



Student teaching : opportunities for observing, experimenting with, and implementing assessment practices recommended by the NCTM Standards documents
by David Alan Buhl

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University
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Abstract:

This study used qualitative research methods to investigate opportunities for two secondary mathematics student teachers, Mark and Paula, to observe, experiment with, and implement assessment practices advocated by the NCTM Standards documents.

Both student teachers observed and implemented assessment practices during student teaching that were similar to preferences stated prior to student teaching. Mark indicated an interest prior to student teaching, and then again at its completion, in exclusively using traditional assessment practices in a typical high school mathematics course. During his student teaching experience, Mark observed his cooperating teacher using traditional assessment practices and then continued to implement his cooperating teacher's assessment practices. Prior to student teaching, Paula indicated an interest in using traditional assessment practices, as well as learning about journals and portfolios. During her student teaching experience, Paula observed her cooperating teacher using traditional assessments, as well as journals, portfolios, group assessments, and self assessments. Initially, Paula was unaware of the various uses of alternative assessment, but became acquainted with their uses as she continued to implement her cooperating teacher's assessment practices.

Both student teachers also indicated an interest prior to student teaching in not "rocking the boat". However, both student teachers made minor changes in their cooperating teacher's assessment practices during student teaching. At the completion of student teaching, both student teachers expressed an interest in implementing assessment practices in their first year of teaching similar to the assessment practices they implemented during student teaching.

Both student teachers stated a lack of exposure and experience in their preservice content and methods courses with the alternative assessment practices advocated by the National Council of Teachers of Mathematics.

Recommendations are made for the necessity of providing preservice students with the opportunity to observe instructors in mathematics content and methods courses implementing alternative assessment practices.

Recommendations are also made for the selection of cooperating teachers who have alternative assessment practices in place for student teachers to observe, experiment with, and implement during student teaching.

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ASSESSMENT PRACTICES RECOMMENDED BY THE
NCTM STANDARDS DOCUMENTS

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

Doctor of Education

MONTANA STATE UNIVERSITY-BOZEMAN
Bozeman, Montana

June, 1995

D378
B867

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Co-chairpersons: Dr. William Hall
Dr. Glenn Allinger

Montana State University - Bozeman
1995

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Signature David Buhl

Date June 26, 1995

DEDICATION

To my wife, JoAnn, and our daughter, Ester

ACKNOWLEDGMENTS

I would like to thank the student teachers and their cooperating teachers for their willingness to participate and also their insights which made this study possible.

I would like to thank my two co-chairpersons, Dr. William Hall and Dr. Glenn Allinger, for their assistance in completing this study. Thanks are also due to the members of my committee for their generous support and editorial assistance.

A special thanks to Dr. Anne Teppo for her editorial assistance and for the many discussions on topics in mathematics education related to this study.

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Abstract

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Introduction

With the publication of the *Assessment Standards for School Mathematics* (1995), the *Professional Standards for Teaching Mathematics* (1991) and the *Curriculum and Evaluation Standards for School Mathematics* (1989), the National Council of Teachers of Mathematics (NCTM) has called for changes in: (1) secondary mathematics curriculum, (2) instruction, and (3) assessment. Other publications, such as *Everybody Counts* (1989) and the *National Assessment of Educational Progress* (1987), have contributed to the call for reform in secondary mathematics classrooms. Thompson (1992) stated:

The conception of mathematics teaching that can be gleaned from documents such as the Cockcroft Report (1983), *Everybody Counts* (1989), and the NCTM Curriculum and Evaluation Standards (1989) is one in which students engage in purposeful activities that grow out of problem situations, requiring reasoning and creative thinking, gathering and applying information, discovering, inventing, and communicating ideas, and testing those ideas through critical reflection and argumentation (p. 128).

Studies (Brown et al, 1988; Dossey, 1988; McKnight et al, 1987) conclude that the conception of mathematics, as an evolving and dynamic process, is quite different from many students' current conception of mathematics as a static field dominated by rules and procedures. To effectively change students' conception of

mathematics, NCTM proposes major changes in the teaching and assessing of high school mathematics.

The *Standards* documents published by NCTM (1995, 1993, 1991, 1989) recommend that the goals of mathematics stress problem solving, reasoning, understanding, and communicating with mathematics. Crawford (1990) stated, "Rather than a curriculum based solely upon a set of skills and procedures to be imparted, mathematics should be explored, discovered, and reasoned" (p. 2). Schoen (1993) stated,

For this vision of the mathematics curriculum to become a reality, textbooks and other instructional material that support these curricular goals will need to be developed. Thus, all assessment, whether developed by the teacher or by agencies outside the classroom, should be aligned with the content topics of the curriculum and should reinforce the view of what is important in the curriculum and in classroom instruction (p. 8).

