaching assistants in the developmental math classes.
12. New students were required to take a freshmen seminar course at the Doctoral Institution.
13. Interviewees at AA I, the Master's Institution, and the Doctoral Institution perceived the least amount of institutional support for developmental mathematics. Interviewees at AA II perceived the most institutional support for developmental mathematics.
14. The Master's Institution had the lowest Math 102 success rates and GPAs.
15. The program at BA II used the fewest "best practices." The program at AA II used the most "best practices."

Discussion of the Meaning

Relationship to Prior Research

Remedial Education Versus Developmental Education. In the literature, distinctions were made between remedial education and developmental education. Remedial education was focused on alleviating deficiencies in students' academic skills and usually was done only through coursework. Developmental education was more holistic. It was offered under an umbrella of services, including courses, counseling,

tutoring, Supplemental Instruction, orientations, seminars, learning labs, and workshops. Its purpose was to develop the entire student, not just fix academic inadequacies. The developmental math programs included in this study were a both remedial and developmental in nature. The programs were remedial for two reasons: (1) Courses were still the primary method used in developmental math education at the studied institutions; and (2) The main goal of these courses was to improve students' skills and to "fix academic inadequacies" in preparation for students' next math courses. The programs were also developmental because other support services, like tutoring, Supplemental Instruction, orientation, labs, and learning centers, were available. Further, developmental math instructors at all six studied institutions were concerned with reducing students' fears and anxieties about math and with improving their self-esteem and confidence.

The Developmental Student. The developmental math students were similar to the types of students described by Abraham and Creech (2000) and by Hardin (1988, 1998). They were very diverse and had different reasons for needing to take developmental mathematics courses.

Cost and Critics of Developmental Education. The cost of developmental education was difficult to determine according to the literature (Merisotis & Phipps, 2000; Phipps, 1998; Saxon & Boylan, 1999; Steinberg, 1998). The same was true in this study. No one seemed to know what was spent on developmental math education, except the ASC Director at AA II and the Continuing Education Director at the Doctoral

Institution. These two institutions were more centralized and had instructors who typically taught only developmental math courses. These things, as Saxon and Boylan (1999) explained, made it easier to calculate costs.

There were critics of developmental education. Some interviewees blamed part of the need for developmental education on the ineffectiveness of high schools. It was also evident that the state of North Dakota and some administrative offices did not believe four-year institutions should provide developmental education. There were limits on the number of underprepared students BA institutions could accept. The Master's Institution and the Doctoral Institution also had restrictions on how developmental courses were funded and who on campus offered these courses. The Doctoral Institution charged additional tuition for these courses.

The Performance of Developmental Students. The National Center for Education Statistics (1996) reported that 24% of all first time freshmen enrolled in developmental mathematics courses during fall 1995. Adelman (1999) reported that 46% of all students who earned more than 10 credits took at least one developmental course in English, pre-collegiate math, or basic study skills. Pre-collegiate math was defined to be any course through the level of what high schools call "intermediate algebra" (Adelman, 1999). In this study, interviewees estimated that 25-60% of all students took a developmental mathematics course. The estimates at the two AA institutions were higher than the estimates at the other institutions. These estimates were definitely in line with those calculated by Adelman (1999) and the National Center for Education Statistics (1996) and cited above.

The National Center for Education Statistics (1996) also reported that 66% and 71% of students at public two-year and four-year institutions, respectively, passed developmental math courses. In this study, grade distribution data were collected for all two-year public institutions and three of the six four-year institutions during fall 1999, 2000, and 2001. Using these data, approximately 86% and 79% of students at two-year and four-year institutions, respectively, passed developmental math courses as defined for this study. These percentages were higher than those determined in the study by the National Center for Education Statistics (1996).

According to Adelman (1999), the top six undergraduate courses with the highest rates of withdrawals, no credit repeats, and incompletes were mathematics courses below the college algebra level (p. 202). The rates for these courses were between 16.5% and 23.7% (Adelman, 1999). In this study 23.5% and 29.3% of students at two-year and four-year institutions, respectively, dropped or received an incomplete in a developmental math course. Students at the institutions of this study dropped more than the national averages computed by Adelman (1999). Also according to Adelman (1999), four of the top five undergraduate courses with the highest rates of failure or penalty grades (F, WF, U) were also mathematics courses below the college algebra level (p. 203). These rates were between 8.6% and 9.5% (Adelman, 1999, p. 203). In this study, 14% and 21% of students at two-year and four-year institutions, respectively, received an F or U grade in a developmental math course. Again, these percentages were much higher than the percentages Adelman (1999) reported.

Penny and White (1998) indicated, "A student's performance in his or her last developmental mathematics course was the strongest predictor of success in college algebra" (p. 10). The grade information, which was summarized by an instructor at AA I, had results that were similar to Penny and White's (1998) findings. During spring 2002, 80% of students who received A and B grades in Intermediate Algebra passed College Algebra. Students who received C grades or D and F grades passed College Algebra 34% and 24% of the time, respectively. Forty-nine percent of students who repeated College Algebra passed. Those students who did well in their last developmental course were most successful in College Algebra, and those who were not successful in their developmental course were not usually successful in College Algebra.

Policies of Developmental Education. Researchers (Boylan, Bliss, & Bonham, 1997; Morante, 1989; Roueche & Roueche, 1999a, 1999b) have advocated mandatory assessment and placement of developmental students. They suggested that developmental programs that mandated assessment and placement were most effective. All six studied institutions had mandatory assessment, but only the Doctoral Institution had mandatory placement. It was not determined if the programs in this study that had mandatory assessment or mandatory placement or both were more effective, only that they did or did not have this policy in place.

All institutions provided financial aid credit for developmental math courses like Astin (1985) and Roueche and Roueche (1999b) advocated. Other credit for these courses depended on the program and the institution.

According to Boylan and Saxon (1998a) and Roueche and Roueche (1999a), it was important for institutions to make a strong commitment to their developmental education programs through public administrative support, appropriate allocation of resources, and institutional acceptance of developmental education. Many of the interviewees at AA I, the Master's Institution, and the Doctoral Institution did not perceive their institution as being strongly committed to developmental mathematics education. They often cited financial issues, policy, and large class sizes as examples of this lack of support (for specific examples, see each institution's Strong Institutional Commitment section above).

Roueche and Roueche (1999b) suggested that institutions abolish late registration, eliminate dual/simultaneous enrollment in skill and regular academic courses, and encourage working students to take a reduced number of credit hours. This did not occur at any of the six institutions. At AA I, a few interviewees commented on developmental math students taking too many credits while working too many hours and raising a family. The cohort program at BA I perhaps did keep underprepared students in a more appropriate level of courses as the four cohort courses were Math 102, basic English, a study skills course, and freshmen seminar.

Organization of Developmental Education. Having a centralized department where all courses and services were provided by one administrative unit was related to increased retention, passing developmental courses, and higher GPAs (Boylan, Bliss, & Bonham, 1997). In this study, the only centralized department was at AA II. In addition, the program at this institution used the most "best practices." All other developmental

programs were decentralized and offered through some type of mathematics department. Some of these programs were more coordinated than other programs. The reported communication and planning that occurred within and across developmental math courses and departments that taught developmental mathematics were indications of coordination. Another indication of coordination was courses with common syllabi, exams, texts, and content. Boylan, Bonham, and Bliss (1992) found the level of coordination was an important factor in the success of decentralized programs. The centralized program at AA II was highly coordinated as was the program at the Doctoral Institution, but the researcher did not determine if these programs were the most successful or effective.

Developmental Faculty and Staff. According to the literature, developmental faculty and staff, especially in mathematics, tended to: have less education and training; were more likely to be part-time; had little involvement with decision-making and planning in their departments; and were less likely to be interested and committed to teaching developmental education (Boylan, Bonham, Jackson, & Saxon, 1994; Penny & White, 1998). Most of these factors were present in the developmental math programs included in this study. Almost all developmental mathematics instructors had bachelor's degrees or master's degrees. Only a few had doctorates, and these few only taught developmental math courses part-time. No instructors had training in developmental education. At some institutions, AA I, BA I, and the Doctoral Institution, developmental math faculty did not participate in the decision-making and planning processes of their

departments. Most interviewed instructors enjoyed teaching developmental math courses so this did not appear to be a problem.

Students who participated in developmental programs that emphasized professional development for faculty and staff were more likely to pass developmental courses, to earn higher grades, and to be retained longer (Boylan, Bonham, Claxton, & Bliss, 1992). Faculty development opportunities were available for most instructors, but these opportunities were not always emphasized and usually received less priority than opportunities for full-time instructors or professors.

In addition, the American Mathematical Association for Two-Year Colleges (2002) cautioned mathematics departments to not overuse adjuncts and part-time faculty. Adjuncts instructors and part-time faculty predominantly were used at most of the studied institutions. Thus, the institutions were not in line with the advice of the American Mathematical Association for Two-Year Colleges (2002).

Developmental Instruction and Curriculum. According to Boylan and Saxon (1999), evidence from studies by Cross (1976) and Kulik and Kulik (1991) supported the use of mastery learning in developmental courses. Boylan, Bonham, Claxton, and Bliss (1992) found that developmental students in courses that used mastery learning techniques were more likely to pass those courses, earn higher grades, and be retained, than developmental students who were enrolled in courses using more traditional teaching techniques. The four-credit Math 102 course at AA I used mastery learning with the Gateway Tests. Students who enrolled in this course had lower ACT or placement scores, yet had similar or higher GPAs and success rates than those students

who had higher placement scores in three-credit Math 102 according to the data collected by an instructor at AA I. It was not know if the use of the Gateway Tests was related to these results. In addition, the four-credit Math 102 course was highly structured and included more applications and active learning activities than the three-credit Math 102 course did.

Tinto (1998) and others (Hunter College, Sacramento City College, the University of Minnesota Twin Cities, Skagit Valley College, Spokane Falls Community College, and Seattle Central Community College; see Tinto, 1998 for more) found that learning communities increased students' level of involvement academically and socially, improved attitudes toward learning. These students had higher pass rates, higher persistence rates, higher grades, and higher completion rates than students who did not participate in learning communities (Tinto, 1998). In this study, the cohort program for underprepared students at BA I had positive results similar to those of Tinto (1998). It had significantly increased retention rates of underprepared students to those of regular college students according to the Director at BA I.

Integration of classroom and laboratory instruction was associated with student success (Boylan, Bliss, & Bonham, 1997). The lab instruction used at AA I, AA II, and the Doctoral Institution was integrated with classroom instruction. It was not determined if this integration was associated with student success.

The American Mathematical Association of Two-Year Colleges (AMATYC) (1995, 2002) and the National Council of Teachers of Mathematics (2000) stated that technology should infuse the curriculum of all mathematics classes to enhance

mathematical thinking, learning, and problem solving. The research of others (Boylan & Saxon, 1998a, 1999; Maxwell, 1997; Vásquez, 2000) indicated that integrated supplemental technology had positive effects on student learning, attitudes toward math, making math more real world based, grades, and retention. All developmental mathematics programs in this study used some type of technology, but the type of technology and extent of its use often varied by instructors and institution. Scientific calculators were used at AA I and at the two BA institutions. Graphing calculators were used at the other institutions. The Doctoral Institution was the only institution to use an online computer program as well.

Researchers (Boylan & Saxon, 1999; Casazza & Silverman, 1996; Cross, 1976; Kulik and Kulik, 1991) determined that developmental students were more likely to be successful when a variety of instructional methods were used and tended to learn best by direct experience and by doing. The use of a variety of instructional methods was observed in some of the developmental math classes, but each instructor and their personal teaching style usually determined the amount of variety in the classroom. When observing, the researcher noticed that students were more positive and participated more in those classes in which the instructor used methods other than straight lecture, made the material meaningful, and actively involved students in their learning. In this study, conclusions could not be made about the relationship between student success and variety.

Boylan, Bonham, Claxton, and Bliss (1992) found that when consistency was ensured between exit standards in developmental courses and entry standards in regular

college courses, the developmental courses were more effective. The researcher did not determine the effectiveness of each program, but she did find intent by faculty and coordination between faculty to align the content of each developmental math course with future math courses. Most interviewees indicated goals of preparing students for their next math course.

Researchers (Boylan & Saxon, 1998a; Casazza & Silverman, 1996; Maxwell, 1997; Roueche & Roueche, 1993; Roueche & Snow, 1977) suggested that successful developmental programs had clearly defined philosophies, goals, and objectives. Having stated these was also related to improved student performance according to the research of Boylan and Saxon (1999). Course syllabi often included course goals or objectives, and the interviewees usually had some kind of goals for their courses and students even if these were not written down. None of the studied developmental math programs had clearly defined and agreed upon written program philosophies, goals, and objectives. Thus, these goals and objectives might not have been clearly made known to others. An increase of written program goals and desired outcomes appeared to be occurring as administration began making this a requirement at institutions, but developmental education was likely to be ignored because it: was not centralized at most institutions; did not always have institutional support; and was not necessarily recognized as a program. For example, at the Master's Institution Math 099 was not required to submit a formal syllabus that included course goals and desired student-learning outcomes.

Other literature recommended instructional methods (Starks, 1998) were practiced by some of the instructors and programs: cooperative learning, frequent student-faculty

contact in class, and frequent evaluations of students with prompt and continuous feedback. At the same time, other instructional methods not recommended in the literature review also occurred. These methods included: large classes, infrequent student-faculty contact in class, and infrequent evaluations of students with little to no feedback.

Developmental Support Services. Researchers (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan, Bonham, Claxton, & Bliss, 1992; Casazza & Silverman, 1996; Commander, Stratton, Callahan, & Smith, 1996; Gardner, 1998; Higher Education Extension Service, 1992; Hodges & White, 2001; Keimig, 1983; Kulik, Kulik, & Schwalb, 1983; Martin, Arendale, & Blanc, 1997; Ramirez, 1997; Roueche & Snow, 1977) found that developmental support services like orientation, freshman seminar, counseling, tutoring that uses trained tutors, and Supplemental Instruction increased retention, student success, GPA, pass rates, and course completion rates. In this study, all six institutions had some type of tutoring service available for developmental math students. Most of the tutors received some type of training, but according to some interviewees, this was not sufficient. Interviewees at the Doctoral Institution said that tutors did not really help when they taught the material in ways inappropriate to the developmental math courses. Freshmen seminar was offered at BA I and at the Doctoral Institution. Supplemental Instruction was included in the courses for the cohort of underprepared students at BA I. Orientation was offered at all institutions, but it was not ongoing like Roueche and Roueche (1999a) recommended. As stated earlier, the cohort program that included freshmen seminar and Supplemental Instruction

increased developmental students' retention. The use of Supplemental Instruction in developmental math courses might be appropriate since most of these courses had drop rates of 30% or more (Martin, Arendale, & Blanc, 1997).

According to Boylan, Bonham, Bliss, and Saxon (1995), the majority of tutors worked part-time, were paid for their services, and were undergraduate peer tutors, except at four-year institutions where graduate students were sometimes used as tutors. This was the case at most of the institutions in this study. Peer tutors tutored at all six of the studied institutions. Graduate students also were used at the Doctoral Institution, and instructors tutored at the Doctoral Institution and at AA II.

Assessment and Evaluation of Developmental Programs. Researchers (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Claxton, & Bliss, 1992;Donovan, 1974; Roueche & Snow, 1977) found that regular and systematic program evaluation was related to program success, student success, and retention. Also, the more effective programs with higher rates of student success used a combination of formative and summative evaluation methods, and the formative data were used to improve the program (Boylan & Saxon, 1998a, 1999).

Some isolated assessment methods took place in the developmental mathematics programs, but none of the programs were formally, regularly, and systematically assessed and evaluated. Students completed course and instructor evaluations in all classes at all institutions but not necessarily for the improvement of the developmental math programs. AA I and AA II were the only institutions that had someone tracking the success of students in current and future developmental math courses. At AA II, the ASC Director

said this was "done for institutional assessment purposes," not necessarily for program improvement. At AA I, tracking student success in current and future math courses was not part of any formal assessment process. One instructor did it out of interest, but also to understand what was occurring in the mathematics courses. Changes might or might not have been made based on this information. Individual instructors and directors used other informal assessment methods that may have affected their programs.

Comprehensiveness. Boylan, Bonham, and Bliss (1994a) stated:

> The literature in the field of developmental education (Boylan, 1983; Keimig, 1983; Kulik, Kulik, & Schwalb, 1983; Maxwell, 1985; Roueche & Snow, 1977) has consistently suggested that the more comprehensive the services of a developmental program, the greater its likelihood of promoting student success. Remedial courses alone, tutoring alone, counseling alone, or academic advising alone are less effective than a combination of these services. The most effective developmental education, therefore, is comprehensive. (p. 1)

The developmental math program at AA II used the most "best practices" of the six studied programs (see Table 19). The developmental math program at the Doctoral Institution used the second most "best practices," and the program at BA II used the least number of "best practices." Effectiveness was not determined in this study, but AA II might have had the greatest advantage with its use of the most ""best practices." In addition, AA II's program was centralized and employed trained and degreed tutors who were also instructors of the developmental courses. These two factors, centralization and trained tutors, were two of the three factors related to the most success variables according to Boylan, Bliss, and Bonham (1997).

Reducing and Improving Developmental Education. Included in the literature were suggestions for reducing and improving developmental education. Programs in this study were not implementing many of these suggestions..

1. Spann (2000b) suggested faculty:student or staff:student ratios that were appropriate for effective and efficient developmental education. Many interviewees complained that class sizes were too large to be effective.
2. According to interviewees, developmental math students often did not take an upper level math course their senior year of high school like Adelman (1999), Abraham and Creech (2000), and the National Center for Education Statistics (2000) recommended.
3. Boylan, Bonham, and White (1999) suggested using more alternatives to traditional coursework, but there were few of these at the studied institutions.
4. Minimum standards and procedures for placement and assessment were not consistent statewide for all public institutions of higher education like Spann and McCrimmon (1998) recommended.
5. Spann and McCrimmon (1998) and Roueche and Roueche (1999a) suggested programs assess, evaluate and take action on what is found. Few programs did this regularly and systematically.
6. Finally, more needed to me done to meet the recommendations, position statements, and standards written by the dominant professional organizations of developmental education. These organizations being the National Center for Developmental Education, the National Association for Developmental Education, and the American

Mathematics Association of Two-Year Colleges. For example, faculty should receive more training and development.

Findings Not Supported and Supported by the Literature

Findings Not Supported by the Literature. The findings in this study that were not supported by the literature typically were ones not in accordance with the literature of "best practice" in developmental education.

1. Placement was not mandatory at all institutions.
2. There was a lack of institutional commitment, as perceived by some of the interviewees at some of the institutions, to developmental mathematics education.
3. The developmental programs were decentralized at all but one institution.
4. Training and faculty development opportunities for developmental mathematics instructors were not emphasized as much as they were emphasized for non-developmental math faculty.
5. The educational levels of developmental mathematics faculty were bachelor's degrees or master's degrees. Very few to none of these instructors had doctorates or training in developmental education.
6. Mastery learning was not practiced in most of the studied developmental mathematics courses and programs.
7. Only one program had a cohort program for underprepared students.
8. Developmental mathematics program philosophies, goals, objectives, or desired outcomes were not clearly defined, stated in writing, and shared with others. The

course goals, objectives, or desired outcomes were often different for the same course since instructors often developed these individually.

9. Orientation programs were not ongoing.
10. Tutoring was the main support service for students, but some of the tutors needed more training because, according to some interviewees, they did not teach the material in ways appropriate to the developmental courses.
11. Assessment of developmental mathematics programs was not done or was not done regularly and systematically using formative and summative forms of assessment aimed at improving the programs.
12. Between 14% and 51% of students dropped developmental math courses at five of the six institutions included in the study. The majority of the drop rates were between one-fourth and one-third. When eight of the 11 institutions were included in the calculations, 24% and 29% of students at two-year and four-year institutions, respectively, dropped or received an incomplete in a developmental math course. Students at these institutions dropped more than the national averages of 17-24% calculated by Adelman (1999).
13. The average grade point averages in developmental math courses at the five of the six studied institutions were between 1.69 and 2.48 with two exceptions of 1.25 and 2.86. The research by one instructor at AA II suggested that students needed A and B grades to be successful in future math courses, and these GPAs did not indicate that most students earned A and B grades.

14. In this study, 14% and 21% of students at eight of the 11 two-year and four-year institutions, respectively, received F or U grades in developmental math courses. These percentages were much higher than and nearly double the national percentages reported by Adelman (1999).

Findings Supported by the Literature. The findings in this study that were supported by the literature typically were ones in accordance with the literature of "best practice" in developmental education.

1. Most interviewed instructors enjoyed teaching developmental mathematics courses and were hired specifically for that purpose.
2. Tutoring was available at all six institutions.
3. Developmental mathematics education was usually supported within the institution's mathematics department or within the developmental program or both.
4. Faculty and departments intended to align the developmental mathematics curriculum with other mathematics courses.
5. Most departments had some level of coordination.
6. Developmental mathematics instructors were included in the departmental planning and decision-making processes at the Master's Institution, AA II, and BA II.
7. Many of the interviewed and observed instructors included variety and structure in their developmental mathematics instruction and wanted to get students actively involved in class.

8. The cohort program at BA I significantly improved the retention of underprepared students, according to the Director at BA I. This program also included freshmen seminar, a study skills course, and Supplemental Instruction.
9. All developmental math courses counted toward financial aid credit.
10. There was one centralized program (with the exception of one course). In this program, the departments that offered these courses and the instructors who taught them worked closely together. Also, this program used the most "best practices."
11. The Master's Institution sometimes used teaching assistants to help with the instruction of developmental mathematics courses. According to survey results that were reported by an interviewee, the teaching assistants had a positive influence on the courses.
12. Some instructors at the Master's Institution consistently offered extra help outside of class as additional support for students.
13. AA I had created an alternate, four-credit version of Math 102 to address the needs of higher risk developmental math students. This course used mastery learning and lab exercises, and it appeared to be successful according to the interviewees. All interviewees at AA I wished more sections of Math 102 were taught this way.
14. Based on the data collected from eight of the 11 institutions, the researcher determined that approximately 86% and 79% of students at two-year and four-year institutions, respectively, passed developmental math courses as defined for this study. These percentages were higher than those found in the study by the National Center for Education Statistics (1996).

Weaknesses, Uncontrolled Factors, and Incongruities in the Study

Several factors weakened the study or could not be controlled. First, the researcher spent a small amount of time on each campus. Only the Director and one instructor of each developmental math course were interviewed at each of the six institutions. Each developmental math course was observed only once. These factors limited the conclusions that could be made about all developmental instruction at an institution. For example, due to the limited amount of time observing, the researcher could not determine if constructivist or discovery based teaching methods and cognitive, teaching, and learning theories were used. Determining the use of these theories and methods would require more extensive observations. Also, since all developmental math instructors were not usually observed at each institution, the researcher could only conclude that the interviewed and observed instructors used course structure and a variety of instructional methods, not that all instructors necessarily used these methods at the institution.

Second, the instructors were not randomly selected at institutions in which there was more than one instructor teaching each course. Instructors who were available at certain times on the day of the visit were usually those chosen for observation and interviews. One course was not offered during fall 2002 at BA II so little information was gathered about it. The order of the interview and the observation of an instructor could not be determined. Sometimes the class was observed prior to the interview, and sometimes it occurred after the interview. This might have had an effect on the questions asked during the interview or even what was observed during the classroom observation.

Third, some institutions were not as cooperative as other institutions. The Director at BA II was very apprehensive about the study. He did not allow the researcher to tape the interviews. He usually gave very brief answers or completely refused to answer questions. This limited the amount of information collected from the Director at BA II. The developmental instructor at one of the originally selected BA institutions refused to be observed and interviewed. Because of this, another BA institution was contacted and invited to participate in the study. The same BA institution in which the instructor declined to participate also declined participation in the request for grade distribution data. Another BA institution and the second Doctoral institution never sent the requested grade distribution data. The lack of grade data from one of the BA institutions included in the study limited the conclusions that could be drawn about BA institutions. All grade data from the Doctoral Institution did not include the number of students who dropped the courses; thus, conclusions and comparisons that involved the students who dropped the courses could not be made. There was a similar problem for two semesters of Math 099 grade data at the Master's Institution. These limitations were addressed each time conclusions about these data were made.

Fourth, the grade data could not be interpreted. It was not known why students dropped courses or if the same courses were actually comparable at different institutions. The grade data were merely descriptive. Statistical comparisons to detect significant differences were not made between GPAs, drop rates, and success rates at different institutions.

Fifth, various indicators of institutional support and lack of institutional support were reported and observed, but no definitive conclusions, except at AA II, were made about the institutional support of developmental mathematics. Further research would need to be done to make confident conclusions in the level of institutional support at the institutions.

Sixth, there were distinct differences in the practices of the studied institutions within the institutional types, and thus, the researcher chose to treat each program individually. Therefore, because the chosen institutions reflected membership in each institutional type, the researcher contrasted the practices of the programs at the six studied institutions as a proxy for the contrasts across institutional types.

Chapter Summary

Data were collected using interviews, observations, course syllabi, and grade distribution reports. These data were analyzed and used to describe six postsecondary developmental mathematics programs in North Dakota. Once each program was described, it was compared to "best practice" in developmental education. Finally, contrasts across between the six programs were highlighted. Below are summaries and highlights of the descriptions, comparisons, and contrasts.

Most institutions offered the developmental math courses, Beginning Algebra and Intermediate Algebra, and AA II offered a number of other courses as well. All programs but one were decentralized and located in some type of mathematics department. Most

programs had some level of coordination, and AA II and the Doctoral Institution had the highest levels of coordination.

Assessment was mandatory at all six institutions but placement was only mandatory at the Doctoral institution. At the Master's Institution and the Doctoral Institution, some of the developmental math courses were funded differently and offered through Continuing Education rather than a math or academic services department.

Most developmental math faculty had bachelor's degrees or master's degrees but lacked training in developmental education. They were usually adjuncts, lecturers, or instructors who had limited training and faculty development opportunities. At AA I, BA I, and the Doctoral Institution, developmental instructors did not participate in the departmental planning and decision-making processes. The most common change faculty desired was smaller class sizes.

Students were diverse at each institution. The interviewees thought that 25-60% of students needed to take developmental math courses. Grade point averages hovered around 2.0, and drop and failure rates were higher than those calculated by Adelman (1999) in his national study.

The curriculum usually was developed by developmental math instructors and by a group of faculty members. These faculty members were not always those who taught the developmental math courses. Instruction usually varied according to the instructors' styles. Lecture, board work, group work, supplemental use of technology, and active learning were the primary methods of instruction used by instructors of this study.

Instructors usually tried to prepare students for their next math course by providing students with material in the current course that was prerequisite material for the following course. Interviewees at all of the institutions also mentioned trying to alleviate students' fears and anxieties about math.

Tutoring was available to students at all six institutions. Freshmen seminar was offered at the Doctoral Institution and at BA I where it was included with Math 102 as one of the courses in the cohort program for underprepared students. Supplemental Instruction supported all cohort courses as well.

None of the developmental math programs had defined and stated program philosophies, goals, or objectives, but most syllabi included course goals or objectives. None of the developmental math programs were regularly and systematically assessed. There were informal or isolated assessment activities, but these activities were not part of a formal process aimed at improving the entire program.

With regard to "best practice," AA II used the most "best practices." It was also the only centralized developmental program. The highly coordinated Doctoral Institution used the second most "best practices," and BA II used the least "best practices." Below are highlights of the comparisons to "best practices" and of the program contrasts.

1. The Doctoral Institution was the most highly coordinated program. It had a director, course supervisors, and common content, syllabi, and exams.
2. AA I, BA I, and the Doctoral Institution did not involve developmental math faculty in departmental planning and decision-making processes.

3. The Doctoral Institution was the only institution in which Math 102 did not satisfy any graduation requirements.
4. All six institutions had mandatory assessment, but the Doctoral Institution was only institution that had mandatory placement.
5. At the Master's and Doctoral Institutions, courses that did not satisfy any graduation requirements were offered through Continuing Education and were funded differently.
6. BA I had a cohort program for underprepared students. Students together took Math 102, basic English, a study skills course, and freshmen seminar. Supplemental Instruction supported all of these courses.
7. Syllabi at all of the institutions, except the Doctoral Institution, had stated goals, objectives, or desired outcomes, but none of the developmental math programs had defined and stated program goals, objectives, or desired outcomes.
8. Assessment of developmental mathematics programs did not occur or did not occur regularly and systematically using formative and summative forms of assessment aimed at improving the programs.
9. All institutions used some form of technology in the developmental math courses. The Doctoral Institution was the only one to supplement the developmental math courses with an online computer program and to teach one section of each developmental course solely online.
10. All institutions had some form of tutoring, and the Master's Institution was the only one that sometimes used teaching assistants in the developmental math classes.

11. The Doctoral Institution was the only institution that required new students to enroll in a freshmen seminar course. As previously mentioned, BA I also offered a freshmen seminar course that was included with Math 102 in the cohort program for underprepared students.
12. The Master's Institution had the lowest Math 102 success rates and GPAs.

CONCLUSIONS

Chapter Introduction

Postsecondary developmental education is prevalent in higher education institutions. Over three-fourths of all higher education institutions that enrolled freshmen in 1995 offered developmental courses in reading, writing, or mathematics (National Center for Education Statistics, 1996), and 46% of all postsecondary students who earned more than 10 credits took at least one remedial course in English, pre-collegiate math, or basic study skills (Adelman, 1999). This demand for developmental education is not expected to change. Demographic changes, such as an aging population, growing minority populations, changing family life, and poverty levels, will impact higher education, especially developmental education. It will be called upon to help educate this diverse population in order to remain globally competitive in the increasingly technical workplace and economy (Boylan, Bonham, & White, 1999; Ghazi & Irani, 1997; Institute for Higher Education Policy, 1998; McCabe, 2000a, 2000b; McCabe & Day, 1998; Merisotis & Phipps, 2000; Phipps, 1998; Roueche & Roueche, 1999a; The Economic Importance, 2001)

It has been shown that the largest need for developmental education is in mathematics (Adelman, 1999; McCabe, 2000a; National Center for Education Statistics, 1991, 1996) but often with the least amount of success (Adelman, 1999; National Center for Education Statistics, 1996). Developmental mathematics courses have the highest rates of withdrawals, no credit repeats, and incompletes and are four of the top five

courses that had the highest rates of failure and penalty grades (Adelman, 1999, pp. 202-203).

Research has been conducted and summarized with regard to what are "best practices" in developmental education (Boylan & Saxon, 1999). The results of this research guided this study and were used to create the Summary of "Best Practices" in Developmental Education below in Table 20 and previously in Table 7.

Developmental education is present in North Dakota, and like the rest of the country, developmental mathematics education had the largest enrollments of all subject areas in 1999-2000 (NDUS, 2000). As, little was known about the developmental mathematics programs, the purpose of this study was to: (a) describe public postsecondary developmental mathematics education in North Dakota; (b) to compare each institution's policies, organizational and instructional characteristics to "best practice" in developmental education; and (c) to contrast these programs by institutional type using the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994).

To accomplish this purpose, data were collected from six public postsecondary institutions in North Dakota using the following methods. The Director of Records at each of the 11 public postsecondary institutions in the NDUS was contacted and asked to send developmental mathematics grade distribution data for fall semesters 1999, 2000, and 2001. Directors and instructors of developmental mathematics courses were contacted at two AA institutions, two BA institutions, one Master's institution, and one Doctoral institution. Dates and times for each campus visit were arranged. During each

visit, the researcher: (a) collected course syllabi, (b) interviewed the director of the developmental mathematics program, (c) interviewed one instructor of each developmental mathematics course, and (d) observed one class of each developmental mathematics course.

Table 20. "Best Practices" in Developmental Education.

"Best Practices"
1. Mandatory assessment and placement of developmental mathematics students.
2. Strong institutional commitment to developmental mathematics.
3. Centralized or highly coordinated developmental program.
4. Training and professional development and for the staff and faculty who work with developmental mathematics students. These staff and faculty should also be involved in departmental planning and decision-making processes. Adjuncts and part-time faculty should not be overused.
5. Developmental courses should be designed and taught using sound cognitive, teaching, and learning theories. This includes integrating strategic learning, critical thinking, and metacognition into the curriculum.
6. Successful instructional and curricular methods include: a. mastery learning techniques; b. learning communities and/or paired courses; c. the integration of classroom and laboratory instruction; d. the supplemental use of technology; e. the use of a variety of instructional methods; f. a high degree of course structure; g. constructivist or discovery based techniques; h. the alignment of exit skills and knowledge in developmental courses with those required to enter regular courses; and i. clearly defining, linking, and sharing with others the philosophies, goals, and objectives of the developmental program and its courses.
7. The provision of various support services, including ongoing student orientation, freshmen seminars, the use of trained tutors, and Supplemental Instruction;
8. Regular, systematic assessment that is both summative and formative and is used to revise and improve the program and its courses.
9. Comprehensiveness, or the use of many "best practices," rather than a few.

Following the data collection, the researcher organized and analyzed the data to address the three parts of this study's purpose and to answer the three research questions. In the fourth chapter, the findings were organized into three sections: (1) descriptions of each developmental mathematics program, (2) comparisons of each program to "best practice" in developmental education, and (3) program contrasts. The findings are summarized below with an emphasis on comparing them to "best practice" as defined in the literature.

Summary of the Findings

Course Offerings

All studied institutions, except AA II and BA I, offered two developmental mathematics courses, Beginning Algebra (ASC 092 or Math 099) and Intermediate Algebra (Math 102). AA II offered the above mentioned courses as well as three other developmental math courses. BA I only offered Math 102. AA I offered two versions of Math 102. One version was three credits. The other version was four credits, slower paced, and included a one-credit lab component. It was intended for students with lower placement scores and who were considered at risk of successfully completing the course.

All courses numbered below 100 did not satisfy any requirements for graduation. Thus, students did not receive graduation credit for Beginning Algebra. Math 102 did not satisfy any requirements for graduation at the Doctoral Institution, but at other institutions, credit for Math 102 depended on the program of study.

Mandatory Assessment and Placement

Mandatory assessment and placement were "best practices" in developmental education and were positively related to student success (Boylan, Bliss, & Bonham, 1997). All six of the studied institutions had mandatory assessment, but only the Doctoral Institution had mandatory placement.

Strong Institutional Commitment

Strong institutional commitment to developmental education was another "best practice" in developmental education. Institutions that were committed to developmental education were more likely to do the things necessary to make developmental education, effective, valued, and an integral part of the institution (Boylan & Saxon, 1998a, 1999; Roueche & Roueche, 1999a).

At AA II, all of the interviewees indicated institutional support for the developmental math courses. Special funds and services, like the large Academic Services Center, were appropriated for the benefit of these students. At BA I, the cohort program for underprepared students was a strong indicator of institutional support for developmental education as was its use of Supplemental Instruction. The practices of these two institutions suggest that developmental students, courses, and support services were valued at these institutions. In the fourth chapter, responses of the interviewees from these institutions supported this statement.

The interviewees at AA I, the Master's Institution, and the Doctoral Institution perceived the least amount of institutional support for developmental mathematics education. Two interviewees at AA I said that they had to fight with administration to

not cancel the four-credit Math 102 course that was designed for slower-paced students. In addition, the Director at AA I said that inappropriate advising was a problem, as faculty did not always follow the placement cut scores. At the Master's Institution, interviewees complained of large class sizes. At the Doctoral Institution, both Directors cited financial issues, such as having students pay extra tuition for developmental math courses, as a lack of institutional support. A final example, as explained by the Remedial Math Director, was the less than positive administrative view of developmental mathematics at the Doctoral Institution (see Strong Institutional Support at the Doctoral Institution in Chapter Four).

Coordination and Centralization

A centralized developmental department or a highly coordinated decentralized department have been found to be related to increased retention, passing developmental courses, higher GPAs (Boylan, Bonham, & Bliss, 1992; Boylan, Bliss, & Bonham, 1997) and was another "best practice." AA II had the only centralized developmental program in this study. One course, Math 102, was offered outside of the Academic Services Center at AA II, but the strong communication and coordination between the Academic Services Center and the Math and Science Department appeared to almost make this irrelevant.

The developmental mathematics program at the Doctoral Institution was highly coordinated. The Remedial Program Director of the Department of Mathematics, course supervisors, and common content, syllabi, and exams contributed to this coordination. In addition, the director and supervisors added structure, support, and accountability for the

instructors. According to an interviewed instructor, having a supervisor or director provided leadership. The instructor observations and reports that were completed by the course supervisors added accountability to the program and its instruction.

Developmental Mathematics Faculty

In agreement with the literature (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Jackson, & Saxon, 1994; Penny & White, 1998), but not with "best practice," the developmental math faculty had less training, education, faculty development opportunities, and involvement in departmental planning and decision-making processes than non-developmental instructors. The highest education level of almost all interviewed developmental math instructors was a bachelor's degree or a master's degree. Many instructors were high school teachers prior to teaching at the postsecondary level.

Many of the interviewed instructors said that they had faculty development opportunities, but these opportunities did not have the same priority as those of full-time professors. Developmental mathematics instructors at AA I, BA I, and the Doctoral Institution had little involvement with decision-making and planning in their departments. As one interviewee at AA I said, "It is not expected of adjuncts to do this." It was different at the Master's Institution and AA II. Faculty at these institutions were included in the departmental decision-making and planning processes.

Instruction and Curriculum

Mastery learning techniques were one of the instructional "best practices" in developmental education. Mastery learning techniques were found to be more likely to

increase developmental students' performance and retention than non-mastery techniques (Boylan, Bonham, Claxton, & Bliss, 1992). This study did not determine if performance and retention improved, but it did determine that mastery learning was only used in the four-credit Math 102 course at AA I.

As recommended in the list of "best practices," when labs were used they were integrated with classroom instruction. At the Doctoral Institution, degreed instructors who taught the developmental math courses tutored in a computer lab where students could work using the computer program that supplemented the developmental math courses. At AA I, the lab assignments were integrated into the instruction and content of the course. At AA II, a Math and Science Lab was available to students. The tutors in this lab were also the instructors of the developmental math courses.

The supplemental use of technology was one of the instructional "best practices." All studied developmental math programs supplemented their courses with technology. How the technology was used and the extent of its use could not be determined as it depended on each instructor. Instructors at BA I sometimes used computer software. AA I, BA I, and BA II primarily used a scientific calculator for calculations. AA II, the Master's Institution, and the Doctoral Institution used graphing calculators. The Doctoral Institution also used an online computer program that supplemented the courses' textbooks. In addition, the Doctoral Institution offered one section of each developmental math course completely online.

The professional mathematics organizations (American Mathematical Association of Two-Year Colleges, 1995; National Council of Teachers of Mathematics, 1998)

advocated the appropriate use of technology. Others (Boylan & Saxon, 1999; Kulik & Kulik, 1991; Vásquez, 2000) found evidence that supported the supplemental use of technology, including computer-based instruction and calculators; yet, the interviewed mathematics instructors sometimes were still apprehensive about overextending the use of technology. Some instructors were concerned that students would overuse technology, especially at the developmental level, and become dependent on it.

Researchers (Casazza & Silverman, 1996; Cross, 1976; Kulik and Kulik, 1991) found that developmental students were more likely to be successful when a variety of instructional methods were used. Cronbach and Snow, Kulik and Kulik, and Boylan, Bonham, Saxon, and Bliss (as cited in Boylan & Saxon, 1999) found that structured learning environments were most beneficial to the weakest students. Thus, instructional variety and course structure were two "best practices."

Course structure and use of a variety of instructional methods were used by many of the interviewed and observed instructors, but this use varied by instructor. Thus, broad program conclusions about these practices usually could not be made as all developmental math instructors at each institution usually were not interviewed and observed. The researcher did conclude that, at BA I, little instructional variety was used by the sole developmental math instructor.

Prerequisite knowledge is essential for success in future courses so exit skills in one course need to be aligned with entrance skills in the next course. The more closely these courses are aligned, then it seems to follow that the more likely students are to succeed in them. If fact, that was what Boylan, Bonham, Claxton, and Bliss (1992)

found. Thus, course alignment was another instructional "best practice." All interviewees included in this study, except one instructor at BA II, indicated intent to align courses as they tried to prepare students for their next math course. Some said that they developed the curriculum with those intentions in mind. If and how well the courses were actually aligned were not determined and would involve more research on the part of the researcher or each program.

AA I was the only institution that tracked students' success in their math coursework and provided that information to the researcher. What they found at AA I was that students who earned A and B grades were usually successful in their next math course. Students who earned C grades struggled and were only successful about one fourth to one third of the time. Students who failed or earned D grades were rarely successful in the next course, and students who repeated a course were only successful about half of the time. These results do not necessarily indicate alignment, but they do suggest that further research be conducted to explore the relationships between grades in successive math courses.

Researchers (Boylan & Saxon, 1998a; Casazza & Silverman, 1996; Maxwell, 1997; Roueche & Roueche, 1993; Roueche & Snow, 1977) suggested that successful developmental programs had clearly defined philosophies, goals, and objectives. Boylan and Saxon (1999) summarized that developmental programs that were based on clearly defined goals and objectives were related to improved developmental student performance. None of the studied developmental mathematics programs had written clearly defined program goals, objectives, or desired outcomes. There were course

objectives or goals on all of the syllabi, except at the Doctoral Institution, but these sometimes differed by instructor for the same course at the same institution. An increase in written program goals and desired outcomes appeared to be occurring as administration began making this a requirement at institutions.

Support Services

Developmental support services, like ongoing orientation, freshman seminar, counseling, tutoring by trained tutors, and Supplemental Instruction, were positively related to increased retention, student success, GPA, pass rates, and course completion rates (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Bliss, & Saxon, 1995; Boylan & Saxon, 1999; Commander, Stratton, Callahan, & Smith, 1996; Gardner, 1998; Hodges & White, 2001; Martin, Arendale, & Blanc, 1997; Ramirez, 1997; Roueche & Snow, 1977). Thus, the presence of these services was considered "best practice." All six of the institutions included in this study had some type of tutoring and orientation. Most of the tutors received some form of training, but, according to some interviewees at the Doctoral Institution, it was not always consistent with the methods of the course and the needs of the students. The orientations were brief and not ongoing, as Roueche and Roueche (1999a) recommended. BA I's cohort program for underprepared students included Supplemental Instruction in all four of the cohort courses. These four courses were Math 102, a basic English course, a study skills course, and freshmen seminar. The Doctoral Institution was the only other institution that offered freshmen seminar. It required new students to enroll in this course.

Assessment and Evaluation

"Program evaluation has been and remains the weakest component of the remedial effort. Most colleges have never defined, described, or evaluated their remediation efforts very well" (Roueche & Roueche, 1999a, p. 16). In agreement with the above statement, none of the developmental mathematics programs included in this study had formal, regular, and systematic assessment and evaluation processes that were both summative and formative and used to improve student learning. Yet, researchers (Boylan, Bonham, Claxton, & Bliss, 1992; Donovan, 1974; Roueche & Snow, 1977) found that regular and systematic evaluation of developmental programs was positively related to program success, long term retention of developmental students, and grades in developmental courses. The more effective programs with higher rates of student success used a combination of formative and summative evaluation methods in which the formative data were used to improve the program (Boylan & Saxon, 1999). These results made program assessment and evaluation a "best practice." Some assessment and evaluation activities did take place at the studied institutions, but these activities were not regular, systematic, or necessarily used to improve student learning.

