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

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.

A DESCRIPTION, COMPARISON, AND CONTRAST OF POSTSECONDARY DEVELOPMENTAL MATHEMATICS PROGRAMS IN NORTH DAKOTA

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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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Signature Laurie Geller

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

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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."

<u>Learning Theory</u>

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.

<u>Developmental Instruction and Curriculum</u>

"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.

<u>Other Instructional Methods.</u> 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)

<u>National Association for Developmental Education.</u> "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.

<u>"Best Practices" Checklist</u>

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.

<u>AA I.</u> 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.

<u>AA II.</u> 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.

<u>Intent to Align Courses.</u> 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."

<u>Assessment.</u> 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.

<u>Centralized or Highly Coordinated Developmental Program.</u> 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.