The vision in the *Standards* documents of mathematics teaching is to provide opportunities for students to form a deeper understanding of mathematics and develop mathematical power. This places new demands on instruction and encourages teachers to reevaluate and align the methods and manner by which students are assessed. Many existing methods of assessment do not adequately measure outcomes identified in the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989). The Curriculum and Evaluation Standards (NCTM, 1989) propose that:

- student assessment be integral to instruction;
- multiple means of assessment methods be used;

- all aspects of mathematical knowledge and its connections be assessed;
- instruction and curriculum be considered equally in judging the quality of a program (NCTM, 1989, p. 190).

One effort in Montana to change mathematics teaching to be more in line with that envisioned by NCTM is the National Science Foundation (NSF) supported Systemic Teacher Excellence Preparation (STEP) Collaborative Project. This project is designed (1) to bring about large-scale improvement in the preparation of K - 12 mathematics and science teachers in Montana, and (2) to serve as a national model for rural areas with significant minority populations.

The STEP Project also developed alliances with two NSF curriculum writing projects, the Systemic Initiative for Montana Mathematics and Science (SIMMS) Project involving grades 9 -12 and the Six through Eight Mathematics (STEM) Project. A summary of the goals of each project are located in Appendix D, page 102. In addition to developing alliances with the SIMMS Project and the STEM Project, the STEP Project is collaborating with the Montana Council of Teachers of Mathematics (MCTM), the Montana Science Teachers Association (MSTA), the Office of Public Instruction, and the Montana University System.

Merely calling for change or reform at the classroom level does not insure impact on teachers' beliefs and practices. Research studies by Crawford (1990) and Goodlad (1990) suggest that calls for reform by sources outside the classroom often fail to make an impact inside the classroom. Future teachers' beliefs about mathematics instruction and assessment, formed over many years of observation and participation as students, are deeply held and difficult to change.

Studies (Davis, 1990; Ball, 1989; & Meyerson, 1977) conclude that methods courses alone are not sufficient in changing future teachers' beliefs about

classroom practices experienced prior to methods courses. When attempting to implement reform at the classroom level, factors that influence beliefs and practices need to be investigated.

Purpose of this Study

The Assessment Standards for School Mathematics (NCTM, 1995) and the evaluation standards contained in the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989) emphasize assessment practices different from current practices occurring in many secondary classrooms. NCTM (1989, p. 190) advocates the following aspects of assessment:

- Assessing what students know and how they think about mathematics;
- Having assessment be an integral part of teaching;
- Focusing on a broad range of mathematical tasks and taking a holistic view of mathematics;
- Developing problem situations that require the applications of a number of mathematical ideas;
- Using multiple assessment techniques, including written, oral, and demonstration formats;
- Using calculators, computers, and manipulatives in assessment

This study investigated opportunities provided for student teachers to observe, experiment with, and implement assessment practices advocated by the NCTM *Standards* (1995, 1993, 1991, 1989) documents. Four general objectives served to guide this study: (1) to describe cooperating teachers' assessment practices and student teacher's perceptions of his/her cooperating teacher's

assessment practices; (2) to determine the cooperating teacher's willingness to allow his/her student teacher to experiment with assessment practices different from what the cooperating teacher was using and the student teacher's interest in experimenting with assessment practices different from what his/her cooperating teacher was using; (3) to describe student teachers' assessment practices used during student teaching; and (4) to identify student teachers' beliefs about assessment at the beginning of student teaching and at the completion of student teaching.

Research Questions

1. What assessment techniques, formats, and rubrics were used by the cooperating teacher?
2. What were the ways in which the cooperating teacher used assessment information?
3. How did the cooperating teacher incorporate students' use of calculators, computers, and manipulatives in the assessment process?
4. What was the student teacher's perception of their cooperating teacher's assessment practices?
5. Was the cooperating teacher willing to allow his/her student teacher to experiment with assessment practices different from what the cooperating teacher was using?
6. What was the student teacher's interest in experimenting with assessment practices different from what his/her cooperating teacher was using?
7. What assessment techniques, formats, and rubrics were used by the student teacher?

8. What were the ways in which the student teacher used assessment information?
9. How did the student teacher incorporate students' use of calculators, computers, and manipulatives in the assessment process?
10. Prior to student teaching, what were the student teacher's beliefs about NCTM recommended assessment practices?
11. Upon the completion of student teaching, what were the student teacher's beliefs about NCTM recommended assessment practices?