Comprehensiveness

"The more comprehensive the services of a developmental program, the greater its likelihood of promoting student success" (Boylan, Bonham, & Bliss, 1994a, p. 1), and certain practices, including centralized structure, tutoring with tutor training, and ongoing and systematic evaluation, were related to the most success variables (Boylan, Bliss, & Bonham, 1997). AA II used the most "best practices" of all institutions included in the

study (see Table 19). The Doctoral Institution used the second most "best practices," followed by BA I, the Master's Institution, AA I, and BA II. AA II's centralized developmental program, high level of communication and coordination, use of instructors as tutors, and institutional support contributed to their use of most "best practices," but it was not determined if this program was most effective.

Grade Distribution Data

Table 21 below includes the drop rates and success rates for Beginning Algebra and Intermediate Algebra during fall 1999, 2000, and 2001 for the studied institutions that sent grade data. Successes were A, B, C, S, and P (pass) grades and were calculated with and without the students who dropped the courses (see Table 32 in Appendix H for the raw grade distribution data).

Table 21. Drop Rates and Success Rates by Course and Institution for Fall 1999, Fall 2000, and Fall 2001 Combined.

	Beginning Algebra			Intermediate Algebra		
Institution	Drop Rate	Success Rate Without Drops	Success Rate With Drops	Drop Rate	Success Rate Without Drops	Success Rate With Drops
AA I	22.5%	74.4%	57.3%	28.9%	74.8%	53.0%
AA II	10.4%	70.0%	62.7%	17.0%	65.4%	54.3%
BA I[a]						
BA II	36.7%	84.2%	53.3%	41.0%	70.9%	41.8%
Master's Institution	21.2%[b]	74.1%	50.0%[b]	28.7%	53.2%	38.0%
Doctoral Institution[c]		62.7%			65.2%	

Note. [a]Grade data not sent. [b]Based only on fall 2001. [c]The number of students who dropped was not included in the grade data.

BA II had the highest drop rates, 36.7% and 41.0% in Beginning Algebra and Intermediate Algebra, respectively. It was also the program that used the least amount of "best practices." AA II had the lowest drop rates, 10.4% and 17.0% in Beginning Algebra and Intermediate Algebra, respectively. The Master's Institution had the lowest success rates in Math 102. If students who dropped the course were not included in the calculations for success, about half of all students earned A, B, and C grades. This percentage dropped to 38% when those who dropped where included in the calculations as part of the total number of students.

There were differences, some larger than others, in the success rates of Beginning Algebra students and Intermediate Algebra students at all institutions. The differences at AA I and the Doctoral Institution appeared to be small compared to the differences at other institutions. In general, a larger percentage of students were successful in Beginning Algebra than were in Intermediate Algebra at the studied institutions.

Suggestions

Suggestions for Developmental Mathematics Programs

The following suggestions reflect observations of the six programs and "best practice," as defined in the developmental literature. It should be noted that most of the institutions studied did not use these practices.

1. Written statement of program goals, objectives, or desired outcomes: None of the developmental mathematics programs had written statements of goals, objectives, or

desired outcomes; yet, the literature has linked the careful process of defining and writing program goals to improved student instruction (Boylan & Saxon, 1999).

2. Centralized or highly coordinated developmental program: Centralization is one of the factors most closely related to higher passing rates and retention rates of developmental students (Boylan, Bliss, & Bonham, 1997). All but one of the studied institutions had decentralized developmental mathematics programs. The only centralized developmental program in this study had the lowest drop rates in the developmental mathematics courses. This program was also highly coordinated within and across departments.
3. Mastery learning: Mastery learning was related to increased pass rates, grades, and retention rates (see Boylan & Saxon, 1999). Mastery learning was only used in one developmental math course at one institution in the study.
4. Learning communities or paired courses: Tinto (1998) found that developmental students who participated in learning communities had higher pass rates, persistence rates, grades, and completion rates as well as better attitudes toward learning. In this study, BA I was the only institution that used a cohort program to address the needs of underprepared students. These efforts had significantly increased the retention of these students according to the Director at BA I.
5. Orientation and freshmen seminar: Roueche and Roueche (1999a) advocated ongoing orientation, but all of the institutions of this study had one or two day orientation sessions. Upcraft and Gardner (1989) recommended freshmen seminar as an alternative to orientation to help successfully integrate students into college life.

Gardner (1998) reported increased retention rates of underprepared students who participated in ongoing orientation or freshmen seminar. The Doctoral Institution and BA I were the only two studied institutions that offered and required freshmen seminar.

6. Supplemental Instruction: Supplemental Instruction is a voluntary academic assistance program that targets high-risk courses, those with a 30% or higher rates of D, F, and W (withdrawals) grades. Leaders of Supplemental Instruction sessions attend course meetings, takes notes, and meet with students to help teach them how to be successful in a course (Boylan & Saxon, 1999; Martin, Arendale, & Blanc, 1997). Supplemental Instruction has been linked to improved success with developmental students (Hodges & White, 2001). One institution in this study, BA I, used Supplemental Instruction with developmental math students, yet all studied developmental math courses had D, F, and W rates of at least 30%, as recommended for Supplemental Instruction.
7. Assessment and evaluation: None of the studied programs had regular, formal, and systematic assessment and evaluation processes, formative or summative, to evaluate and improve the developmental math programs. This type of assessment and evaluation was related to program success, higher retention rates, higher grades, and success in developmental math courses (Boylan, Bliss, & Bonham, 1997; Boylan, Bonham, Claxton, & Bliss, 1992; Donovan, 1974; Roueche & Snow, 1977).

Suggestions for Researchers

There is a body of research linking many policies and practices to positive student outcomes. Boylan, Bliss, and Bonham (1997) found that centralized structure, tutoring with tutor training, and ongoing and systematic evaluation were related to the most success variables. Thus, it might be beneficial for researchers to focus on these few "best practices," rather than many practices, when conducting studies to assess and evaluate developmental math courses and programs.

Roueche and Roueche (1993) advocated strong institutional support of developmental education. Researchers might want to determine how to define and objectively measure institutional support in ways other than asking interviewees if they or their institution supports developmental education. Similarly, supplemental use of technology is a recommended practice, but technology needs to be defined and differentiated so that varying amounts and types of use can be linked to student success.

Suggestions for Further Research

Various policies and practices have been related to positive student outcomes, but none of the research has actually determined if these "best practices" are more than just related to student success. More research, with regard to "best practice," could be conducted to verify the results of other research. Also, experimental and quasi-experimental research studies could be conducted to investigate the effects of "best practice" variables on students' outcomes in general and in specific programs, like developmental mathematics. These studies could lead to the development of a model for

assessing and evaluating developmental math courses and programs. It could also lead to a model of "best practice" in developmental mathematics education.

Implications

Assessment and Placement Polices

While all institutions in this study had mandatory assessment policies, only the Doctoral Institution had a mandatory placement policy. The literature suggests that mandatory placement is positively related to student success in developmental courses (Boylan, Bliss, & Bonham, 1997; Roueche & Roueche, 1999a). It has also been shown to be positively related to retention at four-year institutions but negatively related to retention at two-year institutions (Boylan, Bliss, & Bonham, 1997). While it is not known why the Doctoral Institution was the only institution to have a mandatory placement policy, and the effect of these policies on student success and retention is not clear, more research could be done to determine their effects on student achievement and to determine the most appropriate and valid placement instruments and policies.

Centralization and Coordination

A centralized developmental program was one of the practices related to the most student success variables (Boylan, Bliss, & Bonham, 1997). AA II was the only centralized institution in this study. It had the lowest drop rates in the two studied developmental math courses, but its success rates were not necessarily any better than the success rates at some of the other studied institutions. The Doctoral Institution was coordinated with its Director of Remedial Mathematics, developmental math course

supervisors, and common content and exams in the developmental courses, but how or if this coordination affected drop and success rates are not known. Thus, further research would need to be conducted to determine the effects of coordination and centralization on student success in developmental mathematics.

Instructors and Instruction

The education levels and faculty development opportunities were similar at all studied institutions. Developmental math faculty did not have training in developmental education and generally had less education than non-developmental instructors. Thus, there was no ability to compare outcomes along these variables since variations did not occur. Some of the studied programs included developmental math faculty in departmental planning and decision-making processes and some did not. The effects of this practice are not known and could not be determined in this study.

Support Services

Tutoring by trained tutors was one of the three practices related to the most success variables in developmental education (Boylan, Bliss, & Bonham, 1997). Tutoring was available at all six of the studied institutions, but the training of these tutors and the success rates of students were not consistent. Thus, it is not clear that one structure for training tutors is superior to another.

Orientations were not ongoing, as recommended by Roueche and Roueche (1999a), and freshmen seminar was only available at BA I and the Doctoral Institution. Underprepared students at BA I who were involved in freshmen seminar had higher

retention rates than those underprepared students who did not take freshmen seminar, but these same students were also involved in an entire cohort program targeted toward underprepared students. Thus, freshmen seminar may have had a positive impact on retention, as stated in the literature (Gardner, 1998), but the increase in retention might also have been due to the combination of courses in the program, the way the courses were all part of a cohort program, having Supplemental Instruction in each of the cohort courses, or a combination of all of these factors combined. As stated earlier, Supplemental Instruction and learning communities, like the cohort program at BA I, are also related to positive student outcomes (Hodges & White, 2001; Tinto, 1998). As, BA I did not send grade data, no discussion of student success and the inclusion of these practices can be had.

Goals, Objectives, or Desired Student Outcomes

None of the developmental math programs had written program goals, objectives, or desired outcomes. As most institutions did not have centralized developmental math programs, they did not consider their developmental math courses to be part of a developmental program, as such. Therefore, as only one institution had a centralized program and none of the institutions had program goals, no comparisons between institutions could be made, and relationships to student performance could not be hypothesized.

The lack of program goals and objectives suggests that instructors were left to interpret the goals of the program and its courses independently. Each of their interpretations was likely to be somewhat different and might or might not be aligned

with the intended goals and objectives of the department or program, or with those of other instructors. This was evidenced on the syllabus and course outline at BA II.

Assessment and Evaluation

None of the six studied programs regularly and systematically assessed and evaluated their developmental math programs and courses; yet, program assessment was one of the three practices related to the most success variables (Boylan, Bliss, & Bonham, 1997). Thus, as none of the studied institutions assessed and evaluated their programs, there was no ability to compare the programs along this practice. Also, the lack of this practice implies that the systematic evaluation of the program and its outcomes are not being related back to the goals of the program or the courses.

Recommendations

Recommendations for Academic Leaders

Academic leaders at these institutions may want to review the findings of this study, especially those findings from their institution. They may want to further investigate the literature of "best practice" in developmental education as it may inform them of what can be done to improve developmental education. By being informed they can make decisions about possible implementation of these practices. They also may want to consider conducting more research on these practices and their current effects on student outcomes at their institution.

Recommendations for Researchers

During this study, the researcher observed developmental mathematics instruction at each institution for a small amount of time. Only one instructor of each developmental math course was interviewed, and only one class session of each course was observed. Interviewing and observing more instructors would increase the instructional data and the amount of confidence in these findings. It might also increase the generalizability of each institution's instructional characteristics to all developmental mathematics instruction at each studied institution.

Also during this study, the researcher tried to determine if many "best practices" were being used at many institutions. This approach resulted in less detailed results for some of the "best practices." This lack of detail might be avoided by studying fewer "best practices," especially those most strongly related to student success. It might also be avoided by conducting a more in-depth analysis (a case study) of one institution, rather than many institutions, in order to more completely understand the practices of that program and their relationship to student success.

The collection of course syllabi did not yield as much information as the other data collection methods of this study, and thus, they might not need to be collected in a similar study. In addition, the grade distribution data that were collected for this study did not shed enough light on student success. To better understand student success, a complete analysis that involves tracking of students would need to occur and would need to determine success using a definition like:

> The success of developmental students is typically measured in three ways: (a) the rate at which they pass developmental courses, (b) the rate at which those who

> pass developmental courses later pass regular courses in the same subject, and (c) the rate at which developmental students are retained through to graduation. (Boylan & Saxon, 1998b, p. 9)

If this was done, future studies could likely determine if student achievement was correlated with "best practice."

Recommendations for Further Research

This study created a number of new research questions.

1. Which "best practices" contribute most to developmental mathematics students' success?
2. In North Dakota, are there differences in rigor and content between the same developmental mathematics courses at different institutions and different institutional types?
3. In North Dakota, do the patterns and differences in postsecondary developmental mathematics programs hold across institutional types?
4. Does having a director of developmental education increase the level of coordination and the level of success of developmental mathematics programs and instruction?
5. What is the most effective and valid assessment and placement method?
6. Which developmental mathematics program in North Dakota is most effective and what factors contribute most to this effectiveness?
7. What effect does the use of computer instruction have on developmental mathematics education at the Doctoral Institution?
8. In the NDUS, are developmental mathematics students successful in college level courses and are they retained to graduation?

9. Is the high school math curriculum, specifically the college preparatory math requirements for the NDUS, aligned with students' first college level math courses?
10. Which instructional techniques are most effective with developmental mathematics students?
11. There is a great deal of literature on the retention of the general college population, but very little of this research has dealt specifically with developmental students. Tinto (1998) began to address this, as did Boylan and Bonham (1992), but more information is needed to address why certain factors increase or decrease student retention.

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APPENDICES

APPENDIX A

INSTRUMENTS

Request for Grade Distribution Data

North Dakota University System
Request for data from Third Week Reports:

Report #: USSRG670

What data: Grade Distribution Report

What courses: All remedial math courses (regardless of prefix) numbered below College Algebra (Math 103).
These courses typically have a MATH prefix or an ASC prefix
Current course number possibilities: ASC 090, ASC 091, ASC 092, ASC 093, ASC 099, MATH 099, MATH 100, MATH 102
Past course number possibilities: MATH 080, MATH 105, MATH 110, MATH 115, MATH 123

When: Fall 1999, Fall 2000, Fall 2001

Send to: Laurie Geller
Department of Mathematics
Minot State University
500 University Avenue West
Minot, ND 58707

Questions/concerns can be directed to Laurie at (701) 858-3282 or e-mail geller@minotstateu.edu.

This request has been approved by Ms. Geller's doctoral committee at Montana State University, the school from which Ms. Geller is completing her degree. No institutions, students, or faculty will be identified as result of this study; thus, Montana State University does not require approval by their Human Subjects Committee. All information will be filed in a secure location and shredded upon completion of the study.

☐ The institutional data you requested is enclosed.

☐ I respectfully decline participation in the request for data from our institution.

_____ _____

Signature *Date*

"BEST PRACTICE" CHECKLIST

Institution:_____ Course: _____

Practice	Direct Evidence	Indirect Evidence	No Evidence	Not Clear	Comments
Mandatory assessment					
Mandatory placement					
Strong institutional commitment					
Centralized or highly coordinated program					
Training and professional development					
Learning theories					
Mastery learning					
Learning communities and/or paired courses					
Integration of class and lab instruction					
Technology					
Variety in instruction					
Structure					
Constructivism					
Alignment of exit and entrance skills					
Objectives stated					
Student orientation					
Freshmen seminar					
Counseling					
Trained tutors					
Supplemental Instruction					
Regular, systematic assessment					

GENERAL SYLLABUS CHECKLIST

Institution:_____ Course: _____

	Yes	No	N/A	Not Clear	Comments
Basic Course Information					
Instructor Information					
Prerequisites					
Course Description					
Course Purpose					
Learning Goals or Objectives					
Clarify the Structure and Organization of the Course					
Description of the Activities and Format of the Course					
Texts, Readings, Materials					
Assignments, Papers, Exams					
Evaluation and Grading Policies					
Other Course Requirements					
Course Policies: Attendance, late work, homework, make-up, illness, cheating, etc.					
Disability Statement					
Course Calendar					
Schedule Fast Feedback					
List Important Dates					
Estimate Student Work Load					
Supplementary Material: How to study, glossary, copies of past exams,					
Space for classmate info					

INTERVIEW PROTOCOL FOR DIRECTORS OF DEVELOPMENTAL MATHEMATICS PROGRAMS

The main purpose of these interviews is to elicit responses from the director of developmental mathematics education about the policies and practices used in the institution's developmental mathematics program. These responses will be compared to "best practice" in developmental education as described and recommended in the literature.

Introductory Material:

The focus of my dissertation research is on "best practice" in postsecondary developmental mathematics education. For the purpose of my study, developmental mathematics is defined as any mathematics course numbered lower than Math 103 College Algebra. As part of my research I am seeking (1) to describe postsecondary developmental mathematics education in North Dakota, (2) to compare each institution's policies and practices to those described as "best practice" in the developmental education literature, and (3) to contrast the programs by institutional type using the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994).

Your responses concerning the policies and practices of your institution and its developmental mathematics program will help me to describe postsecondary developmental mathematics education in North Dakota, as well as analyze its use of "best practice" at each institution and each institutional type. With your permission I will tape record the interview. Your statements will remain confidential, and no full transcript will be published. If I use quotations, they will be anonymous. You may withdraw from the interview at anytime.

Interviewee's Name and Title: _____

Institution: _____

Time and Place: _____

Education and Experience: _____

_____

Other descriptive information about the interview: _____

_____

Questions:

1. How would you define developmental mathematics education at this institution?

2. Please describe the students who take developmental mathematics courses at this institution.

3. As director of the developmental mathematics program, do you teach any of the developmental math courses? (The answer to this question will determine the next question.).

4. If he or she has not taught developmental courses: Describe the effective policies and practices of the developmental mathematics program and its courses.

   If he or she has taught developmental courses: Describe an effective lesson or two from the developmental mathematics course(s) you teach or have taught.

5. What are the philosophies, goals, desired outcomes, or objectives of the developmental mathematics program/courses?
   a. Where are these defined and stated?
   b. Who knows about these philosophies, goals, desired outcomes, or objectives? (faculty, students, administration, other members of the institution)

6. How is the developmental mathematics program organized within the overall institutional structure?

7. How do you ensure that students will be prepared for the next math course they must take?

8. Please describe the level of support others (in the dept, institution, state, etc.) have for developmental mathematics.

9. What academic policies and practices are utilized to promote student success in the developmental mathematics program?

10. What are the professional characteristics of the developmental mathematics faculty? Do the developmental faculty take part in the planning and decision-making processes in the dept and at the institution?

11. What instructional methods and materials are commonly used in the developmental mathematics courses?

12. Describe the student support services available to students in the developmental mathematics program/courses.

13. What types of evaluation/assessment are available and utilized in the developmental mathematics program to improve instruction and student learning? Describe when and how this is done.

14. How much money is spent on developmental mathematics education?

15. How many students participate in developmental mathematics education each semester or each year, and what is their success rate in the developmental mathematics courses? How do students perform in the courses that follow the developmental courses (the college level courses)? i.e., Are the developmental courses effectively preparing these students for the college level mathematics courses that they must take?

16. What changes would you like to see occur in the developmental mathematics program/courses?

17. Is there anything else regarding developmental mathematics that you would like me to know?

Conclusion:

Thank you for your time and responses. Please feel free to contact me if you have any questions or comments about this interview or its use in my research.

INTERVIEW PROTOCOL FOR DEVELOPMENTAL MATHEMATICS INSTRUCTORS

The main purpose of these interviews is to elicit responses from an instructor of developmental mathematics courses about the policies and practices used in the developmental mathematics classroom. These responses will be compared to "best practice" in developmental education as described and recommended in the literature.

Introductory Material:

The focus of my dissertation research is on "best practice" in postsecondary developmental mathematics education. For the purpose of my study, developmental mathematics is defined as any mathematics course numbered lower than Math 103 College Algebra. As part of my research I am seeking (1) to describe postsecondary developmental mathematics education in North Dakota, (2) to compare each institution's policies and practices to those described as "best practice" in the developmental education literature, and (3) to contrast the programs by institutional type using the Carnegie Classification of Institutions of Higher Education (Carnegie Foundation for the Advancement of Teaching, 1994).

Your responses concerning the policies and practices of the developmental mathematics courses you teach will help me to describe postsecondary developmental mathematics education in North Dakota, as well as analyze its use of "best practice" at each institution and each institutional type. With your permission I will tape record the interview. Your statements will remain confidential, and no full transcript will be published. If I use quotations, they will be anonymous. You may withdraw from the interview at any time.

Interviewee's Name and Title: _____

Institution: _____

Time and Place: _____

Developmental Courses Taught: _____

Education and Experience: _____

_____

Other descriptive information about the interview: _____

_____

Questions:

1. Describe a few effective lessons from the developmental mathematics course(s) you teach.

2. Please describe the students who take developmental mathematics courses.

3. What goals, desired outcomes, objectives, or expectations do you have for the developmental mathematics students you teach? Where are these defined and stated? Who knows about these goals, desired outcomes, objectives, or expectations? (faculty, students, administration, other members of the institution)

4. How are the developmental mathematics courses/curriculum developed? Who is responsible for this?

5. How do you help ensure that students will be prepared for the next math course they must take?

6. Please describe the level of support others (in the dept, institution, state, etc.) have for the developmental mathematics courses you teach.

7. What types of faculty development opportunities are available for you?

8. Do you take part in the planning and decision-making processes in the program and at the institution? If so, describe your involvement. Describe when and how you do this.

9. What changes would you like to see occur in the developmental mathematics program/courses?

10. Is there anything else regarding developmental mathematics that you would like me to know?

Conclusion:

Thank you for your time and responses. Please feel free to contact me if you have any questions or comments about this interview or its use in my research.

APPENDIX B

PROGRAM DESCRIPTION FOR AA I

Program Description: AA I

Background. During the visit to AA I, the researcher observed two developmental mathematics classes, ASC 092 Beginning Algebra and Math 102 Intermediate Algebra. The Math 102 section that was observed was one of two sections offered four days a week instead of three days a week and described as slower paced and having a lab component. Students who took this course enrolled in a special three-credit section of Math 102 and a concurrent one-credit section of Math 102L, the lab component. The majority of Math 102 sections met three days a week. While visiting the institution, the researcher collected syllabi from the instructors of the observed courses. These syllabi were later analyzed using the Checklists.

The researcher interviewed the contact person in the mathematics department. The researcher assumed that the contact person would have the most knowledge about the Department and that was why she was chosen as the Director. The Director performed administrative duties and helped coordinate the developmental mathematics courses, but she did not hold any special titles, such as Chair or Head of the Department. She had a BA degree in mathematics and a Masters of Teaching in Mathematics. She taught one of the developmental courses, Math 102, and she said that she was the only full-time faculty member teaching this course.

The researcher interviewed two instructors who taught developmental mathematics courses. The classes of both instructors were observed prior to conducting the interviews. This was helpful because it gave the researcher an idea of how the

courses were taught, and it helped her develop probing questions or questions that addressed what was observed in class.

Both instructors were or had been full-time mathematics professors at the institution. The Math 102 instructor was teaching part-time. He had a bachelor's degree in mathematics, science, and physical education and a master's degree in mathematics. He taught at the high school level for 14 years and at the college level for 32 years. The ASC 092 instructor was a full-time faculty member in the department. He had a BS degree in mathematics education and a master's degree in mathematics.

The researcher chose these instructors according to the scheduled times of the classes and the times when faculty were available for interviews on the scheduled day of the visit. One of the interviewees was keeping data on student success rates in the mathematics courses at the institution.

The researcher took notes during all of the interviews and recorded the instructor interviews. The researcher did not record the director interview because it was conducted in a noisy cafeteria over lunch and because the Director provided the researcher with written responses to all of the interview questions. The researcher reviewed these responses and followed up on some of them with questions to probe or clarify the Director's written responses.

Definition and Location of Developmental Mathematics Education. According to the Director, developmental mathematics education at AA I was "all [mathematics] courses below Math 103, College Algebra, especially Math 092 Beginning Algebra." These courses were offered through the Mathematics Department and taught by

mathematics instructors. None of the developmental courses were taught online. According to two of the interviewees, there had been talk of establishing a developmental college of core English and math courses, but it had not gone any farther than discussion.

Developmental Mathematics Faculty. During fall 2002, adjunct faculty members, with the exception of two people, taught the majority of the sections of developmental mathematics courses. One of these people was the Director. She was an assistant professor of mathematics. Most semesters she taught two or three sections of Math 102. The second person was an assistant professor of mathematics. He taught two sections of Math 092 during fall 2002 but usually taught just one section of the course in the evening. A third person was a retired mathematics professor who previously was a full-time professor at the institution. Since his retirement he worked part-time as an adjunct professor of mathematics. He was classified as an adjunct, but he said that he was still involved, although to a lesser and more informal degree, in the functions of the department and the institution. He taught one section of the four-credit Math 102.

According to the Director, the instructors of developmental mathematics courses were required to have BA or MA degrees. They did not receive special training in developmental mathematics education. "Faculty development opportunities depend on the availability of funds," wrote the Director. All interviewees said that adjuncts did not receive the same priority in funding opportunities. The Director wrote, "Funds for adjuncts for major conferences are iffy. State conference, no problem." All mathematics faculty members, including adjuncts, were encouraged to attend the NDMATYC (North Dakota Mathematical Association of Two-Year Colleges) conferences. The Director

attended Developing Mathematical Ideas (DMI) Leadership Institute I during the summer of 2002. She found this was beneficial for her. The Director also noted that there were not many faculty development opportunities on campus.

Full-time faculty members participated in the decision-making and planning processes in the department and on campus, but adjunct faculty did not. One interviewee said, "It is not expected of adjuncts to do this."

Curriculum Development. All interviewees said that instructors of each developmental mathematics course followed an outline of content and used the same text. The full-time faculty members developed the content outline and selected the text. Adjuncts, who taught the majority of the sections of developmental mathematics courses, did not participate in this process, but in their classes they were free to present the content in their own manner. According to one interviewee, "The adjuncts realize that it is not expected of them to try to change the textbook or to go out on their own and do something different." The adjuncts had flexibility in the courses they taught. Each semester they could request which courses they preferred to teach, but they could not teach any course above Math 103 College Algebra.

According to the Math 102 instructor, the Director started to more closely coordinate the developmental mathematics curriculum during spring 2002. She did this because there were differences in the depth of the content being taught by different people. Both instructors of the four-credit sections of Math 102 said that they planned very closely together. Another interviewee said that there might be less coordination between the adjuncts that taught the developmental courses. He said that they all used

different styles and approaches, had different backgrounds, and might not understand the types of students with which they were dealing. The same interviewee also added, "We have had the same adjuncts for a few years and that helps."

Policies. The Director wrote, "There are no policies and practices spelled out for the developmental mathematics program [at AA I]. We do have recommended (not mandatory) cut scores for placements into our math classes. If students and advisors follow these, they are accurate and to the students' benefit." She added, "There is a waiver that students sign if they enroll against the advise of their advisor or placement score." Students in the four-credit Math 102 course were advised and placed in this course because they were thought to be at risk of failure due to their low ACT scores, low placement scores, or having to repeat the course.

No prerequisites existed for ASC 092 since it was the lowest level math course. The prerequisite for Math 102 that was listed in the course schedule and course catalog was one year of high school algebra, ASC 092, or qualifying ACT score (Curriculum/Course Descriptions, 2003). In the Math 102 syllabus, the instructor stated that a qualifying placement score was a prerequisite, in addition to the other prerequisites stated above. A student's placement score was determined using the COMPASS placement exam.

According to the Director, ASC 092 did not satisfy any graduation requirement. Math 102 did satisfy graduation and credit, but it did not meet the program requirements for all programs offered at the institution. Both courses could be used for financial aid credit.

Goals, Objectives, and Desired Outcomes. The researcher reviewed the course syllabi for course objectives, goals, and desired outcomes, and asked the interviewees what philosophies, goals, objectives, or desired outcomes they had for the course or program. Objectives were listed on the syllabi of both courses, and desired outcomes were listed on the Math 102 syllabus. According to the interviewees, students were made aware of the course objectives and desired outcomes since these were on the syllabi and were discussed on the first day of class.

The ASC 092 instructor stated the course objectives in the syllabus as, "Students successfully completing the course will be able to demonstrate an understanding of and apply the following arithmetic and algebra concepts:..." and a listing of concepts were provided. The course objectives of the four-credit Math 102, as stated in the syllabus, were, "Students successfully completing this class will:..." and various skills and concepts were listed. These skills and concepts included: explaining relationships; applying math methods to solve real world problems; understanding concepts; demonstrating proficiency in using technology to facilitate problem solving; and being able to apply the concepts to other disciplines. Two competencies were also listed under an outcomes section of the Math 102 syllabus. These competencies included mathematics and critical thinking and were explained using subcompetencies.

When questioned, the interviewees revealed other philosophies, goals, desired outcomes, and objectives of the developmental mathematics courses. A goal of two of the interviewees was to get students to become more organized and to develop responsible work habits. A second goal was to prepare students for the next math course

they had to take. A third goal was to have students see some relevance of math in real life. A fourth goal mentioned by all interviewees was to try to eliminate the fear or anxiety of mathematics and show students that they could be successful. One interviewee said:

> Whether young or old, whether they are a traditional student or older than average, they all seem to have this common anxiety about math. Where I suspect they've had some kind of a bad experience in the past and automatically they are like, "I am not trying for another math teacher. I don't like this subject. Forget about it." And one of the things, aside from the content of the course, I try to do is get them to just relax a little bit and not be so tensed up about seeing letters with numbers, mixing the alphabet in, as they like to say...So hopefully by the time they are done with 092, I guess, I am hoping that they are at least, they've kind of done away with their preconceived notions of "The course is going to be really difficult and I'm just not any good at it." We try and set that aside and say, "Okay, let's just start over."

There were no objectives for the developmental mathematics program, only the course objectives that appeared in the syllabi. These course objectives were "roughly defined together," according to the Director, but the instructors were free to write objectives in their syllabus and to set goals for their class and their students. The Director also explained that she sat down with new faculty and showed them and explained to them a common form used for a syllabus. Faculty members were expected to use the common form, but they could add to it in any way they wanted.

Students. The interviewees described the students in the developmental mathematics courses at AA I. One instructor said, "Those who are right out of high school usually had poor experiences in math and were not successful before for various reasons." One interviewee described them as low or underachievers in high school. There were older students who did not have the math background, who according to one

interviewee, were ordinarily the ones that were successful. There were those who lacked confidence and had bad study and attendance habits. Two interviewees commented on the number of other things these students had going on in their lives. Many students had families or were single parents who tried to work too many hours and carried a full class load in order to keep their financial aid. One interviewee described them as "hard-lucked" and "carrying a lot of garbage in their lives."

The Math 092 instructor described the differences in the students in his evening and afternoon Math 092 classes. The students in the evening class were described as "eighty percent older than average." Many of them came straight to class from work. They were particularly motivated and a lot of them had been away from math for a long time. The interviewee said:

> It's mostly older than average students, so that's a fun group because they are ready to go, they are always there. They've been in the work force and they now realize, "I probably should have an associate's degree in arts or in science or whatever." So they are coming back to school. They have been away from it so long that they are comfortable being in 092. They do not feel like they are wasting their time like a traditional age student would say, "Why am I in here? I need some college credits. I should be in 103." That is a big difference between the two age groups.

The same interviewee described his afternoon class as mostly freshmen, many of which felt like they were wasting their time in a course that did not fulfill the math requirement. All interviewees mentioned that most of these students had a general fear or anxiety about mathematics and a low self-image about their mathematical ability.

One interviewee said that there were huge numbers of people who needed developmental mathematics courses. High school did not always prepare them and was often a watered down version of what they needed to know. The Director thought that

about 60% of incoming students required developmental mathematics. She said that at least 300 students enrolled in ASC 092 and Math 102 during fall semester and another 300 students enrolled during spring semester. She did not know how many finished each semester, and students' success rates in future math courses depended on their grades. Students who earned A or B grades did quite well in their next math courses. Students who earned C grades struggled. She said that one of the other interviewees had very detailed statistics of students' success rates in their next mathematics.

Instruction. As stated earlier, the developmental math courses were taught in the Mathematics Department. Using the grade distribution data, the researcher determined that no more than 35 students, including those who dropped, were enrolled in each of the sections of ASC 092 and four-credit Math 102 during the fall semesters in which data were gathered. The three-credit Math 102 classes had more students in each section, approximately 50 students including those who eventually dropped the course.

During the observation of the ASC 092 class, the instructor of the class did the following instructional activities: used lecture; explained concepts; used examples to illustrate concepts; explained examples, thought processes, and mathematical methods used to solve the examples; had the students solve problems at their desks individually or with their neighbors while he observed, answered questions, and made comments to students about their work. The students appeared to be comfortable with the instructor and asked and answered questions. Fourteen students attended the observed class.

During the observation of the four-credit Math 102 class, the instructor began class by making students aware of the upcoming topics, assignments, and quizzes and by

taking questions from the homework lesson. At the board he worked problems that students asked about, but he did this with the help of the students. He prompted them with questions and called on specific students by name to have them solve the problems and to help him complete parts of the problems. After taking questions, the instructor reviewed topics, and a lab was handed out.

The students worked in groups to complete the lab. The lab was application based and involved real-life problems that were related to the material being studied in class. The students appeared to be happy to do the lab and to work with the other students. The problems on the lab were not of a rote form. In order to solve the problems, students had to think, reason, problem solve, discuss using mathematical language, and use what they knew from class. While the students worked, the instructor continually walked around the room being available for help. Students asked specific questions, and some just wanted to check to see if their answers were correct. Again, the students appeared to be comfortable with the instructor. The classroom was relaxed, yet the majority of students worked hard to complete the lab. In passing, the instructor commented to me that he and another instructor, the Director, created the labs and activities for the course. He also said that he wished they could do more of these labs. Seventeen students attended the observed class.

During the interviews, the researcher asked the instructors and the Director to describe effective lessons from the developmental courses they taught or to describe the effective policies and practices used in these courses. The instructor of the ASC 092 course said that "repetition and skill builder exercises" were effective with developmental

mathematics students. He described how he taught most classes. He said, "I try to present concepts to students without using a lot of fancy notation and keep the definitions simple until they can grasp what the concept is. Then show them several examples and ask them questions to explore the concepts." After this he had students do problems while he walked among them. This was exactly what the researcher observed in the instructor's ASC 092 class that day.

The ASC 092 instructor put an emphasis on practice, repetition, and building their skills so they could go on in math. He said that in the night class he could do more things in groups since it was a smaller class, but he had not done this with his afternoon class. He also said, "The night class is such a different group. By the second week they are all talking to each other, they know each other's names, they have their phone numbers, they work together, whatever. A lot different than the day class." He said that he did not like to single out students, and it helped to relate with the students.

Everyday in ASC 092, the instructor assigned homework problems from the text, but the instructor did not collect and grade these. He said, "It is their responsibility to do this and try. He said that he assumed they were working the problems, and he provided time in class and during office hours to get help. He said, "They need TLC, yet I don't want to get in a situation where it is like ninth grade math and I am collecting papers and turning them back. With [teaching] 20 some credits it is hard to do something like that." He added:

> I use quizzes a lot to gauge, and in-class exercises, to try to get a gauge of how they are handling different topics. They seem to like that because they are in little chunks, like two sections per quiz or three sections per quiz where they can get a mastery of those topics and then move on to something else.

The instructor gave four tests during the semester, and no retests, but he said there was flexibility to do something like retesting if someone wanted. A scientific calculator was used, but the instructor tried to restrict students' use of it by having them demonstrate two or more steps of a problem on tests and quizzes.

The ASC 092 instructor also mentioned the importance of small class size and the student-teacher relationship in developmental mathematics classes. He said:

> I am glad that I don't have 40 [students]...I don't think the comfort would be what it is for most of those people because now I think they are pretty comfortable as a group and they know their neighbors. I can't imagine having [Math] 102 classes that have like 35-40 people in them. How can you get the student to feel that the teacher knows who you are, and knows your specific difficulties and have a relationship. It is almost like it is a lecture bowl...I think that is really helpful in these lower level math classes if there is somewhat of a relationship between the teacher and the student, even if it is just visiting after class or whatever.

The researcher reviewed the ASC 092 syllabus for other information. The instructor included the following on the syllabus: basic course and instructor information, course materials, course description and objectives, grading policy, a disability statement, course outline, a list of important dates, tutoring information, assignments and exams, and course policies regarding extra credit, group work, and makeup quizzes and exams. The instructor gave 10 quizzes, four tests, and a comprehensive final exam. The lowest quiz score was dropped. The instructor strongly urged students to attend class as well.

Using the General Syllabus Checklist, the ASC 092 syllabus lacked the following: a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; other course requirements (but there may not have been any); an estimate of student work load; a time to schedule fast feedback; and a space for other students'

contact information. This syllabus was one of the more complete ones that were reviewed.

The Math 102 instructor and the Director taught Math 102. Both of them taught one section of the four-credit Math 102 course, and the Director taught a section of the regular three-credit Math 102. The Director said that the most effective lessons were "anything that actively engages the students and causes them to interact with each other." She listed examples of a measuring lab, a box lab, and board work. She said that this was done more easily in the four-credit Math 102 class because the classes were smaller, around 25 students. The three-credit Math 102 classes had too many students, around 40, and it was harder to do board work and to get to know or interact with all of the students. When students sat at two person tables rather than individual desks, it helped promote interaction and conversations between students as well. The Math 102 instructor said that "anything hands-on" was effective. The Director said that you had to love the students, get to know them, and establish a relationship with them. Both interviewees commented on helping students get over their fear of mathematics and on making them feel more comfortable with math. The Director said that most of the instructors used a lecture format, but that she and the Math 102 instructor used board work.

Assignments in the four-credit Math 102 course consisted of homework problems from the text as well as handouts, each called a lesson. The instructors of the course created these lessons. The lessons appeared to provide additional structure for the students and they supplemented the material in the text. The Math 102 instructor said, "The theory behind this was that they would do the book problems first and see that they

knew how to do those, and then they could do the lesson problems and hand those in to be graded and receive points for."

The instructor discussed the use of "Gateway Tests" in the four-credit Math 102 course. These tests were given three times during the semester and covered topics that were important for the future success of the students in current and future math courses. Students had to earn an 80% on the Gateway Tests or else they had to retake them. They could retake them twice within a given time period until they earned at least an 80%. Each time a student did not earn at least an 80%, they were given practice problems like the ones they missed and then they retook a similar test. If a student was close to passing, the instructor sometimes asked the student if he or she knew what was done incorrectly and then he or she had to explain it. The Math 102 instructor said, "If we go on for two more weeks and students do not understand the material then it compounds the problem, so this is a way to make sure all students are up to task to move on with new material." The instructor added, "One of the biggest problems is getting them [the students] to see this [Gateway testing] as an opportunity rather than a punishment."

A scientific calculator was required and used in Math 102. The instructor mentioned this during the interviews and stated it in the syllabus. Assessment methods were described in detail in the syllabus. These methods included four unit tests, a comprehensive final exam, three Gateway Tests, daily work, 10 short quizzes covering only one or two topics, and three or four graded collaborative activities. There was a policy that allowed students to drop tests scores based on their attendance. The following were also included in the Math 102 syllabus: basic course and instructor information;

course materials; course description, objectives, and desired outcomes; grading policy and scale; cheating policy; tutoring description; disability statement; attendance; make-up test policy; important dates; a course calendar; a questionnaire; course syllabus quiz; and a statement for students to sign that indicated they recognized their responsibilities in the course.

Using the General Syllabus Checklist, the Math 102 syllabus lacked the following: a description of the course purpose; a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; other course requirements (but there may not have been any); an estimate of student work load; a time to schedule fast feedback; and a space for other students' contact information. Overall, this was a very thorough syllabus and definitely one of the better syllabi that were collected and reviewed.

Preparation for Success in Future Math Courses. The researcher asked the instructors and the Director what they did to prepare developmental mathematics students for success in the next mathematics courses they took. Some of the responses included: building the students' skills; emphasizing topics that were felt to be necessary for success in future math courses; and eliminating the fear of mathematics and showing students that they can be successful. The ASC 092 instructor said, "I treat the course solely as preparation for intermediate algebra." In the four-credit Math 102 classes, Gateway Tests were given at crucial points. One interviewee said that in theory mandatory assessment and placement should help the students succeed, but depending on the students and who

the students' advisors were, the students may or may not have heeded this advice. Nothing was done during registration to prevent students from registering for a course in which they were not prepared to take.

The ASC 092 instructor said that a review type of worksheet with problems on it was handed out toward the end of the semester in ASC 092. To complete the problems on this sheet, it required the skills and abilities of entry-level Math 102 students. Students could use this to review for the ASC 092 final exam and to gauge their readiness for Math 102. He added, "If they are able to work through this without any big hang-ups, then they are pretty comfortable with what was done in ASC 092." The ASC 092 instructor also said:

> I think by the end of the course, the majority of the students have the skills, but it is the mental part that is kind of hard to gauge. So I should almost have, write myself some kind of a confidence, opinion type questionnaire to give to them to see how they feel now that they have completed 092 and whether or not they still have anxieties or if they feel real good about it.

The ASC 092 instructor said that students often wanted the same instructor as they moved through the sequence of math courses, but that was not always possible. He said:

> Another thing, and I don't know if this is a good thing or a bad thing, or maybe it's neither, but near the end of the semester I will get a lot of people who will start asking me, "Do you teach the next one?" I think they get comfortable with an instructor and a style, and say, "Okay, I'm good with your class. I feel okay in here. I feel that I am learning things. I am willing to go on and take this next step as long as you are there teaching the class." It is hard to kind of explain to them that you might have three completely different instructors for 092, 102, and 103, stats. You just have to kind of get used to it, and they do not like that. So they may have the skills when they get in someone else's 102 class, and they are doing some factoring, hopefully they are going to know what they are supposed to do, but they might not be that comfortable with a new group of kids around them, or a different instructor, it might be a different grading system, but who knows. We

> can do our best to ensure they have the skills that they need, but developing their confidence and their openness to new instructors, they get, I guess they are kind of hesitant about taking somebody else.

One of the instructors calculated success rates of students in the mathematics courses. He found that students who got A and B grades in ASC 092 and in Math 102 did well in their next math course, and students who got C grades in these courses struggled in their next math course. According to the spring 2002 data he collected, 64% of students who earned A or B grades in ASC 092, 19% who earned C grades, and 7% who earned D or F grades passed three-credit Math 102. Seventy-three percent of students who earned A or B grades, 35% who earned C grades, and no one who earned D or F grades in ASC 092 passed four-credit Math 102. Eighty percent of students who earned A or B grades, 34% who earned C grades, and 24% who earned D or F grades in Math 102 passed Math 103. Ninety-four percent of students who earned A or B grades and 33% who earned C grades in Math 102 passed Math 107 Precalculus. The students in the four-credit Math 102 with the lab component appeared to perform better than the students in the regular three-credit Math 102 course, even though the students in the four-credit class entered Math 102 with higher risk factors, such as lower ACT scores and repeating the course.