Appendix A, page 87, summarizes the questions and related procedures and methods.

Significance of this Study

This study will build on previous research by providing greater depth to the knowledge base in two areas: (1) the opportunities provided for student teachers to observe and model NCTM advocated assessment practices; and (2) the role of student teaching in formulating student teachers' beliefs about assessment.

This study will also contribute to the evaluation of the preservice education and career component of the STEP Project by providing data in two areas: (1) identifying inservice topics that need to be included in the Professional Development for cooperating teachers in the STEP designated eight model schools, and (2) describing actions of cooperating teachers that influence student teachers' beliefs about effective assessment practices.

Definition of Terms

assessment - the process of gathering evidence about a student's knowledge of, ability to use, and disposition towards mathematics and of making inferences based on that evidence for a variety of purposes (NCTM, 1995, p. 87)

assessment practices - the method of assessment and the purpose of the assessment

method of assessment - the method by which the teacher gathers evidence about a student's knowledge of, ability to use, and disposition towards mathematics

purpose of assessment - the use to which the assessment information will be used

alternate forms of assessment - a variety of assessment methods and formats which may include, but not be restricted to, the following:

performance assessment - involves presenting students with a mathematics task or project and then observing, interviewing, and/or looking at their product to assess what they actually know and can do (Stenmark, 1989, p. 13)

portfolio - a purposeful or useful collection of students' work which exhibits the student's efforts, progress, and achievement

(Paulson et al, 1991)

student interviews - questioning a student

student journal - student writing which may be used to describe or summarize key topics in an internal dialogue as they reflect on and explore the mathematics they have encountered

evaluation - the assignment of a value to the results of the assessment

beliefs - an individual's understanding and feelings that shape the ways that the individual conceptualizes and engages in mathematical behavior

cooperating teacher - the individual whose in classroom the student teacher assumes control

student teacher - the individual who assumes control of teaching from the cooperating teacher

mathematical power - mathematical power includes the ability:

- to explore, conjecture, and reason logically;
- to solve non-routine problems;
- to communicate about and through mathematics;
- to connect ideas within mathematics and between mathematics and other intellectual activity (NCTM, 1989, p. 1)

integrated mathematics - mathematics curriculum utilizing various aspects of content and emphasizing problem solving, mathematical reasoning, real-world applications, and the appropriate use of technology

SIMMS Materials - one type of integrated mathematics curriculum

Systemic Initiative for Montana Mathematics and Science (SIMMS) - a National Science Foundation funded project supporting 9 - 12 integrated mathematics curriculum writing and related professional development

Review of Literature

Preliminary Comments

With the publication of the *Standards* documents (1995, 1993, 1991, 1989), the National Council of Teachers of Mathematics (NCTM) has called for changes in secondary mathematics curriculum, instruction, and assessment with the purpose of developing mathematical power in all students. To reach the goal of developing

mathematical power for all students, the National Council of Teachers of Mathematics advocates teaching and assessment practices different from much of the current practice in secondary mathematics classrooms. The purpose of this study was to investigate opportunities provided to student teachers to observe, experiment with, and implement assessment practices advocated by NCTM.

The review of literature begins with an historical perspective of assessment in education and mathematics education pertinent to this study. The review also presents research relative to: (1) assessment practices; (2) conceptions of mathematics related to assessment; (3) efforts to change mathematics preservice teachers' beliefs about teaching and assessment; and (4) the influence of the student teaching experience on student teachers' beliefs about teaching and assessment.

Historical Perspective on the Role of Assessment

In the early 1920's, assessment became mis-aligned with instruction when it became necessary to detect individual differences to meet specific manpower requirements for factories (Mitchell, 1992; Stiggins, 1991). Mitchell (1992) argues the factory model produced three levels of workers: (1) college-track students who prepared for public universities, (2) general-track students who prepared for clerical jobs, and (3) vocational students who became the manual workers for the assembly lines. As a result of manpower need, teacher-made objective tests were used to detect individual differences in achievement among students.

As immigration to the United States increased causing the population of the United States to become more ethnically diverse, Stiggins (1991) suggests that

teacher-written, objective tests were often seen as inherently biased and inferior in quality. As such, these tests were replaced by more scientific and cost effective instruments. Stiggins (1991) states that when teacher written objective tests were replaced by more scientific instruments, such as standardized tests, assessment and instruction became separated from each other.