Support Services. Support services were available to developmental mathematics students at AA I. The Director said that the Sykes Student Success Center had tutors available many hours a week at a variety of times during the day. She added, "Those who have a documented disability qualify for more extensive help—special tutors, note takers, special testing arrangements." This was done through the Disability Office on

campus. New students participated in a very brief orientation at the beginning of their entering semester.

The Academic Support Services Web site stated that students received small group tutoring from both degreed and peer learning assistants. Programmed learning materials, audio-visual material, and computer assisted instruction were available to students. These services were free and available for students in all programs. Study skills seminars were held each semester to help student success and increase student retention (Academic Support Services, 2003).

The Director of Academic Support Services at AA I was contacted by e-mail and asked to describe the qualifications and training of the employees, including the peer assistants who performed tutoring services. According to the Academic Support Services Director, there were two part-time mathematics assistants employed during fall 2002. One assistant had a bachelor's degree in mathematics and had participated in peer tutor training at AA I. The other assistant was majoring in mathematics at a local university and had participated in peer tutor training at AA I. According to the Director, the department employed about 20 peer tutors each semester. The tutoring program was certified by the College Reading and Learning Association, so the peer tutors were required to participate in 10 hours of training. Four of these hours were given prior to the first tutoring experience. Further training, with an ongoing evaluation process, was conducted throughout the remainder of the semester. Some of the tutor training topics included: definition of tutoring and tutor responsibilities; basic tutoring guidelines; techniques for successfully beginning and ending a tutor session; some basic tutoring dos

and don'ts; communication skills; active listening and paraphrasing; study skills; and compliance with the ethics and philosophy of the tutor program.

Program and Course Assessment. The developmental mathematics program was not formally assessed except for the course and instructor evaluations completed at the end of each semester in all classes on campus. The Director said, "Individual instructors may give an opinion type assessment at the end of the course. My personal methods are more reactions to what appears to go well and how confused or happy the students are with what has been going on." The Director said that there was assessment being done down through Math 103 and there had been talk of an institutional assessment of the developmental courses, but this had not occurred yet.

Perception of Support. The researcher asked all interviewees to describe the level of support others (department, administration, state, etc) had for developmental mathematics. All interviewees said that the developmental mathematics courses were highly supported in the Mathematics Department. One interviewee said, "Within the department, the developmental math courses are a high priority. People understand that students in 092, 102, and 103 need more attention and more one-on-one time as opposed to upper level students." Another interviewee said, "No one [in the department] says, 'I don't want to teach those [courses].'"

Both instructors were not sure of the institution's perception of these courses. One instructor did say that he thought the institution made these courses a higher priority since attempts at controlling class size were made, but another interviewee thought the

Math 102 classes were too large. The Director said that campus wide support depended on the person (advisor) and depended on whether or not math was needed in that field. Departments that required math in their programs advised students more accurately. The Director said, "It took a long time to convince administration that the four-day [Math 102] class would be a good idea. It took longer to get paid for [teaching] the extra day." At one point they had to fight to keep the course. The course had since become fairly well established. The Math 102 instructor made similar statements about administration's support for the four-credit Math 102.

One instructor said that it seemed like the institution wanted to be up higher than it was; that it wanted to be able to prepare students to enter a four-year institution in two years, but this was not always possible. Sometimes it took more time. He said:

> I have a problem with being called a two-year institution because we should be thought of as taking people where they are, and no matter how long it takes, get them to get to the point where they can enroll as a junior in a degree-granting institution.
>
> We are expected in two years to take these people who could not get into UND [University of North Dakota] when they got out of high school and in two years get them up to the same level as they would have been had they started at UND. And again I have no problem with the mission I just think the length of...If a person spends more than two years at this school it shouldn't be frowned upon.

In terms of financial support, the developmental mathematics courses were funded like any other course on campus. According to the Director, no special funding occurred or was devoted to these courses.

Desired Changes. The researcher asked each of the interviewees what changes they would like to see occur in the developmental mathematics program and its courses. The Director said, "I would like to see two levels of Math 102 taught. One for those who

need to take [Math 103] College Algebra and higher classes and the other for those who will take statistics or just be done." She also said, "I would also like to see a seamless transition course for ASC 092 [Beginning Algebra] to Math 102 [Intermediate Algebra] that would cover two semesters but avoid the repetition that occurs in these two classes."

The Math 102 instructor said that he would like to add an arithmetic class that was taught at the Sykes Center or in the Math Department or was self-paced, but that the students who needed the course might not work best from a self-paced format. If an arithmetic course was taught, then ASC 092 could be more of an algebra class and less of an arithmetic course, especially at the beginning of the course when there was a lot of review of arithmetic. He mentioned combining ASC 092 and Math 102 into a more condensed version by adding a day or so in order to do it He also described what was done for students in the past. He said that they took those students who were falling behind or were failing in Math 102 and started them up again at the sixth or eighth week. He said, "We called this the second chance math," but after teaching it he realized that they should have called it "fat chance math" because it was unsuccessful.

The ASC 092 instructor said, "Less students in the class the better. A small group is better for confidence and comfort. It helps make them more open to the reception of content." He would push involvement with Sykes Success Center and their tutoring. He wished all sections of Math 102 were offered four days a week, instead of three days a week. Last, he said that it might help if ASC 092 was offered three days a week in three 50-minute sessions instead of two days a week in two 75 minute sessions. His reasoning for this was, "The more exposure the students have, the better."

Other Comments. The Director said that attendance was better in the four-credit Math 102 sections than in the three-credit sections of the course. She said that these students seemed to recognize the need for it. The Math 102 instructor who worked part-time said that it was nice being in an adjunct office because he got to share ideas, worksheets, and teaching experiences with other adjuncts.

Grade Distribution Data. Grade distribution data were collected for each developmental mathematics course offered during the fall semesters of 1999, 2000, and 2001. These data are summarized below in Table 22. The numbers of students who received each grade in all sections of the courses are listed for each course. The number of and percentage of students who dropped after the last day to add are provided as well.

The researcher divided up the grades for Math 102. The grades for all sections of Math 102, including the two sections that had a one-credit lab, are given first. Next, the grades were divided and summarized according to the three-credit Math 102 sections without a lab and the three-credit Math 102 sections that required concurrent enrollment in the one-credit lab. According to the Director, in the three-credit part of the four-credit Math 102 course, students received a letter grade based on all graded items. Students that earned grades of D or higher in the three-credit portion of the course received S (satisfactory) grades in the one-credit lab portion of the course, Math 102L. Students who failed the course received U (unsatisfactory) grades as their lab grades. The lab grades in Math 102L are listed in the final row of Table 22.

The percentage of students who dropped ASC 092 ranged from 18-27%. In all sections of Math 102, the drop rates were between 26% and 34%. When the Math 102

classes were divided according to the three-credit and four-credit sections, the drop rates were between 24% and 35% for three-credit Math 102 and between 31% and 36% for four-credit Math 102.

Table 22. Grade Distribution Information for Fall 1999, Fall 2000, and Fall 2001 at AA I.

Course	Year	Grade									Number of Students Enrolled	Number of Students Who Dropped	Percentage of Students Who Dropped	GPA
		A	B	C	D	F	P	I	S	U				
ASC092	1999	34	15	38	16	17					120	27	18.4%	2.27
	2000	23	23	25	10	8		1			90	27	23.1%	2.48
	2001	17	25	29	12	16		1			100	36	26.5%	2.15
All Sections of Math102	1999	31	65	98	31	24		4			253	91	26.5%	2.19
	2000	35	63	96	30	39		1			265	93	26.0%	2.09
	2001	44	60	64	34	29	1	2			234	121	34.1%	2.24
Three-Credit Math102 No Lab	1999	23	55	78	26	21		3			206	69	25.1%	2.16
	2000	33	54	77	26	36		1			228	72	24.0%	2.09
	2001	37	49	52	30	26	1				195	105	35.0%	2.21
Three-Credit Math102 with Lab	1999	8	10	20	5	3		1			47	22	31.9%	2.33
	2000	2	9	19	4	3					37	21	36.2%	2.09
	2001	7	11	12	4	3		2			39	16	30.8%	2.41
Math102L	1999							1	43	3	47	17	26.6%	
	2000								36	1	37	18	32.7%	
	2001							2	34	3	39	22	36.1%	

The average GPAs are provided in Table 22 as well. This was done only for those courses in which letter grades were assigned. In ASC 092, the average GPAs ranged from 2.15 to 2.48. In the three-credit Math 102, the average GPAs ranged from 2.09 to 2.21. In the four-credit Math 102, the average GPAs ranged from 2.09 to 2.41 in

the three-credit portion of the course. When all sections of Math 102 were combined, the average GPAs ranged from 2.09 to 2.24.

If earning a grade of C or better or a grade of P (passing) is considered a success in developmental courses, then the percentages of students who were successful in developmental mathematics course each semester are listed in Table 23 below. These percentages were calculated without the students who dropped and with the students who dropped the courses. There was one exception to using a grade of C or higher as a success. This was in the one-credit Math 102L (lab) sections. Students, who in the four-credit sections of Math 102 received grades of D or higher in the three-credit portion of the course, passed Math 102L with an S grade. Thus, the first success rates for Math 102L in Table 23 are based on D grades or higher. The researcher then identified the sections of Math 102 that accompanied the Math 102L lab sections and recalculated the success rates in Math 102L based on a letter grade of C or higher in the three-credit portion of the course. There were differences in the number of students who dropped the three-credit portion of Math 102 and the concurrent one-credit lab portion of the same course even though the same number of students should have signed up for both sections of the course. Thus, individual percentages were calculated for the three-credit and the one-credit sections of the course based on the number of students who dropped and completed each respective part of the course.

Using the percentages based on grades of C or higher and passing grades (P), not S/U grades, about 71-81% of students were successful in all included courses when students who dropped the courses were not included. These percentages dropped to

about 46-61% when students who dropped the courses were included. In ASC 092, about 72-80% were successful before dropped students were included. Once students who dropped were included about 53-59% of ASC 092 students were successful. In the three-credit Math 102 without the lab, about 71-77%, and 46-57%, were successful without and with dropped students included, respectively. In the three-credit portion of the four-credit Math 102, about 81-83%, and 52-60%, were successful without and with dropped students included, respectively. As expected, the percentages of students passing Math 102L were higher when the percentages were based on S/U grading rather than on letter grades of C or higher.

Summary. AA I offered two developmental mathematics courses, ASC 092 Beginning Algebra (three credits) and two versions of Math 102 Intermediate Algebra. One version of Math 102 was three credits, and the other version was four credits, slower paced, included a one credit lab component, and was intended for students with lower placement scores and who were considered at-risk of successfully completing the course. These courses were taught in the Mathematics Department by adjuncts and a few full-time mathematics faculty members. These instructors had bachelors or master's degrees but no training in developmental education. Faculty development opportunities depended on funding, and full-time faculty received priority. Adjuncts did not participate in the planning and decision-making processes of the department.

Table 23. Success Rates for Fall 1999, Fall 2000, and Fall 2001 at AA I.

Course	Year	Success Rate	
		Without Drops	With Drops
ASC092	1999	72.5%	59.2%
	2000	79.7%	61.2%
	2001	71.7%	52.6%
All Sections of Math102	1999	77.9%	57.1%
	2000	73.5%	54.3%
	2001	72.8%	47.9%
Three-Credit Math102 No Lab	1999	76.8%	57.4%
	2000	72.2%	54.8%
	2001	71.2%	46.3%
Three-Credit Math102 with Lab	1999	82.6%	55.9%
	2000	81.1%	51.7%
	2001	81.1%	60.0%
Math102L[a]	1999	93.5%	68.2%
	2000	97.3%	65.5%
	2001	91.9%	57.6%
Math102L[b]	1999	82.6%	60.3%
	2000	81.1%	54.5%
	2001	81.1%	50.8%

Note. [a]Percentages based on grades of D or higher. [b]Percentages based on letter grades of C or higher in the three-credit portion of the course.

Full-time mathematics faculty developed the curriculum. Instructors used the same text and outline of content but could present the material using individual methods. The program did not have goals or objectives stated anywhere. Objectives and sometimes, desired outcomes were included on course syllabi. These objectives and goals were usually content and skills goals. The interviewees also had goals that were not stated on any documents, including improving students' organizational skills,

preparing them for the next math course, and eliminating students' fear and anxiety of math.

Students were assessed using ACT math scores or a mathematics placement exam, but placement in the appropriate course was not mandatory. There were recommended cut scores based on the placement exam or ACT scores, and students had to sign a waiver if they enrolled in a course against the advise of the placement exam and the Mathematics Department. Students did not get graduation credit for ASC 092, and credit for Math 102 depended on students' programs of study. Both courses counted toward financial aid credit.

The developmental mathematics students varied. Some students were traditional age college students who had poor experiences in math or had little background in math. Other students were older than average and were returning to school after an absence or had a weak background in mathematics or both. Many students had families and worked many hours while trying to go to school full-time. Most of the developmental students feared math or had math anxiety. The Director thought that about 60% of students at AA I needed to take developmental mathematics courses.

The instruction used by the observed and interviewed instructors included lectures, board work, labs, group work, student-teacher interaction, critical thinking, and structure. The interviewees thought that the following were important and effective when teaching developmental mathematics courses: repetition, skill builder exercises, hands-on activities, active engagement and interaction of the students, small class size, and positive student-teacher interactions. Students were assessed using homework, collaborative

activities, tests, and quizzes. Gateway Tests, in which students had to pass with a B grade or higher, were given in the four-credit Math 102 classes. Scientific calculators were used in both courses.

The interviewees prepared students for success in future math courses by doing the following: building students' skills; emphasizing topics needed in the next course; eliminating fear; using Gateway Tests; in theory, using assessment and placement, but this depended on students and advisors; and by providing a review sheet at the end of Math 092 to help students determine if they were ready for Math 102. Students who earned A and B grades were most likely to be successful in their next math course.

Tutoring by trained tutors and study skills seminars were available for students at AA I. Disability services were available and so were programmed learning materials, audiovisual materials, and computer assisted materials.

The developmental mathematics program was not assessed, but some assessment methods were used in each course. Students completed course and instructor evaluations in each class each semester. Individual instructors sometimes used other assessment methods in their classes.

The interviewees thought the Mathematics Department supported the developmental mathematics courses. They were unsure about the level of institutional support. They discussed issues of large class size, initial lack of support for the four-credit Math 102 course, and how support sometimes depended on the person and the department. The courses were funded like all other courses at AA I.

The interviewees desired the following changes to the developmental program: teaching two levels of Math 102; adding an arithmetic course; having a two semester transition course for ASC 092 and Math 102 without the repetition that was in these courses; smaller classes; more involvement with Sykes tutoring services; making all sections of Math 102 four credits; and having ASC 092 meet during three 50 minute class sessions each week instead of during two 75 minute class sessions each week.

During fall 1999, 2000, and 2001, student GPAs in developmental courses were between 2.09 and 2.48. About one-fifth to one-third of students dropped developmental math courses. Success rates were between 71% and 81% when dropped students were not included in the calculations and were between 46% and 61% when dropped students were included.

AA I: ASC 092 Syllabus

Course: ASC 092 Beginning Algebra

Credit Hours: 3 semester hours

Instructor: Name, Title
Office: Building, Room *Phone:* XXX-XXXX
Office Hours: MTWF 10:00-10:50 T 12:00-12:50
MWF 1:00-1:50 R 11:00-12:50
e-*mail address*

Textbook: Basic Mathematics (You Can Count on Yourself) by Falstein
REQUIRED

Course Description: Fundamental skills in mathematics beginning with basic arithmetic and proceeding to elementary algebra. Designed for those students with little to no mathematics background who wish to prepare for future study in mathematics. Will not satisfy the mathematics/science/technology requirements at AA I and will not be accepted for credit at transfer institutions.

Course Objectives: Students successfully completing the course will be able to demonstrate an understanding of and apply the following arithmetic and algebra concepts:

(1) addition, subtraction, multiplication, and division of whole numbers, integers, rational numbers and decimals
(2) understand and apply the order of operations, associative and commutative laws
(3) addition and subtraction of fractions with and without like denominators
(4) mixed number operations, cancellation conversion, perimeter and area applications of dimensional analysis
(5) percents and conversion to decimals and fractions
(6) combining algebraic terms, addition and subtraction of polynomials, dividing polynomials by monomials, distributive law, factoring of polynomials
(7) solving linear equations and inequalities
(8) applications of linear equations
(9) graphing linear equations and inequalities; slope, intercepts, and writing equations of lines

Assessment Methods:	4 exams	100 points each
	10 quizzes (*drop lowest*)	10 points each
	Final Exam (*comprehensive*)	200 points
		700 total points

Grading Policy: Letter grades will be determined by dividing total points earned on exams and quizzes by 700 total points.

92-100% A	60-68% D
82-91% B	0-59% F
69-81% C	

Disability Statement: Students with documented are strongly encouraged to discuss their needs with the instructor and with the professional staff in the Disability Office. We are anxious to work closely with you to provide the assistance to which you are entitled.

Attendance Policy: Is *strongly recommended.* You will be responsible for all material covered during lectures and any announcements or schedule changes made in class.

Course Outline: *Chapter 1:* To become comfortable working with whole numbers, understand the order of operations and work with perimeters, areas, and volumes.

Chapter 2: To add and subtract signed numbers, carry out multiplication and division, and examine some applications.

Chapter 3: To become skilled at factoring, multiplication, division and addition of fractions with different denominators, and unit cancellation.

Chapter 4: To work with powers of ten, conversion of decimals, addition, multiplication and division of decimals.

Chapter 5: To manipulate algebraic terms, combine like terms, add and subtract polynomials, and evaluate expressions.

Chapter 6: To solve more challenging algebraic equations, solve fractional equations, and work with inequalities.

Chapter 7: To solve percent equations, work with ratios and proportions, and applications.

Chapter 8: Examine vertical and horizontal lines, graph linear equations, study function notation, discuss slope, and examine various forms for the equation of a line; graph linear inequalities.

Last day to add: September 5, 2002 (Thursday)

Last day to drop without record: September 13, 2002 (Friday)

Last day to withdraw: November 29, 2002 (Friday)

Additional Information:

1. Tutoring will be available at no charge to AA I students in the Student Success Center. As soon as a schedule of tutoring hours becomes available, it will be announced in class.

2. A calculator may be used for this course.

3. Final exam data and time: To be announced

4. There will be no opportunity for extra credit in this class.

5. No in class collaboration or "group work" will be allowed during quizzes, exams, or the Final Exam.

6. Makeup quizzes and makeup exams will be given for *extenuating circumstances only*. You must contact me beforehand to make arrangements.

AA I: MATH 102 Syllabus

Course:	Math 102 Intermediate Algebra Math 102L Int Algebra Lab Meets MTWF 10:00-10:50 Room: XXX
Credit Hours:	3 semester hours
Instructor:	Name, Title Office: Room, Building Phone: (W) XXX-XXXX (H) XXX-XXXX before 10 pm please Office hours: 8:30-9:00 MWF 9:00-10:00 T 11:00-12:00 MTWF afternoons by appointment e-mail address
Materials:	Textbook: Intermediate Algebra 3rd Edition Addison Wesley Publishing Mark Dugopolski (Required) A calculator is necessary in the class. It need not be expensive, but should allow you to add, subtract, multiply, divide, find square roots, and raise to a power. If you plan to go on to College Algebra, a graphing calculator will be required so it may be worthwhile to buy one at this time. The TI-83 is recommended. There is also a student solutions manual, which is optional, that contains worked out solutions to the odd numbered exercises
Course Description:	Prerequisite: One year of high school algebra, ASC 092, or qualifying placement score. Topics covered include a review of basic algebra concepts including signed numbers, linear equation and inequalities, operations with algebraic fractions, exponents, radicals, systems of equations and inequalities, and the quadratic formula. This course may not be accepted for credit at transfer institutions. If students use this course to meet AA I general education requirements for the AA degree, they must also take an additional 3 semester credit math/science/technology course to meet GERTA requirements.
Course Objectives:	Students successfully completing this class will: 1) Be able to apply mathematical methods to set up and solve real world problems. 2) Be able to understand algebraic factoring, operations with polynomials, and rational expressions in order to solve any linear or quadratic equation.

3) Be able to explain the relationship between the slope and y-intercept, the graph and the rule for any linear function.
4) Be able to demonstrate proficiency in operating a scientific calculator in order to facilitate problem solving.
5) Be able to apply the concepts above to solve problems in other academic disciplines.

Outcomes:

Competency 1: Mathematics
Sub competency 1: The student will develop an appreciation for the language of algebra and the link between algebra and other disciplines.
Sub competency 2: The student will be able to perform elementary algebraic operations including factoring, equation solving, graphing, and the use of exponents.
Measure: Eight problems will be given throughout the semester addressing these topics.
Competency 2: Critical Thinking
Sub competency 1: The student will demonstrate the ability to solve real life problems using the principles of algebra.
Measure: Students will be asked to complete a project designed to determine the cost of renting a car and make a decision as to which of two possibilities is the most economical.

Assessment Methods:

1) Unit Tests: These will be announced at least two days prior to the test. There will be four of these throughout the semester. Each will contain 100 possible points.
2) Final Test: A comprehensive exam will be given at the end of the semester. This will be worth 200 points. You will be allowed a 3 x 5 card of notes that you may use on this test.
3) Gateway Tests: These will be given three times during the semester covering topics that are especially important for success in your future math classes. These tests, worth 25 points each, may be retaken up to 2 times within a given time period until you earn a passing grade.
4) Daily Work: Daily assignments will be given with all assignments for the previous week turned in each Wednesday. Selected problems will be graded and all assignments will be returned. These will be worth approximately 100 total points. Please neatly show all work. There will be penalty for late papers, which will be accepted through the following Monday at the beginning of class. After that, no credit will be given except in the case of prolonged illness. You will be asked to have a 3 ring binder for this course to keep assignments and notes.

5) Quizzes: About ten times during the semester, a short quiz will be given during the last 10-15 minutes of the period. These will be announced in advance and will cover only one or two topics. If a student has an excused absence, the quiz must be made up within the next two class periods. There will be no makeups for unexcused absences.
6) Collaborative Activities: There will be three or four graded collaborative activities assigned during the semester.

Grading Policy: Your final average will be based upon total points earned divided by the total possible points. Your letter grade will be based upon the following scale:

A	92-100
B	83-91
C	68-82
D	58-67
F	0-57

Cheating Policy: In accordance with the Student Academic Honor Code from page 1 of the Student Policies section of the AA I Policies and Procedures document, I will not tolerate cheating, plagiarism, or collusion in class work or test taking. Any evidence of cheating will result in a zero for that quiz or exam.

Tutoring: Math tutors are available at the Student Success Center. Also, feel free to stop if you have questions or need help any time I am in the office even if it is not during regular office hours.

Disability Statement: Students with documents disabilities are strongly encouraged to discuss their needs with the instructor and with me and with the Disability Office. We will work closely with you to ensure the assistance for which you are entitled.

Attendance: Since some of the material covered in this course will come from sources outside the text, regular class attendance is important. Attendance is not a factor in the determination of a final grade except in the instance of a borderline case where good class participation will ensure the student of the higher grade. Class participation is impossible if one it's not in class. If you must be absent, please call. My number is XXX-XXXX. If I am not in the office, leave a message on voice mail or by e-mail. THIS IS

VERY IMPORTANT, ESPECIALLY ON DAYS WHEN TESTS ARE GIVEN.

Make-up Test Policy: Unit tests may be made up without penalty if the student is absent due to illness or other valid excuse. There will be a 20% penalty for the first test missed without excuse, 30% for the second, and 50% for the third. All tests must be made up before the next unit test unless there is a prolonged illness or like circumstance. Unless I am informed, either in person, via e-mail, or voice mail before or on the day of the test, the absence is considered to be unexcused. However, since we are aware that there will be days when you are not emotionally or physically capable of doing your best, we will allow you to drop either your lowest unit test or ½ of that test depending upon your final attendance record as follows:

# of absences	
0-3	drop full test
4-6	drop half test
over 6	no tests dropped

Academic Calendar: Fall Semester 2002

Tuesday, August 27	Classes Begin
Monday, September 2	No Class Labor Day
Friday, September 13	Last Day to Drop (No Record)
Wednesday, October 23	No Class Employee Development Day
Monday, November 11	No Class Veteran's Day
Thursday-Friday, Nov. 28-29	No Class Thanksgiving Vacation
Monday-Friday, Dec. 16-20	Final Test Week

Course Calendar: (There dates are only approximate. We will deviate from these somewhat.)

Gateway Test 1	September 10	Linear Equations
Unit Test 1	September 24	Chapters 1 and 2
Gateway Test 2	October 13	Graphing
Unit Test 2	October 18	Sections 3.1-4.2
Gateway Test 3	November 12	Factoring
Unit Test 3	November 22	Sections 5.1-5.9, 8.2
Unit Test 4	December 11	Topics from Chapters 6 and 7
Final Test	December 16-20	(exact date to be determined)

You are enrolled in an Intermediate Algebra class that meets 4 days a week for 3 semester credits. In addition to the extra class period, we have limited the enrollment to try to give you every opportunity to be successful. We hope that you will take advantage of this opportunity. Success in mathematics can only be attained through the cooperation of the teacher and the student. We as instructors will do our utmost to provide guidance, explanation, and assistance both collectively and individually to make success in this class attainable. However, we cannot and will not "water down" the content of the course since receiving credit in Intermediate Algebra signifies that you have reached a certain level in your mathematical development. In order to take advantage of the educational opportunity that you have we ask that you read and sign the statement below:

Recognizing my responsibility for my own success, I will agree to do the following:

1) I realize the importance of daily class attendance and will make every effort to avoid missing class. If I must be absent, I will notify my instructor as soon as possible.
2) I will spend a minimum of 4 hours/week studying outside of class.
3) I will set aside a time at least 4 days a week to work on homework and will come to class prepared to learn.
4) If I am having difficulties, I will seek help through the Success Center, my instructor, or other reliable courses.
5) I will attend extra help sessions as needed.

Signed _____

In order to get to know more about you, please complete the following and return along with this form by the end of the week.

Name _____ Career Goal (if known) _____

College	Year	College Math Courses Taken Course Name or Number	Grade
_____	_____	_____	_____
_____	_____	_____	_____

High School	Year	High School Math Courses Taken Course Name or Number	Grade
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Have you had any experience with graphics calculators such as TI-82 or TI-83? _____
Do you own a calculator? _____ What kind? _____

Please write a few paragraphs on one or more of the following themes and return along with this form by the end of the week. (Use the back of this sheet.)
1) What are your feelings toward mathematics?
2) What are your reasons for taking a slower paced algebra course?
3) Have you had any unusual positive or negative experiences that affected your attitude towards mathematics? What were they?
4) What else is there that you would like me to know about you?

Course Syllabus
Intermediate Algebra-4 days a week

The course number for this course is Math _____(a)_____.

The class meets in Room (b) of the XXXX building.

If you are going to miss class or if you need help, please feel free to call me. If I am not there, leave a message. My phone numbers are:
Office: (c) (d) Home: (e) (f)
(Please call before (g) pm if you expect to get a civil answer.)

You can also reach me in my office in room (h) -I in the XXXX building or by e-mail at xxxx@xxxx.nodak.edu

Your grade will depend upon:
I. (i) unit tests which are each worth (j) points.

II. (k) "Gateway tests" which are each worth (l) points.
(These will be further explained in class.)

III. About (m) quizzes which are worth a total of approximately (n) points.

IV. A final tests which is worth (o) points.

V. Homework evaluation worth approximately (p) points. This will be explained in class.

VI. 3 or 4 collaborative activities worth about (q) points.

My grading scale is as follows:

To earn an A, you must average at least (r) .

To earn a B, you must average at least (s) .

To earn a C, you must average at least (t) .

To earn a D, you must average at least (u) .

After class today, we have only (v) class periods left, excluding the final test.

Evaluate each of the following to fill in the blanks of the Course Syllabus. You may not be able to do all of these, but do not be discouraged. We will spend some time going over each of the ideas used later in the class.

a) One added to the number of Dalmations in the Walt Disney movie. (The original, not the latest.)

b) The perimeter of a triangle having sides of 30, 42, and 47 inches.

c) $|\,48 - 272\,|$

d) $-|\,(3)\,(1891)\,|$

e) $127 - 18 + 10 - (-\,139\,)$

f) $8000 - 14750$

g) $8 + |\,-2\,|$

h) $(\,-3\,)\,(\,-34\,) - 1$

i) Number of inches in a foot divided by the number of quarts in a gallon plus the number of representatives that North Dakota has in the US House of Representatives.

j) $50 \div \frac{1}{4} - 125 + 5(5)$

k) The width of a rectangle whose length is 20 inches and area is 60 sq. in.

l) 5^2

m) The number of bowling pins you have to knock down with one ball to get a strike.

n) $3(\,5 + 2\,) + 12 + 3(19)$

o) The distance around a square where one side is 50.

p) Multiply the number of stripes on the United States flag by the number of degrees in a right angle. Divide that answer by 10 and add the number of sides in an octagon. From your answer, subtract the number of quarts in a Texan's hat.

q) Two squared subtracted from twice the freezing point of water on the Fahrenheit scale.

r) The number of trombones in the big parade added to the number of Stooges + the number which is supposed to be unlucky (particularly if it falls on Friday).

s) $10 [3 - (-4)] + 13$

t) The area of a rectangle whose length is 17 and width is 4.

u) 10 less than the value of t.

v) $a/2 + (u-18)/10$

APPENDIX C

PROGRAM DESCRIPTION FOR AA II

Program Description: AA II

Background. AA II offered many developmental mathematics courses, including ASC 090 Math Preparation (one credit), ASC 091 Pre-Algebra (one to two credits), ASC 092 Beginning Algebra (two credits), ASC 093 Pre-Trigonometry (one credit), and Math 102 Intermediate Algebra (three credits). During the process of conducting the interviews, the researcher discovered other courses at AA II that could be considered developmental mathematics courses based on their content, but using the definition of developmental mathematics education defined in the first chapter, Introduction to the Study, mathematics courses and support services for college students taking mathematics courses numbered below Math 103 College Algebra, these courses were not considered to be developmental for the purposes of this study. At times during the description of AA II's developmental mathematics program, the researcher refers to these courses and describes them as well.

During the day of the visit to AA II, the researcher was not able to schedule and observe all of the developmental math courses, so two developmental mathematics courses were observed, ASC 092 Beginning Algebra and Math 102 Intermediate Algebra. These courses were offered by most of the other institutions and were taught using classroom instruction rather than individualized or lab instruction. The researcher took notes during the observations, and collected and later analyzed the syllabi of the observed courses.

Developmental mathematics courses at AA II were taught out of the Math and Science Department and out of the Academic Services Center. Therefore, the researcher

interviewed directors and instructors from both departments. These interviewees included the Director of the Academic Services Center (ASC Director), Chair of the Math and Science Department (Math and Science Chair), the ASC 092 instructor, and a professor in the Math and Science Department (Math 102 instructor). The interview with the Math 102 instructor was conducted over the phone prior to the visit because the instructor had to leave for a conference shortly after the researcher arrived on campus. The researcher took notes during all of the interviews. She also tape-recorded all interviews except for the phone interview with the Math 102 instructor.

All interviewees had some type of education degree. The ASC Director had a bachelor's degree in elementary education and a master's degree in vocational education. The Math and Science Chair had a bachelor's degree in elementary education. The Math 102 instructor was a professor in the Math and Science Department who had a master's degree in education. He did post-master's work for two summers and had 10 years of high school teaching experience and 34 years of college teaching experience. The ASC 092 instructor was a lecturer in the Academic Services Center. She had a bachelor's degree in elementary education with a kindergarten endorsement and another bachelor's degree in secondary education with majors in mathematics and chemistry and a minor in physics. She taught and tutored at all levels for over 25 years.

Definition and Location of Developmental Mathematics Education. According to the ASC Director, developmental mathematics education at AA II was "the skill building or preparatory courses that are the foundation for many of the higher level math courses," including Beginning Algebra, Intermediate Algebra, and Basic Mathematics. The Math

and Science Chair said that developmental mathematics education at AA II "was anything below College Algebra that was not program driven." He said that some of the basic math courses and technical math courses were numbered higher than Math 103 College Algebra and were required for specific programs, but the content of these courses might be remedial. The Math 102 instructor who was interviewed held a similar view. He said, "Developmental math is a course or courses that students would enroll in to prepare themselves for college level mathematics courses. Such courses would be tailored to the abilities and needs of the students. The level of the courses is program directed."

The developmental mathematics courses were offered through the Math and Science Department and through the Academic Services Center. The Math and Science Department offered Math 102 Intermediate Algebra. The Academic Services Center offered ASC 090 Math Preparation, ASC 091 Pre-Algebra, ASC 092 Beginning Algebra, ASC 093 Pre-Trigonometry, and Math 120, 123, and 125, the Basic Mathematics sequence in which the content might be considered developmental even though the courses were numbered higher than Math 103. None of the developmental courses were taught online.

All interviewees said that there was a good relationship between the Math and Science Department and the Academic Services Center. The ASC Director said, "There is a good relationship with the Math Department because it is student-focused." The Math and Science Chair said that their department referred students who struggled in the developmental courses or basic math courses to the Academic Services Center so that the students could "get more structure and more one-on-one attention." Instructors in the

Academic Services Department attended the Math and Science Department meetings, and sometimes math faculty members volunteered in the Math and Science Lab located in the Academic Services Center.

Developmental Mathematics Faculty. Employees of the Academic Services Center taught the majority of the developmental mathematics courses, especially those numbered lower than 102. Academic Services Center instructors taught the following developmental mathematics courses: ASC 090 Math Preparation, ASC 091 Pre-Algebra, ASC 092 Beginning Algebra, ASC 093 Pre-Trigonometry. The instructors of Math 102 varied each semester, but were usually professors in the Math and Science Department and instructors in the Academic Services Center, including one who tutored in the Academic Services Center's Math and Science Lab during the evening.

According to the Director of the Academic Services Center, all instructors in the Center were required to have a bachelor's degree and an education degree. They also had to be vocationally certified due to Carl Perkins Vocational Grant funding. Thus, instructors in the Academic Services Center had to take additional coursework to do this. Some of this coursework dealt with the philosophy of vocational education, working with special population students, and other areas of importance in vocational education. The ASC Director also said, "Developmental instructors need empathy for student learning."

The Chair of the Math and Science Department said that their faculty did not receive special training nor were they specialists in developmental education. Mathematics faculty needed a degree.

Faculty members in both departments took part in the planning and decision-making processes of their departments, usually by attending their respective departmental meetings. Some of the developmental mathematics instructors in the Academic Services Center attended the Math and Science Departmental meetings. All math faculty members were encouraged to participate in departmental activities. The Math 102 instructor said that he took part in the planning and decision-making processes of the department and the institution through committee work, curriculum development, and departmental meetings. The ASC 092 instructor said that she had complete control over what was taught in ASC 092 so she had a big part in the planning and decision-making of that course, but more of the administrative duties were performed by the ASC Director.

Both departments provided some type of professional development opportunities for their instructors. The ASC 092 instructor said that she usually attended the Midwinter Special Needs Conference. The Math 102 instructor said that he had picked up skills as he went along by working with colleagues, through experiences, and through conferences. Other faculty development opportunities were available to him, usually in the form of conference attendance.

Curriculum Development. In the Academic Services Center the faculty developed the developmental mathematics curriculum. The ASC Director said, "Faculty decide the text, format, and the delivery of the material." The ASC 092 instructor said that the teachers who taught Beginning Algebra, Intermediate Algebra, and College Algebra sat down and made a flowchart of the content in these courses. They then divided the content into each of the appropriate courses (Beginning Algebra, Intermediate

Algebra, and College Algebra), and they later tweaked the content whenever it became necessary.

The ASC courses focused on skills so the instructors sometimes had to limit the amount of material taught in these courses. For example, the ASC 092 instructor said that students became frustrated with the chapter on word problems so they eliminated a big section of these problems and instead they do them in every chapter. The new text they were using made this easier because it connected word problems to each section of new material. The ASC 092 instructor also said that there was a "coordinated effort" between the instructors in the Math and Science Department and those in the Academic Services Center.

In the Math and Science Department, the instructors developed the developmental mathematics curriculum for the courses they taught, along with the developmental mathematics instructors in the Academic Services Center. The Math 102 instructor said, "Teachers agree on a text and 90% of the content." He also said that they made the assumption that Math 103 College Algebra, Math 104 Finite Math, or Math 210 Elementary Statistics would be the student's next course. The Math and Science Chair and the Math 102 instructor said that the teachers decided how to present the material. The Math and Science Chair said that the Math and Science Department and the Academic Services Center had the "same basic philosophy regarding the developmental courses." He thought that the math courses offered in the Academic Services Center might not include as many application problems and that the Center's philosophy was "to provide the students with some success for self-esteem."

Policies. Mandatory assessment existed at AA II, but mandatory placement did not. Student placement in a mathematics course was subject to ACT math scores or the COMPASS placement test scores or departmental approval. Students with ACT math scores of 20 or above could enroll in any mathematics course with numbers up to and including Math 146 or Math 165 depending on their ACT math score. Students with ACT math scores below 20, or no ACT math scores, were required to take the COMPASS placement test. Students were then advised based on their placement score and their program of study (Assessment, 2001; Course descriptions: Mathematics, 2001). In theory, placement of students was based on the level of achievement on the test, but in reality this did not always happen. The ASC Director believed, "The math area on campus would be supportive of mandatory placement issues because they would benefit from that. They would not have students sitting in their classes that are struggling because they placed themselves [incorrectly]." She said:

> It was like a catch 22 in a way. They don't want mandatory placement sometimes because then it forces the student to do that, and yet the student ends up, like you say, having to take it three times because they don't understand it. They don't have the foundation they need. Or they drop out.

The Math and Science Chair said that they tried to place the students within the Math and Science Department by telling the students what course they should take based on their placement score, ACT score, or both, but there was no guarantee that students heeded the advice. Two interviewees said that the placement test often was not accurate at predicting what a student could do in math. The Math and Science Chair and the Math 102 instructor thought the ACT math score was the best indicator for student placement in math courses. Faculty conducted research was the basis for these conclusions.

There was no prerequisite for ASC 092 since it was one of the lowest level math courses offered. The prerequisite for Math 102 was ASC 092 or appropriate placement test score as described above.

The ASC Director said that students could receive credit for developmental courses, but the credits did not always transfer or count toward program and graduation requirements. ASC 092 did not satisfy any graduation requirements. A specific department could choose not to allow Math 102 to count toward total hours required for graduation (Course descriptions: Mathematics, 2001).

Goals, Objectives, and Desired Outcomes. There were no objectives for the developmental mathematics program, but the Academic Services Center did have a mission statement: "The Academic Services Center (ASC) works cooperatively with other college departments, high schools, and funding agencies to provide a broad spectrum of educational courses, activities, and services to improve academic achievement and increase retention of students" (Academic Services Center, 2003).

Course objectives were listed in course syllabi of both courses. The Math 102 instructor said that these were discussed with students on the first day of class. "Math faculty, ASC faculty, students, and hopefully, administration" were aware of these objectives, said the ASC 092 instructor. The ASC Director said that the instructor of each course was responsible for the development of course objectives. Seven course objectives were listed in the ASC 092 syllabus:

1. To review the basic properties of operations that are used in both arithmetic and algebra.

2. To offer the students the methods of simplifying variable expressions using the addition, multiplication, and distributive properties.
3. To introduce the translation of verbal expressions into variable expressions and simplify the resulting expression.
4. To introduce linear equations and graphing procedures.
5. To introduce functions.
6. To instill in the student an appreciation of the orderly, connected, and related nature of mathematics.
7. To teach a methodology and strategy for problem solving. To instruct procedures for formulating and displaying a problem and its solutions in an organized, orderly, clear and precise manner.

The Chair of Math and Science said that the first day handout listed the course objectives. Syllabi were handed out campus-wide, and this was one of the quality standards at the institution. Four course objectives were listed in the Math 102 syllabus. These objectives were:

1. To present to the student a basic understanding of numbers, functions and relationships, and arithmetic and algebraic operations.
2. To present to the student the means of using algebra for problem solving.
3. To prepare the student with the tools of algebra needed to understand and work in disciplines other than mathematics.
4. The student is expected to formulate and display problems and their solutions in a neat, organized, orderly, clear, and precise manner.

The researcher asked the interviewees what philosophies, goals, objectives, or desired outcomes they had for the courses or the program. The Math 102 instructor simply stated the objectives on the syllabus, but in responses to other questions said, "They are all scared. I have to help them overcome their fear. It has taken until almost now [over two months into the semester] for many of the students not to fear the mathematics course." He went on to say, "You take a kid where he is at and try to improve his lot somewhat." The ASC 092 instructor said that her main goal was to get students ready for Intermediate Algebra so "that they will have the necessary background

and skills necessary to successfully take Intermediate Algebra. We also work on their phobias and attitudes, but that's not written down." The ASC Director said that their role in developmental education was "to build students' math skills, but also help them become more competent and confident in math, which in turn affects their self-esteem."

Students. The interviewees described the students in the developmental mathematics courses at AA II as being at every level and every motivation. Some students had learning disabilities. Many students had a negative experience in school the first time around. Some students were right out of high school, and others were in their 30s, their 40s, or even their 50s. Many of the older than average students were returning to school because they had been injured on a job, needed to retrain, had been out of school for a long time, or needed to prepare for tests in business and industry. One interviewee described the students as coming "from the inner city of Minneapolis to the outer plains of North Dakota."

In the Basic Mathematics sequence of courses (which were not defined as developmental for this study, but could be considered developmental according to their content), many of the students were enrolled in a trade or services program according to the Math and Science Chair. The ASC 092 instructor said that there were "students who have never had algebra, those who did not do well in algebra in high school, and those who had algebra a long time ago, but for whatever reason did not do well."

When describing some of the students, the ASC 092 instructor said, "One comment I hear real often from guys especially is, 'You know when I was in high school all I was interested in was cars and girls, but now I'm married and I've got a kid, I gotta

know this.'" She also said, "One common thing to practically everybody is panic. Fear. Phobia." All interviewees at some point during the interviews mentioned the students' fear of mathematics or their lack of confidence in their ability to do mathematics.

The ASC Director said that at least 25% of entering freshmen placed into some kind of developmental area based on the placement testing that was done. The ASC 092 instructor said, "There are a number of students that go on and do well. A lot of them do and a lot of them don't. Maybe about half of them." The Chair of Math and Science said that not many students started above the developmental level. He said that it was probably 60:40 developmental to non-developmental students. With regard to the number of students who succeed in Math 102 Intermediate Algebra, he said, "Those in Intermediate that fail, they're not failing by, they're failing by choice by not doing the homework and not...Anybody that really wants to get through it, is going to get through it. I don't think there is a student in there that can't do the work." Motivation was an issue. Of those who earned Cs in Math 102, it was probably due to motivation, not skills. Students who earned A and B grades in Math 102 were most successful in their next math courses. The Math 102 instructor said that students really needed to do "A" work in Math 102 in order to go on and be successful in other math courses

Instruction. In the developmental mathematics courses, the instructors used lecture, interactive lecture, individualized instruction, group work, board work, and technology. Instructors used individualized instruction to teach ASC 090 Math Prep, ASC 091 Pre-Algebra, and ASC 093 Pre-Trigonometry. Regarding individualized

instruction, the ASC 092 instructor said, "We have a lot of material that is geared to different areas that we pull out for what people need."

Using the grade distribution data, the researcher determined that no more than 30 students, including those who dropped, were enrolled in the each of the Math 102 sections during the fall semesters in which data were gathered. The courses offered in the Academic Services Center were usually smaller than this, but about 20 students, including those who dropped, were enrolled in the each of the ASC 092 sections each fall.

The ASC 092 classes were taught in the Math and Science Lab located in the Academic Services Center along with the offices of the Academic Services Center math instructors and supplemental materials for student use, including videotapes, books, and computers. During the observation of the ASC 092 class, the instructor began class with what was called the Daily Dozen Quiz. This was a list of problems for students to do in two minutes. The students did these, and then the instructor went over the answers and asked if there were questions on any of the problems. Similarly, the instructor stated the answers to each section of homework problems and asked if there were questions. The students asked about problems, and the instructor solved these problems at the board. Next, the instructor presented a new concept at the chalkboard. As she did this she connected the new topic to what the students had previously learned. She completed and explained two examples on the board, and then she had the students complete similar problems at their seats. While the students did this, the instructor walked around and helped them. She often got down on one knee on the same level as the student. The

instructor correctly used mathematical language and its vocabulary. She used the rules and properties of algebra so no "shortcuts" were shown. Four students were present during the observed class meeting.

During the observation of the Math 102 class, the instructor chatted and joked with the students prior to the start of class. Fifteen students were present. The main topic was a property of logarithms. The instructor did not simply state the new property; instead, he had the students discover the new property through the use of examples and patterns, through students' previous knowledge of logarithms and exponential functions, and through the use of the calculator. Once the students developed the property and were convinced that it was true, the instructor wrote the property on the board and gave it a name. After this, the instructor completed a few examples at the board using the new property, and then he had all of the students go to the board in groups of two or three.

While at the board the instructor gave the students a problem to solve. This problem was read orally to the students. This forced students to determine how to write down the mathematical concepts they heard. Some of them had trouble doing this, and the instructor had to repeat the problem or help the students. Once written on the board, the groups of students attempted to solve the problem. The instructor helped some groups, but most of the time he let them work together. The instructor eventually provided the correct solution. This process was repeated for the remainder of the class. The problems continually drew on the new material presented that day in class but also on previously learned material. Some of the problems were difficult for students, but they appeared to enjoy the board work. Students willing went to the board in groups and

seemed determined to get the correct solution to each problem. The students seemed extremely at ease with the instructor, and his use of humor seemed to help make the class fun and enjoyable.

The researcher asked the instructors and the directors to describe effective lessons from the developmental courses they taught or to describe the effective policies and practices used in these courses. The instructor of the ASC 092 course said:

> You have to have rapport with the students. If they don't like you, they are not going to pay much attention. You have to get over the panic part of it. You have to get over the phobias. I think that is actually more important than the actual teaching, is the rapport, at this level especially. You also have to teach in a way that they understand. I know that a lot of people start on too high of a level, and you have to remember that these students are complete novices. They do not know anything about math.

She said that they focused on skills and tried to make it fun. The course started with positive and negative numbers, and the checkbook was used as a real-life application to help teach the students about these because "everyone knows the checkbook." The ASC 092 instructor said that this example was particularly helpful for the older than average students because it was something with which they were familiar.

According to the ASC 092 instructor, ASC 092 originally was a no homework class and the Academic Services Center had the books. All of the work was done in class using the Center's textbooks, and worksheets were created for the students to take home. "Eventually it got to the point where there was too much to do in the course and there was not enough time to do everything in class," said the ASC 092 instructor, and she persuaded the ASC Director to have the students buy their own books and do homework outside of the Academic Services Center. With the students buying and having their own

texts, the instructor said that she could give them more homework problems than she could put on the worksheets. She said:

> I know there's a lot of people that think, in math if you know how to do it that's kind of good enough—you don't need practice. Well, I don't go along with that, because especially with these people, every time they do it, a little bit more sinks in. And if they don't do a million of them, none of it sinks in and none of it stays there. I always relate it to kind of like, like playing the piano. You know I can watch somebody play the piano, and see, I used to be a piano teacher too. You can watch somebody play the piano. You can know exactly why they put their fingers in exactly what place and every thing about it, but unless you do it and you practice, you can't play the piano. You have to do it. You have to practice.

The instructor said that a lot of quizzes were given in ASC 092 and that students had the opportunity to retake these quizzes. She explained:

> We do a lot of quizzes. I call them quizzes because [the students] don't get as panicky over quizzes than they do if you say it's a test. We do a lot of them partly because I want the feedback right away and partly because they will forget, and partly because I want to get rid of some of this test anxiety because there are a million of these that have test anxiety too. It goes along with it very much. And the more we do, the easier it is for them. And we try to not play them up too much, you know, just kind of be real informal about them, and um, I also let them, you know if they do poorly on a quiz, that they can always come back, we will work the subject some more and they can retake quizzes. Because the whole purpose of this is not for a grade, it's to get them ready for intermediate [algebra] so that they will be successful.

The ASC instructor said that she gave the students a journal question everyday. They were not graded as such, but she definitely read them and made comments on them before they were handed back. In an e-mail response, she wrote:

> It's more of a dialogue, I suppose. I'm constantly changing the questions from one semester to another! Some of them are opinion questions, some of them are more for assessment, and some of them are directly related to things we've done in class. Some students don't do them and they aren't penalized for that, but they don't know that! I get some very good answers sometimes, and some very humorous ways of saying "I don't know" sometimes!

The ASC 092 instructor had started using the TI-83 calculator a little bit. She introduced it in the course so the students got comfortable with it and could use it in Math 102. She said that Academic Services talked about an evening calculator workshop or mini-class to get the students to learn the calculator so they would know how to use it when they entered class to save the instructors time, but this had not occurred yet. The ASC 092 instructor mentioned the different personalities of her classes and how the active participation and contributions of students made some classes more fun than others.

The researcher gained other information about ASC 092 by reviewing the course syllabus. Included in the syllabus were: basic course and instructor information, course materials, course description and objectives, grading policy, and course policies regarding attendance and makeup quizzes. The instructor provided an explanation of the quizzes and stated that there was a comprehensive final. Regular attendance was expected of the students, and students were expected to call or e-mail when they could not attend.

Using the General Syllabus Checklist, the ASC 092 syllabus lacked the following: prerequisites; a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; other course requirements (but there may not have been any); a disability statement; a course calendar; a list of important dates; an estimate of student work load; a time to schedule fast feedback; supplementary material; and a space for

other students' contact information. The syllabus was dated 1999-2000, but it was the copy that the instructor gave the researcher for the course.

The Math 102 instructor was interviewed by phone prior to the visit to the institution. The researcher also spoke with this instructor when she first arrived at the institution prior to observing any of the classes or conducting any of the interviews. During the phone interview, the instructor said that he had a really great lesson that day in class, and he described it. He said that the students previously were working with exponential functions in which they had to determine different parts of an exponential equation. During class he defined the exponential equation and provided the students with examples on the board. After this he sent the students to the board to do similar problems in groups. He said, "You have to put them to work or you lose them." During the observation of Math 102, the instructor demonstrated this same type of instruction.

The Math 102 instructor and students used the TI-83 calculator. According to the syllabus, the instructor required students have some type of graphing calculator, and the TI-83 was the recommended brand and model. The course assignments were homework problems and projects from the text. The instructor said that he allowed time in class to answer questions about the homework. He also said that the students' motivation for homework was low so when there was time, homework problems were done in class. When this was done students could ask specific questions about the problems while he was there to answer them and help them. There were eight homework quizzes, one for each chapter, a cumulative midterm exam, and a cumulative final exam.

The Math 102 Course Handout (syllabus) described the approach for the course as: "The student works in a social context to construct mathematics ideas using a curve fitting approach, and to reflect on these constructions, all as a means for understanding problem solving situations." Also included in the syllabus for Math 102 were the following: basic course and instructor information, prerequisites, course materials, course description and objectives, assignments, grading policy and scale, other course requirements, tutoring description, make-up test policy, and a course outline.

Using the General Syllabus Checklist, the Math 102 syllabus lacked the following: a clear description of the course purpose; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; a disability statement; a list of important dates; an estimate of student work load; a time to schedule fast feedback; and a space for other students' contact information.

The ASC Director did not teach any of the developmental math courses, and the Math and Science Chair taught the Basic Mathematics sequence, but he did not teach ASC 092 or Math 102. The researcher still questioned both of them about the instructional methods used in the developmental mathematics courses. The ASC Director said that the students got smaller class sizes and more individualized attention. She said, "The instructors taught in a more traditional manner with the instructor giving some lecture and then the students working on things with the instructor walking around and facilitating the [students'] learning," and there was "more partnering with students." She said that the ASC 092 instructor set up the course similar to what was done in Math 102

and Math 103 to help prepare the students and provide them with a foundation for their next math courses. The ASC courses were graded S/U so there was less pressure on the students. The Director of Academic Services also described how ASC 092 used to be "more of an independent course" where students worked independently to learn the material, but later "we changed the format and found that we had more student success."

The courses in the Basic Mathematics sequence, not considered to be developmental for the purposes of this study, but often developmental in content, were offered in the Math and Science Department and in the Academic Services Center. In the Academic Services Center the courses were offered as FLEXtime courses where there was no scheduled class period. Students set their own schedules and worked at their own pace. A FLEXtime lab with texts, videos, and computer software was available for students. Tutors were available for individual attention as well (North Dakota State College of Science, 2002).

The Math and Science Chair discussed how he managed the Basic Mathematics sequence in the Math and Science Department. These courses were self-paced independent study courses in which the students came to a lab on campus, worked on problems, received assistance from the instructor, and took tests. The students took unit tests and placement tests to pass or to place out of each unit in the course. There were four units in each Basic Mathematics course in the sequence. Students could place out of an entire unit or course by taking placement tests. Students had to receive at least a 70% on each unit test or else they had to go back and do additional assignments. They had to earn at least an 80% on these assignments to retest for that unit. The Math and Science

Chair said, "They cannot leave the math class with anything less than a C." A graphing calculator was not required in the Basic Mathematics courses due to the high costs students paid for their tools in their programs.

The Math and Science Chair said, "Ninety percent of the problems [in the Basic Mathematics courses] are application problems. We want problem solvers because that's what industry wants." He said that you had to teach the students how to "dissect" application problems for the important and relevant information. The ASC Director said that in many situations students did math problems that did not just involve numerals. She said, "They have to take a written scenario and use it to solve a problem because that is real life." She said that what she had seen in her experiences working with students with math difficulties was that they did not understand or could not figure out what the problem asked them.

The Math and Science Chair said, "You have to be patient with the students and treat them on an individual basis." He also said that he and others in the Math Department referred students to the ASC Math and Science Lab for tutoring and more structure. Students got a lower student to faculty ratio in the Academic Services Center.

Before the Basic Mathematics courses were taught as a self-paced individualized lab course, they used to be taught in a more traditional setting where the instructor went over the assignment, corrected them, answered questions, presented new material, put the work on the board, gave examples, and left the students with 15 to 20 minutes of free time to ask questions, to stay and do work, or to go. Board work was also used then, and the Math and Science Chair said that the students seemed to like this and wanted to do it.

The Math and Science Chair said that their department and the Academic Services Center coordinated the math courses. They used the same texts and had the same basic philosophy. He said, "They may not do as many application problems as we do over here, but I know their philosophy is to provide the students with some success for self-esteem."

Preparation for Success in Future Math Courses. The researcher asked the instructors and the directors what they did to prepare developmental mathematics students for success in the next mathematics course they took. The ASC 092 instructor prepared students by knowing what was taught in Math 102 and Math 103 so the appropriate background material could be covered in ASC 092. She said, "I know what is taught in 102 and 103 because we have those students come in for help, and I try to cover all the background material." One of the Math 103 instructors required struggling students to go to the Academic Services Center for help and to get a signature that showed they did this. Study groups led by peer tutors were available for students. As part of institutional assessment, one of the Academic Services Center instructors tracked students who took ASC 092 to determine how they did in their next math course and if they were retained. One of the Math 102 instructors allowed students to redo tests up to a grade of C with any kind of help (books, notes, ASC faculty) to focus on learning the material. One interviewee said that ASC 092 helped the students review for Math 102. The ASC Director said that a college-prep program was offered during the summers for students to build their skills before they entered the regular curriculum.

The ASC Director said, "The Academic Services Center has extensive hours." It was open Monday through Friday from 8:00 a.m. to 5:00 p.m. and Monday through Thursday from 6:30 p.m. to 9:00 p.m. The Math and Science Lab was open during these times, except when a class was in session, and even then, students dropped in to work or to use one of the other labs.

The ASC 092 instructor said that a pretest was given in ASC 092 to help place students. Those who scored high could move up to Math 102. A posttest was given as well. This was used to help the instructor adjust the material to improve student understanding and success. The math faculty tried to place students in math courses based on their placement scores, but according to the Director of Academic Services, they did not "have any teeth behind it" since placement was not mandatory.

According to the Math and Science Chair, one week of the school year, called Assessment Week, was designated for assessment activities. He said that this took place too early in the semester for students to have an informed opinion, but later in December they gave students a questionnaire. He said, "We used some of the thoughts [from the questionnaire] to change things because that is what assessment is for." One day during Assessment Week, the math faculty got together and on another occasion during this week students were included and asked to give feedback about courses and instructors.

One interviewee said that one thing that could be done was a competency-based education where you had to be competent with certain skills before moving on, but that was not how it was done. There was no exit competency. In the Basic Mathematics

sequence this was done to a degree. Students had to earn at least a C on each test, and thus, in the course, before they could go on to the next test or course.

Support Services. The Academic Services Center offered support services to developmental mathematics students and other students at AA II. These services included: courses; study services; workshops; Disability Support Services; study groups led by trained peer tutors; tutoring provided by the Academic Services Center faculty; supplemental materials, like video tapes, texts, and computer software; summer college-prep programs and workshops; a tutoring program for refugees; and various labs where students worked and got walk-in help from tutors. The labs included the Math and Science Lab, a Writing Lab, a Reading Lab, and a FLEXtime lab. There was also an open center that offered credit courses, provided walk-in help and other services like proctored testing, taped texts, video tapes, internet, and e-mail (North Dakota State College of Science, 2002). The ASC Director said that they referred students to academic counselors. There was a freshmen orientation during the summer before the semester started. Placement tests were given during this. The orientation was not ongoing, but the ASC Director said that the retention, enrollment, and orientation committee was looking at doing more with orientation.

The Math and Science Chair said that department faculty members were always available to students. He also said, "Academic Services Center is the place for support services on campus."

Program and Course Assessment. There was no formal assessment being done of the developmental mathematics program. According to the Director of ASC, the institution was certified every five years by the State Board of Vocational Education, and it was accredited every 10 years by The Higher Learning Commission. Math 102 was assessed as part of general education, but not as part of the developmental mathematics program. Students completed course and instructor evaluations at the end of each semester in all classes on campus. The ASC 092 instructor gave a survey during the course to get comments from students regarding the course. She also used their journals, informal feedback from conversations with students, and a pretest and a posttest to inform and improve her teaching and student learning.

The ASC Director mentioned the tracking of ASC math students to determine how they did in their next math course(s) and if they were retained. She also said that she used personal interviews with students in which she very informally asked students how it was going. She said that the students' views were not always the same as the faculty's views so she got a bigger picture. She said, "I listen to my instructors and observe a lot. If the lab is full all of the time, it lets me know that I may need more room or need to extend hours." The Academic Services Center kept a record of the number of students who logged in and used their labs each month.

The Math and Science Chair said that students' placement scores were compared to their final grades in order to assess the Basic Mathematics courses. In addition, a pretest and a posttest were given in the last course in the sequence. Assessment Week was previously described, and the results of that were used to improve the Math and

Science Department and its courses, but these assessment efforts were not usually targeted at the developmental mathematics program and its courses.

Perception of Support. The researcher asked all interviewees to describe the level of support others (department, administration, state, etc) had for developmental mathematics. All interviewees said that the developmental mathematics courses were highly supported. The Math and Science Chair said, "The two-year school is a stepping-stone for those individuals wanting to go on to the four-year institutions, and they may be better off starting here in Intermediate Algebra and College Algebra and not getting in large classrooms."

The ASC Director said that the institution supported the developmental mathematics courses. She said that there were "extensive hours" in the Math and Science Lab, and "it is an extremely busy lab." The Math Department, Academic Services Center, and the institution were very focused on student learning. She also said that because it was an open enrollment institution, it had a tendency at times to attract students of lower academic ability, and yet, the institution wanted retention and placement of students.

The ASC 092 instructor said, "ASC is obviously supportive. Both Intermediate and College Algebra instructors are very supportive in keeping us informed, telling their students about us [ASC], and using our services for making up tests and correcting tests." She also said that overall they had what they needed and were treated pretty equally. "We could always use more, but we're doing fine," she said.

The Math 102 instructor said that there was support from the Math and Science Department, the Institution, and the State. In terms of politics, there was a greater demand to get students into the institution and to have them stay there since there were fewer students enrolled.

In terms of financial support for the developmental mathematics courses offered through the Academic Services Center (not including those courses offered through the Math and Science Department), the ASC Director said that most of their budget went to faculty salaries. They spent about $35,000 to $40,000 on developmental mathematics faculty salaries, not including staffing in the evening. A few hundred dollars were spent on other resources like videos, CDroms, tutorials, and manipulatives. The Math and Science Chair had no idea about the amount of money spent on developmental mathematics education. He said that they needed more staff members. He said, "With the budget cuts, everyone has lost people, and ASC is not the place to lose it." He said, "Many students feel like they would never had completed their degree without their help." He also said that space was limited in the Academic Services Center so it would be helpful if Math and Science had their own room for peer tutoring.

Desired Changes. The researcher asked each of the interviewees what changes they would like to see occur in the developmental mathematics program and its courses. The ASC Director said, "I would like to see it not be so teacher driven...and more applicable to their daily lives or the workplace. How does it apply to the workplace that they are entering?" The ASC Director continued:

> So that when you are working with that refrigeration and air conditioning student, they understand the philosophy behind it, why you need to do it the way you do it. Not just learning or memorizing a process, but they truly understand why it has to be done this way. What's behind all of that. They can memorize how to do a problem, but then you say to them, "Now tell me why you had to have, why we put this here, or why this goes there, or why it's done with this step." They can't tell you. And I think mathematics is an excellent, what is the word I want to use, not tool, but it has, it just lends itself naturally to teaching some of these other things.

The Chair of the Math and Science Department said he could use more staff to decrease class size. He said, "Money's not an issue because it's not there to ask for."

The ASC 092 instructor said that the main change she wanted was mandatory placement. The Math 102 instructor said he wanted more involvement of the math faculty with the developmental courses. In the past, math faculty volunteered in the Academic Services Center and worked with students, but there was no recognition or pay for this so the motivation of faculty to continue this decreased. He said that when this did take place, it was positive. He also said that students feared the Math Department less when there was more coordination between the Math Department and the Academic Services Center. He said, "There should be more recognition that a course like Math 102 takes more time." The class sizes were too large. He said that the Math 102 sections often started with about 30 students but usually dropped down to about 20 students. The Math 102 instructor wanted "to learn how to work with and motivate particular types of students." He wanted to stay on top of students who missed a lot of class. Finally, he wanted to track Math 102 students to see how they did in future math courses and if they were retained.

Other Comments. The ASC 092 instructor said that she enjoyed teaching the developmental mathematics courses. Her biggest challenge was making sure each student was learning, partly because they had such a variety of learning styles. She said that she taught "students, not content." She also said:

> Our belief is that everybody deserves a college education, or postsecondary, of some sort, and we will do everything we can to help them. They have to put forth their own effort, of course, but we will help them with anything that they need help with. And that's why our Academic Services Department is quite large because we do get a lot of students here that really do need help. And also because they are not required to have an ACT score, there is no cutoffs or anything. We get people that actually have a GED, have never had an ACT score, but it is a wonderful place for them to start. And of course, they don't all make it, but a lot of them do too.

In the Math and Science Department, the Math 102 instructor thought that for about half of the students it was probably worthwhile to be in class. The Math and Science Chair said, "Students need to be assessed before leaving high schools. Or counseled better. It is really obvious that they are lacking writing and math skills. It would be nice know what they can do algebraically and with basic consumer math. Algebra drives the calculus."

The ASC Director emphasized the importance of reading skills. Students' reading abilities affected their math. Students needed to be able to read well to do math well.

Grade Distribution Data. Grade distribution data for AA II are summarized below in Table 24 and Table 25. The courses included in the tables are: ASC 090 Math Preparation, ASC 091 Pre-Algebra, ASC 092 Beginning Algebra, ASC 093 Pre-Trigonometry, and Math 102 Intermediate Algebra. The researcher received grades for

the Basic Mathematics sequence of courses, but she did not include these grades in the tables.

Table 24. Grade Distribution Information for Fall 1999, Fall 2000, and Fall 2001 at AA II.

Course	Year	Grade									Number of Students Enrolled	Number of Students Who Dropped	Percentage of Students Who Dropped	GPA
		A	B	C	D	F	P	I	S	U				
	1999								1	1	2	1	33.3%	
ASC090	2000								18	2	20	1	4.8%	
	2001								3	0	3	2	10.0%	
	1999								20	2	22	11	33.3%	
ASC091	2000								14	4	18	4	18.2%	
	2001								6	1	7	26	78.8%	
	1999								35	17	52	8	13.3%	
ASC092	2000								51	21	72	3	4.0%	
	2001								40	16	56	10	15.2%	
	1999								12	0	12	0	0%	
ASC093	2000								11	1	12	0	0%	
	2001								6	0	6	1	14.3%	
	1999	7	11	24	3	17					64	15	19.0%	1.79
Math102	2000	4	14	16	9	15					58	10	14.7%	1.70
	2001	16	11	18	8	10					63	13	17.1%	2.23

The percentage of students who dropped ASC 092 ranged from 4-15%. In Math 102, the drop rates were between 14% and 19%. In ASC 090, the drop rates were between 5% and 40%. In ASC 091, the drop rates were between 18% and 79%. In ASC 093 the drop rates were between zero and 14%.

The average GPAs ranged from 1.70 to 2.23 for Math 102. Grade point averages were not calculated for the other developmental mathematics courses since they used S/U grading.

Since students earned S/U grades in the ASC courses, the researcher calculated percentages of students who were successful by assuming an S was a success, and a U was not. In Math 102, the researcher calculated the success rates by defining a grade of C or better to be a success. This was done without the students who dropped and with the students who dropped the courses.

In the ASC courses, the success rates varied greatly from 50-100% before drops. Some of this was due to small class sizes. When only three students enrolled in a course and one dropped, it dramatically affected the success rates. When the students who dropped a course were included, the success rates for ASC courses dropped in all courses during all semesters except for ASC 093. During fall 1999 and fall 2000, no students dropped ASC 093. In ASC 092, the success rates ranged from about 67-71% when student who dropped were not included, and decreased to about 58-68% when students who dropped were included. In Math 102, the success rates ranged from about 59-71% when students who dropped were not included and dropped to about 50-59% when students who dropped were included. There was a difference of about 10% between the percentage of students who successfully completed ASC 092 and the percentage who successfully completed Math 102 when drops were included, especially when students who dropped were included.

Table 25. Success Rates for Fall 1999, Fall 2000, and Fall 2001 at AA II.

Course	Year	Success Rate	
		Without Drops	With Drops
ASC090	1999	50.0%	33.3%
	2000	90.0%	85.7%
	2001	100%	60.0%
ASC091	1999	90.9%	60.6%
	2000	77.8%	63.6%
	2001	85.7%	18.2%
ASC092	1999	67.3%	58.3%
	2000	70.8%	68.0%
	2001	71.4%	60.6%
ASC093	1999	100%	100%
	2000	91.7%	91.7%
	2001	100%	85.7%
Math102	1999	65.6%	53.2%
	2000	58.6%	50.0%
	2001	71.4%	59.2%

Summary. AA II offered five developmental mathematics courses, ASC 090 Math Preparation, ASC 091 Pre-Algebra, ASC 092 Beginning Algebra (two credits), ASC 093 Pre-Trigonometry, and Math 102 Intermediate Algebra (three credits). There were other courses, especially three Basic Mathematics courses, whose content might be considered developmental, but the courses were not defined to be developmental according to this study.

The developmental math courses were taught in the Academic Services Center and in the Mathematics Department. Academic Services Center personnel taught ASC 090, ASC 091, ASC 092, ASC 093, and Math 102. Math faculty also taught Math 102.

The instructors had bachelor's degrees or master's degrees but no training in developmental education. Academic Services Center faculty members had education degrees and were vocationally certified. Faculty development opportunities were available for faculty in both departments. The instructors of the courses participated in the planning and decision-making processes of their respective departments, and some of the math instructors in the Academic Services Center attended the Math and Science Departmental meetings.

The developmental mathematics instructors from both departments developed the curriculum. This included choosing the texts and deciding the content of the courses. Instructors presented the material using individual methods.

Program goals or objectives were not stated anywhere. Individual courses had objectives written by the instructors and included on course syllabi. Indicated in the written objectives were what would be done during the course, the content to be taught, and the skills students should gain as a result of the course. The interviewees also had goals or objectives that were not stated on any documents, including: helping students overcome their fears and phobias of math; improving students' skills; preparing students for their next math course; and improving students' self-esteem and confidence in math.

Some were assessed using ACT math scores or the COMPASS placement exam, but placement in the appropriate course was not mandatory. There were recommended cut scores based on the placement exam scores or ACT scores. Students were advised to enroll in the appropriate course using these scores. Students did not receive graduation

credit for ASC 092, and graduation credit for Math 102 was left up to specific departments. Both courses counted toward financial aid credit.

The developmental mathematics students varied. They came from farms and from inner cities. Many of them were trades and services students. Some students were traditional age college students, and other students were older. Some students had a negative experience in math their first time around, and most of them had a fear of math and lacked confidence in their mathematical abilities. Many had no or little background in math. There were students who returned to school after an injury, or to retrain, or to prepare for tests in business and industry. The ASC Director said that about 25% of students placed into some form of developmental education. The Math and Science Chair thought that about 60% of students started in a developmental mathematics course.

The instruction used by the observed and interviewed instructors included lectures, board work, labs, group work, student-teacher interaction, structure, integrated technology, and sometimes a discovery approach. The interviewees thought that the following were important and effective when teaching developmental mathematics courses: having a good rapport with students; helping students get over their fears of math; teaching in a way that students understand; a non-threatening learning environment; focusing on skills; repetition; small class size; individualized instruction; patience; active student involvement in class; and board work. The interviewed instructors used homework, journals, tests, and quizzes to assess students. Students could retake quizzes or tests in ASC 092 and sometimes in Math 102, depending on the instructor. Graphing calculators were used in both courses, especially Math 102.

The interviewees prepared students for success in future math courses by doing the following: knowing what was taught in the next math courses students took; offering peer led study groups; allowing students to retake quizzes or tests so students learned the material; offering a summer college prep program; having extensive hours in the Academic Services Center; giving and using the results of a pretest in ASC 092 to help place students appropriately and to adjust instruction; giving a posttest in ASC 092 and using the results to help adjust instruction; and advising students on appropriate math courses based on placement exam or ACT results.

The Academic Services Center offered almost all of the student support services at AA II. The Academic Services Center referred students to academic counselors, offered tutoring by ASC instructors, and had study groups led by trained peer tutors. Courses, study services, workshops, videos, texts, computers and software, summer programs, and labs were offered in the Academic Services Center as well. Disability services were available on campus, and a freshmen orientation, which was not on-going, took place before each new term. In the Math and Science Department, instructors were available to help students.

The developmental mathematics program was not assessed, but some assessment methods were used in each course. Students completed course and instructor evaluations in each class each semester. The ASC 092 instructor used a pretest and a posttest for placement and for improving the course. The ASC 092 instructor also used a survey, journal assignments, and informal feedback from conversations with students to gain more knowledge about the course and the students in order to improve the course. Some

tracking of students was done in the Academic Services Department for institutional assessment purposes, but this information was not shared with the researcher. The ASC Director used informal personal interviews with students, observed, and listened to her faculty to help assess how the Academic Services Center was functioning. An Assessment Week was also held on campus.

The interviewees thought the institution and their departments supported the developmental mathematics courses. There were extensive hours in the Academic Service Center labs, and the focus at the institution and in both departments was on student learning. Both departments, Math and Science and Academic Services, supported each other through student referrals and coordinated efforts.

The interviewees desired the following changes to the developmental program: mandatory placement; more staff to decrease class size; less teacher driven and more real-life curriculum; more complete understanding by the students; more involvement of math faculty with developmental math courses; more space so Math and Science could have its own tutoring room; recognition that courses like Math 102 took more time; to learn more about working with and motivating different students; and tracking Math 102 students to determine if they were successful in future math courses and were retained.

During fall 1999, 2000, and 2001, student GPAs in Math 102 were between 1.70 and 2.23. During these same semesters, 4-15% of students dropped ASC 092 and about 15-19% of students dropped Math 102. In all developmental mathematics courses, success rates were between 59% and 71% when dropped students were not included in the calculations and were between 50% and 68% when dropped students were included.

The success rates in Math 102 were about 10 percentage points lower than the success rates in ASC 092 with and without dropped students.

AA II: ASC 092 Syllabus

Course Information
Beginning Algebra 092
2 credits

Instructor Information
Name of instructor
Location
Phone XXX-XXXX
E-mail Address

Course Description
This course is designed for students with little or no algebra background who wish to prepare for further study in mathematics or who need to review basic algebra concepts. It includes topics such as signed numbers, fundamental operations, algebraic expressions, linear equations and problem solving. Does not satisfy any graduation requirement. Offered only through the Academic Services Center.

Textbook
Beginning Algebra with Applications
Fifth Edition
Aufmann Barker Lockwood
Copyright 2000 by Houghton Mifflin Company

Attendance Policy
Regular attendance in reporting to class is expected of each student. Students are expected to call or e-mail the instructor if student is unable to attend a class period.

Testing
Periodic quizzes will be given to assess students' understanding. If a quiz is missed, students will be given two weeks to make it up. A comprehensive final test will be given.

Grading
Beginning Algebra (ASC 092) is a course based on time spent in class and successful completion of instructional units. Grading is Satisfactory/Unsatisfactory.

Course Objectives:
1. To review the basic properties of operations that are used in both arithmetic and algebra.
2. To offer the students the methods of simplifying variable expressions using the addition, multiplication, and distributive properties.
3. To introduce the translation of verbal expressions into variable expressions and simplify the resulting expression.

4. To introduce linear equations and graphing procedures.
5. To introduce functions.
6. To instill in the student an appreciation for the orderly, connected, and related nature of mathematics.
7. To teach a methodology and strategy for problem solving. To instruct procedures for formulating and displaying a problem and its solution in an organized, orderly, clear, and precise manner.

AA II: Math 102 Syllabus

Intermediate Algebra: MATH 102 Course Handout

Text: Intermediate Algebra, Jay Lehmann, Prentice Hall, ©2000
Instructor: Name, Office: Building and room
Phone: XXX-XXXX, E-MAIL: XXX@XXX.nodak.edu
Course: Intermediate Algebra MATH 102 3 credits
Properties of the real number system, factoring, linear and quadratic equations, functions, polynomial, and rational expressions, inequalities, systems of equations, exponents and radicals. Prerequisite: placement test
Objectives of Course:

1. To present to the student a basic understanding of numbers, functions and relationships, and arithmetic and algebraic operations.
2. To present to the student the means of using algebra for problem solving.
3. To prepare the student with the tools of algebra needed to understand and work in disciplines other than mathematics.
4. The student is expected to formulate and display problems and their solutions in a neat, organized, orderly, clear, and precise manner.

Class Periods: Monday, Wednesday, and Friday, 11:00-11:50am\2:00–2:50
Approach: The student works in a social context to construct mathematical ideas using a curve fitting approach, and to reflect on these constructions, all as a means for understanding problem solving situations.

Topics: Text chapters 1-4 and 6-9 will be covered (as time permits)

Tests: Two - 100 point tests-Midterm on October 17 and Final.
eight - 25 point quizzes - Completion of each chapter.
Make-up tests – Extenuating circumstances only.

Class work: Reading and problem solving activities will be assigned during the class period. Work will require the use of a graphics calculator. Hand-in problems and drop quizzes will be assigned and graded. Please make a commitment to be in class each day and to do your best to learn the material. My commitment is to facilitate in you learning.

Homework: Students are requested to complete homework problems in a notebook in a neat, organized, and orderly fashion.

Technology: Each student is required to have a graphics calculator. Recommended is the TI-83. The instructor can help with any TI-graphics calculator. For other brands, students are on their own.

Extra Help: Students are encouraged to contact the instructor for additional help in learning the subject material. Or, work with the Academic Service Center at the Library.

Grades: Determined by the following grade scale.

90 – 100	A
80 - 89	B
65 - 79	C
55 - 64	D
0 - 54	F

Intermediate Algebra: MATH 102 Course Outline

Course: Math 102 Intermediate Algebra 3 credits
Properties of the real number system, factoring, linear and quadratic equations, functions, polynomial, and rational expressions, inequalities, systems of equations, exponents and radicals. Prerequisite: placement test. F,S,Su

Text: Intermediate Algebra, Jay Lehmann, Prentice Hall, ©2000

Technology: Each student is required to have a graphics calculator. Recommended is the TI-83. The instructor can help with any TI-graphics calculator. For other brands, students are on their own.

Objectives of Course:

1. To present to the student a basic understanding of numbers, functions and relationships, and arithmetic and algebraic operations.
2. To present to the student the means of using algebra for problem solving.
3. To prepare the student with the tools of algebra needed to understand and work in disciplines other than mathematics.
4. The student is expected to formulate and display problems and their solutions in a neat, organized, orderly, clear, and precise manner.

Approach: The student works in a social context to construct mathematical ideas using a curve fitting approach, and to reflect on these constructions, all as a means for understanding problem solving situations.

Topics: Text chapters 1-4 and 6-9 will be covered (as time permits)
Chapter 1 – Linear Functions
Chapter 2 – Modeling with Linear Functions
Chapter 3 – Systems of Linear Equations
Chapter 4 – Exponential Functions
Chapter 5 - Logarithmic Functions and Inverse Functions
Chapter 6 – Quadratic Functions
Chapter 7 – Using Quadratic Functions to Model Data
Chapter 8 – Polynomials and Rational Functions
Chapter 9 – Radical Functions

Class work: Reading and problem solving activities will be assigned during the class period. Work will require the use of a graphics calculator. Hand-in problems and drop quizzes will be assigned and graded.

APPENDIX D

PROGRAM DESCRIPTION FOR BA I

Program Description: BA I

Background. BA I offered one developmental mathematics course, Math 102 Intermediate Algebra (three credits). During the visit to BA I, the researcher observed a Math 102 class, collected the course syllabus, and conducted and tape-recorded interviews.

The researcher interviewed the Math 102 instructor after observing the Math 102 class. The instructor taught other courses in the Health and Physical Education Department, but Math 102 was the only math course he taught. He was the only person who taught this course at the institution for the previous six years. He received a bachelor's degree in math education and a master's degree in physical education. He also was a high school math teacher for three years. He was chosen as an interviewee because he was the only person who taught a developmental math course at BA I.

The researcher interviewed the Chair of the Division of Science and Mathematics. The director had never taught the developmental course, but he had taught Math 103 College Algebra during a summer session. His bachelor's degree and doctoral degree were in chemistry. He is referred to as the Director of the program.

Definition and Location of Developmental Mathematics Education. According to the Director, developmental mathematics education at BA I was the one class, Math 102 Intermediate Algebra. The Director said:

> We don't really have a program to deal with that other than we've got, um, and I don't know how familiar you are, [BA I] is approved by the Board [of Higher Education] to accept students that are underprepared...Everyone else has a limit about how many students they take that don't meet all the college prep

> requirements. And so we're approved to do that, so what we've done in the last probably four years is kind of develop a program for those students. It is kind of a cohort program. We try and get them all to take the same classes, and so we set up a section of Intermediate Algebra for those students. There's a section of basic English for those students that they all kind of get in together and kind of build that cohort. That's really the program. If you are just looking at the math, it's just the one course. And then there's Supplemental Instruction in all those [cohort] classes.

The Division of Science and Mathematics offered the developmental mathematics course and an instructor of mathematics and physical education taught it. The course was not taught online.

Developmental Mathematics Faculty. As described above, an instructor in the Health and Physical Education Department taught the developmental math course at BA I. The Director did not specify any degree qualifications for developmental mathematics faculty. The instructor that taught the courses had a master's degree, but not in mathematics. His undergraduate degree was in mathematics. He had not received special training in developmental mathematics education. He said that he had not pursued any faculty development opportunities, so he did not know of any. The instructor also served on campus committees.

The Director described the Math 102 instructor as "very personable, and [he] relates well with students and that is important in that classroom." He said that, if possible, he would not have just any instructor teach the course. He would want someone to teach the course who could relate well with the students and be very student-centered. The Math 102 instructor did not participate in the Science and Mathematics Departmental meetings since he was more of a full-time employee in the Health and Physical Education

Department where he participated in their departmental meetings and decisions. The Director did say, "If there is something that he [the instructor] needs to be here for, we would make sure he is included."

Curriculum Development. The Director said that the development of the Math 102 curriculum was "left up to the individual instructor." The instructor chose the Math 102 text, the course content, and the method of delivery of the content. The instructor said that he saw the Math 103 College Algebra tests and tried to align the content of Math 102 with the content of Math 103. He also spoke with instructors and students of Math 103 to familiarize himself with the content of that course.

Policies. The Director said that there were no specific policies or practices for the developmental mathematics course at BA I. At one time students took a placement exam to determine what mathematics course they should take, but that was no longer done. Students were assessed using ACT math scores. The Director said, "As far as determining those underprepared students, my predecessor correlated ACT scores and performance. And so anyone who gets less than a 16 on the math component of their ACT is recommended that they take Intermediate Algebra." According to the Director, the ACT math score was as effective at placing students as the placement test, so the placement test was no longer used. Placement was not mandatory, just recommended by advisors. Students who were away from math for a while usually took Math 102 since no other developmental math course was offered for these students to take.

Math 102 could be used towards credit for graduation and financial aid, but it did not meet the program requirements for all programs offered at BA I. It did not meet the general education mathematics requirement either.

Goals, Objectives, and Desired Outcomes. The instructor listed course objectives on the Math 102 syllabus. These objectives were:

> Successful completion of Intermediate Algebra requires that the student demonstrates: (1) Competency in each of the prescribed units of instruction. (2) An understanding of the material in both the concrete and abstract world. (3) The ability to work in groups to enhance academic achievement.

Part of the course description on the syllabus was, "This course is designed to prepare students for successful entry into college level courses such as College Algebra, Finite Mathematics, Trigonometry, Chemistry, Biology, and the Physical Sciences." Students received copies of the syllabus.

According to the Director, the formal objectives listed on the syllabus were the result of a requirement by the institution's assessment program that began 10 years ago. The Director said that most of the formal objectives probably came from that process, but he thought that the Math 102 instructor probably selected most of the objectives. These objectives were revised after so many years. The Director added that, more and more, common course numbering forced them to formally write objectives.

Two of the objectives on the syllabus, "the ability to work in groups to enhance academic achievement" and "competency in each of the prescribed units of instruction," were not practiced in the course. The instructor said that he only used groups twice a

semester at the most, and students could pass the course even if they did not demonstrate competency and failed one or more exams.

When the interviewer questioned the Math 102 instructor, he revealed other philosophies, goals, desired outcomes, and objectives. The Math 102 instructor said, "My main goal really in there is just get them ready for [Math] 103. Because they are not going to take any more math. I don't have any math majors in my class. Get them through 103 is my goal." In addition, the instructor said that he tried to alleviate the students' anxiety, fears, and dislike of mathematics.

Students. The interviewees described the developmental mathematics students at BA I. The Math 102 instructor said, "Most of the kids who are here, I think, are either the nontraditional students who haven't came [to school] for quite a while, or those who either didn't take much in math in high school or just don't like it and are scared of it." The Director said:

> Typically it's going to be, actually it falls into two groups. The underprepared students, which generally means, for whatever reason, they probably only have one math class that they took in high school and so they're short the college prep requirement there. And, so that's the majority. That's the major share. There is also a smaller size group that kind of self selects. A lot of them tend to be returning, older than average students, who haven't had math in a long time. They have really severe math anxiety, and so they tend to self-select and say, "I don't want to go into [College] Algebra. I want to do Intermediate Algebra first." Interestingly, as in most classes, they tend to be the better students. Really, probably didn't have to take it in the first place, but they do.

The Director said that during fall semesters there was usually two sections of Math 102, and during spring semesters there was one section. He said that this meant there were about 50 or 60 students per year taking Math 102 out of about 170-180

incoming freshmen. The Director said that freshmen were not the only students who took Math 102, but they were usually the majority of students who did. He guessed that about 25% of incoming students required developmental mathematics. When asked about the developmental mathematics students' success rates, he said that a "good share" of the students passed Math 102 and went on to pass Math 103.

Instruction. During the observation of the Math 102 class, the instructor reviewed material for a test that was going to be given during the next class meeting. Therefore, the researcher was not able to observe the instructor presenting new material, but the researcher did observe the instructor's interaction with students and his explanations of problems.

At the start of class, the instructor quietly took attendance and then read aloud the answers to the homework problems. He asked the students if they had questions on any of the homework, and he proceeded to answer these questions by completing the problems at the chalkboard. While he completed these problems, he asked the students questions in order to have them help him solve the problems. He also explained what he did as he worked the problems.

After he answered homework questions, the instructor gave the students three problems from the text to complete at their desks as review for the upcoming test. The students worked quietly and individually. While the students worked, the instructor put the initial parts of the problems on the board. He also walked around the room, watched the students work, and helped them if they had questions or if he noticed something was incorrect on their papers. This lasted for about five to 10 minutes, after which he went

over the solutions to the problems on the board. Like the homework explanations, the instructor had the students help him solve the problems by prompting them with questions.

The students worked problems from the text two more times. Again, the instructor walked around, and the students worked individually, and the instructor went over the solutions to the problems at the board. After this, the instructor gave the students some problems to complete to study for the test. He also announced the times for two review sessions.