Once separated, assessment practices became more complex and technical, thus putting greater distance between instruction and assessment. As the distance between instruction and assessment became greater and as technology became available, testing programs using standardized instruments such as multiple choice tests became more centralized and widely used within school districts and/or state agencies.

Policy level decision makers and school officials became consumed by the growing use of standardized tests at all levels. The unfortunate results were that these standardized tests were rarely aligned with the objectives of the local curricula, yet they started to drive the curriculum (National Research Council, 1989).

By the late 1950's, U.S. education was stirred by the response to *Sputnik*, the Soviet Union's triumph in space, which gave rise to a flood of curriculum reform projects that became known as the new math (Mitchell, 1992; Cooper, 1985). This new math disappeared amid the turmoil of the 1960's and 1970's leaving the basic structure of the school, that of tracking students, unchanged (Mitchell, 1992).

In 1983, the National Commission on Excellence released *A Nation at Risk* which acknowledged the inadequacies of American education. Webb (1992) stated,

The Nation at Risk report (National Commission on Excellence in Education, 1983) delineated the problem by comparing American students' relatively low test scores with those of students from other industrialized nations, as well as noting the decline from 1963 to 1980 in average mathematics scores on the College Board's Scholastic Aptitude Tests (p. 661)

By the late 1980's, all aspects of American education came into question, including the role of assessment (Mitchell, 1992). Movements began to restructure American schools, to reshape curricula, to professionalize teachers, and to reform assessment (Kilpatrick, 1992).

The National Council of Teachers of Mathematics initiated the *Standards Project* in 1986 which has now resulted in the publication of three sets of recommendations that together provide a coordinated vision of the school mathematics curriculum, the teaching of mathematics, and the assessment of mathematics abilities (NCTM, 1995, 1991, 1989).

The *Curriculum and Evaluation Standards for School Mathematics* (1989) presents a vision of mathematical content appropriate for each student and an evaluation system to complement this content vision. The *Professional Standards for Teaching Mathematics* (1991) presents a vision of pedagogy relevant to and supportive of this content. The working draft of the *Assessment Standards for School Mathematics* (1995) provides a set of standards that focus on considerations involved in examining or developing assessment tasks, assessment events, assessment instruments, and assessment frameworks for a continuum of educational reform purposes.

Assessment Practices

Assessment systems currently used by most states, provinces, districts, and schools are not consistent with the goals of the reform efforts in school mathematics (NCTM, 1993). Webb (1992) states, the dominance of paper and pencil and short-answer test forms and the lack of clear expectations of performance suggest that assessment in classrooms is not embedded in instruction (p. 276).

The data on teachers using assessment methods in secondary classrooms is limited. Stiggins and Bridgeford (1985) report secondary teachers' assessment methods are dominated by traditional paper and pencil tests. Of the mathematics teachers responding, eighty-five percent reported using published tests.

Webb (1992) reported, ... although teacher-made objective tests and published tests have received the most attention in measurement textbooks and research articles, forty-seven percent of teachers surveyed rated performance assessment as the most important type of classroom evaluation (p. 276).

Linn (1983) researched how teachers diagnose students' strengths and weaknesses. He found that seventy-four percent of those surveyed said they preferred using results from standardized achievement tests.

If the vision of the NCTM recommendations is going to be realized, students' performance needs to be assessed in a manner consistent with these reform efforts. NCTM (1989) proposes:

- student assessment be integral to instruction;
- multiple means of assessment methods be used;
- all aspects of mathematical knowledge and its connections be assessed (NCTM, 1989, p. 190).

To accomplish these proposed changes, NCTM (1995, p. 83) advocated these major shifts in assessment practice:

<u>Toward</u>	<u>Away From</u>
<ul style="list-style-type: none"> • Assessing students' full mathematical power 	<ul style="list-style-type: none"> • Assessing only students' knowledge of specific facts and isolated skills
<ul style="list-style-type: none"> • Comparing students' performance with established criteria 	<ul style="list-style-type: none"> • Comparing students' performance with that of other students
<ul style="list-style-type: none"> • Giving students multiple opportunities to demonstrate their full mathematical power 	<ul style="list-style-type: none"> • Restricting students to a single way of demonstrating their mathematical knowledge
<ul style="list-style-type: none"> • Developing problem situations that require the applications of a number of mathematical ideas 	<ul style="list-style-type: none"> • Using exercises or word problems requiring only one or two skills
<ul style="list-style-type: none"> • Using assessment results to ensure that all students have the opportunity to achieve their potential 	<ul style="list-style-type: none"> • Using assessment to filter and select students out of the opportunities to learn mathematics
<ul style="list-style-type: none"> • Aligning assessment with curriculum and instruction 	<ul style="list-style-type: none"> • Treating assessment as independent of curriculum and instruction
<ul style="list-style-type: none"> • Basing inferences on multiple sources of evidence 	<ul style="list-style-type: none"> • Basing inferences on restricted or single sources of evidence
<ul style="list-style-type: none"> • Regarding assessment as continual and recursive 	<ul style="list-style-type: none"> • Regarding assessment as sporadic and conclusive