The researcher noted that the instructor did not label points and axes on his graphs, nor did he label key items, like the slope of a line, with appropriate symbols. Problems were solved in a rote manner by following a set of rules or steps. There was no further explanation of what the solutions to the problems meant. For example, in one problem, students had to determine if the point (-2, 0) was a solution to a set of two linear equations. The instructor substituted the point into both equations for the appropriate variables. He demonstrated that the point was a solution to one equation since it made this equation a true statement, and it was not a solution to the other equation since the point made that equation a false statement. No explanation was given regarding what this meant graphically so that students could visualize and understand the full meaning of a solution to a set of linear equations. Solving the problems was simply a series of steps and rules that had been memorized. Again, since this was a review day, this suggested type of material could have been covered in previous class sessions, but the researcher did not see it demonstrated during the observed class.

The Director and the instructor were asked to describe effective lessons, policies, and practices used in Math 102. The Director described the instruction in Math 102 as primarily lecture. A calculator with fraction mode, not a graphing calculator, was used. As mentioned previously, it was important that the instructor was personable and related well with the students. He said:

> [The Math 102 instructor] is very personable and relates well with students and that is important in that classroom....[He] spends a lot of time working individually with the students, as much time as he can, because in 102 there really is a range of ability that I can't imagine beginning to deal with....It goes from the underprepared, really unprepared, to those who are in there just because they self-selected, really probably have the ability, they just don't have the confidence in themselves.

He added:

> [The instructor] seems to be pretty successful at it because if they made it through his class [Math 102] there hasn't been a lot of issues on being successful in College Algebra. So I think he gets the material covered that they need to be successful. And changes their attitude a little bit if that's what it takes.

The Director commented on the importance of class size. He said, "We try to keep the classes small so we can get as much one-on-one as we can." This was easier to do in the spring and summer, when the course was capped at 20 students, than in the fall.

Having observed the Math 102 class prior to the interview with the instructor, the researcher had a little more knowledge of how the course was taught. This helped her direct specific and probing questions toward what was observed in class that day. During the interview with the Math 102 instructor, he said that he taught the course somewhat like a high school Algebra I course. He said:

> What I find is most effective is kind of relaxing their fears about math, giving them a lot of shortcuts or at least telling them, "Here's a shortcut to get to the

> answer," but let them try and relax their fears a little bit about math and let them realize that they are going to get through it.

He said that he wanted to get the students ready for Math 103 College Algebra. He did not use cooperative learning or groups, except maybe "twice a semester at the most." When this was done, he said that he usually did it on a review session day to have them do problems together in groups.

The students were required to have a calculator with a fraction mode. One of the first few weeks each semester he showed the students how to use it. He said:

> I want them to use it for anytime that they want to use it. Calculators are so accessible right now and I think it is more important that they know how to use the calculator and how to find the right answer, than that they know how to add two-fifths plus one-seventh. I'd rather have them know how to do it on the calculator than know how to find it otherwise.

Homework assignments came from the text and were assigned after each class. He said that he graded five of the homework assignments throughout the semester so "they could choose not to do it, but then they just better hope that's not one we turn in."

The instructor had a mandatory attendance policy and made attendance worth 50 points of their grade. The instructor explained the policy in more detail on the course syllabus. Students who had no absences received 60 points for their attendance grade. Students with one to three absences received 50 points. Students with four or five absences received 25 points. Students with six or seven absences received no points, and students who had more than seven absences failed the course. He said, "I was encouraged to do this by my mentor." He said that one year ago he added, that students who had perfect attendance did not have to take the final exam, "and that has really been a good motivator to get kids to class."

Five tests and a final exam were given during the semester. No regular retesting was done for these, but the instructor said that sometimes if the exams were poor he let students correct their tests for credit toward their scores.

The researcher obtained other information about Math 102 by reviewing the course syllabus. The instructor included the following on the syllabus: basic course and instructor information; course materials; course description, purpose, and objectives; the grading policy; a disability statement; a learning services statement; and course policies regarding attendance and missed classes. Assignments were stated on the syllabus with their point values but were not described in any more detail. Quizzes and homework together comprised one-twelfth (50 points) of students' grades. Five exams and a comprehensive final were given.

Using the General Syllabus Checklist, the Math 102 syllabus lacked the following: a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; other course requirements (but there may not have been any); a course calendar; a list of important dates; an estimate of student work load; a time to schedule fast feedback; and a space for other students' contact information.

Preparation for Success in Future Math Courses. The instructor said that he prepared students for success in future math courses by speaking with the Math 103 instructors and students. Doing this helped him determine what should be taught in Math 102 so that students were prepared to take Math 103.

The Director said that they helped prepare the students for success "by making sure that you get through whatever basic information they need for that, to lay that groundwork and trying to help them make connections, which is always difficult." He clarified what he meant by connections, "There are the thinking connections. There are connections to, 'Why is this important? Why do I need to do it?' Um, to give them some motivation." Even though placement was not mandatory, they still recommended the math courses that students should take based on students' ACT math scores or other relevant information. The Director said, "That's the best we can do. We can't say, 'You must take it.'" If misplaced, students were also allowed to move between Math 102 and Math 103 early in the course. The Director said:

> We try to get the first test out of the way as soon as we can to see where they are. If it is the situation where they really already know it. After that first couple weeks they feel okay, we can move them over. And to make that easier we try and schedule Intermediate Algebra at the same time as the College Algebra class so we don't have scheduling, schedule changing conflicts, time conflicts.

The institution had a cohort program for students who entered the institution underprepared. In a previous section, the researcher partially described this cohort. All of the underprepared students in the cohort program enrolled in Math 102 Intermediate Algebra, a section of basic English, a section of freshmen seminar, and a study skills course. There was Supplemental Instruction in all of the cohort's classes where a tutor or Supplemental Instruction leader sat in all of the classes and held help sessions outside of class. The cohort program was very successful according to the Director. "The retention has improved significantly for those underprepared students. It used to be like 30% and now it is closer to what the regular freshmen class is, which is 55% or 60%."

Support Services. Support services were available to developmental mathematics students at BA I. The Director said that the Academic Support Center offered tutoring and Supplemental Instruction in various courses, including Math 102, by trained tutors and leaders. The cohort program for underprepared students, a one-day orientation, freshmen seminar, a study skills course, counseling services, academic advising, and Disability Student Services were also provided on campus (Academic Support Center, 2002). The Math 102 instructor said, "There was a [Supplemental Instruction] tutor that sits in the class, and she can be reached at any time if the students are needing extra help. And then usually the day before a test she'll set up one or two study sessions for them to go to." He said about 12 of his 50 students attended the study session before the previous test.

The Director of the Academic Support Center was contacted by e-mail to determine if the tutors and Supplemental Instruction leaders were trained. The Academic Support Center Director said:

> Our tutors are students, paid at minimum wage for their services by Student Services (some on federal work study, others by regular student employment). They must be recommended by the instructor for whom they are tutoring, and in the math field, really don't receive any additional training other than the mechanics of the program (time sheets, how to handle overly dependent students, etc.). The instructors continue to mentor them and assist them if they need more in-depth knowledge.

Program and Course Assessment. The developmental mathematics course, Math 102, was not formally assessed except for the course and instructor evaluations completed at the end of each semester or once a year. Students completed these evaluations in all classes on campus. According to the Director, there was some

monitoring of student success in subsequent courses, for example, students who took Math 102 and then took Math 103. The Director said that there were a small number of students who were still not successful in Math 103. Often these were students who passed, but did poorly in Math 102.

Perception of Support. The Director thought the institution supported the developmental mathematics course. He said, "It's part of that associate program, that cohort program." The instructor said that he never had any support and never needed any. He said that if he asked for support he would get what he needed. He said the course was important and not looked down upon. He added:

> People in the math department who then teach the [Math] 103 realize the importance of the class, and part of it is too that I am mostly in the HPE [Health and Physical Education] Department teaching a math class. I think that if I was in the Math Department more they might be more, concerned is not the word, but more interested in it.

The course was funded like any other course on campus. The instructor was paid, and there was a budget for tutoring and Supplemental Instruction.

Desired Changes. The Director said, "I wish that we could make it [Math 102] more individualized. That would be good for everyone involved, but that requires personnel and time, and all those other things that no one seems to have." The Math 102 instructor said, "The only thing that I would like to add in, a Math 099 [Beginning Algebra]. Because of the 50 kids I have this fall, six to eight of them would really have benefited from an 099."

Other Comments. The researcher asked the instructor what was toughest about teaching Math 102. He said:

> Probably teaching to the different levels. I don't think I challenge the top end kids enough and maybe the bottom end kids are too challenged. But, I'm just trying to get them ready for 103 and if they are doing very well in my math class, you know the top end, they're going to do fine in 103. So maybe I teach more to the lower end just because I want them to be able to get through 103.

Grade Distribution Data. BA I did not send the requested grade distribution data. The researcher asked and reminded the Admissions and Records Office to please send the data on three separate occasions, but these data were never sent. A reply was never sent to indicate a refusal or respectful decline from participation in the request either.

Summary. BA I offered one developmental mathematics courses, Math 102 Intermediate Algebra (three credits), so it did not really have a developmental mathematics program, per se, except for the one course. BA I was allowed to accept underprepared students, and it had developed a cohort program for these students. Math 102 was one of the courses included in this cohort program.

Math 102 was taught through the Division of Science and Mathematics. One instructor had taught the course for the previous six years. He taught and coached in the Health and Physical Education Department, and his only math teaching assignment was Math 102. His undergraduate degree was in mathematics education and his master's degree was in the health and physical education discipline. He had no training in developmental education. The instructor did not know of any faculty development opportunities because he had not pursued any such opportunities. He attended the

departmental meetings in Health and Physical Education, but he did not attend the meetings in the Division of Science and Mathematics.

The Math 102 instructor developed the course's curriculum. He chose the text, content and instructional methods of the course. He spoke with Math 103 instructors and students and looked at Math 103 exams to help him determine what was taught in Math 103 so the curriculum in Math 102 better prepared students for Math 103.

The instructor had course objectives on the Math 102 syllabus. These objectives were: competency in each unit of material; understanding of the material in the concrete and abstract world; and the ability to work in groups to enhance academic achievement. The first objective had no minimum competency level associated with it, and the final objective was rarely done, according to the instructor. Another objective or goal listed in a different section of the syllabus was to prepare students for successful entry into other courses. The interviewees also had goals or objectives that were not stated on any documents. These goals were to get the students ready for Math 103 and to alleviate students' anxiety, fear, and dislike of math.

Students did not take a mathematics placement exam. ACT math scores were used to advise students on appropriate placement in math courses, but placement was not mandatory. Students who had an ACT math score less than 16 were advised to take Math 102. Students who had not taken math for a while typically enrolled in Math 102 since there was no placement exam and no math course below Math 102. Students received graduation credit and financial aid credit for Math 102, but Math 102 did not meet all program requirements.

The developmental mathematics students were traditional and nontraditional students. The traditional students usually did not take much math in high school. Some students were scared of math and disliked it. The Director said the students fitted into two groups, the underprepared students and the students who self-selected. The underprepared students usually had one math in high school and were the majority of the developmental students. The students who self-selected were usually older and returning to school. They had math anxiety and chose to take Math 102 before taking Math 103. The Director thought that about 25% of incoming students needed to take Math 102.

The Math 102 instructor used the following methods of instruction: lecture; the students and the teacher doing examples; and the teacher walking around while students worked. The instructor said that he taught it like a high school math class. He tried to relax their fears and gave them "shortcuts" to help do this. The interviewees thought that the following were important and effective when teaching developmental mathematics courses: being personable; working with students individually; small class size; and helping students get over their fears of math. Students were assessed using homework, quizzes, exams, and attendance, which was mandatory. A scientific calculator with a fraction key was used.

The interviewees prepared students for success in future math courses by doing the following: speaking with Math 103 instructors and students to find out what was taught in Math 103; looking at Math 103 exams; making sure students got the basic information and groundwork laid to take Math 103; getting students to connect math to other things; advising students on an appropriate math course to take; allowing students

to move between Math 102 and Math 103 so that they were in the appropriate course; and having the cohort program for underprepared students.

Tutoring, Supplemental Instruction, counseling, advising, and Disability Student Services were available for Math 102 students. The tutors and Supplemental Instruction leaders had received some training from the Academic Support Center. There was a one-day orientation, a study skills course, and freshmen seminar. The study skills course and freshmen seminar were also part of the cohort program.

The developmental mathematics program was not assessed, but some assessment methods were used in each course. Students completed course and instructor evaluations in each class each semester. The Director said that a little bit of monitoring of student success in subsequent courses took place, but not formally and on a regular basis.

The Director thought the institution supported Math 102 since it was part of the associate program and the cohort program. The instructor said that he had no support and did not need any, but he thought that he would get support if he asked for it. The course was paid for like any other course. Funds went for the instructor's salary and for the tutoring and Supplemental Instruction budget.

The Director wished Math 102 instruction was more individualized. The instructor wished Math 099 was offered for those students who were not quite ready for Math 102.

BA I did not send the requested grade distribution data. Therefore, nothing could be said about student drop rates, GPAs, or success rates in developmental math courses.

BA I: Math 102 Syllabus

Course Number: 102
Semester: Fall 2002
Hours of Credit: 3
Time: MWF 10:00-10:50 am
1:00-1:50 pm

Course Title: Intermediate Algebra
Instructor: Name
Office: Building and location
Office Hours: T & R 9:00-10:00
Office Phone: XXX-XXXX

COURSE DESCRIPTION: Intermediate Algebra is a three-credit course with content ranging from basic computational skill review to intermediate algebra. This course is designed to prepare students for successful entry into college level courses such as College Algebra, Finite Mathematics, Trigonometry, Chemistry, Biology, and the Physical Sciences.

OBJECTIVES OF THE COURSE: Successful completion of Intermediate Algebra requires that the student demonstrates:

1. Competency in each of the prescribed units of instruction.
2. An understanding of the material in both the concrete and abstract world.
3. The ability to work in groups to enhance academic achievement.

EVALUATION:
Homework & quizzes (50 pts total)
Tests will be announced one week before they are given (5 @ 80 pts – 400 total)
Final (100 pts) (those with perfect attendance are not required to take the final!)
Attendance is mandatory and is taken at the beginning of class! There are NO excused absences!

0 misses.....60 pts
1-3 misses.....50 pts
4-5 misses.....25 pts
6-7 misses.....0 pts
after 7 misses you fail the class!!

GRADING:

Quiz and Homework	50	540-600	A
Attendance	50	480-539	B
Tests	400	420-479	C
Final	100	359-419	D
TOTAL	600	below 359	F

It is the responsibility of the student to get all information needed in regards to assignments and material covered in class when a class is missed.

LEARNING AIDS:

Required: Text: Aufmann, Richard N., & Vernon C. Barker. Introductory Algebra: An Applied Approach. (5th edition). Houghton Mifflin, Boston. 1999.
Calculator: A scientific calculator with a fractions mode (Sharp EL-506V)

Optional Learning Services: It is recommended and encouraged that students needing extra help use the learning services or seek the teacher for needed help.

As required by section 504 of the Rehabilitation Act, appropriate accommodations will be made for students with documented disabilities. If you have a disability requiring accommodations in the class, please notify the instructor as soon as possible. This information will remain confidential.

APPENDIX E

PROGRAM DESCRIPTION FOR BA II

Program Description: BA II

Background. BA II offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 College Algebra (four credits). One section of Math 102 was being taught during the campus visit, and Math 099 was canceled that semester due to low enrollment in the course. Thus, the researcher observed the one Math 102 class and interviewed its instructor. The instructor was an assistant professor that had completed a bachelor's degree and a master's degree in computer science and was completing his doctoral work in computer science education. The researcher chose him for the interview because he was the only instructor teaching the course that semester. During the interview, the researcher collected the course syllabus that was later analyzed using the Checklists.

The researcher interviewed the Chair of the Mathematics and Computer Science Department. He is referred to as the Director of the program. He was an associate professor and had a bachelor's degree, a master's degree, and a doctoral degree in mathematics. He taught one of the developmental courses, Math 102, but not during the semester in which the visit was conducted. He was apprehensive about the interview and did not want the interviews tape-recorded, so the researcher did not do this. The researcher took notes during both of the interviews.

Definition and Location of Developmental Mathematics Education. When the researcher asked the Director to define developmental mathematics education at BA II, the Director said that he would not define it. He said that they did the best they could in

each course and tried to tailor it to the students' needs. The Director also said that they were just a small institution that did not really have a formal developmental math program.

Both of the developmental mathematics courses, Math 099 and Math 102, were offered through the Mathematics and Computer Science Department. None of the developmental courses were taught online, but the Math 102 instructor supplemented the course with material on his Web page.

Developmental Mathematics Faculty. Math and computer science faculty members taught the developmental mathematics courses at BA II. The Director said that each position in the department was a little different. Each person was hired to teach specific areas. During the next semester, a new faculty member who was hired as a math educator would teach Math 099. This person had a master's degree and a bachelor's degree in mathematics education. As mentioned earlier, the interviewees were the only other faculty who regularly taught the developmental mathematics courses.

The instructors of developmental mathematics courses did not have special training in developmental education. The Math 102 instructor said that the institution was very supportive of teaching. He said that people knew their discipline, but they often needed help with teaching. There were campus faculty development opportunities, like seminars and workshops on teaching and technology, and at the Math and Science Division meetings, the Division Chair reserved time for discussions regarding the classroom and teaching. The Math 102 instructor also said that there was minimal

support for conferences because money was limited. He said that he did not attend conferences unless he had a paper to present.

The Math 102 instructor said that the department was pretty inclusive with regard to his involvement in the planning and decision-making processes of the department and the developmental mathematics courses. He said that they did ignore him when they created the math schedule. He remarked that he tried to stay out of the way of the math people since he primarily was a computer science faculty member. He liked to let the math faculty make the math decisions.

Curriculum Development. The Director said that faculty decided on a common text every three or four years or as needed for the developmental courses. Sometimes there was coordination between instructors, but usually there was just one instructor teaching each course each semester. Each instructor decided how to teach the material, but the content was partly determined by the Common Course Numbering system of the NDUS.

Like the Director, the Math 102 instructor said that that the mathematics faculty agreed on a text for the courses. He said, "No one is really gung-ho about the course." Faculty did not formally meet to discuss the course; rather, the instructors were basically given the text and told to teach through a certain chapter. He said that some of the content of Math 102 Intermediate Algebra and Math 103 College Algebra overlapped.

Policies. The Director said that there was mandatory assessment, but placement in the developmental mathematics courses was not mandatory. He said that there was a

test for Math 103 College Algebra and one for Math 102 Intermediate Algebra, and sometimes the ACT math score was used to advise students on placement into mathematics courses. The instructor said that this test was given during the first day of classes. Those students who did poorly on these tests were advised to drop and take the next course below the one they were taking. Sometimes Math 102 and Math 103 were scheduled during the same hour to help prevent time conflicts in students' schedules if they needed to change courses. According to the Math 102 instructor, administration was lenient on the last day to add Math 102 when students dropped Math 103.

Math 099 did not satisfy any graduation requirements at BA II. Math 102 satisfied graduation credit, but it did not meet the program requirements for all programs offered on campus (Connect, 2002). Prerequisites for Math 102 were not listed in the institution's course catalog (Connect, 2002). Both courses could be used as financial aid credit.

Goals, Objectives, and Desired Outcomes. The developmental mathematics program did not have formal objectives, but Math 102 had course goals and objectives. The instructor listed these in the course syllabus. The Math 102 instructor posted the Math 102 syllabus and Math 102 course outline on his Web course page. The instructor wrote the goals and desired learner outcomes on the Math 102 syllabus. The goals of Math 102, as stated in the syllabus, were:

> We will attempt to build the mathematical sophistication of students using algebra. It is the goal then to give students the ability to translate practical problems into equations and inequalities and then to solve them. Clearly there are far more classes of problem than can be covered in this class. The classes of problems to cover should include...

The instructor then had a list of classes of problems on the syllabus. The desired learner desired outcomes stated on the syllabus were:

> Upon successful completion of this course students should be able to apply the basic ideas of algebra in most everyday problems and be prepared for subsequent College Algebra course. They should be able to translate a practical problem in to one or more equalities or inequalities. A student should be able to evaluate formulas as well as solve those classes of problem enumerated in the goals.

The course outline, not the course syllabus, appeared to be a formal course and departmental document created by the Director. The major objectives of Math 102 were stated on this outline as:

> Upon successful completion of this course students will have reviewed some of the basic ideas of algebra and learned to solve routine algebraic problems. They also will have an appreciation of the concepts and reasoning involved in algebra and how to apply them to specific situations.

The purpose of the course was stated on the syllabus and course outlines as well. The purpose was different on each document. On the syllabus, the purpose was stated as:

> A wide variety of real-world situations provide problems where a solution may be found by the application of the techniques and principles of algebra. The purpose of this course is to teach the skills needed to recognize and translate the problem into mathematical expressions, such as equations and inequalities, then to solve these expressions to obtain useful results.

The purpose on the course outline was "to serve students who recently completed an elementary algebra course or who have taken up mathematics after a lapse of time and require a terminal course of some substance to serve as a tool in other disciplines."

When the researcher interviewed the Director and the instructor, they mentioned other philosophies, goals, desired outcomes, and objectives for the developmental courses. The Director said that his goal was to try to get students to learn mathematics.

The Math 102 instructor said that his goals were on the syllabus and that these were his goals, not the department's goals, for the course. The Math 102 instructor also said that his goal was to develop the students' formal thinking skills.

Students. The Director described the developmental mathematics students at BA II. He said that there were those students who had been away from math for a long time. Other students had no background or courses in math or were not strong in math. The Math 102 instructor said that some students had math in high school, but this was not sufficient for them to avoid taking developmental math in college. He also said that most students needed just one math course to graduate. He thought that about half of all programs at the institution required Math 102 Intermediate Algebra.

Instruction. As stated earlier, the developmental math courses were taught in the Mathematics Department. Using the grade distribution data, the researcher determined that no more than 20 students, including those who dropped, were enrolled in each of the sections of Math 099 during the fall semesters in which data were gathered. The Math 102 classes had more students in each section, approximately 50 students including those who eventually dropped the course.

Math 099 was not offered during the time of the study but the online course description was:

> MATH 099 Beginning Algebra (3 hours): Use computer software (Excel) to understand and solve problems that facilitate connection among equations, tables, and graphs. Emphasis on linear functions, quadratic functions, systems of linear equations, and on powers and roots. Not open to students having credit in MATH 102, or any math course numbered above MATH 102. For students with little or

> no background in algebra. Does not satisfy any graduation requirement. (Connect, 2002, p. 97)

Thus, according to the course description, Math 099 was taught using integrated technology.

The researcher observed the Math 102 class immediately following both interviews. The Math 102 instructor taught the course by lecture in a long room with long tables that were equipped with electrical plug-ins and Internet connections. The instructor began class by taking questions from the homework and then working the solutions on the board. After this, the instructor presented a new topic, the rules of exponents, at the chalkboard. The Math 102 instructor did not explain why these rules of exponents were true; instead, he just stated the rules and wrote them on the chalkboard. After this, the instructor completed examples to demonstrate the stated rules of exponents.

The instructor often skipped steps in the solution process while completing problems, but the students never questioned what he did. They either understood or just did not ask. Some students took notes consistently, while others did not. The students did not appear to be excited about the material and rolled their eyes at the instructor's attempts at humor. At the end of class, the next homework assignment was written on the board. Six students were present.

The researcher obtained other instructional knowledge during the interviews. The Director sometimes taught Math 102. The Director said that the department and its instructors tried to do the best they could with each student. He said that the biggest challenge teaching the course was the different levels of the students. In Math 102, he

said that he presented the material, had the students work some problems, and walked around to see how they did. This was a laptop university where all students were required to have a laptop computer, so the Director sometimes used Maple mathematical software in Math 102. He said that it helped the students visualize the material. Students did homework and took tests. Sometimes students solved problems in groups during class. He said that this was done with challenging problems that forced students to use and develop critical thinking and problem solving skills.

The Math 102 instructor described the instruction he used. He said that he took questions from the students and did them on the board. He presented new material on the board and announced new homework at the end of class. He said that he sometimes did group work at the end of class. This usually consisted of equations and word problems on worksheets for the students to solve in their groups.

He said that he was anti-technology in Math 102. The students had Maple mathematical software on their laptop computers, but he did not use it with the students. The students used a simple calculator. His view of technology in developmental mathematics classes was that the students needed hand holding through the steps of problems, but not a device that did all of the steps for them. He wanted to promote formal thinking and to link the content to practical applications.

According to the Math 102 instructor, students' grades were based on tests, homework, and in class exercises. The Math 102 instructor said that he collected the homework to force students to do it, but he did not grade it. He dropped each student's lowest exam score and excused the best students from taking the final exam. On each

exam he used the highest score to determine the total number of points each exam was worth, then all other students' scores were determined using the highest score. In the past, he had students create something they could include in their portfolio, but he discontinued doing this because he thought the students did not gain much from it.

The instructor made other comments about teaching the course. He said that he taught the course to fill his schedule. He did not like teaching the course and told his students on the first day of class that they both did not want to be there and so they should just get through the class. He said that his biggest challenge was generating enough of his own enthusiasm for teaching the course.

The researcher gathered other information about Math 102 by reviewing the course syllabus and course outline. Included in the syllabus and outline were: basic course and instructor information; course materials; course purpose, description and objectives; desired learning desired outcomes; a description of the format of the course and its activities; descriptions of the assignments and exams; grading policy; course outline; and course policies regarding makeup exams and computer use in class. The instructor encouraged students to attend class and provided rationale for this.

Using the General Syllabus Checklist, the Math 102 syllabus lacked the following: prerequisites; a clarification of the structure used to organize the course and the logic behind why this structure and content were selected; a list of other course requirements and supplementary material (but there might not have been either of these); an estimate of student work load; a time to schedule fast feedback; a list of important dates; a disability statement; and a space for other students' contact information. The

syllabus and course outline included many of the same parts, like goals and purpose, but there were differences on each. The descriptions on this Math 102 course syllabus were more complete than on some of the other syllabi that the researcher collected during the study.

Preparation for Success in Future Math Courses. When asked how he helped prepare students for success the their next math course, the Director said that he did not know if they were prepared. He said that a lot of the content in Math 102 and Math 103 overlapped. He said that the course was adjusted when necessary to help students learn, and that each instructor had office hours.

The Math 102 instructor said that he tried to develop the students' algebraic skills, symbolic manipulation, and formal thinking. He did not think of the students in Math 102 as going on to Math 103.

Support Services. The Director said that tutoring was available for students through Student Academic Services. He also thought that the more poorly students were doing in a course, the more likely they were to get a tutor. The Director of Student Academic Services was contacted on two occasions but never provided a response describing the services offered to students. The researcher found nothing on the institution's Web site that described these services either.

Program and Course Assessment. Students completed course and instructor evaluations at the end of each semester in all classes on campus. This was the only assessment method used in the developmental mathematics program and its courses. The

Director said that he watched students attempt problems and informally assessed how they were doing in class. He also mentioned the seven-year accreditation of the institution by North Central Accreditation, but this did not specifically assess developmental math courses or programs.

Perception of Support. When the researcher asked the Director to describe the level of support others (department, administration, state, etc) had for developmental mathematics, the Director said, "I have no feeling about this one way or the other," and he would not elaborate further. He said that the costs of the developmental math courses included instructors' salaries and Maple software licensing fees.

The Math 102 instructor provided a response similar to that of the Director. He said that he was neutral and did not feel one way or the other about this. He said that faculty were inherently unmanageable, and as long as there were no impediments in his way, he was happy. He liked to be left alone to do his thing.

Desired Changes. The researcher asked both of the interviewees what changes they would like to see occur in the developmental mathematics program courses. The Director said that there would be summer advertising for Math 102. The instructor said that he did not want anything changed, and that change was bad. He wanted the least amount of work possible, and acknowledged that this was not in the best interests of the students. He said that he did not try to improve Math 102, but he just did it.

Other Comments. During the interview with the Math 102 instructor, other topics were discussed. He thought that there was a lack of effort by the students, and drop rates

were high. He said that 32 students started his course, but only 15 to 20 students were still enrolled. He added that attendance was also poor, and the researcher observed this when only six students were present in class during the class observation. He thought maybe high schools were not making the students work; education had failed the math area, and this spilled over into science and information technologies. He was concerned about the numbers of mathematically illiterate students and about the numbers of primary teachers who disliked math or were scared of it.

Grade Distribution Data. The researcher collected grade distribution data for each developmental course offered during the fall semesters of 1999, 2000, and 2001. These data are summarized below in Table 26. Math 099 was not offered during fall 2000 so that row was left blank. The percentage of students who dropped Math 099 ranged from 25-60%. In Math 102, the drop rates were between 35% and 51%. The average GPAs ranged from 1.25 to 2.86 in Math 099 and from 2.03 to 2.30 in Math 102.

Table 26. Grade Distribution Information for Fall 1999, Fall 2000, and Fall 2001 at BA II.

Course	Year	Grade									Number of Students Enrolled	Number of Students Who Dropped	Percentage of Students Who Dropped	GPA
		A	B	C	D	F	P	I	S	U				
Math099	1999	5	3	7	0	0					15	5	25.0%	2.86
	2000													
	2001	1	0	0	1	2					4	6	60.0%	1.25
Math102	1999	2	9	4	4	4					23	13	36.0%	2.04
	2000	2	9	8	2	2					23	24	51.1%	2.30
	2001	3	9	10	8	3					33	18	35.3%	2.03

The researcher calculated the success rates of developmental math students in Table 27. These calculations were based on a grade of C or better and were calculated with and without the students who dropped the courses. Again, Math 099 was not offered during fall 2000. Twenty-five percent to 100% of Math 099 students were successful when students who dropped the courses were not included. These percentages dropped to about 10-75% when students who dropped the courses were included. The large variation in the Math 099 percentages might have been due to the small class size in fall 2001.

In Math 102, about 65-83% of students were successful when drops were excluded. These percentages decreased to about 40-43% when drops were included.

Table 27. Success Rates for Fall 1999, Fall 2000, and Fall 2001 at BA II.

		Success Rate	
Course	Year	Without Drops	With Drops
Math 099	1999	100%	75.0%
	2000		
	2001	25.0%	10.0%
Math 102	1999	65.2%	41.7%
	2000	82.6%	40.4%
	2001	66.7%	43.1%

Summary. BA II offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (4 credits). Both courses were offered through the Mathematics and Computer Science Department and taught by full-time faculty members in this department, including a computer science professor. During the time of the study, Math 099 was not offered due to low enrollment.

The instructors had master's degrees or doctoral degrees but did not have training in developmental education. Faculty development opportunities were available on campus. These opportunities usually included seminars or workshops on teaching or technology. Also, the Division Chair left discussion time for teaching and classroom issues at each division meeting. Money for other faculty development opportunities was limited. The instructors of the courses participated in the planning and decision-making processes of the department, but the computer science instructor who taught Math 102 liked to leave the math decisions to the math faculty members.

Faculty decided on a text for the developmental courses, and then instructors took the text and taught up through a certain chapter. Sometimes there was coordination between instructors, but most of the time instructors worked on their own and taught the material as they chose fit. The Common Course Numbering system of the NDUS dictated some of the content in the courses.

Program goals or objectives were not stated anywhere. Course objectives and desired learner outcomes were written by the Math 102 instructor and included on the course syllabus. The course outline also listed course objectives, but these objectives were different from the objectives on the syllabus. A course purpose was included on both documents as well. The interviewees said that they wanted to help students learn math and to develop students' formal thinking skills.

Students' ACT math scores were used to assess and advise students on placement in math courses. Students also took a mathematics placement exam on the first day of class in Math 102 and in Math 103. Students who did poorly on these exams were

advised to drop and take the next lower course. Students did not receive graduation credit for Math 099. Math 102 could count toward graduation credit, but individual programs decided if it met their requirements. Both courses counted toward financial aid credit.

The developmental mathematics students were those students who had been away from math for a long time or who had no background or a weak background in math. Many students had the required amount of math in high school, but it was not sufficient to avoid taking developmental mathematics in college.

The instruction used by the observed and interviewed instructors included lecture, showing and explaining examples, and some group work. The Math 102 instructor did not enjoy teaching the course and did it to fill his schedule. He was anti-technology, while the Director sometimes had students use Maple software to visualize problems. Students were assessed using homework, tests, and in class exercises. The instructor collected homework to force students to do it, but he did not grade it.

The Director said that he was not sure if students were prepared for their next math courses. He said that all instructors had office hours to help students. The instructor tried to prepare students for success by developing students' skills and formal thinking. He said that he did not think of the students as going on to another math course.

Tutoring was available from Academic Services. The researcher could not determine if the tutors received training, nor could she determine if other support services were available to students.

The developmental mathematics program was not assessed, but some assessment methods were used in each course. Students completed course and instructor evaluations in each class each semester. The Director said he informally assessed students' skills and understanding during class time.

The interviewees had no comments or were neutral regarding support for the developmental mathematics courses. All funds for the course went to faculty salaries and software.

The interviewees wanted no changes made to the developmental courses. The Math 102 instructor was concerned about the lack of student effort, high drop rates, poor attendance, and the lack of math and science knowledge students had.

During fall 1999, 2000, and 2001, student GPAs in Math 099 were between 1.25 and 2.86, and in Math 102 were between 2.03 and 2.30. Approximately 25-60% and 35-51% of students dropped Math 099 and Math 102, respectively. In Math 099, success rates were between 25% and 100% when dropped students were not included in the calculations and were between 10% and 75% when dropped students were included. In Math 102, the success rates were 65-83% without dropped students in the calculations and 40-43% with dropped students in the calculations.

BA II: Math 102 Syllabus

Instructor information:	Name, Phone
Office:	(Link to Online Weekly Schedule)
E-mail:	XXX@XXX.nodak.edu
Important dates:	(Online link)

Text: *Intermediate Algebra for College Students* by Robert Blitzer

Catalog Description: Introductory concepts, techniques and applications of college algebra. Provides a basis for Mathematics 103 and other courses that require an understanding of algebra.

Purpose: A wide variety of real-world situations provide problems where a solution may be found by the application of the techniques and principles of algebra. The purpose of this course is to teach the skills needed to recognize and translate the problem into mathematical expressions, such as equations and inequalities, then to solve these expressions to obtain useful results.

Goals: We will attempt to build the mathematical sophistication of the students using algebra. It is the goal then to give students the ability to translate practical problems into equations and inequalities and then to solve them. Clearly there are far more classes of problem than can be covered in this class. The classes of problems to cover should include: simple linear equalities and inequalities of one or two variables, systems of linear equalities with less than four variables, quadratic and cubic equations that can be solved with factoring, rational polynomial problems that can be solved with factoring, radical equations with rational exponents that can solved by factoring and squaring or cubing both sides of the equation and applications of the quadratic formula for solving equations.

Learner outcomes: Upon successful completion of this course students should be able to apply the basic ideas of algebra in most everyday problems and be prepared for a subsequent College Algebra course. They should be able to translate a practical problem in to one or more equalities or inequalities. A student should be able to evaluate formulas as well as solve those classes of problem enumerated in the goals.

Homework: Regular homework will be assigned and collected. It will be graded for completeness not correctness. It will be accepted any time up to the taking of the test for that chapter. It is worth nothing after that.

Tests: There will be one test for each chapter that we cover, as well as a comprehensive final exam. Each of the tests will be equally weighted, except the final which will be worth two tests. The low test will be thrown out, leaving the score to be merely the sum of the remaining tests. Each test is scored using the student's score divided by the highest score for that test.

Learning activities: The instructor will teach this class with a combination of lectures, readings from the text, homework over problems from the text and some group problem solving activities. The majority of class time will be devoted to a lecture format, driven by the presentation of new material and techniques and student questions on past material. However, it is almost always the case that when a problem is solved in class it appears to be relatively easy and when done outside of that context it appears much harder. Therefore a student needs to be diligent in doing the assigned homework before class.

Class room: Good attendance usually translates into good grades and poor attendance almost always means poor grades. However, no points are awarded for attendance. Since the laptop computers do not take notes in mathematics very well, they may not be used in class, unless a computer demonstration is in progress. You are encouraged to ask questions at any point in the lecture or in any demonstration.

Grading: Attendance is not graded, however in class exercises or quizzes cannot be made up. The scores from the homework will constitute 10% of your grade, the in class exercises will constitute 5% and the tests will make up the remaining 85%. The final score will then be a percent. Given that score, the grades will be determined in a conventional percent way, 90-100: A, 80-89: B, 70-79: C, 60-69: D, with anything less an F.

Lecture Schedule: The goal is to cover most of stated topics, which in the Blitzer text includes the first seven chapters. Therefore we need to cover a chapter in about four to seven class days, including the test.

COURSE OUTLINE

Academic Division Mathematics, Science & Technology Department Math/CIS

Instructor(s) Name

Course Title Intermediate Algebra

Course Prefix and Number Math 102 (4 hours)

I. Catalog Description: Introductory concepts, techniques and applications of college algebra. Provides a basis for Mathematics 131 and other courses that require an understanding of algebra.

II. Course Purpose: The purpose of this course is to serve students who have recently completed an elementary algebra course or who have taken up mathematics after a lapse of time and require a terminal course of some substance to serve as a tool in other disciplines.

III. Major Objectives of the Course: Upon successful completion of this course students will have reviewed some of the basic ideas of algebra and learned to solve routine algebraic problems. They also will have an appreciation of the concepts and reasoning involved in algebra and how to apply them to specific situations.

IV. Learning Activities: The major learning activities include problem solving along with a question-answer type format. Video tapes are on reserve in the library for student use as well as computer assisted instruction packages on algebra in the computer learning laboratory.

V. Evaluation: Three to eight exams along with several graded homework papers as well as a two hour comprehensive final exam form the major basis of evaluation.

VI. Topic Outline:

A. The sets of natural, whole, integer, rational and real numbers. The four fundamental operations, relations of order and equality

B. Polynomial operations

C. Factoring

D. Operations with fractions. Complex fractions

E. Linear equations and inequalities. Absolute value problems. Word problems

F. Ordered pairs, functions, the Cartesian coordinate system and graphing

G. Integral and rational exponents

VII. Special Course Projects: Not applicable

VIII. Research Base: Course guidelines follow the Recommendations on the Mathematical Preparation of Teachers as published by the CUPM Panel on Teacher Training.

IX. Textbook(s) and Selected References: Intermediate Algebra With Applications; Aufmann/Barker/Lockwood, 1989

X. Maximum Enrollment Per Section: 40

XI. Type of Course:
Lecture _X_ Laboratory _ Discussion _ Seminar _
Tutorial _ Independent Study _
Other (describe) _

APPENDIX F

PROGRAM DESCRIPTION FOR MASTER'S INSTITUTION

Program Description: Master's Institution

Background. The Master's Institution offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (four credits). The researcher observed one section of Math 099 and two sections of Math 102. The same instructor taught both observed sections of Math 102, but one section had a teaching assistant, and the other section did not. The researcher interviewed the instructors of these observed classes as well as the Chair of the Department of Mathematics and Computer Science. The Chair is referred to as the Director of the developmental mathematics program. The researcher took notes, tape-recorded all interviews, and collected and analyzed course syllabi using the Checklists.

As mentioned earlier, the Director of the developmental mathematics program was the Chair of the Department of Mathematics and Computer Science and an associate professor of computer science. The Director taught math and computer science classes. He had not taught any of the developmental courses since Math 180 became Math 102 10 years earlier.

The Math 099 instructor was a part-time lecturer who taught both developmental mathematics courses. She had a bachelor's degree in mathematics education, and she had taken graduate courses in counseling and guidance. Prior to teaching at the Master's Institution, she taught high school physics, general science, chemistry, and home economics, did guidance and counseling for one year, and substitute teaching in the high schools. At the time of the interview, it was her nineteenth year teaching math at the Master's Institution. The researcher chose the Math 099 instructor because she was the

only one teaching the course on campus at the Master's Institution. She also taught Math 102 when the department needed her.

The Math 102 instructor was a full-time instructor of mathematics. His bachelor's degree and master's degree were in mathematics education. At the time of the interview, it was his third year teaching math at the Master's Institution. He previously had taught high school math for 31 years. He began teaching graduate courses in the institution's Master's of Teaching: Mathematics (MAT) program during the summer of 2002. The researcher chose the Math 102 instructor because he taught two sections of Math 102 every semester, while other instructors of the course did not teach as many sections of the course or did not teach it as frequently.

Definition and Location of Developmental Mathematics Education. According to the Director, developmental mathematics education at the Master's Institution was "what you do in courses that are nominal prerequisites for College Algebra. Anyone interested in a university education should be able to operate at that level." Developmental mathematics was those courses that were prerequisites for College Algebra. He also said that it was an advising issue.

The developmental mathematics program was not totally centralized. Courses were offered on campus through the Department of Mathematics and Computer Science, off campus at a U.S. Air Force Base, at a two-year coordinate campus, and by correspondence. The Director said that it was a local issue. There were arrangements made between the parent and coordinate campuses for certain numbers of courses to be taught at each campus. The Director's involvement included passing judgment on the

qualifications of the instructors at the U.S. Air Force Base. There was a person from the Master's Institution who managed the courses that were taught at the Base. The Director said that this person knew the most about the Base courses and handled the administrative duties associated with them. The Dean of the College of Arts and Sciences was involved as well since the salary money came from his office. None of the developmental courses were taught online at the time of the interviews.

Developmental Mathematics Faculty. Faculty members, who were instructors or lecturers of mathematics, taught the developmental mathematics classes at the Master's Institution. Developmental math courses offered at the Base were usually taught by local high school and junior high school math teachers and by one math professor from the Master's Institution. This professor also taught the correspondence section of Math 102.

The Director said that the instructors of developmental mathematics courses were required to have bachelor's degrees, but even those who had a higher degree could teach the developmental courses if that was what they did best. Some of the instructors had been high school math teachers. The Director said that they still needed to "enjoy being in the classroom" and "have the fire to teach with some expectation of longevity." The Director said, "Here it is has been a little bit of serendipity having high school teachers, teachers with experience at that level. I think that is the way you do it, that's not the only way, but it's the most effective way." He continued:

> Those courses obviously are more about pedagogy, than content. That is pedagogy broadly defined. If I am a successful high school teacher, I know these kids kind of like an aunt or an uncle. I think about successful high school teachers that I know, they will talk about Johnny. They have an idea, Johnny's got some issues going on at home. Here's what Johnny's good at, here's what

> works for him. Even in large classes, they sort of bring that into the classroom. Frankly, it's probably the biggest single argument against the nonsense of every seat in the lecture hall being full....I think just that idea that the way I do my class is kind of like what I did in high school, and maybe up in the back of the room talking to somebody who has a question. It's aspects like physically getting out where the students are that translates into teaching style—I'm not just up here putting on a show...I think that's a style that good high school teachers maybe practice and certainly good college university instructors do too.

In addition, the Director said that the instructors of these courses needed to have good relationships with students. He said, "A lot of it is your social perspective. There are people that really enjoy working directly with students. Some people just eat that up and others don't."