The National Council of Teachers of Mathematics (1993) stated, "Unless corresponding changes are made in assessment practices, promising new programs developed by teachers and schools will certainly clash as they come into contact with outdated, but often-used and revered, tests" (p.13).

Conceptions of Mathematics

The conception of mathematics presented in each of the NCTM Standards documents is best characterized by "doing" mathematics rather than just "knowing" mathematics. Thompson (1992) stated:

The conception of mathematics teaching that can be gleaned from documents such as the Cockcroft Report (1983), Everybody Counts (1989), and the NCTM Curriculum and Evaluation Standards (1989) is one in which students engage in purposeful activities that grow out of problem situations, requiring reasoning and creative thinking, gathering and applying information, discovering, inventing, and communicating ideas, and testing those ideas through critical reflection and argumentation (p. 128).

This view of mathematics is quite different than students' current conception of mathematics. Research studies (Thompson, 1992; Brown et al, 1988; Dossey, 1988; McKnight et al, 1987) show student's current conception of mathematics is that of a subject dominated by rules, facts, and procedures. Dossey (1988) and McKnight et al (1987) reported that most students in the United States believe that mathematics is useful, but its main characteristics are memorizing facts and following rules and procedures.

Supporting research by Brown et al (1988) and Thompson (1992) on students' beliefs about mathematics indicate that students believe that mathematics is important, difficult and based on rules. Brown et al (1988) stated, "A large

majority of the students felt that mathematics is rule based, and about half of the students reported that learning mathematics is mostly memorizing" (p. 339).

Thompson (1992) concluded, "For many, mathematics is a discipline characterized by accurate results and infallible procedures, whose basic elements are arithmetic operations, algebraic procedures, and geometric terms and procedures" (p. 127).

Preservice students are in the transition from being a student to becoming a teacher. Preservice students' beliefs about mathematics formed as students should have an impact on the way they assess when they teach. Changing preservice students' deeply held beliefs of mathematics and assessment practices that have been formed over many years of observation and experience is no easy task. There is a need for research on how observing, experimenting with, and implementing assessment practices recommended by NCTM during student teaching influence preservice students' beliefs about assessment practices.

Role of Student Teaching Experience

In their review of the literature on the role of teacher education in changing student teachers' beliefs, Borko and Brown (1992) stated, "There is debate about the extent to which formal teacher education programs can encourage teachers to modify the beliefs that they bring with them. Twelve to fourteen years of experience as students in classrooms serve as a strong socializing influence not easily overcome later in formal teacher education programs or even as teachers in the classroom" (p. 227).

However, research studies (Bush and Davis, 1982; Goodlad, 1990; Richardson-Koehler, 1988) suggest teachers do credit their student teaching experience with impacting how they teach. Bush and Davis (1982) surveyed

teachers about the effectiveness of their undergraduate education program in preparing them to teach. Almost three-fourths of the teachers identified student teaching as the most useful component of their program. Supporting studies (Goodlad, 1990; Richardson-Koehler, 1988) show that teachers believe their field experiences and student teaching had the greatest impact on the way they teach.

Research studies (Nagel and Driscoll, 1992; Smith, 1991; Goodlad, 1990; Richardson-Koehler, 1988; Bush, 1986; Bush and Davis, 1982; Veenman, 1984; Hodges, 1983) have examined influences within the student teaching experience that have impacted how prospective teachers teach. These influences include relationships between the cooperating teacher and/or university supervisor (Bush, 1992; Joyner, 1991; Bush et al, 1990, Bush and Davis, 1982;), the curriculum (Bush, 1986), dilemmas between practices that support student learning and practices that appear efficient and widely used (Nagel and Driscoll, 1992), personal variables (Hodges, 1983), discipline problems (Hodges, 1983), and prior experiences in mathematics classrooms (Smith, 1991).