The Director invited all campus developmental mathematics faculty members to all departmental meetings. Any faculty member on special contract, like the Math 099 instructor, was not officially obligated to attend the meetings, but these faculty members usually did. The Director said that he told those instructors that he valued their opinions and they had a right to be included in departmental conversations. He added:

> There are several veteran instructors in this department who are on special contract. The implication is they're here to teach. They've been doing it a while and they're doing a good job....I cannot afford not to have these people involved in decisions because they are in the classroom everyday much more so than I am dealing with students from all over campus. They know the problems. They know what works. They know what the options are. How dumb would it be for me to say, "Well, I'm sorry, I don't care what you think." That just makes no sense to me.

Developmental mathematics faculty had not received special training in developmental education, but some faculty development opportunities were available. The Math 099 instructor said that she had been to some workshops and conferences and had taken some graduate courses. She was invited to and attended departmental

meetings, and was involved in the planning of Math 102. She was not invited to some of the events at the Master's Institution since she was on special contract.

The Math 102 instructor said that he had attended calculator workshops that helped him develop his calculator skills. He had interaction with high school math teachers who participated in the MAT program at the Master's Institution. He had given presentations at North Dakota Council of Teachers of Mathematics (NDCTM) meetings and had received Bush Grant funding for the use of teaching assistants in his Intermediate Algebra classes. He said that he took part in the planning and decision-making processes in the department, especially with Math 102 and Math 103. He was invited to and attended departmental meetings and said that he was listened to in the same way as other faculty members in the department. He served on the Bush Grant Committee and the Math 103 Committee.

Curriculum Development. The Director said the curriculum development process involved the selection of a text with the consensus of the course instructors and other concerned faculty members. It also involved an agreement on the course's content. He said that the teaching style was left up to the instructors, and he was not about to tell an experienced faculty member what their final exam should look like. He said that the Math 099 instructor did her own thing. At the Base, the instructors got a syllabus from the Department of Mathematics and Computer Science at the Master's Institution. The syllabus outlined the content to be covered and provided consistency. The same texts were used at the Base and on campus. The Director said that it would be good for

everyone to come together and say, "After taking this course, students will be able to...and will know..." but that had not been done yet for the developmental courses.

The Math 099 instructor said:

> I don't think I've ever been given, "These areas must be covered..." I've never been given a basic plan so I've kind of developed a plan over the years, and my goal is to get them to the point where they have experience in factoring skills and a little bit of graphing. That's the goal that I kind of have set for myself.

She said that she knew what students needed to be able to do when leaving Math 099 and entering Math 102 since she taught Math 102 as well.

The Math 102 instructor described the curriculum development like the Director did. All Math 102 instructors and others who were interested, including some of the Math 103 instructors, determined the text and the content of the course. This did not include the Base instructors. The Math 102 instructor added that during the selection of the text there was an emphasis on the calculator. After these things were done, it was left up to the instructors to present the material. He said that he taught some things that others did not teach, and he taught some things differently than other instructors, but he always taught the content that was outlined for the course.

Policies. No specific policies were spelled out for the developmental mathematics courses at the Master's Institution. There were recommended math courses based on students' ACT math scores or COMPASS placement exam scores, but placement in these courses was not mandatory. The COMPASS exam was used to place students who had not taken math in a while or who had not taken the ACT. Prerequisites for the developmental mathematics courses were not listed in the college catalog.

When the researcher first asked the Director about mandatory placement, the Director said that he was not sure if it would make a difference, but "I can't see why it would make things worse. That's a pretty weak statement. I can't see how it would hurt. I think you'd want to talk about an option." He thought that the option to challenge a course should always be available for students.

The Director added that some type of mandatory placement would be good bureaucratically, but he said, "There is this notion that we don't want to do anything that might make the prospective student go someplace else. It is the balance thing again of free choice and more structure. I think it would work for a lot of freshmen." He said that he tried to lay his biases aside because they tended to skew things, and added, "As long as I have been in the business, I still haven't quite gotten over the idea that you ought to aim as high as possible."

The Director said that advising was important. He said, "You want to get them slotted in as appropriately as possible based on things like ACT." Sometimes he gave a student some problems to complete that were typical of a certain course. He had the student work the problems, and he knew by watching the student if he or she could do the problems and thus, succeed in a certain course.

Math 099 did not satisfy any graduation requirements. Math 102 did satisfy graduation credit, but it did not meet the program requirements for all programs offered on campus, nor did it meet the general education mathematics requirement.

Goals, Objectives, and Desired Outcomes. Goals and desired outcomes for the developmental mathematics program were not stated formally in a written document. As

mentioned above, the Director did say that it would be nice to all come together and say, "After taking this course, students will be able to...and will know..." Administration required departments to write and submit structured syllabi for all courses, but instructors did not necessarily use these syllabi. Most instructors created their own syllabi for their courses using their own format. Course goals and desired student outcomes were included as part of the outline used to write the structured syllabi, but instructors did not necessarily include this information on the course syllabi they gave to students. These syllabi had not been completed for all courses at the time of the interviews, and this was not required for Math 099.

On the Math 099 syllabus, the Math 099 instructor stated, "The main objective of this class is to review fundamental mathematics and beginning algebra." The Math 102 instructor did not have course goals, desired outcomes, or objectives stated on his Math 102 course syllabus.

When the researcher asked, the interviewees stated goals, objectives, or desired outcomes they had for the developmental courses they taught or directed. The researcher forgot to ask the Director about this during the interview so the researcher e-mailed him and received the following response. He wrote:

> The current general objective is that the student will leave the program equipped with the mathematical skills necessary to pass college algebra (i.e., Math 103) successfully. "Pass successfully" may seem redundant, but there is a difference between simply passing and mastering the Math 103 material well enough to use it in other courses (e.g., Math 277/377). This implies that intermediate algebra (Math 102) is part of the developmental mathematics program.
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> Specific objectives (skills) include, for example, being able to analyze linear and quadratic relationships (implying familiarity with elementary coordinate geometry) and to develop simple mathematical models from verbal descriptions of problems.

> These objectives are implicitly defined in the prerequisites for Math 103 and, more explicitly, in the pretest for Math 103. They are part of the "tribal knowledge" of the math department.

These objectives were not in writing anywhere, but they were objectives that the Director listed in response to the question.

The Math 099 instructor said, "My goal is to get them to the point where they have experience in factoring skills and a little bit of graphing...[and] to plant a firm foundation that they can build on for success in [Math] 102." The Math 099 instructor also said that she tried to dispel students' fears.

The Math 102 instructor said:

> My main objective, and I give this to them immediately, is that when they leave my course they're ready to take their College Algebra course, which is their required course for graduation. And we try to tie as much of our course as possible to that course. And emphasize when we are in a topic how that is going to be used in 103, how important it is going to be in 103. It really, I think, makes the class a little bit more intent, in fact. When they hear how important it is going to be that next semester, they have a tendency to focus on it pretty hard.

He also said:

> I would like to enhance the students' feelings about mathematics. We get so many students in 102 who have a block, kind of mental block or phobia about math. They're generally the "I hate math" group. I'm trying as much as possible to make that feeling go away. Try to give them a little success, make them feel a little bit better about themselves and mathematics.

Students. The Director said that many of the developmental mathematics students were older than average or operating at a third of fourth grade level in math. Many received financial support. They were reentering school from the workforce after 20 or 30 years, when many people did not have to take much math in high school. Many students had test-taking anxiety or phobias. He said that he had less contact with the

developmental mathematics students, so he was as familiar with these students as the developmental instructors were. He also said that he has tunnel vision. He saw many students that were interested in something to do with computer science or information systems. Later in the interview, the Director said that many students believed that academics were not important except for getting a job. Many students had families to take care of as well, and this sometimes made the job more important than school.

The Math 099 instructor described the students in Math 099. She said:

> I see everything. From students who have not finished high school to students who already have a degree and are coming back and need to meet the math requirement. And so they're wise to start in 099 because they know. And I've seen students that have been in 102 and then they decide that it was too fast and they come down to 099. So I've got a big, big variety. I've had people that are as old as I am. I've had people that are older than I am.

The Math 102 instructor said, "We get a tremendous range. We get students who have taken or should have taken [Math} 099, very low math skills. We get students who have come out of a high school with a precalc background. I have two students right now in that situation." There were also traditional students and nontraditional students. It was tough to meet all of the students' needs in Math 102. He said:

> Tremendous spread in ability in that class... and it becomes a problem in a sense to keep that upper level student from being bored to death and from dominating the class and the lower level student getting so depressed that they drop the class. So it is a more difficult class to teach sometimes than a [Math] 103 [course].

The Director said that there were about 250 to 300 students who took Math 102 each year, and he guessed that about 60% earned a grade of C or higher. About 50 to 75 students took Math 099 each year. The Director said that you measured their success by how well they did in the next math course.

Instruction. As stated earlier, the developmental math courses primarily were taught in the Department of Mathematics and Computer Science. Using the grade distribution data, the researcher determined that no more than 27 students, including those who dropped, were enrolled in each of the sections of Math 099 during the fall semesters in which data were gathered. The Math 102 classes had more students in each section. Fifty-five students or less, including those who eventually dropped the course, were in each section of Math 102 during the three fall semesters in which data were collected.

The Director described effective instructional methods for developmental mathematics courses. He described how a former graduate of the MAT program wrote his thesis on techniques for teaching beginning algebra. He said that instructors dealt with a variety of individual problems and concerns about math. He said:

> I think part of the battle there is convincing whoever you are working with that there is an approach going on here that stands a pretty good chance of success for whatever reason. It puts the instructor on the same plane with the student. I think with the older students especially sometimes are a little bit intimidated by, say Dr. Geller, you are not necessarily on the same planet anymore...For all students, especially for the older ones, just setting up some kind of line of communication. It's time consuming. You cannot have more than 20 students in a group to accomplish much of anything. You have to convince the students that they need to work and give them some guidance in how to work.

He said that he had gotten more open about tests over the years as a way of dealing with students' math phobia. He said that he thought these courses had to be taught with the preconception that the students might have been from a small town where they were socially promoted or where the math curriculum was not rigorous. Students might have

done well in these high school math programs, but they were kind of misled about their mathematical abilities because they succeeded, but only in a watered-down program.

Some of the instructors, including the Math 102 instructor, used teaching assistants in their classes. The Director said that if it helped students, then it was good. It was the Director's experience as a teaching assistant that the assistants were on the students' side and understood where the students came from. He said that communicating that idea, being on the students' side of the fence, could make for a good environment.

The Director said that instructors tried to convince people that it was worth their time and effort to take the courses. Multiple instructional approaches were used and so was technology. The Director had some concerns about technology because sometimes he received complaints about it being used too much. He said that sometimes these complaints were a convenient scapegoat for someone who was doing poorly. He said, "Anymore, I don't know that there is an alternative." The problem was not, should technology be used, but how to use it and to what extent.

During the observation of the Math 099 class, the Math 099 instructor did the following instructional activities: used lecture; explained concepts; used examples, including real-life situations, to illustrate concepts; explained terms, examples, thought processes, and mathematical methods used to solve the examples; had the students solve problems at their desks individually or with their neighbors while she observed, answered questions, and made comments to students about their work; provided the students with mnemonic devices to remember concepts; used a graphing calculator; provided structure;

told the students the historical development of a concept; and answered students' questions individually. The students appeared to be comfortable with the instructor and asked and answered questions. Many examples were real life examples, and the Math 099 instructor connected the mathematical concepts to things students understood or did in life. She solved problems, but only with the help of the students. When the students were learning how to graph the equation of a line, she provided them with a very structured method for doing this, and she did this with the correct mathematical vocabulary and notation. She also explained what her grading expectations were for their work.

The researcher observed two sections of Math 102. The same instructor taught both sections, but one section had an undergraduate teaching assistant and the other did not. The teaching assistant helped with instruction during class by writing things on the board, calling on students, or explaining topics. The teaching assistant was able to teach topics that were considered review material, and she usually did this during the help sessions that were conducted each week on the course's day off. The teaching assistant collected and graded homework and tests too.

Math 102 was taught using: a very active lecture; consulting the text; student participation in their seats and at the board; and with graphing calculator technology. The Math 102 instructor referred students to new theorems or concepts in the book while he carefully walked them through each new concept. This appeared to help the students learn how to read, write, and understand mathematical language and notation. The instructor used technology extensively—sometimes to solve a problem and other times to

verify answers. During the entire class period, one student ran the graphing calculator that was attached to the overhead projector. This freed the instructor of this task and might have indicated to the students that there was a student in class who could do the calculator work. It also demonstrated the instructor's trust in the students' abilities.

The Math 102 instructor demonstrated, explained, and used multiple methods to solve problems. The instructor reminded students of the importance of knowing the concepts for Math 103. The instructor reviewed past concepts while teaching new ones. He encouraged students to work in their groups. He called students to the board to do problems. They were given the choice of going to the board alone or with their group or a partner. The instructor explained each problem and concept and what students should be thinking as they solved the problems. At the end of class, the instructor provided the students with some tips and clarifications for the homework assignment. All students were awake and paid attention. The instructor was very enthusiastic and knowledgeable, and he made students aware of his expectations.

There were some differences between the class with the teaching assistant and the class without the teaching assistant. The teaching assistant helped write material on the board, whereas students or the instructor had to do this in the class without the teaching assistant. With the help of the teaching assistant, the instructor was free to move around the room and watch the students. The teaching assistant also knew what the instructor was going to do and could help the instructor with this, whereas a student at the board did not know the instructor's intentions. The teaching assistant interacted with the students.

She called them by name, had them do board work, and led the help sessions. She offered another perspective on some problems.

The researcher asked the instructors and the Director to describe effective lessons from the developmental courses they taught or to describe the effective policies and practices used in these courses. The classes of both instructors were observed prior to conducting the interviews.

At the beginning of the interview, the Math 099 instructor gave the interviewer many handouts that the instructor thought were examples of effective lessons. There was a handout in which students had to convert ladies' shoe sizes in different countries. This demonstrated functions and compositions of functions. There was a handout that used white and black beans as negative and positive charges, like electrons and protons. This helped demonstrate and explain addition, subtraction, and multiplication of positive and negative numbers. Another handout was an article that explained how to use black and white beans and paper cups to demonstrate and explain how to solve simple algebraic equations. Another handout was a practical application. It related an electrician's job time and a customer's job cost. On this worksheet, students graphed the relationship between job time and cost, and then answered questions about it. The Math 099 instructor gave this worksheet to students to do together in groups. She said that she hardly said a word while they worked on it. She let them explore and discover to see what they could figure out while she wandered the classroom and watched them. The last handout included graphing calculator instructions for students to use when factoring mathematical expressions.

The Math 099 instructor said that she used manipulatives to explain many concepts in Math 099. These were hands on and visual and took the students from the "concrete to the representative to the abstract." She said that she used the correct mathematical terminology with the manipulatives too. Small class size, less than 20 students, was important. She said that this allowed her to do more with manipulatives and to give students more individualized attention. The class was not always kept under 20 students so she was hoping to get a student who took the course during a previous semester to help her in the classroom so she could do more with manipulatives.

The Math 099 instructor said that she did not teach from any particular teaching or learning theory. She said, "I just try to meet needs wherever I see, whatever I can do and do one thing with one person, and something else seems to work over here." She offered students words of wisdom and inspiration on the syllabus or on the board each week. She also said:

> The other thing I really work on is to dispel fear. If I can get rid of the fear for some of them, that is a big thing at that level because they've met so much defeat. And if I can give them a little bit of taste of success then the confidence level rises, they lose the fear, and over and over I've heard people say, "I like this. This is kind of fun." And of course it comes from they're seeing success....We take baby steps. You gotta learn to crawl before you can walk. You gotta learn to walk before you can run.

The class met three days a week and on a fourth day the Math 099 instructor held a voluntary help session for students. Homework usually came from the text, and on the syllabus the instructor told students "to do as many problems as you need to do to learn the material." The homework was not graded. Exams and quizzes were given. On all exams except the final exam, students got a chance to retake a similar exam. The second

score was the one that counted so students could not "blow off" the retake option. Campus students were graded S/U since the course did not meet any graduation requirements. Students received an S if they had a 70% or higher. Students from the coordinate campus received a letter grade in the course.

The students were told to buy the TI-83 calculator because that was what the instructor used and because that was the calculator they would need in future math courses. The instructor said that the students used the calculator to check equations, to check the order of operations, for factoring, for graphing, for fraction operations, and to check their work, but all work had to be shown so that students did not become dependent on their calculators. She said, "They get excited when I hand them calculator materials." She showed students how to use it for factoring and said, "Once they saw that, then they became convinced about buying one if they had not bought one yet." She had students use the calculator if they could not do basic arithmetic. She did not have time to re-teach them their arithmetic facts, and they probably would not learn them now if they had not mastered them yet.

The Math 099 instructor also taught Math 102. She said, "My 102 is a faster paced class [than Math 099] and no manipulatives basically." She said that she tried to avoid calculator dependence by the students. It was more abstract and used the graphing calculator more for graphing and to check students' understanding.

The researcher obtained other information about Math 099 when she reviewed the course syllabus. Basic course and instructor information were provided, as well as the course materials, course description and objectives, grading policies, and tutoring

information. Using the General Syllabus Checklist, the Math 099 syllabus lacked the following: a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; other course requirements and policies (but there might not have been any); an estimate of student work load; a disability statement; a time to schedule fast feedback; course calendar; a list of important dates; and a space for other students' contact information.

The Math 102 instructor said, "The most effective lessons are the ones where I get my students involved either in groups or individually. I can accomplish that sometimes by moving them to the board. That gets them involved. Straight lecture does not work in those classes generally." He said that in groups or individually they went to the board to do problems. Sometimes there were many different answers for the same problem so students voted for an answer, and then they discussed the correct solution. The students enjoyed the board work and by the end of the course often asked for more of it, but there often was not time. The students also stayed actively involved taking notes. The instructor said, "Because of my philosophy about letting students use notes on exams, they value their notes so they take lots of notes. They are very busy writing things down."

The Math 102 instructor extensively used technology, in the form of a TI-83 graphing calculator. The researcher asked the instructor about his philosophy regarding technology, and he said:

> After all of my experience at the high school level, if a student hasn't developed some fundamental concepts by the time they are about 16 or 17 [years old], then if

> you are going to study any mathematics that has decent math content, there has to be some alternative approach to those areas where they are having fundamental problems. And so by using the math frac portion on the calculator we get away from some things that cause phobias. Graphing certainly allows us to look at a visual approach to a lot of problems where prior to that they did not have that option. Graphing was too tedious. And the other thing is we can look at patterns now because we can do so many problems so quickly that they can begin to see patterns, whereas before it would have taken you a month to do enough problems for them to see patterns.

He said that he began using the graphing calculators when the TI-81 came out. Prior to that he always used the scientific calculator and tried to get calculators that had a fraction key.

During each class, the Math 102 instructor gave students a "lengthy" amount of homework problems from the text. He said:

> I do grade homework almost everyday. And so they get my grade comments back. They know what they've done wrong. Those problems aren't the problems that have the answers in the back of the book or in the student solutions manual. I assign evens. And I make homework about 20% of their daily grade. And then their homework papers become part of their notes and they can use those on exams.

Tests were given after each chapter, and a comprehensive final exam was given at the end of the course. Students could use their notes and homework on their exams. Retests were given for all exams except the last one and the final. The retests were similar to the original exams, but students were given twice as much time to complete them. The instructor said:

> Retesting is a lifesaver for those students because sometimes in the learning process they don't do well on the first exam. A lot of them have test phobia. A lot of them are crunched by time. So my retesting in the morning and in the afternoon where I extend the time limit to two hours really helps those students.
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> My retesting has been part of my philosophy since before retesting was used by anyone, really, way before mastery learning. I've retested in my geometries, my advanced algebra. I have found that students generally improve

> on retests, even though the retest may be a little harder or a little longer than the original test. And as long as they have learned the material, that's what matters.

When asked, the instructor said that retesting was not limited to his lower level undergraduate math courses, but that he would and had used retesting in graduate courses.

The course met four days a week, and on the fifth day the instructor held a help session for students to come and ask questions and receive help. If the Math 102 section had a teaching assistant, then the teaching assistant usually led the help sessions. It was informal, student led, promoted interaction, and the students saw many more problems. He said that it was almost one-on-one during the help sessions because there were a lot of interaction and student comments.

The Math 102 instructor said that he used a little bit of mastery learning theory and cooperative or group philosophy. He said:

> I have a little bit of the mastery learning theory because of the things I do with the retesting and because one of my other philosophies from mastery learning is that a student should receive partial credit at all times for attempting problems so generally my students get half credit on homework problems, just for attempting them. I also, from the mastery learning philosophy, again buy into the retesting plan because it fit right into what I was doing. I also have a tendency to agree a little bit with Johnson and Johnson, the group philosophy. I try to do as much grouping as I can, however the class size and our facility isn't really conducive to grouping. It doesn't work real well, but we do still have it. You could even see that when you were in there. We have informal groups and they do use their groups. And some of those groups carry outside of class. They meet at the library. They meet in the mornings. There's a lot of that going on.

With regard to critical thinking in Math 102, the Math 102 instructor said:

> I think we get a fair amount of critical thinking because many of the graphic type problems that we look at and many of the written problems we look at involve critical thinking. Range and domain certainly, functions certainly, those are not rote problems. You cannot memorize those. The other thing too that I think that

> instills critical thinking is we try to attack problems from multiple methods. We look at the visual. We look at some algorithmic. We try to look at some rational approach to problems, and so we don't have this one methodology in this class.

The Math 102 syllabus included the following: basic course and instructor information; course materials; a description of the format of the course and its activities; grading policy and scale; policies on cheating, groups, attendance, late work, retests, and make up exams; other course requirements; a tutoring description; a course calendar. Using the General Syllabus Checklist, the Math 102 syllabus lacked the following: a description of the course purpose; the course description and objectives; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; an estimate of student work load; a disability statement; a list of important dates; a time to schedule fast feedback; and a space for other students' contact information.

Preparation for Success in Future Math Courses. The Director said that the department helped prepare students for success in their next math course by using a lot of the instructional techniques previously mentioned. He said that placement was an issue. If the students could be convinced to start in an appropriate class then "success breeds success." He said, "We give them every opportunity to succeed...Try to limit their risk of failure. Hopefully after completing their homework they will have some level of success and some level of confusion," said the Director. There was concern about the pace of Math 102 and Math 103. The pace and possible solutions to decreasing it were discussed at departmental meetings, but nothing had changed at that time.

Many instructors offered help sessions on courses' off days. The Director said that these were times for questions to be asked and answered. These sessions helped students get over the fear of asking questions, and students found out that it was okay to say they did not understand. The Director said:

> If there is a way to make sure that questions are able to be asked and answered, get, especially by the younger students, over this idea that you don't ask questions, this is college, I'm not supposed to ask questions, that's one of the real pluses of having the non-traditional students that sit in the front row and bug you. Even if a kid in the back row won't actually ask questions, they definitely figure that these people have questions, just like they're a surrogate for me. It does two things: It gets the question out, plus it says, "It's okay that I didn't get it because here is somebody else who is older and wiser than me and they didn't get it either so it's not my fault."

The Math 099 instructor mentioned retests as a way of helping students prepare for their next math course. She said that she provided many handouts, walked around and helped the students, and offered help sessions during the week. She thought the institution should have mandatory placement. She guessed that about 70% of students passed Math 099.

The Math 102 instructor said he helped ensure students were prepared for their next math course "through a good exposure to and at least an introduction to topics that will meld well into the [Math] 103 [course]." He offered help sessions and used a teaching assistant as well. He said that the help sessions got the students into a habit of seeking help and let them develop a trust with the instructor, which was really critical in Math 103. He said that a steady clientele developed and became pretty cohesive, almost like another class. Some students came to the help sections for both of the Math 102 sections taught by the instructor.

The issue of placement was discussed and the Math 102 instructor was concerned that too many students were not ready to take Math 103 but did anyway. Many of these students failed and failed miserably, and some became so frustrated that they dropped out of the university. He said:

> There seems to be a philosophy that since 102 is not required it is a waste of money and whether their math is there or not they seem unwilling to consider strengthening themselves by taking the 102 course. Even if they have to take 103 three, four, five times....There are some students who are even derogatory in a way about taking 102. They seem to belittle the students who take 102, and it isn't a negative thing at all. It is very positive, in fact, that they are strengthening their math.
>
> I like the philosophy of a couple of advisors who have a tendency to underplace students a little bit rather than overplace them. What happens in many of those cases, true they may be a little bit bored at times, but they get a fairly decent grade in that first course which gives them some impetus, gives them review. They get feeling good about themselves, and then they move on to the next course with a good background.

He said that he would still want a challenge process for students, but he was in favor of more strict guidelines on placement.

Support Services. Support services were available to developmental mathematics students at the Master's Institution. These services included peer tutoring, a drop-in math clinic, teaching assistants, Disability Student Services, orientation, a critical thinking course, learning communities, Veteran's Upward Bound instruction, study skills development, and a study skills course.

The tutors used in the Math Clinic did not receive training in tutoring. They were undergraduate students with strong math skills who often were mathematics majors or mathematics education majors. The orientation held on campus was not ongoing, and the peer tutors used by the Student Development Center received training. According to the

Director of Student Development, there was a monthly in-service training for tutors that included conflict management, working with others, classroom techniques, and behavior management. The Director of Student Development relied on faculty recommendations to ensure tutors knew the content.

According to one interviewee, TRIO Student Success Services handled some developmental students, but they were having "birthing pains." They helped with advising and placement of students and monitored and tracked their students.

Learning communities existed on campus, but these were not directed at underprepared or developmental students. Developmental mathematics courses were not included as one of the three courses students took in the learning communities program, although students might have been enrolled in such courses (L. Eriksmoen, personal communication, February 3, 2003).

Program and Course Assessment. The only formal assessment of the developmental mathematics program was the course and instructor evaluations completed at the end of each semester in all classes on campus, and these were not used intentionally to assess the program. According to the Director, "More assessment may be coming down from administration."

The Math 099 instructor sometimes gathered feedback from the Math 099 students to be given to the next Math 099 class. The Math 099 instructor said:

> I have in the past sometimes asked students to write for me a list of suggestions that I could share with the next class. It's really not an evaluation of myself. I ask them, "If you could give advice to the incoming students, what would you tell them?" And then I've typed that all up sometimes and said, "Okay, here is some advise from previous students."

Students assessed the Math 102 teaching assistants using a survey. The teaching assistant project was originally part of a Bush Grant and had to be assessed. The teaching assistant project no longer was funded by the Bush Foundation Grant, but the instructor continued the assessment of the teaching assistant. He said that this gave him "another measure of the students' perceptions of what's going on [in the course]." It also provided the teaching assistants with feedback that could be used for improvement.

The help sessions also provided the Math 102 instructor with valuable student feedback. He said, "I get a lot of student comments, though, because of my help sessions, and I get a lot of interaction with students there, almost one-on-one....It's a really valuable tool for assessment and finding out where you're at."

Perception of Support. The Director said that developmental mathematics education was not fully supported at the Master's Institution. He said that there was a lot of "pious talk about remediation." He added:

> Math 099 is not part of the regular load so the University System does not really think this is something the University System ought to be doing. There are those who, if given six years to succeed here, will. It is not something I am comfortable with, but somebody somewhere has to say, "Is it a good investment on the part of society to spend the money it is going to take to hire somebody here to work with 10 students full-time?" Are you going to pay them, what you pay somebody like that, $30,000 a year? From my perspective, the short answer has been, "No." The political system says, "No, we don't want to go that far. Figure out a way."

The Director said that the courses were not needs based. For example, when Math 099 should have 10 students, it had 25, but administration was happy because they did not have to pay another instructor. The Director continued:

> It is a complex issue because there is some level of personal responsibility, and I would like to think, not to pick on Job Corp, but I'm somebody who's dropped

> out of high school when I was 14 and the last math I took was eighth grade arithmetic...so now I want to get this degree and I'm not dumb. If anything it is the opposite because I was able to survive. Well, I've got somebody like the 099 instructor, who between classes goes over to the Union and runs her own little math clinic, then I can take advantage of that too. So there is this balancing act, I don't know how you do it, but if you are serious about getting this group of people in university mainstream, then somebody needs to look at a way to do that. I'm not even sure that it is even necessarily up to individual institutions....Maybe what you do is have some type of separate operation. Maybe like this Upward Bound program. Maybe you have some input into who is doing it. There has to be some local presence. It takes some doing to convince me that 099 can be done online.

In addition, Math 099 was funded differently and offered through Continuing Education because the Master's Institution could not spend state dollars on remedial education. The Director said that the numbers did not count for student credit hour production so there was actually kind of a "disincentive to spend money on these courses."

The Math 099 instructor said that she had asked to split the fall 2002 Math 099 class into two sections because it was too large. She said that she mentioned it to the Chair, never heard back, and was not persistent about following up on it. She said she had lost about one-third of that class. The Math 099 instructor also said that administration did not invite her to faculty recognition dinners because of her special contract status.

The Math 102 instructor thought that the Department of Mathematics and Computer Science was supportive of the developmental mathematics courses. The Math 102 instructor said:

> The department understands and has a pretty consistent feeling that 102 is an essential course. And we have a fairly large number of students who should be taking it who aren't. And I think most of the department is comfortable with the

> kinds of things we are doing in 102, getting students ready for movement to the other class. If they leave a 102 class with a C, a B, or an A, I think we're fairly comfortable that they are going to get into a 103 class and survive. If they have a D, that's a little more frightening....No one in the dept belittles those courses.

The Math 102 instructor thought that the institution was fairly supportive of Math 102. He said that he got the feeling administratively, they were not as comfortable with remedial classes, but from visits with administration up to the vice president's level, "they seemed to understand the need for the courses." The Math 102 instructor also mentioned that the state was getting tougher on incoming students who did not meet minimum entrance requirements, such as having completed the college preparatory curriculum.

Desired Changes. The Director said that he did not necessarily want anything changed, but "it might be useful for somebody to do something about it. To actually look at how we do remedial, what we think we want to do with remediation...across the whole system." He said that they were constrained by student credit hours because that generated the revenue they had to use. He said, "The Board [of Higher Education] says, 'Well, here's what you can count, and here's what you can't.' It really has to be a Board matter. The Board defines the mission." What happened at each institution in the state was different. He continued, "Somebody's got to get some heads together and say, 'Okay, I've got this problem.' They've got to get high schools to face up to the problem that students aren't adequately prepared," but he did not think that would happen.

The Math 099 instructor wanted mandatory placement of students in appropriate math classes. She was looking forward to working with a student assistant during spring semester so she could do more with the Math 099 students.

The Math 102 instructor said that he would like to change some of the topical content so more investigative time could be spent in certain areas, such as data analysis, curve fitting, and math being used in the real world. He said that he did not have time for enough practical applications because he was so busy developing math concepts. He did not want to make big changes to the content on his own. Other instructors had to agree with any changes. He said that the speed at which the content was covered was an issue. He said, "It is fast."

Other Comments. The Math 099 instructor said, "I wish I was a miracle worker." She said that she still tried to dispel students' fears and tried to instill confidence, while "sneaking in some algebra."

The Math 102 instructor said that three things were important to Math 102. First, "class size is critical." The course needed reasonable caps on enrollment, meaning less than 40 students. Second, the teaching assistant was important. He said that the teaching assistant had a positive experience and so did the students as a result of using the teaching assistant. He thought that the teaching assistant freed him up in the classroom so he could move about and keep eye contact with the students. The teaching assistant signed a confidentiality agreement and was mentored by the instructor. "Almost 100% of the students have indicated that the course would not be better without the TA." He also said that the teaching assistant added diversity because she sometimes did a problem

differently than he did. The third important thing for Math 102 was attendance. The students needed to attend to do well.

Grade Distribution Data. The researcher collected grade distribution data for each developmental math course offered during the fall semesters of 1999, 2000, and 2001. These data are summarized below in Table 28. For Math 099, grade distribution data were not reported the same way for fall 1999 and fall 2000 as they were for fall 2001. The Records Office did not generate grade distribution reports for this course since it was offered through Continuing Education during those years so grade sheets with individual students grades for each section of the course were kept on file. The fall 2001 sections of Math 099 were reported in the same way as the Math 102 sections. Because of this difference, the number of students who dropped Math 099 might not have been reported the same way during the fall 1999 and fall 2000 semesters; thus, the percentages of students who dropped Math 099 during fall 1999 and fall 2000 cannot necessarily be compared to the percentages for fall 2001 or those calculated for Math 102.

During fall 2001, approximately 18% of students dropped Math 099. In Math 102, the drop rates were between 25% and 32% for the three fall semesters. According to the instructor of Math 099, students who received grades of C or higher (70% or higher) received S grades. The average GPAs in Math 102 ranged from 1.69 to 1.81 during the fall semesters of 1999, 2000, and 2001.

Table 28. Grade Distribution Information for Fall 1999, Fall 2000, and Fall 2001 at the Master's Institution.

Course	Year	Grade									Number of Students Enrolled	Number of Students Who Dropped	Percentage of Students Who Dropped	GPA
		A	B	C	D	F	P	I	S	U				
Math099	1999								34	8	42	1	2.4%[a]	
	2000								26	7	33	0	0%[a]	
	2001								20	13	33	7	17.5%	
Math102	1999	24	20	33	31	41		1			160	53	24.9%	1.69
	2000	22	30	33	23	45		1			156	72	31.6%	1.74
	2001	16	30	33	30	29					139	57	29.1%	1.81

Note. [a]The number of students who dropped was not reported in the same manner as it was for Math 102 and fall 2001 Math 099.

The percentages of students who were successful in developmental mathematics course each semester are below in Table 29. These percentages were calculated with and without the students who dropped the courses. A success was defined as an S grade or as a grade of C or better. About 50-79% of all Math 099 students successfully completed the course when students who dropped were included during the three fall semesters. These percentages were a little higher, about 61-81%, when students who dropped were not included when calculating percentages. In Math 102, about 36-40% of students were successful when students who dropped the courses were included. These percentages were about 48-57% when students who dropped the courses were not included.

Table 29. Success Rates for Fall 1999, Fall 2000, and Fall 2001 at the Master's Institution.

Course	Year	Success Rate	
		Without Drops	With Drops
Math099	1999[a]	81.0%	79.1%
	2000[a]	78.8%	78.8%
	2001	60.6%	50.0%
Math102	1999	48.4%	36.3%
	2000	54.8%	37.4%
	2001	56.8%	40.3%

Note. [a]The number of students who dropped was not reported in the same manner as it was for Math 102 and fall 2001 Math 099.

Summary. The Masters Institution offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (four credits). These courses were taught in the Department of Mathematics and Computer Science, by correspondence, at a coordinate campus, and at a U.S. Air Force Base. On the campus of the Master's Institution, mathematics instructors and lecturers taught the developmental math courses. A math professor at the Master's Institution taught the correspondence section of Math 102. Local high school and junior high school teachers and one math professor taught the courses at the Base. Instructors at the coordinate campus taught the courses there. The instructors had bachelor's degrees or master's degrees, and in the case of the mathematics professor, had a doctorate, but no one had training in developmental education. These developmental instructors were required to have bachelor's degrees, but someone with a higher degree could teach these courses. Many of the developmental instructors were or previously were high school math teachers.

Faculty development opportunities were available for faculty in the Department of Mathematics and Computer Science. These opportunities included workshops, seminars, conferences, presentations, grant and committee participation, and teaching in the Master's program. Developmental instructors were invited to and did participate in the planning and decision-making processes of the Department even though they were not obligated to do so. They attended departmental meetings and were especially involved in the development and planning of the courses they taught.

The developmental mathematics instructors developed the developmental mathematics curriculum. For Math 102, this process included choosing the text and agreeing on the content of the course with the consensus of the developmental instructors and other concerned faculty members. The Math 099 instructor was in charge of the curriculum for Math 099. The instructors at the base used the same texts and followed the same course syllabi and outlines of content as the campus instructors. The Math 099 instructor also taught Math 102, so she was aware of what knowledge and skills students needed when they left Math 099 and entered Math 102. Teaching style was left to individual instructors.

Program goals or objectives were not formally stated anywhere. The Director said that it would be nice to have this written down somewhere. He also said that, informally, the goals of the developmental program were to provide students with the skills to successfully pass Math 103 and to teach students specific math skills. On the Math 099 syllabus, the instructor said that the main objective of the course was to review fundamental mathematics and beginning algebra. She wanted students to gain some

experience in factoring and graphing. She also wanted to dispel students' fears and to build a strong foundation for students to build on for success in Math 102. The Math 102 instructor did not list any objectives on his syllabus, but during the interview he said that he wanted to prepare Math 102 students for Math 103, to enhance their feelings about math, and to provide them with success to improve their attitudes, confidence, and self-esteem. All courses, except Math 099, were required to have formal syllabi that included course goals and desired learning outcomes, but most faculty did not use the formal syllabi.

Students were assessed with ACT math scores and the COMPASS placement exam. They were advised to take specific math courses using recommended cut scores that were based on ACT math scores or COMPASS scores. Placement in courses was not mandatory. Students did not receive graduation credit for Math 099. Credit for Math 102 depended on specific program requirements. Both courses counted toward financial aid credit.

Developmental students were traditional age college students or older than average students. Often the older students were reentering school from the work force. There were some students in Math 099 who had not finished high school. In Math 102 there was a wide range of students. Some of these students had very low math skills and others had taken precalculus in high school. Approximately 300 to 400 students enrolled in these two courses each year.

The instruction used by the observed and interviewed instructors included: active lecture, board work, manipulatives, group work, student-teacher interaction, structure,

integrated technology, real-life and abstract examples, help sessions, use of a teaching assistant, student participation, and using the text. The interviewees thought that the following were important and effective when teaching developmental mathematics courses: being an approachable instructor; positive student-teacher relationships; using multiple methods of teaching and solving problems; group work; retesting; technology; using the correct mathematical vocabulary and notation; getting the students actively involved; attendance; class size; the use of a teaching assistant; providing individual attention; help sessions; dispelling fear; providing success; and lots of homework. Students were assessed using homework, in-class activities, tests, retests, and quizzes. The graphing calculator was used in both courses.

The instructors prepared students for success in future math courses by doing the following: using effective instructional techniques; placing students in the appropriate courses; having help sessions; using retests; using teaching assistants; and by giving the students a good introduction and exposure to the topics they would need in Math 103. Both instructors thought there needed to be a better placement method.

A variety of support services were offered to students at the Master's Institution. There was peer tutoring by trained tutors. Undergraduate students with strong math backgrounds, but no tutor training, staffed a drop-in math clinic. Teaching assistants, Disability Student Services, one-day orientation, Veteran's Upward Bound, TRIO Student Success Services, learning communities, a critical thinking course, and a study skills course were also available to students. The learning communities were not targeted

toward developmental students, but still existed for certain groups of students, of which those taking developmental math courses were not excluded.

The developmental mathematics program was not assessed, but some assessment methods were used in each course. Students completed course and instructor evaluations in each class each semester. More assessment might eventually come down from administration. The Math 099 instructor collected course survival suggestions from her students for the next class of students to use. The teaching assistants were evaluated in the Math 102 courses using a survey. Each week during the help sessions the Math 102 instructor received feedback from students that helped him assess student learning and instruction.

The Director did not think developmental math was fully supported. Math 099 was not part of regular teaching loads. The student numbers did not count toward student credit hours so there was a disincentive to spend money on the course. The courses were not needs based either. The instructors thought the Department of Mathematics and Computer Science was supportive of the courses, and administration might have understood the need for the courses but was not necessarily in full support of them.

The interviewees desired the following changes to the developmental program: someone to examine and decide how to deal with remediation across the State; mandatory placement; changes in content to include more practical applications; and smaller class sizes.

During fall 1999, 2000, and 2001, student GPAs in Math 102 were between 1.69 and 1.81, and approximately 25-32% of students dropped the course. During fall 2001,

about 18% of students dropped Math 099. In Math 099, success rates were between 61% and 81% when dropped students were not included in the calculations and were between 50% and 79% when dropped students were included. The success rates in Math 102 were between 48% and 57% when dropped students were not included and were between 36% and 40% when dropped students were included.

Master's Institution: Math 099 Syllabus

"To win, you must begin."
Author Unknown

Math 099 Beginning Algebra (3 cr)
The main objective of this class is to review fundamental mathematics and beginning algebra. Topics covered include real numbers, equations, inequalities, exponents, polynomials, factoring polynomials, and graphing linear equations.

Text: Introductory Algebra, K. Elayn Martin-Gay

Instructor: Name

Office: Room and Building e-mail: xxx@xxxx.edu

Office Phone: XXX-XXXX Home Phone: XXX-XXXX

Class meets: 12:00 noon; TWR; Room 205 Building (No class Sept. 25)

Help!!?? I will give help during my office hours, and by appointment. The math clinic schedule will be posted around the building.

Assignments: Your assignment is always to do as many as you need to do to learn the material. Do not work in the book. Work all problems in a notebook.

Grades: If you are a Master's Institution student, your final grade will be recorded as "S" or "U." The "S" will represent a 70% or higher. The coordinate campus students' grades will be entered as regular letter grades. Grades will be determined by the following scale:

100-90% = A 89-80% = B 79-70% = C

69-60% = D < 60% = F

This is an informal class; I hope you will come, enjoy, and learn.

When buying a calculator, purchase the TI 83 Plus. This is what the instructor will be using in class.

"The control center of your life is your attitude."

Master's Institution: Math 102 Syllabus

1:00-1:50 MTWF Building, Room
2:00-2:50 MTRF Building, Room

Instructor's Name, Title
Office: Building, Room
Phone: XXX-XXXX

Textbook: Intermediate Algebra: Dugopolski M., McGraw Hill (2000).
Calculator: TI-83 or TI-83 Plus Graphing Calculator required

General Requirements:

1. Regular class attendance. Three consecutive days of absence without notification and a valid excuse will be considered as an unexcused absence. An unexcused absence on an exam eliminates any chance of a retest.
2. Participate in class activities, group or individual.
3. Take notes in class and from the text as needed.
4. Do the assignment {6, 12, 18, ...} as assigned from each section covered in the book. Do the assignment in a notebook or binder and bring the completed assignment to class the next day. Absent students must prearrange, call, or e-mail to notify me with a legitimate excuse or zeros will be given after three consecutive days of absence (no retest possibility). If you are absent one or two days it is still important to notify me and to do the specified assignment(s) in the Daily Plan. Be prepared to hand in any assignments collected when you return.
5. Do any handed out problem sets.

Grading:

A total point system evaluated with percentage grading system of 100-90% = A, 89-80% = B, 79-70% = C, and 60-60% = D will be used. A visual curve may be used on materials that are especially difficult, to modify the base percentage system.

Approximately 20% of the daily grade is generated by homework, notebook, daily grades, quiz scores, and/or project scores. About 80% of the daily grade is generated by test scores. The daily grade will could 80% of the course grade. The comprehensive final will generate 20% of the course grade. Retests may be offered on some tests, not the final exam. These tests are generally offered out of class. If a student is able to improve their grade over the original score, they will be given the amount improved as extra credit. There is no penalty if a student happens to do worse on the retest. Corrective work or extra help outside of class may be required to qualify for a retest.

Cheating will not be tolerated! A student caught cheating will receive a zero on that work. Cheating on a test will remove any chance for rest.

Material to be covered from the text: This is a tentative plan and is subject to change in class.

Chapter 1, all sections. Exam 1 Chapter 1 and all material covered to this point.
Chapter 2, all sections. Exam 2 Chapter 2 and all material covered to this point.
Chapter 3, all sections. Exam 3 Chapter 3 and all material covered to this point.

Chapter 4, sections 1-3. Exam 4 Chapter 4 and all material covered to this point.
Chapter 5, all sections. Exam 5 Chapter 5 and all material covered to this point.
Chapter 6, sections 1-5. Exam 6 Chapter 6 and all material covered to this point.
Chapter 7, all sections. Exam 7 Chapter 7 and all material covered to this point.
Chapter 8, sections 1-3, Chapter 9, sections 1-2. Exam 8 Chapter 8, 9 and all material covered to this point.

Help Available:

Wednesday 2:00-2:50 Rm 330	Math Clinic: Schedules posted in the halls
Thursday 1:00-1:50 Rm 330	Office Hours: 8:00-8:50 and 3:00-3:50 M-F

Lab Groups and Peer Tutoring:

Some of the time this class will work in Lab Groups chosen by me or by the students. Some assignments and projects will be given in a group format. In many cases the individual will still have responsibility to finish work at home. Some assignments will be collected as a single assignment from the group, but the majority will still be collected as individual assignments. Some topics will be investigated by groups of students for presentation to the class or to other small groups.

Group Classification:

1) Base Group: Chosen by students, instructor, or random assignment as a long-term group. The primary purpose is for members to give each other the support, help, encouragement, and assistance each needs to progress academically. Most daily detail issues will be handles through the base group.
2) Informal (ad hoc) Group: A temporary instructor assigned group. The purpose may be to (a) focus student attention on the material to be learned, (b) ensure that students cognitively process the material being taught, (c) create a mood conducive to learning, and (d) bring closure to a topic being taught.

Board Work and Oral Participation:

Going to the board and oral presentation are major components of this class! When you are called to the board or asked to participate orally you must at least try. You learn mathematics by being involved. Don't be afraid to make a mistake, we learn from our errors.

Assignments:

Assignments must be handed in on time. No late work will be accepted. It is better to hand in partially completed assignment than to take a zero! On most assignments, the student receives half credit on a problem just for doing the problem. No credit will be give for random numbers or nonsense answers. See attendance requirement.

Exams and Retests:

If you have an excused absence the day of the exam, you must arrange to take the exam before the original exam and key are returned to the class. Failure to do so will eliminate your option to take the original exam and leave only the retest option. There will not be a retest opportunity offered on this test. Retests are not returned to students. The results are reported back on the top of the original exam turned in at the time of the retest. An excused absence on the original exam eliminates any chance of retesting on the test.

Intermediate Algebra 102 Fall 2002 Daily Plan

T Aug 27	Sect 1-1 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
W Aug 28	Help Session
R Aug 29	Sect 1-2 {6,12,18,24,30,36,42,48,54,60}
F Aug 30	Sect 1-3 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96,102,108,114}
M Sept 2	No classes
T Sept 3	Sect 1-4 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96}
W Sept 4	Help Session
R Sept 5	Sect 1-5 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
F Sept 6	Sect 1-6 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90 & Proofs}
M Sept 9	No Classes
T Sept 10	Exam 1 (All material covered as of the end of Chapter 1)
W Sept 11	Help Session
R Sept 12	Sect 2-1 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96}
F Sept 13	Sect 2-2 {6,12,18,24,30,36,42,48,54,60,66,72,78}
M Sept 16	Sect 2-3 {6,12,18,24,30,36,42,48,54 (in class),60}
T Sept 17	Sect 2-4 {6,12,18,24,30,36,42,48,54,60,66}
W Sept 18	Help Session
R Sept 19	Sect 2-5 {6,12,18,24,30,36,42,48,54,60,66,72,78,84}
F Sept 20	Sect 2-6 {6,12,18,24,30,36} calc method (#36 use "x" on calculator)
M Sept 23	Review Chapter 2
T Sept 24	Exam 2 (All material covered as of the end of Chapter 2)
W Sept 25	No class-Assessment Day
R Sept 26	Sect 3-1 {6,12,18,24,30,36,42,48}
F Sept 27	Sect 3-2 {6,12,18,24,30,36,42,48}
M Sept 30	Sect 3-3 {6,12,18,24,30,36}
T Oct 1	Sect 3-3 {42,48,54,60,66,72,78,84}
W Oct 2	Help Session
R Oct 3	Sect 3-4 {6,12,18,24,30,36,42,48}
F Oct 4	Sect 3-5 {6,12,24,36,42,48,5466}
M Oct 7	Sect 3-6 {6,12,18,24,30,36,42,48,54,60,66,72}
T Oct 8	Exam 3 (All material covered as of the end of Chapter 3)
W Oct 9	Help Session
R Oct 10	Sect 4-1 {6,12,18,24,30,36,42,48}
F Oct 11	Sect 4-2 {6,12,18,24,30,36,42}
M Oct 14	Sect 4-3 {6,12,18}
T Oct 15	Exam 4 (All material covered as of the end of Chapter 4)
W Oct 16	Help Session
R Oct 17	Sect 5-1 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96,102,108}
F Oct 18	Sect 5-2 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
M Oct 21	Sect 5-3 {6,12,18,24,30,36,42,48,54,60,66,72}
T Oct 22	Sect 5-4 {6,12,18,24,30,36,42,48,54,60,66,72,78,84}
W Oct 23	Help Session

R Oct 24	Sect 5-5 {6,12,18,24,30,36,42,48,54,60,66,72,78}
F Oct 25	Sect 5-6 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
M Oct 28	Sect 5-7 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
T Oct 29	Sect 5-8 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96}
W Oct 30	Help Session
R Oct 31	Sect 5-9 {6,12,18,24,30,36,42,48,54,60,66}
F Nov 1	Exam 5 (All material covered as of the end of Chapter 5)
M Nov 4	Sect 6-1 {6,12,18,24,30,36,42,48,54,60,66,72,78,84}
T Nov 5	Sect 6-2 {6,12,18,24,30,36,42,48,54,60,66,72, }
W Nov 6	Help Session
R Nov 7	Sect 6-3 {6,12,18,24,30,36,42,48,54,60,66,72,78,84}
F Nov 8	Sect 6-4 {6,12,18,24,30,36,42}
M Nov 11	Sect 6-5 {6,12,18,24,30,36,42,48,54}
T Nov 12	Review Chapter 6
W Nov 13	Help Session
R Nov 14	Exam 6 (All material covered as of the end of Chapter 6)
F Nov 15	Sect 7-1 {6,12,18,24,30,36,42,48,54,60}
M Nov 18	Sect 7-1 {66,72,78,84,90,96,102,108,114}
T Nov 19	Sect 7-2 {6,12,18,24,30,36,42,48,54}
W Nov 20	Help Session
R Nov 21	Sect 7-2 {60,66,72,78,84,90,96,102,108}
F Nov 22	Sect 7-3 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96,102,108}
M Nov 25	Sect 7-4 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
T Nov 26	Sect 7-5 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90,96}
W Nov 27	Help Session
R Nov 28	No Class
F Nov 29	No Class
M Dec 2	Sect 7-6 {6,12,18,24,30,36,42,48,54,60,66,72,78,84}
T Dec 3	Exam 7 (All material covered as of the end of Chapter 7)
W Dec 4	Help Session
R Dec 5	Sect 8-1 {6,12,18,24,30,36,42,48,54,60,66,72,78,84,90}
F Dec 6	Sect 8-2 {12,18,24,30,36,42,48,54,60}
M Dec 9	Sect 8-3 {6,12,18,24,30,36,42}
T Dec 10	Sect 9-1 {6,12,18,24,30,36,42,48,54,60}
W Dec 11	Help Session
R Dec 12	Sect 9-2 {6,12,18,24,30,36, 60,66}
F Dec 13	Exam 8 (All material covered as of the end of Chapter 9)

No Help During Finals Week:

2:00-2:50 class	Final Exam	R Dec 19	12:00-1:50

Intermediate Algebra
Course Plan

Text: Intermediate Algebra
Mark Dugopolski
McGraw Hill
2000

Chapter 1: Real Numbers
- 1.1 Sets
- 1.2 Real numbers
- 1.3 Operations on the set of Real numbers
- 1.4 Evaluating expression
- 1.5 Properties of Real numbers
- 1.6 Using the properties

Chapter 2: Linear equations and inequalities in one variable
- 2.1 Linear equations in one variable
- 2.2 Formulas
- 2.3 Applications
- 2.4 Inequalities
- 2.5 Compound inequalities
- 2.6 Absolute value equations and inequalities

Chapter 3: Graphs and functions in the Cartesian coordinate system
- 3.1 Graphing lines in the coordinate plane
- 3.2 Slope of a line
- 3.3 Three forms for the equation of a line
- 3.4 Linear inequalities and their graphs
- 3.5 Relations and functions
- 3.6 Graphs of functions

Chapter 4: Systems of linear equations
- 4.1 Solving systems by graphing and substitution
- 4.2 The addition method
- 4.3 Systems of linear equations in three variables

Chapter 5: Exponents and polynomials
- 5.1 Integral exponents and scientific notation
- 5.2 The power rules
- 5.3 Addition, subtraction, and multiplication of polynomials
- 5.4 Multiplying binomials
- 5.5 Division of polynomials
- 5.6 Factoring polynomials

5.7 Factoring $ax^2 + bx + c$
5.8 Factoring strategy
5.9 Solving equations by factoring

Chapter 6: Rational expressions
6.1 Properties of rational expressions
6.2 Multiplication and division
6.3 Addition and subtraction
6.4 Complex fractions
6.5 Solving equations involving rational expressions

Chapter 7: Rational exponents and radicals
7.1 Rational exponents
7.2 Radicals
7.3 Operations with radicals
7.4 More operations with radicals
7.5 Solving equations with radicals and exponents
7.6 Complex numbers

Chapter 8: Quadratic equations and inequalities
8.1 Factoring and Completing the Square
8.2 The Quadratic Formula
8.3 More on quadratic equations

Chapter 9: Additional function topics
9.1 Combining functions
9.2 Inverse functions
11.4 The Factor Theorem

APPENDIX G

PROGRAM DESCRIPTION FOR DOCTORAL INSTITUTION

Program Description: Doctoral Institution

Background. The researcher observed two developmental mathematics classes, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (four credits), during her visit to the Doctoral Institution. In addition, the researcher interviewed four people: the Director of Distance and Continuing Education, and the Remedial Program Director of the Department of Mathematics, and two instructors, both of whom taught Math 099 and Math 102. In order to distinguish between the two directors, the Director of Distance and Continuing Education is referred to as the Continuing Education Director, and the Remedial Program Director of the Department of Mathematics is referred to as the Remedial Math Director. To distinguish between the instructors, the person who supervised Math 102 and whose Math 102 class was observed is referred to as the Math 102 instructor. The second instructor is referred to as the Math 099 instructor since that was the course addressed most often during his interview. The researcher collected and analyzed syllabi of the observed courses using the Checklists.

The researcher interviewed the Continuing Education Director because developmental mathematics courses were offered through Continuing Education. The Continuing Education Director answered administrative questions and left the more instructional questions for the Remedial Math Director and the instructors. The Remedial Math Director was in charge of the developmental mathematics courses and instructors. He also was the University Mathematics Placement Director. He was a senior lecturer in the Mathematics Department with an undergraduate degree in math and physical science

and a master's degree in math. Prior to teaching at the Doctoral Institution, he taught at the high school level.

The Math 099 instructor taught Math 099 Beginning Algebra, Math 102 Intermediate Algebra, Math 103 College Algebra, and ITV (interactive television) Math 103. His undergraduate degree was in mathematics, and he was a high school math teacher for 29 years. He was completing his master's degree in mathematics education at the Doctoral Institution while working as a mathematics lecturer.

The Math 102 instructor had a bachelor's degree in math education. She had taught math to grades 7 through 12 and had been the education director at a private learning center as well. During an initial phone call, the Remedial Math Director suggested to the researcher that she interview the Math 102 instructor, so the researcher did.

The Math 102 instructor taught Math 099 and Math 102. She taught these courses in a regular classroom format, and she taught one section of Math 102 online. She also was the supervisor of Math 102. As part of her supervisory duties she observed each Math 102 instructor at least once each semester. After the observation she and the instructor met to discuss the observation, and then a report was placed in the instructor's file.

The interviewed Math 099 instructor was different than the Math 099 instructor that was observed. This difference was due to scheduling difficulties during the time of the visit, but it provided the researcher with an additional source of information regarding the developmental mathematics program at the Doctoral Institution.

The researcher took notes during all of the interviews. She also tape-recorded all interviews, except the interview with the Continuing Education Director. The interview with the Continuing Education Director was brief and addressed the more administrative questions.

Definition and Location of Developmental Mathematics Education. The Remedial Math Director described developmental mathematics education at the Doctoral Institution as:

> Developmental mathematics on this campus is designed to aid a traditional student that had been there, to get back into the swing of things—that they are going to have to take [Math] 104, 146, or 165, the two calcs [two calculus courses] or whatever, but it has been a while since they have done anything there, or maybe they have not done it very well, or whatever the case may be. So our developmental math is to say, "Okay, we are heading you toward 104 or 146 and so on, we know that, that is exactly what we are doing. We are trying to fill in the holes, the gaps. We are going to do some calculator things eventually. We are going to do graphing things eventually. We are going to do all the kinds of tools that you need, and hopefully teach you to think a little bit about how you are doing stuff, and whatever, so that when we ask you to do that in the that gen ed [general education] requirement course, that you will be okay."

The Remedial Math Director later added, "The program is designed to give a caring hand to anyone that will take it."

Math 099 and Math 102 were offered through Continuing Education, but the Mathematics Department was responsible for the development of the curriculum and its instruction. The Continuing Education Director said the Remedial Math Director handled all of the instructional duties, and Continued Education handled the money and had a roll in supporting the developmental math students through advising and counseling.

Several sections of Math 099 and Math 102 were offered each semester. One section of each course was taught online using MyMathLab, an online program for all major Addison-Wesley mathematics titles. The other sections were taught on campus in classrooms and were supplemented with MyMathLab.

Developmental Mathematics Faculty. The Remedial Math Director said:

> The majority of the instructors are lecturers. They probably are teaching something in the Department. If not that, they are very experienced instructors that are perhaps working on their degrees, their advanced degrees, with years of high school experience and have bought into the idea that students that are in 099 and 102 need to have not have been there...And then there is a few that are undergraduates, especially math major types, that have gone through and are close to being done....We try to use the best possible candidates we have available to teach these courses.

The undergraduates who taught were allowed to teach developmental mathematics courses in order to gain teaching experience without the worries of disciplining students that occurred in high schools.

One of the instructors said that in order to teach a credit course (Math 103 or higher), an instructor needed a master's degree, except for courses taught after 3:00 p.m. The Math 102 instructor said, "We use a lot of teachers from the community." Quite often, experienced local high school teachers were recruited to teach the developmental math courses. The Math 102 instructor said that this worked because the local instructors saw what was done at the college level and took it back to the high school to use or help with their curriculum. The Continuing Education Director said that it was important that the Remedial Math Director was a math educator and not a mathematician.

The developmental mathematics faculty had input for tests and for how things were done with the developmental mathematics courses. The Director said that instructors had a "nonvoting voice." "They are listened to if they voice their opinions and change can start to happen," he said. He also said that different instructors had impacted the course over the years through their input and concerns. The Math 099 instructor that was interviewed thought that he had a voice in anything that went on and that he would be listened to and considered. He felt as if he was as important as anyone else. The Math 102 instructor said that the developmental mathematics instructors had no voting rights or say in other courses. They were not included in departmental meetings, but they were included in the developmental mathematics course meetings.

The Math 102 instructor said that there were faculty development opportunities available to her. She was currently participating in a peer review program with another mathematics instructor. She said the program was beneficial, and she was revising her course syllabi and incorporating cooperative learning as a result of it. Other faculty development opportunities on campus included: various workshops on computers, personal response systems, problem-based learning, and many other things. The Math 099 instructor said that he really had not participated in any faculty development opportunities. He said, "Because I am a veteran of teaching they kind of trust me, but if I ever feel that I have a problem, I have no problem talking to anybody about it." He also added:

> We don't have per say, "Okay, we'll go for the afternoon and have a seminar on it." My seminar is when I walk in their office and say, "Hey, I can't get this to work." Or this morning I walk in [the Math 102 supervisor's office] and I said, "We have our test in 102 on Monday and tomorrow in class I want to do a

> practice test. Do you have one for me?" [She said,] "Just a minute I'll print one up for you."

He later said that he had been to state conferences on mathematics education and that the department encouraged and paid for this.

Like at other institutions, many faculty development opportunities depended on the availability of funds. Developmental mathematics instructors, because they were lecturers, graduate students, or undergraduate students, did not receive the same priority in funding of faculty development opportunities as professors.

Curriculum Development. The Mathematics Department, the Remedial Math Director, and the instructors of developmental math courses developed the developmental mathematics curriculum at the Doctoral Institution. The Remedial Math Director proceeded to describe how some of the curriculum was developed in recent years.

He said that three or four years ago it was decided that a Web course would be created. Math 102 was chosen for this. A written syllabus, tests, and problem sets were developed for the course. Initially the course was not done well. Finally, they went into a studio and made videotapes for the course lessons. This way students and teachers would know what was in each course, and the curriculum had to be aligned if they were going to put Math 099 online as well. The Remedial Math Director said that they had to know what the content was in Math 099 to know how to deal with Math 102 and vice versa. The videos also provided a backup for instructors who were not sure about what was in a course or how it was taught. "They could just go look at the videos," he said.

Common syllabi, content, and exams were used in Math 099 and Math 102 as a result of the video and online course development. The Remedial Math Director said, "[The video development] forced people to talk. It forced people to make sure they were on the same page. That priorities got set in general, instead of specifically to the instructor." He continued:

> We have an outline of day by day or whatever for the course so that when we get to the end we are fairly assured that students have had the experience that is comparable to someone else's experience. This mushroomed into other courses. We now do this in [Math] 103, [Math] 104, [Math] 105, [Math] 146 stuff, like common syllabi, common tests, common content.

Beyond this, instructors were free to teach using their own styles, but the instructors of Math 099 and Math 102 were observed each semester and a report regarding this observation was placed in each instructor's file after a meeting was conducted between the instructor and the observer.

One of the instructors said that the curriculum was developed in the Mathematics Department and "came from what the students could not do in the upper level courses" according to what professors of those courses said students needed to do, were doing, or were not doing. This same instructor also said that she pushed for the calculator in the developmental math courses because that was where students stumbled when they got beyond the developmental courses.

Policies. Mandatory assessment and placement was practiced at the Doctoral Institution. The Remedial Math Director said that a "battery of tests" was given to students to place them in appropriate courses, and "this has been done for years." There was an algebra experience exam that was used to determine students' knowledge of

algebra. A precalculus experience exam was used to determine if students were ready for calculus. The Remedial Math Director said that ACT math scores were used until about three years ago, but many students had not taken the ACT for many years so the placement exams were adopted to deal with that problem. At the end of Math 099, students were offered another placement exam, the Math 102 final exam. If they passed the Math 102 final, they could skip Math 102. The Remedial Math Director said that was "somewhat successful." Some students took the Math 102 final exam and realized that they needed to take Math 102 because they did not know much of the material on the final exam.

The Remedial Math Director said that students often took Math 099 and then wanted to take the algebra experience placement exam again. This was not allowed because, according to the Remedial Math Director:

> The placement test is a simplistic view of algebra, and an 099 student could probably pass it and not have to take Math 102, but probably would not be successful in Math 103 or Math 104. Like in high school, right after they take a course, they can do well, and a month later they don't remember anything. And that is the piece that we need. The kinds of things that we need from them are the things that they should never lose. They should not lose the idea that $2x + 1 = 7$ is a linear equation. That they can recognize that, or they have got an idea of how to do the graph or something about it instead of just staring blankly....Maybe when first asked you may not be able to answer, but you'd be able to start, and then say, "oh yeah," and start to recognize it, and then you can explain how to do the problem.

As mentioned earlier, the developmental math courses were offered through Continuing Education because the Doctoral Institution was not allowed to spend state dollars on courses considered remedial or developmental. The Continuing Education Director explained how the courses were funded. The tuition students paid for the

courses funded the developmental math courses. The tuition dollars had to pay for instructor salaries, tutoring wages, and other costs associated with the courses. All students, including out of state students, paid a special fee for these courses. The special fee was 70% of the normal in-state tuition and was the same for all students regardless of other factors, such as program and residency. Since the courses did not satisfy any requirements for graduation, the tuition was discounted, and student fees were not charged for these courses as well. Students did receive financial aid credit for taking the courses, but no graduation credit. The revenue from the developmental mathematics courses was split between Continuing Education and the Mathematics Department.

Goals, Objectives, and Desired Outcomes. Goals, objectives, and desired outcomes were not included on either course syllabus. During the interview with the Remedial Math Director, he said that there were no stated goals, objectives, or desired outcomes for the developmental mathematics program or its courses. Nothing else about goals was mentioned during this interview, but during lunch with the researcher and one of the interviewees, the Remedial Math Director said that they wanted to emphasize teaching for conceptual understanding, not teaching for rote memorization.

The Math 099 instructor said that his goal in Math 099 was:

> They [the students] be successful at the next level is all. Just that they, when they get out 099 they can go to 102 and do 102, and when they get out of 102, they can go to 103 or 104 and they can get their credit...Because the whole idea here is, we've talked about, is that success thing. So we can get all these kids so that they can get through here. How many of them have been told, "Oh, it's not your fault. I don't like math either, son," by their moms and dads, and you know, the elementary teachers.

When discussing his effective lessons, the Math 099 instructor said that he tried to get rid of students' fear of mathematics and build up their confidence. More related to the program, the Math 099 instructor said:

> The reason...[they] started this program is so that a kid doesn't take [Math] 103 five times. You know, this way at least they can get a foundation in this and [Math] 102 and then they can go into their [Math] 103 and [Math] 104 and have the basics. I've got a young man who is in my 102 class who took 103 and [Math] 105 [Trigonometry] and started in [Math] 165 [Calculus 1], he's an engineering major, but his algebra was so weak he is taking 102 now to get his skills up for that and then he is going to take 165 next semester.

The Math 102 instructor said that her goal was to help the students become proficient in the necessary areas. She said, "Another goal of Math 099 and Math 102 is to help students become familiar enough with the calculator that they can be successful in [Math] 103 and [Math] 104 so they don't spend that whole first semester learning the calculator." She said that students could use the calculator too much. She explained, "We get students who say, 'I never knew why I did this before. All I knew was if I put this in the calculator, it gave me an answer.'"

When discussing the instruction of Math 102, the Math 102 instructor said:

> My main goal for this semester has been that they, I am having them keep all their work in a notebook of work so that I can go and look in that notebook and say, "Yes you are doing it." And so we can look to see that, number one, they're doing it; number two, trying to figure out that they can do it in a more organized fashion to make them better math students.

At the time of the interview the Math 102 instructor was revising the Math 099 and Math 102 syllabi to include more things, like specific course goals. She was doing this as a result of the peer review in which she was participating.

Students. The Remedial Math Director said that the developmental math students were "mostly freshmen and a smattering of non-traditional students." He said:

> The ones that you get in here that are mostly freshmen survived their high school courses, but when you ask them, and I have a large number of them that have sat right there, "What do you know about, what do you remember?" [They say,] "Oh, I don't remember anything." Well, they are going to just zero out our first gen ed if that is their attitude and that is true. We try to prompt them with some clues to as, can you do this material, and the answer is, no, they can't.

The Remedial Math Director continued and explained that they gave students a battery of placement tests. He said that it was his experience that students who wanted to take the placement exam and who were willing to go review and brush up on their skills before taking the exam and were successful were also the ones who were willing to do the necessary things to succeed and move forward in the math courses they took. If they were not willing to go back and review before the exam, then their chances of success were very limited not only on the placement exam, but also in the math courses they took. He added that about 20-25% of freshmen ended up in developmental mathematics courses.

The Math 099 instructor described the developmental mathematics students:

> In [Math] 099, they are the ones...math is really hard for them. A lot of cases I am finding too, it's people that are coming back to school. It might be an older student. I know I've got a 35 year old lady in there that's got five kids. A 30 year old lady that's got a little girl. I've got another lady that's about forty something that's got four kids that is coming back for nursing now. In [Math] 102, the ones I got there are mainly freshmen that just didn't test into [Math] 103 or [Math] 104.

He later said:

> The 099s, I think, they're the ones, the type of kid that has a little trouble with math so you've got to be very, very cautious with them and very, very positive with them just to get them to build up. And if they go from there, then they can step into 102, then they can step into 103 or 104 or whatever they need.

The Math 102 instructor described the developmental mathematics students as:

> A lot of older than average. Some that have never had algebra one....I have one that's as old as I am right now in my Web class. We have some that have never gone beyond, or they've taken some algebra, and that's students that are in high school. And then I had one a couple years ago that never thought he'd go to college. He was going to be a farmer and then the farm is going down the drain, and so he had to come and get involved in it. A lot of students that just dislike math, but a lot of them also took math early in their high school years and didn't take it since and that is big...Some two, three years since they've had math...They wanted an easy senior year.

The Continuing Education Director said that about 800 students enrolled in Math 099 and Math 102 each year. Some of these were repeats; meaning, students who took the course unsuccessfully in the past and were retaking it again. The Remedial Math Director said:

> I would say, that of those 800 heads that go in there in a year, 60-70% probably go on and are successful in the kinds of courses they need to take. We did, not for a couple of years probably, did studies about, where did these students come from and so on...and some of the better students that we have in those classes are the kids that are coming out of these classes. And this is across the board. You know whatever class that you want to pick on, according to our past Chair, the best students that we have are the ones that were in a previous course in our system.

Instruction. When the researcher asked the Remedial Math Director about effective teaching methods, he said:

> The effective teachers get away from the board and get the students involved and get them to dare to ask questions. And that's a hard sell. I mean, it's hard for us, and it's hard for me to get to that level everyday, but it seems to be best policy here because the traditional, "I'm going to sit up here and show you seventeen examples" didn't work....It's become an active learner....Get them making mistakes.

He explained that if the students were actively participating in class, he knew how they did a problem, and then he could help the students in those teachable moments. He

compared it to a student having trouble doing something on a calculator. The student asked a question about something they did on their calculator but pressed the clear button before showing you what he or she did, and the teachable moment was lost.

The researcher and the Remedial Math Director discussed some of the technology that was used in the developmental courses. The Remedial Math Director said that the computer was used as technical support in all of the developmental math courses. He explained that the textbooks also had an online computer component called MyMathLab that students used to do homework problems, take quizzes, and read the text. One section of each developmental course was offered online using a text, Cdrom, MyMathLab, and WebCT. The Continuing Education Director said that this type of course format served a certain crowd. The Remedial Math Director said that the calculator was used some in Math 102. This topic led to discussions about students and instruction.

The Remedial Math Director said:

> Students fight, "I have to do it exactly." Well, this is the whole thing. This is why they're having a problem because they're not paying attention to detail when they're doing the problems by hand. They're being sloppy about it and the computer is forcing them to be very exacting in how they write things.

The calculator did the same thing. When students misused a calculator by being sloppy they were not going to get a good result. So he said they tried to build into the students some common sense ideas about what should be a correct answer to a problem so that they did not just assume the calculator gave them the correct answer just because it was a calculator. He said the calculator was like an "on-going check of their understanding." He continued and explained a new piece that was entering developmental math, the students' understanding. He said:

> "Do you understand how to do it and do you know why you can do that?" Are they listening to the why or are they just wanting to do seventeen problems. "Show me one and I'll do 20 like it, and then if you change the one you showed me I won't know how to do it." It is just like you are doing a problem, and of course in the problem you have an apple orchard, da, da, da, da, da, okay and you get an answer. And the next day you say we have an orange orchard and they go, "Well, we've never done one like this." And it's exactly the same words, and they can't pick out that it's the same kind of a problem. Whether it is a developmental class or a trig class or whatever, "Have you not gotten beyond the fact that you are just mimicking whatever I just did or do you know how to do the problem?"

The Remedial Math Director said that the students were given an assignment list and activities that they did online on MyMathLab. The assignment list sometimes included problems from the text and problems to be done online. The students did things online "as many times as they needed." Students did them until they were comfortable with their grade and understood the material. Quizzes and chapter tests could be done on MyMathLab as well. Some teachers scheduled time in the computer lab so students had time to ask questions about the online material and how to use the program.

During the observation of the Math 099 class, the instructor reviewed material for a test that was to be given during the next class meeting. Therefore, the researcher was not able to observe the instructor presenting new material, but the researcher did observe the instructor's interaction with students and his explanations of problems.

At the beginning of class, the instructor told the students that there was a practice exam on MyMathLab for students to use to review. He said that one problem on the review test was for extra credit. To help the students review, the instructor gave the students problems to solve while they were in class. While the students worked on problems, the instructor walked around and checked on the students and their work.

After giving the students time to work on a problem, the instructor asked the students about the solution to the problem. The instructor knew the students by name and called on them to answer his questions and to provide the solutions to the review problems. The instructor had the students use correct mathematical language when they spoke, and he forced the students to explain the concepts, the problems, and their solutions.

At times, the instructor conceptually explained a solution process before actually writing anything down. For example, there was a word problem in which the students had to derive the correct equation before they could solve it. The instructor talked about the thought processes students needed to derive and write the necessary equation that would be solved. He explained how to think about the problem and how to pull out the key parts as well as why he used certain formulas and numbers. At one point, the instructor was incorrect, but he handled it quite well. One student was continually frustrated. The instructor remained positive with the student and helped her as much as possible without letting her dominate and disrupt the class. Less than 10 students attended class that day.

During the observation of the Math 102 class, the instructor began class by placing the answers to the homework assignment on the overhead projector. The students checked their work, and the instructor walked around to see how the students did. After allowing sufficient time for the students to check their work, the instructor asked if there were questions on the homework. The students asked about some of the problems, and the instructor did those problems on the board. As she worked the problems she said, "Think about this as you are working problem number..." She talked the students

through the solution processes and prompted them with questions in order to have them help her solve the problems. At times the instructor became frustrated with the students' lack of responses to her questions. When this occurred she mildly reprimanded them or thanked those who finally gave her a response.

After the instructor answered all of the homework questions, she presented new concepts and reviewed old concepts at the board. As she presented new concepts, she connected them to previous concepts the students had learned. The instructor did some examples that involved the new concepts, and she did a specific example in two different ways to illustrate that only one way was the correct method and was based on the new definition the instructor presented.

After the instructor finished presenting the new concepts and examples, she placed some problems on the board. She had the students get into their groups to work on the problems. Each student had to complete the problems, but they did not have to work alone. They could get help from their group members. After the instructor checked to ensure that every group members' problems were complete, the group picked one problem, one that another group had not already completed, and wrote its solution on the board. The students worked on these problems until the end of class. After class, a few students stay to ask questions, and the instructor helped them.

Overall, the students appeared to be more talkative and motivated in their groups. Some groups communicated effectively, and the students helped each other solve the problems. Some students worked alone and rarely asked their group members for help, even when they did not know how to solve one or more problems.

During the interview with the Math 099 instructor, which was not the same instructor that was observed teaching Math 099, he described how he effectively taught the course. He said:

> There's a lot of interaction. You introduce what you are going to do that day, and then you'll do an example problem, and then you'll have them do an example problem, and then you'll try to get some interaction that way. Because [Math] 099 is basically algebra one from high school and [Math] 102 is algebra two from high school, and those are the things that I taught in high school for many, many years. It hasn't changed much, just the book.

Later he added, "It's not much different than teaching a high school class except that they [the students] don't have to be there." He said that he liked algebra and teaching the developmental math courses, but a lot of people did not. He was a high school math teacher so he was used to teaching at that level. He said:

> To me it's like teaching high school, and I don't mind that. I like, I like algebra. That's my, and when I was in high school I taught algebra one and algebra two for many, many years and then the last 10 years I taught algebra two, precalc, trig, and AP calculus. And I've been everywhere on that, and I don't mind this. It's fun. And you try to make games out of it. And you try to have...I have to use a lot of humor because of my size because I can intimidate the hell out of anybody, so then you try to use a lot of humor with it. You try to get them relaxed. You know, and I don't want a fear factor in there because their fear right now is the word, math. What you are trying to do is get rid of that and the anxiety part of it. Hopefully we can build them up...You don't try to do things in big chucks. You try to do things in little pieces and then you take the little pieces and try to build it up...Again this is a kid who...no confidence. "I don't like math."

The Math 099 instructor tried to do some type of assignment everyday in class. He had students grab a partner or group. They did one problem in their group and handed in one solution for the entire group. He said, "Of course they all get a 10 out of 10. Which is good and that's the whole idea there." These assignments also did two other

things. They acted as an attendance check and made students do problems. He sometimes intentionally partnered certain students together. He explained:

> I think in that class [Math 099] more, I partner them up. And what I'll do is kind of go okay, "Well, Mary you go with Johnny today." Well, Mary's your number one student. Johnny's your lowest student, and your hoping that Mary works with Johnny and helps him that way because that's a different voice trying to do the same thing that you do.

The students' critical thinking skills were weak. The Math 099 instructor said that the students got good at solving equations, but he had to talk them through story problems and break them down for the students. He said, "It's easy to teach a kid how to solve an equation, but the next step is taking the words and making it into an equation. So you break down, break down, and talk them through it."

Assignments were the same for all sections of the course. There were problems from the text or there was a combination of problems from the text and on MyMathLab. The Math 099 instructor said that he liked the way the text was set up. He said, "The book does a nice job of doing a little one thing and teaching that and then a lot of repetition in the problems. And that's what I like to see. Lots and lots of homework."

As stated earlier, Math 099 was supplemented by technology, including the graphing calculator and MyMathLab. The Math 099 instructor said that the calculator was used in Math 099 and Math 102, but the first two chapters of Math 099 were done without the calculator. In the third and fourth chapters, they introduced the graphing calculator. He said that in Math 102 they did some linear graphing where students found the slope of the line and other things on paper, and then they showed the students how to do this on the calculator. He said it was like he taught it as a high school teacher.

The Math 099 instructor gave quizzes using the online MyMathLab computer program. He said that there were 10 online quizzes created by the instructor. Students did them on their own, and they had to complete the quiz by a certain date. The computer program graded the quizzes immediately so students received instant feedback. The instructor let the students take the first quiz as many times as they wanted. After that, the instructor let the students have five tries on each quiz. The instructor could put a time limit on quizzes, but the Math 099 instructor did not do this. He said, "At this level the most important thing you are looking for is success. If a kid gets in there and he has eight problems done and he runs out of time it could ruin their psyche." Exams were given in class. On all exams, students who scored below 75% could retake the exam once and earn a maximum of 75%.

The researcher reviewed the Math 099 syllabus for other information using the Checklists. Basic course and instructor information were provided on the syllabus, as well as descriptions of and a listing of the course materials, the assignments and exams, the grading policy, a disability statement, a course calendar, and course policies regarding conflict exams, makeup exams, and academic dishonesty. Because of the online supplement to the course, students were required to have an e-mail address and access to a computer with Internet access and an Internet browser. Using the General Syllabus Checklist, the Math 099 syllabus lacked the following: the course description; the course purpose; course objectives or desired outcomes; a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; an estimate of student work load;

a list of important dates; a time to schedule fast feedback; and a space for other students' contact information.

The Math 102 instructor described what were effective teaching methods in her Math 102 classes. She said that she tried to get them to be "more active in class and in their learning." She was trying to incorporate cooperative learning in her classes. She had students sit together in groups, work on problems, and do board work. The researcher observed these activities during the observation of the Math 102 class taught by this instructor.

The Math 102 instructor said that technology was used in Math 099 and Math 102. This included a graphing calculator and the MyMathLab Internet program that accompanied the course's textbook. She described her experiences with MyMathLab and how she used it for the students' homework assignments:

> I have a number of students that like it. They use it all the time. And some that just really fight it. What I have finally done, I did have homework where they did part on MyMathLab and part on paper, and I finally, because of the fact that MyMathLab was not as reliable as it should be because, they told me, they expected a 12% increase and they had an over 25% increase in usage, and so I think they are just struggling to keep up with it. And so I did, and because the students, some of them disliked it so much that they were just struggling in class. I said, "Okay you have a choice. Either turn your work into me everyday so I see that you've done the odd ones because the odd ones go out on MyMathLab, or you can do it on MyMathLab, in which case you don't have to have it done that day. You can have a little extra time that you can go out and work it there." And then sometimes I just take in all the even ones and we correct the even ones. So that they have a choice in how they do it. And that has been a real help.

The Math 102 instructor continued to describe how some of the features on MyMathLab informed her instruction of the course and how she made changes based on this information:

> We have used something called a formative assessment. Students can go into, we have a site where they can go in, and they evaluate us. They evaluate me. I can look at what their comments are. It only goes to me. But then I can look at some things that I can do. And that was one of the things that I did as a result of those, was giving them some options [on their homework assignments]. I got good comments about that....You put [a formative evaluation question] out once, but what I could do, is go take it off and have them put another one out. We do have them evaluate as part of the University. I can go in and say, "Okay, this is something I have received from a number of you and that makes sense to me. Let's do this." And a lot of them have appreciated that part of it. Other changes I have made, that was another reason why I really had them sit in groups. Some said, "You know it really helps if I can sit in that group and talk to them." And so I did make that more of an everyday type thing.

The assignments were problems from the text that students did either on paper or a combination of problems from the text and on MyMathLab. She graded the even problems from the text. As mentioned earlier, when students did problems on MyMathLab, the program immediately corrected the problems so students got fast feedback. She said:

> And I do try with their assignments to make sure they get application problems and some challenging ones that they sometimes do. Like we have one today, they won't have the answer for it. And I'm not giving them the answer and they are going to work in their groups and turn it in. To get that one done, I will give them a hint today.

In Math 102, the instructors gave retests on two of the three major exams. If students showed that they had studied the material, those who scored below 75% could retake the test once for a maximum of 75%.

The Math 102 instructor also taught one online section of Math 102. She required local students to stop in once a week and show her their work and give her their homework assignments. She provided the answer keys outside her office so the students

could check their work before they came in to meet with her. She said that together they went through the ones about which the students' had questions.

The Math 102 instructor had students keep all of their work in a notebook of work to ensure that students did the work and to help students "do it in a more organized fashion to make them better math students." The researcher previously mentioned this as one of the instructor's goals for the course. She told the other Math 102 teachers:

> I want you to model this, and I want you to say, "This is what makes you a better math student because you are more organized. If you have it written all over the page, it's not going to work. And I want you to comment about those things when you look at their work."

She described how this helped one student:

> And I know the one, she brought her work up to me the other day and I said, "This is really nicely done. It's organized. I know exactly what you've done. You can go back and check it." And I said, "So, tell me, is this what you did at the beginning of the semester?" because I couldn't remember exactly. And she said, "No. It has gotten better." So they can see that it makes a difference.....Part of the time that's why they're there because they are so disorganized with what they're doing.

The researcher found other course information on the Math 102 syllabus. The instructors gave in-class exams and a final exam. Because of the online supplement to the course, students were required to have an e-mail address and access to a computer with Internet access and an Internet browser. Also included on the syllabus were the following: basic course and instructor information; course materials and requirements, grading policy; assignments and exams; course policies, including academic dishonesty and conduct, conflict exams, and make up exams; a disability statement; a course calendar; and supplemental information regarding announcements, homework, and tutoring.

Using the General Syllabus Checklist, the Math 102 syllabus lacked the following: course prerequisites; course description; the purpose of the course; course goals or objectives; a description of the format of the course and its activities; a clarification of the structure used to organize the course and the logic behind why this structure and the content were selected; an estimate of student work load; a list of important dates; a time to schedule fast feedback; and a space for other students' contact information.

Preparation for Success in Future Math Courses. When asked how the developmental mathematics program prepared students for success in the next mathematics course, the Remedial Math Director said, "That the kinds of questions they are being asked are conceptual in nature. That it doesn't just ask them to repeat solving the equation. It involves formulating the equation, then solving it. Because that is what they are going to need to know how to do." The use of mandatory assessment and placement also helped.

The Continuing Education Director said that success meant "smaller numbers of [developmental] students and less revenue." She said that she would rather have successful students even if it meant less revenue.

The Math 102 instructor described many things that helped prepare developmental mathematics students for success in the next math course. She said:

> We try to make certain that our testing covers the areas that we have mentioned. We do give them a chance to do retests as long as they show that they have studied the material, but most of it, and we don't pass them unless they get the score....And it's just a passing grade is all they need to go on to the next course.

> What we also have done this year is, my teachers have been really good about doing this. Many of the graduate students find it hard to tutor a student at this level. So when we see a 103 student coming back with a calculus answer to a 103 problem, we know they didn't do it. The students get frustrated and so do the graduate students...So my teachers have agreed to give up one or to take one of their office hours a week in the tutoring lab that we have. So that they sit there for an hour and help the students that come in. And this time we did it in the computer lab so that they could help them with MyMathLab.

The Math 099 instructor said he helped ensure students were ready for the next math course "just by, if they pass, but you kind of get a feel for how a kid's doing." He described how he helped advise some students based on their previous math courses or their performance in class. He said:

> I had a kid that I had in class and I said, after the second week, he was working with me on the table out in the hallway out there and with a couple other people. He had no clue. In high school he took prealgebra and tech math, and he graduated from high school in town here....So I talked to him and said, "You gotta go down to [Math] 099," and thank goodness I had a girl there that said, "I took 099 last year, now I'm taking 102 and I can see that I'm doing so much better now because I have the basics."

The Math 099 instructor also emphasized the importance of students having successes in the developmental courses they took. He said that what Math 099 and Math 102 did for some students was build their confidence or "build them up." "Successes, success is so, inside if you feel good about yourself, that you can do it, you know you can."

Attendance and motivation of students were also important. The Math 099 instructor described a story of a student who struggled all semester and finally got a B on a test. He said, "He's never missed a class and that makes a big difference."

The syllabi for both developmental math courses contained statements regarding grades in the current course and success in the next course. The Math 099 syllabus

contained the statement: "In order to succeed in Math 102 you should get at least a 'C' in this course." The Math 102 syllabus had a similar statement: "In order to succeed in Math 103 or Math 104, you should earn at least a 'C' in this course." Regarding grades, the Math 099 instructor said, "The only bad thing about this, and the kids say it too, you know basically it's pass/fail. They suggest a C or above, but if they pass the course they can go on."

Support Services. A number of support services were available to developmental mathematics students at the Doctoral Institution. The Continuing Education Director said that tutoring was offered through the Math Department. Graduate students and upper level undergraduate students usually were the tutors. Mathematics teaching assistants ran a drop-in tutorial center in the Mathematics Department (Department of Mathematics, n.d.). Regarding tutor training, the Remedial Math Director said, "We try to do some on site (tutor room) observations [of the tutors] with directions on how to improve their contact with the students. We also have done some workshop time with the use of calculators."