Research studies (Joyner, 1991; Bush et al, 1990; Campbell and Wheatley, 1983) do show that within the student teaching experience, the cooperating teacher has a major impact on how student teachers teach. Bush et al (1990) found that, although student teachers' conception of teaching was based more on pre-college classroom experiences than college mathematics content courses, the cooperating teachers' performance had more influence on the preservice teachers than either the cooperating teacher's or supervisor's suggestions.

Campbell and Wheatley's (1983) earlier findings support the importance of cooperating teachers when they found student teachers were eager to imitate any technique without much concern as to whether it was appropriate for them or for

their students (p. 61). Nagel and Driscoll (1992) found that student teachers were willing to abandon what they had learned at the university in order to align themselves with the school where they practice teach.

Joyner (1991) found that cooperating teachers had a large impact on student teachers' beliefs about the implementation of new strategies appropriate to learning mathematics. Student teacher responses on favoring the use of a new strategy changed from sixty-three percent to forty percent when their cooperating teacher did not implement the new strategy. Therefore, it would seem that a cooperating teachers actual classroom performance in instruction and assessment is a key to bringing about change in their student teachers' assessment philosophy.

There is no published research on how cooperating teachers' assessment beliefs and practices influence student teachers' assessment philosophy. From the research available on how cooperating teachers do influence student teachers beliefs about teaching and implementing new strategies appropriate to learning, it would seem logical that the assessment beliefs and observed practices of the cooperating teacher will also influence the student teachers' assessment philosophy.

With the publication of the *Standards* documents (1995, 1991, 1989), NCTM has presented a vision of mathematics curriculum, instruction, and assessment different from what many preservice students have experienced prior to the preservice program. Preservice students' beliefs about assessment have been formed through many years of observation and experience as students in a traditional curriculum and are difficult to change. To effectively change preservice students' beliefs about assessment toward the model advocated by NCTM, opportunities are needed during student teaching for student teachers to observe,

experiment with, and implement effective assessment strategies. Research is needed on how these opportunities to observe, experiment with, and implement effective assessment practices influence student teachers' beliefs about assessment.

Efforts to Change Preservice Teachers' Beliefs

Research studies (Dossey, 1992; Steinberg et al, 1985; Thompson, 1984; McGallaird, 1983) have shown that how teachers interpret and implement curricula is influenced significantly by their knowledge and beliefs about mathematics formed from observations and past experiences. Research studies (Ball, 1989; Meyerson, 1978) have also shown that changing preservice teachers long held beliefs about instruction and assessment requires more than one or two specifically designed methods courses. It would seem that benefits could be gained from research on how preservice teachers' beliefs about instruction and assessment change in the transition from being a preservice teacher education student to a practicing teacher.

Studies (Shirk, 1973; Collier, 1972) suggest that without preservice programs designed to elicit change in future teachers' beliefs about an innovation, there will be little movement or change in their beliefs throughout the preservice program. Neither researcher investigated preservice teachers' beliefs about instruction and assessment and the influence of student teaching on these beliefs.

In 1989, Ball designed a methods course to elicit change in preservice teachers' beliefs more towards of a philosophy of learning and teaching mathematics advocated by NCTM. Ball observed that although the prospective teachers stated the methods course shifted their philosophy about teaching towards a philosophy of teaching advocated by the *Standards* documents (NCTM 1989,

1991, 1993) when placed in a teaching environment, they found it easy to fall back on previously experienced learned patterns of teachings.

Meyerson (1978) investigated the effects of a methods course designed specifically to change preservice teachers' beliefs about mathematics. Meyerson observed that students' beliefs had been developed over many years of observing and experiencing mathematics and how it was taught, and concluded one methods course was not sufficient to change these deeply held beliefs.

At this time there is no research on the success of a methods course designed to elicit change in preservice teachers' beliefs about assessment. However, the research on the success of methods courses designed to elicit change in future teachers' beliefs about mathematics would suggest that methods courses are not sufficient in themselves in changing preservice teachers' beliefs about assessment practices.

CHAPTER 2

METHODS AND PROCEDURES

Introduction

This study investigated opportunities provided to two student teachers to observe, experiment with, and implement assessment practices recommended by the NCTM Standards documents. Four general objectives guided this study: (1) to describe cooperating teachers' assessment practices and student teacher's perceptions of his/her cooperating teacher's assessment practices; (2) to determine the cooperating teacher's willingness to allow his/her student teacher to experiment with assessment practices different from what the cooperating teacher was using and his/her student teacher's interest in experimenting with assessment practices different from what his/her cooperating teacher was using; (3) to describe student teacher's assessment practices used during student teaching; and (4) to identify student teachers' beliefs about assessment practices at the beginning of student teaching and at the completion of student teaching.