Orientation and Student Success had a tutoring program on campus. Tutoring sessions were held at various times and locations, including evenings and in residence halls (Orientation and Student Success, 2003). Their Assistant Director said:

> We hire current students for our Super Tutor program. Students who have successfully (grade of A or B) completed that course(s) are able to tutor other students. We have a minimum cumulative GPA that they must also meet. As for training, I must admit, this is something I would like to further develop. In the past we have trained them on the ins/outs of the program itself, different learning styles, specific high-tech calculator usage, and study/test taking tips.

TRIO and the Veterans Upward Bound Program also offered tutoring through the Student Support Services Office (TRIO: Student Support Services, 1999). According to the Continuing Education Director, counseling and advising were available from Continuing Education. Disability Student Services were available as well. There was orientation for new students, but this was not ongoing. Also, all new freshmen and students who transferred less than 24 credit hours were required to take a one-hour course called First-Year Experience Course. This course was comparable to a freshmen seminar (NDSU Bulletin, 2002).

The Continuing Education Director said that a portion of the revenue generated by student tuition for the developmental math courses went to pay the tutors in the Mathematics Department's Tutorial Center. The Math 102 instructor mentioned the use of developmental mathematics instructors as tutors in the Math Department. This was previously discussed in the Instruction section for this institution.

All three interviewees from the Mathematics Department made comments about the math tutors. The Math 099 instructor said that there was tutoring every hour of the day somewhere on campus, but the tutoring was hard for the graduate teaching assistants to do. He said:

> The TAs can get down to that level, but the way that they do it is a little bit over some of these kids' heads. You can't blame the TAs. They've never done this. Most of them were probably doing it in the sixth grade when they took algebra one or whatever, you know, eighth grade at the latest. It's hard for them to realize they have a love of math, and it's their chosen field, and these other ones, it's an obstacle to get through to graduate. Some of them will never use it again, the algebra part.

The Math 102 instructor made similar comments about the teaching assistants who did tutoring, and said that this was one of the reasons she asked her instructors to give up one office hour each week to tutor in the lab.

The Remedial Math Director mentioned the tutoring done in the Mathematics Department and across campus by Orientation and Student Success. He said:

> We tutor in an area that's not within this department which is always unhandy for me and uncomfortable for me because you can't kind of watch them or walk in on them and see what in the world is going on unless you walk up two blocks over there, and you might not do that. And the same thing that we have Super Tutor on campus where they are there all over and all different times of the day and night and so on, and then you might not see them either, but the main thing with both is that they haven't taken this class [Math 099 or Math 102]. They haven't done any of this. They've never taken a class like this. They've never taught a class like this. They're not sure what is in there. They attempt to help at a level that isn't appropriate to the student.

The Remedial Math Director said that he was uncomfortable making some of these comments, but he was told that the tutors were not able to assist in how to do a certain function on the calculator. "They went to the tutor, asked the tutor how to do it so they could find out how to do it themselves. The tutor did not know, and in one case said, 'Look it up in your manual.' Which wasn't really a very helpful, caring answer." He said that even some of the instructors were not helpful because they did it differently than another instructor "so their help is not helpful." All this did was make the students not like going to anyone else because the tutors just gave them information that was incorrect.

Due to the issues with the tutors, the Remedial Math Director scheduled tutor time with him. He had all of the tutors come in and fill out a sheet indicating what they were and were not comfortable doing as tutors. Next he set up a time when all of the tutors

were available, but hardly anyone showed up during the time he scheduled for training and help. He was quite disappointed.

Program and Course Assessment. According to both directors, the developmental mathematics program was not formally assessed except for the course and instructor evaluations completed at the end of each semester in all classes. The Remedial Math Director said that informal assessment took place through discussion. He said, "Is there a set way of assessing? No. Is there discussion? Yes....The step between formal and informal assessment is a big one." He also said that some of the things they were doing and had started doing over the past 10 years were common things, common exams, common syllabi, common content, but formal assessment would burden others with high expectations and little pay each semester.

As mentioned earlier, the Math 102 instructor used formative assessment measures to gain feedback from the students via an Internet site used with the course. The Math 099 instructor did not mention any formal assessment measures used in his classes. Each semester course supervisors observed and evaluated all developmental math instructors.

Perception of Support. When the researcher asked the Continuing Education Director about the level of support for developmental mathematics courses, the Continuing Education Director said that money was an issue. There was no resistance from administration on what rates to charge for these courses. Central administration had not siphoned off any money for other causes, and that was an indication of their support,

according to the Continuing Education Director. As mentioned before, the courses were supported by student tuition, and all revenue was split between Continuing Education and the Mathematics Department.

Regarding support, the Remedial Math Director said:

> The university would like that course, the population of the course, to be much, much smaller. It is being perceived as a negative for incoming. I don't know if freshmen perceive it that way, but the administration, I think, does. That it's saying that you can come here, but you're scum. You know, I don't think it ever said that anywhere, and no one is probably ever going to say it that way, but you, you know, "All right, come on down and play, but your chances of success are being diminished."
>
> So we're fighting the perception of the parent that says, "Well, you know my student has always gotten a B in math," but the student is telling me they don't know anything. They're not comfortable with their understanding at all.

The Remedial Math Director also mentioned financial issues. He said:

> Now we get this issue of additional fees because this is supported by the fee structure. And so they pounded it as being full-time equivalent and all that sort of stuff, but it does not receive credit for graduation. Eighty percent of the students or 75% of the students who take these courses go right into a college level course. They may not meet the general ed [requirement] that they need, but maybe it's College Algebra moving on toward their general ed course or whatever, but it's not one of these. So it is kind of hard to support.
>
> This is where the math department at one time asked and kind of threw this out and said, "We're not going to fund this course anymore because it is a drain on the department." Well then it became under control of somebody else, and the department in a short period of time was not happy with what was being done. And now they have control over the content of instruction, and how it is being delivered, and so they just took it back. So okay, they just want to be in charge of this, they just don't want to have to pay for it. So classes are created as to the numbers of students that are there.
>
> [The developmental math program] is financially good for the department because it supports people. It supports TAs. It supports undergrads who do the tutoring services and so on. You know, it is very important. There are a lot of things that have happened in the department and been generated because we have a revenue stream. However small it is, at least it's a stream. It's, you know, not a dry creek bed.

Both of the interviewed instructors felt very supported within the developmental mathematics program. The Math 102 instructor said that the Department Chair was "very supportive," and it was great having the Remedial Math Director as their leader. The Math 102 instructor helped the Remedial Math Director with scheduling to make sure teachers got what they needed, and she helped find teachers to teach the developmental math courses.

One of the instructors said that the professors did not know what the developmental math instructors did and probably thought it was less important. "They have what they do and we have what we do....There definitely is a break. We're the lecturers. They're the professors. We have no voting rights. We have, nothing. They tell us what to do, and we do it." Even the senior lecturers, like the Remedial Math Director, "They don't have votes like the faculty," according to one instructor. An instructor said that the lecturers had no say in what happened in other courses outside of the developmental courses. The lecturers were separate from the professors, but the instructor said, "That's okay, I like what I do. But I'm not certain that makes what we do less important."

Desired Changes. The researcher asked the interviewees what they would like changed in the developmental mathematics program and its courses. The Remedial Math Director said, "I'd like to see less students take it, but I don't know how to do that." The Continuing Education Director also wished there were less developmental math students even when it meant less revenue. The Math 099 instructor did not suggest any changes. He said, "I can't say anything now because I don't have enough experience."

The Math 102 instructor suggested many changes. First, she wanted to see two levels of Math 102 offered. One type that was a year long Math 102 course so that students and teachers were not so rushed. The second type that was a faster course for those students who just needed a review. She said that the pace of the course was a common complaint of students, but she thought other departments would complain because a year-long course, rather than a semester course, would slow down the completion of students' programs. The Math 102 instructor said that it still took many students a year because they failed and had to retake the course. The Math 102 instructor wanted to have "a math tutor center for the [developmental mathematics] students. A place where they know they can go and have someone that would tutor them at their level, or with computers and whatever. Just a resource center, that would be good, but for students at this level." She wanted smaller classes, around 20 students, and class size was more of a problem for her than for other instructors. She said that since Continuing Education paid for itself, she had to take more students in her class in order to pay her salary since she earned a little more than other lecturers because of her administrative duties. Finally, she wished technology were in all the classrooms so instructors could show students exactly what to do on MyMathLab.

Other Comments. The Math 099 instructor said his biggest challenge was "the kids that don't show up. That's just a personal thing with me because of the high school. Twenty-nine years of high school teaching and you kind of have control over the kids and you have parent backing." Another challenge he mentioned was teaching students at so many different levels. He said, "In Math 099 you'll have a kid over here that has no

problem with it and probably shouldn't be in the course. Then you got the one over here that the simplest thing, x, throw that x in there, and all the sudden they're lost."

Grade Distribution Data. The researcher collected grade distribution data for each developmental mathematics course offered at the Doctoral Institution during the fall semesters of 1999, 2000, and 2001. These data are summarized below in Table 30. The Registration and Records Office at the Doctoral Institution did not generate grade distribution reports for the developmental mathematics courses because they were offered through Continuing Education. Thus, someone in the Registration and Records Office had to write a program to generate these data. When this was done, the number of students who dropped was not calculated; therefore, the columns titled, "Number of Students Who Dropped" and "Percentage of Students Who Dropped," were left blank in Table 30. During fall 1999, 2000, and 2001, the average GPA in Math 099 ranged from 1.78 to 2.22, and the average GPA in Math 102 ranged from 1.81 to 2.15.

Table 30. Grade Distribution Information for Fall 1999, Fall 2000, and Fall 2001 at the Doctoral Institution.

		Grade									Number of Students Enrolled	Number of Students Who Dropped[a]	Percentage of Students Who Dropped[a]	GPA
Course	Year	A	B	C	D	F	P	I	S	U				
Math099	1999	18	39	37	33	39		2			168			1.78
	2000	26	31	47	17	18		2			141			2.22
	2001	22	37	32	27	38		2			158			1.86
Math102	1999	56	86	84	48	58		1			333			2.10
	2000	32	69	66	49	69		0			285			1.81
	2001	71	90	81	53	62		4			361			2.15

Note. [a]The number of students who dropped these courses was not provided.

The researcher calculated the percentages of students who were successful in developmental mathematics courses during fall semesters 1999, 2000, and 2001. A success was defined as a grade of C or better. These percentages are in Table 31 below. Since the numbers of students who dropped these courses were not included in the grade distribution data, the success rates were only calculated without the students who dropped the courses; thus, the "With Drops" column was left blank in Table 31.

About 57-75% of all Math 099 students successfully completed the course when drops were not included during the three fall semesters. In Math 102 about 59-68% of students were successful when students who dropped the course were not included.

Table 31. Success Rates for Fall 1999, Fall 2000, and Fall 2001 at the Doctoral Institution.

		Success Rate	
Course	Year	Without Drops	With Drops[a]
Math099	1999	56.6%	
	2000	74.8%	
	2001	58.3%	
Math102	1999	68.1%	
	2000	58.6%	
	2001	67.8%	

Note. [a]The number of students who dropped was not provided, and thus, these success rates were not calculated.

Summary. The Doctoral Institution offered two developmental mathematics courses, Math 099 Beginning Algebra (three credits) and Math 102 Intermediate Algebra (four credits). The courses were offered through the Department of Continuing

Education and taught by instructors in the Mathematics Department. One section of each course was offered online each semester.

Lecturers taught the developmental mathematics courses. They had bachelor's degrees or master's degrees but no training in developmental education. A bachelor's degree was all that was required to teach the developmental courses, but a master's degree was necessary to teach Math 103 College Algebra or higher numbered courses, unless they were taught after 3:00 p.m. The lecturers were local high school teachers, graduate students, upper level undergraduate mathematics education majors, or part-time or full-time lecturers who were specifically hired to teach these courses. There was a Remedial Program Director of the Department of Mathematics who was in charge of the developmental math courses and instructors.

Faculty development opportunities, like campus workshops, seminars, or local and state conferences, were available to faculty. Local and state conferences were paid for by the Mathematics Department, but funding priority for faculty development opportunities went to the professors, not the lecturers.

The developmental mathematics instructors participated in the planning and decision-making processes of the developmental mathematics courses, but not in the planning and decision-making of the Mathematics Department. They were not included in departmental meetings, just the meetings for the developmental math courses.

The Mathematics Department, the Remedial Math Director, and the instructors of the developmental courses developed the developmental mathematics curriculum. These courses had common syllabi, common content, and common exams.

All exam dates will be announced in class and through the MyMathLab site.

Conduct Notice: All work in this course must be completed in a manner consistent with University Senate Policy, section 335, Code of Academic Responsibility and Conduct. (http://www.ndsu.nodak.edu/policy/335.htm). Violation of this policy will result in a failing grade on the assignment or exam.
ADA Notice: Any students with disabilities or other special needs, who need special accommodations in the course, are invited to share these concerns with the instructor as soon as possible.

Tentative Schedule for Math 102-Semester 031

Week #	Dates	Assignment
1	8/27-8/30	Review 3.1-3.3, 3.4
	9/2	Labor Day Holiday
2	9/3-9/6	3.5, 3.6
3	9/9-9/13	3.7, Review 5.1-5.3, 5.4
4	9/16-9/20	5.5, 5.6, 5.7
5	9/23-9/27	5.8, Unit 1Review, Unit 1 Exam (3.3-3.7, 5.1-5.8)
6	9/30-10/4	Review 6.1-6.3, 6.4, 6.5
7	10/7-10/11	6.6, 6.7, 6.8
8	10/14-10/18	7.1, 7.2, 7.3
9	10/21-10/25	Review, Unit 2 Exam (6.1-6.8, 7.1-7.3), 9.1
10	10/28-11/1	9.2, 9.3, 10.1
11	11/4-11/8	10.2, 10.3, 10.4
	11/11	Veterans Day Holiday
12	11/12-11/15	10.5, 10.6
13	11/18-11/22	10.7, 10.8, Review
14	11/25-11/27	Unit 3 Exam(9.1-9.3, 10.1-10.8), 11.1
	11/28-11/29	Thanksgiving Day Holiday
15	12/2-12/6	11.2, 11.3, 11.4
16	12/9-12/13	11.5, Review, Review
	Final Exam	Mon., 12/16; 3:00-5:00

Math 102 Assignments-031

Section	Topic	Assignment
3.3	Graphing & Intercepts	pp. 159-160; 3-6,8,9-52 (* of 3), 60,63,65,68,73-78
3.4	Rates of Change	pp. 164-168; 3-30 (* of 3), 33-38, 41, 41,44,49
3.5	Rate and Slope	pp. 177-182; 5-25 * of 5), 30-54 (* of 3), 58,60,63-68
3.6	Slope-Intercept form	pp. 190-191; 3-51 (* of 3), 52, 57-72 (* of 3), 77-82, 84, 86
3.7	Point-Slope Form	pp. 196-197; 3-48 (* of 3), 49-54, 57-81 (* of 3)
5.4	Factoring Perfect Square Trinomials and Differences of Squares	pp. 305-306; 3,6, 10-40 (* of 5), 41-48, 50-85 (* of 5), 89-94
5.5	Factoring Sums or Differences of Cubes	pp. 309-310; 1-36 (* of 3), 39-44, 47, 49
5.6	Factoring: A General Strategy	pp. 315-316; 3-72 (* of 3), 75-80, 83, 84, 87
5.7	Solving Polynomial Equations by Factoring	pp. 323-325; 3-60 (*of 3), 63-68, 71,73,74
5.8	Solving Applications	pp. 331-333; 3-33 (* of 3), 37-44, 47, 51, 52, 53
		Unit 1 Exam
6.4	Addition and Subtraction with Unlike Denominators	pp. 369-370; 3-69 (* of 3), 73-78, 81, 83
6.5	Complex Rational Expressions	pp. 375-376; 5-35 (* of 5), 39-44
6.6	Solving Rational Equations	pp. 381-382; 3-36 (* of 3), 39-44
6.7	Applications Using Rational Equations and Proportions	pp. 390-394; 3-6, 8, 13,15,16,18,21,22,23,26,29,30,32-35, 38,39,42,51-56,63,64
6.8	Formulas and Equations	pp. 400-402; 3-42 (* of 3), 47-58, 55, 56, 58
7.1	Introduction to Functions	pp. 416-420; 1-6, 8, 10, 12, 15-51 (* of 3), 55-60, 63, 64
7.2	Domain and Range	pp. 429-433; 1-4, 6-39 (* of 3), 42, 45, 48, 51, 55-61, 63, 64, 66-70
7.3	Graphs of functions	pp. 443-447; 1-12, 15-54 (* of 3), 59-64, 68, 69
		Unit 2 Exam
9.1	Interval Notation and Problem Solving	pp. 550-552; 1-40 (* of 5), 41, 42, 45, 47, 49, 53-58
9.2	Intersections, Unions, and Compound Inequalities	pp. 559-561; 5, 10, 15-35 (* of 5), 39-72 (* of 3), 75-80, 85, 88, 91
9.3	Equations with Absolute Value	pp. 569-570; 5-80 (* of 5), 85-90, 99, 100
10.1	Radical Expressions and Functions	pp. 603-604; 5-30 (* of 5), 33-84 (* of 3),85, 90, 95, 99-104
10.2	Rational Numbers as Exponents	pp. 608-610; 1-42 (* of 3), 45-95 (* of 5), 97-102, 105, 108
10.3	Multiplying Radical Expressions	pp. 615-617; 1-69 (* of 3), 73-78, 80, 83,87
10.4	Dividing Radical Expressions	pp. 622-623; 1-63 (* of 3), 67-72, 79
10.5	Expressions Containing Several Radical Terms	pp. 628-630; 3-57 (* of 3), 59, 62, 65-95 (* of 5), 99-104107-110
10.6	The Principle of Powers	pp. 636-637; 3-33 (* of 3), 35, 38, 40, 45, 46, 51-56, 59, 62

10.7	Geometric Applications	pp. 643-646; 3, 6, 9, 12, 13, 16, 18, 19, 21-36 (* of 3), 37, 40, 41, 47-52, 55
10.8	The Complex Numbers	pp. 652-653; 3-87 (* of 3), 91-96
		Unit 3 Exam
11.1	Quadratic Equations	pp. 669-671; 3-21 (* of 3), 25-35 (* 0f 5), 39-57 (* of 3), 63,66,69, 75-80
11.2	The Quadratic Formula	pp. 676-677; 3-42 (* of 3), 45, 47, 49, 50
11.3	Applications Involving Quadratic Equations	pp. 682-683; 3-30 (* of 3), 33-35, 45-50
11.4	Studying Solutions of Quadratic Equations	pp. 689-690; 1-45 (* of 5), 51-56
11.5	Equations Reducible to Quadratic	pp. 695-696; 5-30 (* of 5), 37-42
		Final Exam: Dec. 16; 3:00-5:00

APPENDIX H

GRADE DISTRIBUTION DATA

The program and its courses did not have goals or objectives stated anywhere. During the interviews, the interviewees stated the following goals or objectives they had for the program and its courses: to have students gain conceptual understanding of the material, not just memorize concepts; to have the students be successful at the next level and eventually get their math credit; to rid the students of their fears of math and build their confidence; to help students become proficient in the necessary areas; to help students become more familiar with the calculator so they could be successful in Math 103 or Math 104; and to improve students' organizational skills.

Assessment and placement were mandatory at the Doctoral Institution. Mathematics placement exams were used to do this. The tuition students paid to take the developmental mathematics courses funded these courses since state dollars could not be used to pay for them. Students paid an additional flat rate regardless of other circumstances, such as residency, and did not pay any fees for the courses. Neither course could be counted as graduation credit, but they could be used for financial aid credit hours.

The developmental mathematics students varied. Some were traditional students right out of high school, while others were nontraditional students who were returning to school for various reasons. The traditional students often did not take math their senior year, took little math in high school, or simply did not place out of developmental mathematics. The Remedial Math Director said that about 25% of all freshmen were in developmental mathematics courses. About 800 students enrolled in Math 099 and Math 102 each year. Some students were repeating the courses. Research at the institution

showed that the best students were those that were successful in a previous math course at the Doctoral Institution.

The instruction used by the observed and interviewed instructors included lecture, board work, group work, student-teacher interaction, structure, integrated technology, in class assignments, and teaching the course like a high school class. The interviewees thought that the following were important and effective when teaching developmental mathematics courses: getting students involved and asking questions; technology; interaction between the students and the material and the students and the teacher; relaxing the students; using humor; making it fun; doing a little at a time with a lot of repetition; building the students' confidence; using groups; partnering students to help each other; retaking quizzes and tests; talking students through a problem; application problems; and teaching students how to be organized and neat. Students were assessed using homework, in class assignments, tests, and quizzes. Graphing calculators and a supplemental online computer program were used in both classes.

The interviewees prepared students for success in future math courses by doing the following: asking questions that were conceptual in nature, not questions involving rote skills; mandatory assessment and placement; retesting; testing the students on appropriate material; advising; providing the students with success to build their confidence; and having instructors use one office hour per week to do tutoring in a lab.

Tutoring was offered in the Mathematics Department, through a large on campus tutoring program, and through TRIO Student Success Services. The tutors received a small amount of training, but the instructors and one of the directors complained that the

tutors often were not helpful because they could not come down to the level of the course, or because they did not know how to do the material with the methods used in the courses. The developmental instructors also used one office hour per week in a lab to help the students of these courses. All students were required to take the First-Year Experience Course. Counseling, advising, Disability Student Services, and a non-ongoing orientation were other support services available to students.

The developmental mathematics program was not assessed. Students completed course and instructor evaluations in each class each semester. Informal assessment took place through discussion. The Math 102 instructor used an online formative assessment tool in her class and participated in a peer review program. Both of these informed her teaching practices. Each semester course supervisors observed all developmental instructors and met with them regarding this observation.

When asked about support for the developmental courses, one Director said that money was always an issue, but there had not been any resistance or siphoning of money by administration so that was an indication of their support. Another interviewee thought that the institution viewed the developmental courses in a negative light and wanted fewer students in them. It was hard to support something that was not "college level" even though most students went on to take college level math courses. There was support within the group of developmental instructors, but there appeared to be a rift between the professors and the lecturers.

The interviewees desired the following changes to the developmental program: less students in the developmental courses; two levels of Math 102, one being a year long

course and the other being a one semester course; a tutoring center just for the developmental math courses; smaller classes; and technology in all of the classrooms. In addition, it was hard to teach a class where students were at so many different levels.

The grade distribution data collected for fall 1999, 2000, and 2001 did not include the numbers of students that dropped each course; therefore, the success rates were only calculated without dropped students. Student GPAs in Math 099 were between 1.78 and 2.22. In Math 102 the GPAs were between 1.81 and 2.15. The success rates in Math 099 were between 57% and 75%. In Math 102 the success rates were between 57% and 68%.

Doctoral Institution: Math 099 Syllabus

Math 99 Class Information
Instructor: Name
Office: Building and Room E-mail: xxx@xxx.nodak.edu
Office phone: XXX-XXX-XXXX FAX: XXX-XXX-XXXX
Web Site: Web address given
Help sites:
Campus office hours: Monday, Wednesday, 9:00-9:50, Tuesday, 10:00-11:00
MyMathLab website: www.students.pearsoned.com

Required materials:
1. Text: Elementary and Intermediate Algebra, 3rd edition by Bittinger-Ellenbogen and Johnson, 2001
2. MyMathLab, an online Blackboard site which contains announcements, an online textbook, tutorials, tests and quizzes, etc.
3. an e-mail address, access to a computer with Internet access and an Internet browser

Recommended: a scientific or graphing calculator. (The TI-83+ or TI-86 graphing calculator will be used in class demonstrations.)

Evaluation will be based on:
40 % in-class exams
40% homework, projects, quizzes, etc.
20% final exam
In order to guarantee a particular grade, consider A=90%, B=80%; C=70%, D=60%, below 60% is failing. Extra credit points assignments may be given. Graded assignments and extra credit assignments will be announced in class or on the Internet message board.

Any conflict concerning an exam must be cleared IN ADVANCE of the exam time. A 10% penalty is assessed on any exam taken late, with out the instructor's prior approval. All make-up exams must be taken within ONE WEEK of the original exam. Any corrections in grading must be reported before the next exam.

In order to succeed in Math 102 you should get at least a "C" in this course.

The final exam is a common exam given to all students enrolled in Math 99. The date and time is Monday, December 16, 3:00-5:00, place to be announced.

Suggested homework problems are posted on MyMathLab or on the instructor's website. Successful completion of the suggested homework problems should get you a passing grade. Don't spend a lot of time on problems you know how to do, spend time on those problems that present a challenge. If you spend more than 10 minutes on one problem, reread the text, get help from a tutor, check the computer tutorial or see the instructor.

All exam dates will be posted on the website and MyMathLab.

Conduct Notice: All work in this course must be completed in a manner consistent with University Senate Policy, section 335, Code of Academic Responsibility and Conduct. (http://www.ndsu.nodak.edu/policy/335.htm). Violation of this policy will result in a failing grade on the assignment or exam.

ADA Notice: Any students with disabilities or other special needs, who need special accommodations in the course, are invited to share these concerns with the instructor as soon as possible.

M99 – Tentative Schedule – 031

Week	Dates	Assignment
1	8/27-8/30	1.1, 1.2
	9/2	Labor Day Holiday
2	9/3-9/6	1.3, 1.4
3	9/9-9/13	1.5, 1.6, 1.7
4	9/16-9/20	1.8, 2.1, Exam 1
5	9/23-9/27	2.2, 2.3, 2.4
6	9/30-10/4	2.5, 2.6
7	10/7-10/11	2.7, 3.1, Review chapter 2
8	10/14-10/18	Exam 2, 3.2, 3.3
9	10/21-10/25	Graphing calculator instruction, 4.1
10	10/28-11/1	4.2, 4.3, 4.4
11	11/4-11/8	4.5, 4.6, 4.7
	11/11	Veterans Day Holiday
12	11/12-11/15	4.8, 5.1, Exam 3
13	11/18-11/22	5.1, 5.2, 5.3
14	1125-11/27	5,4, 5.7
	11/28-11/29	Thanksgiving Holiday
15	12/2-12/6	6.1, 6.2, 6.3
16	12/9-12/13	Exam 4, Review for final
	12/16	Final Exam: 3:00-5:00

Math 99 Homework

Section	Problems
1.1	1-60 (multiples of 3), 58, 61, 65, 69, 70
1.2	1-36 (multiples of 3), 37-68 (odd), 60
1.3	1-93 (multiples of 3)
1.4	1-10, 12-63 (multiples of 3), 77, 82, 85-90
1.5	1-75 (multiples of 3)
1.6	1-130 (multiples of 5)
1.7	1-120 (multiples of 5)
1.8	1-105 (multiples of 5), 118-125
2.1	1-70 (multiples of 3), 96
2.2	1-84 (multiples of 3), 92
2.3	1-53 (multiples of 3), 7
2.4	1-60 (multiples of 5), 72,73
2.5	1-36 (multiples of 3), 45, 47, 53
2.6	1-22 (odd), 24-96 (multiples of 3)
2.7	1-10, 11, 12, 14, 16, 18, 23, 25, 28, 29, 31, 35,37, 38, 41, 43, 45
3.1	1-41 (odd)
3.2	1-41 (odd), 44, 46, 61
3.3	1-72 (multiples of 3)
4.1	1-80 (multiples of 3)
4.2	1-72 (multiples of 3)
4.3	1-63 (multiples of 3), 83, 84
4.4	1-70 (odd), 81, 83, 85
4.5	1-99 (multiples of 3), 113, 115, 121, 127, 129
4.6	1-66 (multiples of 3), 73-78
4.7	1-34 (odd)
4.8	1-78 (multiples of 3), (79-122 optional)
5.1	1-46 (odd), 26, 36, 59
5.2	1-58 (odd), 24, 40, 71, 73
5.3	1-83 (odd), 6, 40, 64, 72
5.4	1-100 (multiples of 3)
5.7	1-31 (odd), 63-68
6.1	1-50 (odd), 16, 28
6.2	1-65 (multiples of 5), 34
6.3	1-74 (multiples of 5), 64

Doctoral Institution: Math 102 Syllabus

Math 102 Class Information
Instructor: Name
Office: Building and Room E-mail: xxx@xxx.nodak.edu
Office phone: XXX-XXX-XXXX FAX: XXX-XXX-XXXX
Help sites:
Campus office hours: To Be Announced
Tutoring in FLC 320F per schedule posted in MyMathLab

Required materials:
1. Text: Elementary and Intermediate Algebra, 3rd edition by Bittinger-Ellenbogen and Johnson, 2002
2. MyMathLab an online testing and tutorial computer program.
3. an e-mail address, access to a computer with Internet access and an Internet browser

Recommended: a scientific or graphing calculator such as the TI-83 or TI-83 Plus, TI-86 or TI-89. The TI-86 graphing calculator will be used in class demonstrations. If you have another model, check to make sure that it is suitable for this course.

Evaluation:
30% homework, projects, quizzes, etc.
50% unit tests
20% final exam
Grading scale: A=90%, B=80%; C=70%, D=60%, below 60% is failing. There is no curving of grades.

Extra credit assignments may be given. Graded assignments and extra credit assignments will be announced on the Blackboard site.

Any conflict concerning an exam must be cleared IN ADVANCE of the exam time. A 10% penalty is assessed on any exam taken late, with out the instructor's prior approval. All make-up exams must be taken within ONE WEEK of the original exam. Any corrections in grading must be reported before the next exam.

In order to succeed in Math 103 or Math 104, you should earn at least a "C" in this course.

The final exam is a common exam given to all students enrolled in Math 102. The date and time is Monday, Dec. 16, 2002, 3:00 - 5:00 p.m., place to be announced.

Suggested homework problems are posted in MyMathLab. Students will be expected to keep all homework assignments in a loose-leaf notebook. If you spend more than 10 minutes on one problem, reread the text, get help for a tutor, check the computer tutorial or see the instructor.

Table 32. Grade Distribution Data for Eight of the Eleven Public Postsecondary Institutions in North Dakota.

Institution*	Year	Course	Grade										Total	Number Who Dropped	Total with Drops	GPA
			A	B	C	D	F	P	I	S	U	CW				
AA I	1999	ASC 092	34	15	38	16	17	*	*	*	*	*	120	27	147	2.27
AA I	1999	MATH102	31	65	98	31	24	*	4	*	*	*	253	91	344	2.19
AA I	1999	MATH102L	*	*	*	*	*	*	1	43	3	*	47	17	64	*
AA I	2000	ASC 092	23	23	25	10	8	*	1	*	*	*	90	27	117	2.48
AA I	2000	MATH102	35	63	96	30	39	*	1	*	*	*	265	93	358	2.09
AA I	2000	MATH102L	*	*	*	*	*	*	*	36	1	*	37	18	55	*
AA I	2001	ASC 092	17	25	29	12	16	*	1	*	*	*	100	36	136	2.15
AA I	2001	MATH102	44	60	64	34	29	1	2	*	*	*	234	121	355	2.24
AA I	2001	MATH102L	*	*	*	*	*	*	2	34	3	*	39	22	61	*
AA II	1999	ASC090	*	*	*	*	*	*	*	1	1	*	2	1	3	*
AA II	1999	ASC091	*	*	*	*	*	*	*	13	1	*	14	4	18	*
AA II	1999	ASC091	*	*	*	*	*	*	*	7	1	*	8	7	15	*
AA II	1999	ASC092	*	*	*	*	*	*	*	4	4	*	8	4	12	*
AA II	1999	ASC092	*	*	*	*	*	*	*	8	6	*	14	1	15	*
AA II	1999	ASC092	*	*	*	*	*	*	*	11	4	*	15	3	18	*
AA II	1999	ASC092	*	*	*	*	*	*	*	12	3	*	15	0	15	*
AA II	1999	ASC093	*	*	*	*	*	*	*	12	0	*	12	0	12	*
AA II	1999	MATH102	2	6	5	0	8	*	*	*	*	*	21	8	29	1.71
AA II	1999	MATH102	4	3	16	3	1	*	*	*	*	*	27	1	28	2.20
AA II	1999	MATH102	1	2	3	0	8	*	*	*	*	*	16	6	22	1.14
AA II	2000	ASC090	*	*	*	*	*	*	*	2	1	*	3	1	4	*
AA II	2000	ASC090	*	*	*	*	*	*	*	16	1	*	17	0	17	*
AA II	2000	ASC091	*	*	*	*	*	*	*	12	0	*	12	0	12	*
AA II	2000	ASC091	*	*	*	*	*	*	*	2	4	*	6	4	10	*
AA II	2000	ASC092	*	*	*	*	*	*	*	14	6	*	20	2	22	*
AA II	2000	ASC092	*	*	*	*	*	*	*	11	2	*	13	1	14	*
AA II	2000	ASC092	*	*	*	*	*	*	*	14	5	*	17	0	17	*
AA II	2000	ASC092	*	*	*	*	*	*	*	14	8	*	22	0	22	*
AA II	2000	ASC093	*	*	*	*	*	*	*	11	1	*	12	0	12	*
AA II	2000	MATH102	2	5	6	2	5	*	*	*	*	*	20	5	25	1.85

Table 32 Continued.

Institution*	Year	Course	Grade										Total	Drop	Total with Drops	GPA
			A	B	C	D	F	P	I	S	U	CW				
AA II	2000	MATH102	2	5	5	3	5	*	*	*	*	*	20	2	22	1.80
AA II	2000	MATH102	0	4	5	4	5	*	*	*	*	*	18	3	21	1.44
AA II	2001	ASC090	*	*	*	*	*	*	*	3	0	*	3	2	5	*
AA II	2001	ASC091	*	*	*	*	*	*	*	1	1	*	2	14	16	*
AA II	2001	ASC091	*	*	*	*	*	*	*	5	0	*	5	14	19	*
AA II	2001	ASC092	*	*	*	*	*	*	*	15	2	*	17	3	20	*
AA II	2001	ASC092	*	*	*	*	*	*	*	13	3	*	16	0	16	*
AA II	2001	ASC092	*	*	*	*	*	*	*	9	6	*	15	4	19	*
AA II	2001	ASC092	*	*	*	*	*	*	*	3	5	*	8	3	11	*
AA II	2001	ASC093	*	*	*	*	*	*	*	2	0	*	2	0	2	*
AA II	2001	ASC093	*	*	*	*	*	*	*	4	0	*	4	1	5	*
AA II	2001	MATH102	6	4	10	2	2	*	*	*	*	*	24	1	25	2.41
AA II	2001	MATH102	8	2	2	2	7	*	*	*	*	*	21	2	23	2.09
AA II	2001	MATH102	2	5	6	4	1	*	*	*	*	*	18	10	28	2.16
AA III	1999	MATH100	4	2	1	1	1	*	*	*	*	*	9	1	10	2.77
AA III	1999	MATH102	0	3	4	1	1	*	*	*	*	1	10	5	15	2.00
AA III	1999	MATH102	0	1	2	1	0	*	*	*	*	*	4	1	5	2.00
AA III	1999	ASC091	1	0	1	1	1	*	*	*	*	*	4	3	7	1.75
AA III	1999	ASC092	0	0	5	0	0	*	*	*	*	*	5	1	6	2.00
AA III	2000	MATH100	3	4	7	0	2	*	*	*	*	*	16	3	19	2.37
AA III	2000	MATH102	1	4	7	5	3	*	*	*	*	*	20	6	26	1.75
AA III	2000	ASC091	5	3	1	0	0	*	*	*	*	*	9	1	10	3.44
AA III	2000	ASC092	0	1	1	1	1	*	*	*	*	4	8	1	9	1.50
AA III	2001	ASC091	4	2	3	0	2	*	*	*	*	*	11	3	14	2.54
AA III	2001	ASC092	2	4	5	2	1	*	*	*	*	*	14	4	18	2.28
AA III	2001	MATH100	1	4	8	2	0	*	*	*	*	*	15	1	16	2.26
AA III	2001	MATH102	2	3	5	1	1	*	*	*	*	*	12	1	13	2.33
AA IV	1999	ASC099	5	1	1	1	0	*	*	*	*	*	8	1	9	3.25
AA IV	1999	MATH100 (MATH099)	8	3	4	3	2	*	*	*	*	*	20	8	28	2.60

Table 32 Continued.

Institution*	Year	Course	Grade										Total	Drop	Total with Drops	GPA
			A	B	C	D	F	P	I	S	U	CW				
AA IV	1999	MATH102	19	14	6	2	1	*	*	*	*	*	42	8	50	3.14
AA IV	1999	MATH102	7	2	1	1	2	*	*	*	*	*	13	7	20	2.84
AA IV	2000	ASC092	5	0	4	0	3	*	*	*	*	*	12	1	13	2.33
AA IV	2000	MATH100 (MATH099)	11	3	1	1	1	*	*	*	*	*	17	4	21	3.29
AA IV	2000	MATH102	12	7	4	1	5	*	*	*	*	*	29	7	36	2.68
AA IV	2000	MATH102	17	5	1	0	4	*	*	*	*	*	27	10	37	3.14
AA IV	2001	ASC092	10	1	0	0	0	*	1	*	*	*	12	2	14	3.90
AA IV	2001	MATH100 (MATH099)	5	4	2	0	1	*	*	*	*	*	12	4	16	3.00
AA IV	2001	MATH102	23	3	0	2	3	*	*	*	*	*	31	7	38	3.32
AA IV	2001	MATH102	7	4	5	0	2	*	*	*	*	*	19	5	24	2.77
AA V	1999	MATH099	2	2	3	2	5	*	*	*	*	*	14	0	14	1.57
AA V	1999	MATH102	3	3	5	2	6	*	*	*	*	*	19	1	20	1.73
AA V	1999	MATH102	7	6	5	3	2	*	*	*	*	*	23	0	23	2.56
AA V	1999	MATH102	2	5	1	6	5	*	*	*	*	*	19	0	19	1.63
AA V	2000	ASC092	3	2	1	0	3	*	*	*	*	*	9	1	10	2.22
AA V	2000	MATH102	0	4	0	8	0	*	*	*	*	*	12	2	14	1.66
AA V	2000	MATH102	7	5	8	1	2	*	*	*	*	*	23	0	23	2.60
AA V	2000	MATH102	1	6	3	5	0	*	*	*	*	*	15	2	17	2.20
AA V	2001	ASC092	0	2	2	4	3	*	*	*	*	*	11	1	12	1.27
AA V	2001	MATH102	3	4	1	3	0	*	*	*	*	*	11	1	12	2.63
AA V	2001	MATH102	9	5	2	0	2	*	*	*	*	*	18	0	18	3.05
AA V	2001	MATH102	3	4	2	0	2	*	*	*	*	*	11	0	11	2.54
BA II	1999	MATH110 (MATH099)	5	3	7	0	0	*	*	*	*	*	15	5	20	2.86
BA II	1999	MATH115 (MATH102)	2	9	4	4	4	*	*	*	*	*	23	13	36	2.04
BA II	2000	MATH102	2	9	8	2	2	*	*	*	*	*	23	19	42	2.30
BA II	2000	MATH102	0	0	0	0	0	*	*	*	*	*	0	5	5	*

Table 32 Continued.

Institution*	Year	Course	Grade										Total	Drop	Total with Drops	GPA
			A	B	C	D	F	P	I	S	U	CW				
BA II	2001	MATH099	1	0	0	1	2	*	*	*	*	*	4	6	10	1.25
BA II	2001	MATH102	2	8	9	7	3	*	*	*	*	*	29	15	44	1.96
BA II	2001	MATH102	1	1	1	1	0	*	*	*	*	*	4	3	7	2.50
Master's	1999	MATH099	*	*	*	*	*	*	*	11	7	*	18	1	19	*
Master's	1999	MATH099	*	*	*	*	*	*	*	8	0	*	8	0	8	*
Master's	1999	MATH099	*	*	*	*	*	*	*	15	1	*	16	0	16	*
Master's	1999	MATH102	7	5	9	6	9	*	1	*	*	*	39	15	54	1.86
Master's	1999	MATH102	5	4	12	7	11	*	*	*	*	*	42	11	53	1.61
Master's	1999	MATH102	4	6	4	11	10	*	*	*	*	*	39	16	55	1.51
Master's	1999	MATH102	2	3	6	5	7	*	*	*	*	*	24	9	33	1.47
Master's	1999	MATH102	6	2	2	2	4	*	*	*	*	*	16	2	18	2.25
Master's	2000	MATH099	*	*	*	*	*	*	*	9	7	*	16	0	16	*
Master's	2000	MATH099	*	*	*	*	*	*	*	17	0	*	17	0	17	*
Master's	2000	MATH102	6	7	6	8	6	*	*	*	*	*	34	16	50	1.96
Master's	2000	MATH102	4	7	6	5	7	*	1	*	*	*	30	8	38	1.86
Master's	2000	MATH102	0	2	7	4	15	*	*	*	*	*	28	18	46	0.85
Master's	2000	MATH102	6	8	8	3	5	*	*	*	*	*	30	12	42	2.23
Master's	2000	MATH102	4	2	3	1	7	*	*	*	*	*	17	8	25	1.70
Master's	2000	MATH102	2	4	3	2	5	*	*	*	*	*	17	10	27	1.75
Master's	2001	MATH099	*	*	*	*	*	*	*	15	10	*	25	2	27	*
Master's	2001	MATH099	*	*	*	*	*	*	*	5	3	*	8	5	13	*
Master's	2001	MATH102	1	2	7	9	5	*	*	*	*	*	24	18	42	1.37
Master's	2001	MATH102	2	11	8	8	6	*	*	*	*	*	35	11	46	1.85
Master's	2001	MATH102	4	7	5	7	10	*	*	*	*	*	33	10	43	1.63
Master's	2001	MATH102	6	6	8	3	8	*	*	*	*	*	32	11	43	1.96
Master's	2001	MATH102	1	2	2	1	0	*	*	*	*	*	6	2	8	2.50
Master's	2001	MATH102	0	2	2	2	0	*	*	*	*	*	6	3	9	2.00
Master's	2001	MATH102	2	0	1	0	0	*	*	*	*	*	3	2	5	3.33
Doctoral	1999	MATH099	18	39	37	33	39	*	2	*	*	*	168	*	*	1.78
Doctoral	1999	MATH102	56	86	84	48	58	*	1	*	*	*	333	*	*	2.10

Table 32 Continued.

Institution*	Year	Course	Grade										Total	Drop	Total with Drops	GPA
			A	B	C	D	F	P	I	S	U	CW				
Doctoral	2000	MATH099	26	31	47	17	18	*	2	*	*	*	141	*	*	2.22
Doctoral	2000	MATH102	32	69	66	49	69	*	*	*	*	*	285	*	*	1.81
Doctoral	2001	MATH099	22	37	32	27	38	*	2	*	*	*	158	*	*	1.86
Doctoral	2001	MATH102	71	90	81	53	62	*	4	*	*	*	361	*	*	2.15

Note. *The institutions labeled AA I, AA II, BA II, Master's, and Doctoral are the same five institutions that were included in the study; the other AA institutions that sent data were randomly labeled AA III, AA IV, and AA V.

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