Pelto and Pelto (1978) suggest the task of the qualitative researcher is to reduce to a minimum the distortions of an uneven mirror by a careful definition of concepts and specification of research operations, so that the powers and vagaries of the human mind work to our advantage (p. 37). The research design required qualitative methods since qualitative research approaches are focused on the interpretive description and explanation of people, places, conversations, and phenomena not easily handled by statistical procedures. This research seeks to

provide readers with understanding of observed behavior from the participants' own frame of reference.

Bogden and Biklen (1992) and Goetz and LeCompte (1984) state several guidelines for qualitative research which indicate the appropriateness of qualitative research for this study. First, they recommend the mathematics classroom as the most direct source of data, where the researcher is the key instrument for collecting data. The data for this study was collected in the classroom where the researcher observed events as they occurred and through audio-taped interviews prior to, during and after student teaching.

Second, the research takes on the form of a descriptive text. The written word is very important in the qualitative approach, both in recording data and disseminating the findings. This study guided the researcher to develop descriptions from all data collected. Forms of data used include interview transcripts, field notes, student teacher journals, and assessment documents.

Third, the research describes a process rather than documenting outcomes or products. This study focused on mathematics classroom events in which preservice teachers observed and modeled assessment practices during their student teaching experience.

Fourth, qualitative data is analyzed inductively, where theory is developed from the bottom up from many interconnected pieces of collected evidence. For this study, patterns in perceptions or beliefs of cooperating teachers and student teachers will be drawn out from the data, rather than starting from an hypothesized pattern and attempting to prove or disprove it.

Fifth, meaning is of essential concern in qualitative research. Qualitative researchers are concerned with participant perspectives to help illuminate the

dynamics that are often invisible to the outsider. This study will investigate student teachers in the process of teaching secondary mathematics while they attempt to make sense out of assessment practices.

Pre-Pilot Study

The conceptual basis for this study originated while assisting with the secondary methods course, Methods in Teaching Senior High Mathematics, at Montana State University-Bozeman during the fall semester, 1993. The course was designed to:

- Model a variety of effective teaching strategies;
- Fully integrate uses of technology into instruction;
- Model appropriate assessment techniques that involve higher-order thinking skills and problem solving;
- Model approaches found to be effective in engaging female and minority students, especially Native Americans, in mathematics and science coursework (STEP Proposal, 1992).

Course requirements included two thirty minute classroom mini-lessons presented by each student. Each presentation was video taped with the first set of presentations occurring midway through the semester and the second set of presentations occurring during the last week of the semester. Students were responsible for the content and methodology of each of their presentations. At the completion of the presentations, students were required to review and self assess their video taped presentations.

Two students in the methods course volunteered to individually participate in an interview with the researcher after reviewing and self assessing their second video taped presentation. Since the use of cooperative learning, technology, and alternative assessment were integrated in the design of the methods course, the interview format encouraged the participants to describe how the delivery and assessment of the mathematics content could have been improved using cooperative learning, technology, and/or alternative assessment.

Reviewing data from the interviews suggested that the participants were planned to use technology, cooperative learning and alternative assessment in their mathematics classrooms. Both participants perceived a lack of experience with alternative assessment in their personal school careers, and stated concerns about the impact that this lack of experience will have on their ability to implement alternative assessment in the future.

To further investigate the student teaching experience as it related to implementing technology, cooperative learning, and/or alternative assessment, two additional preservice students from the secondary mathematics methods course participated in an interview at the completion of student teaching spring semester, 1994.

The interview protocol, located in appendix B, page 92, was designed to allow the four participants to describe their student teaching experience as it related to implementing technology, cooperative learning, and alternative assessment. Interviews were audio recorded, transcribed, and analyzed to determine future direction of this study.

After analyzing data collected from the interviews with the preservice students in the secondary mathematics methods course and from the student

teachers at the completion of their student teaching experience, four areas of interest emerged suggesting further study.

One area for further study involves the opportunities provided for student teachers to observe NCTM recommended assessment practices being modeled by their cooperating teacher. All four pre-pilot student teachers that were interviewed perceived their cooperating teacher's assessment practices as traditional, with assessment being used for the sole purpose of assigning grades. Thus, one of the objectives of this study was to describe the cooperating teacher's assessment practices and his/her student teacher's perceptions of these assessment practices.

A second area for further study is the opportunity provided for student teachers to implement NCTM recommended assessment practices during their student teaching experience. The two participants interviewed prior to student teaching expressed enthusiasm and interest in implementing various assessment methods during their student teaching.

A third area for further study is the student teacher's perception of his/her cooperating teacher's willingness to allow them to implement different assessment techniques. Two of the participants that were interviewed after their student teaching experience perceived their cooperating teachers as reluctant to allow them to implement assessment methods different from assessment methods already in place by the cooperating teacher. This suggested a third objective for this study which was to determine the cooperating teacher's willingness to allow his/her student teacher to experiment with assessment practices different from what the cooperating teacher used and the student teacher's interest in experimenting with assessment practices different from what his/her cooperating teacher used.

A fourth area to emerge for further study is the change in student teachers' assessment beliefs from before to after the student teaching experience. Changing preservice teachers' deeply held beliefs about assessment practices that have been formed over many years of observation and experience is no easy task. This suggested a fourth objective of this study which was to identify student teachers' beliefs about assessment at the beginning of student teaching and at the completion of student teaching.

Pilot Study

One student teacher and his cooperating teacher at a class AA school in Montana participated in a pilot study during fall semester, 1994. The researcher visited the classroom a minimum of once per week during the twelve week student teaching experience. Techniques of qualitative data collection and data analysis described by Bogden and Biklen (1992), Patton (1990), and Goetz and LeCompte (1984) were used. Difficulties encountered with the data collection during the pilot study were noted, and this data was used to make modifications or corrections for the actual study.

At the completion of the pilot study, final preparations for the research study were completed. These preparations, which are described in the next section, included selecting participants and identifying appropriate data collection methods for this study.

Selection of Participants

Three secondary mathematics preservice students at Montana State University-Bozeman were initially selected in November, 1994, for participation in this study which began January, 1995. Prior to student teaching all three students had completed the prerequisites for student teaching, including the course, Methods in Teaching Senior High Mathematics.

Diversity of geographic location of student teaching sites, within the limitation of the researcher's ability to visit each location weekly during this study, was used as the criterion when considering eligible participants for this study. Permission for participation in this study was asked for and granted by all the participants, including the preservice students and their cooperating teachers.

The three student teachers in this study are identified as Donna, Mark, and Paula. Due to difficulties encountered during student teaching, Donna was removed from the mathematics classroom six weeks into the study and subsequently rescinded her permission to be included in this study.

Data Collection Methods

Goetz & LeCompte (1984) recommend multiple methods of data collection to provide the triangulation or cross reference of data desired in qualitative studies to create a diverse source for and reinforcement of researcher observations.

The following methods of data collection were used to triangulate the data for this study: (1) using a participant journal, each student teacher recorded impressions and reflections related to observing, experimenting with, and implementing assessment practices, as well as, reflections on interaction with

his/her cooperating teacher related to assessment; (2) an observer field journal was used by the researcher to record field notes from classroom observations, informal interviews with cooperating teachers and/or student teachers, and researcher's impressions and reflections; (3) classroom observations focused on assessment practices used during this study and also focused on the interaction between student teachers and cooperating teachers as the interaction related to this study; (4) informal interviews were used to question participants on observations of classroom episodes and to clarify researcher misconceptions of entries in the participant journal; (5) three formal interviews, located in Appendix C, page 95, with individual student teachers were conducted during the student teaching experience to elicit information about student teacher's beliefs about assessment practices and their perceptions of the cooperating teacher's assessment practices; (6) one formal interview, located in Appendix C, page 95, was conducted with each cooperating teacher and focused on his/her assessment practices and his/her willingness to allow the student teacher to use NCTM recommended assessment practices; and (7) a document file for each pair of cooperating teachers and student teachers was kept for assessment documents and rubrics used by the participants during this study.

Participant Journal

Bogden and Biklen (1992) recommend journals as a method of collecting first person narratives describing individual's actions, experiences, and beliefs. Journals represent evidence on how social situations appear to actors in them and what meanings various factors have for participants (p. 132). When written under the immediate influence of an experience, journals can be particularly effective for student teachers to capture their thoughts and perceptions.

Initially, student teachers were asked to record, a minimum of twice per week, a description and reflective commentary on the following aspects of their student teaching experience: (1) perceptions of assessment practices modeled by their cooperating teacher, (2) perceptions of their cooperating teacher's encouragement and willingness to allow them to experiment with and use NCTM recommended assessment practices, (3) assessment practices personally used in their student teaching experience, and (4) outside influences (i.e. parents, administrators, and university supervisor) as they relate to assessment practices in the classroom.

During the third week of the study, both student teachers indicated that making journal entries twice a week was difficult considering their busy schedules. It was mutually agreed upon by the researcher and the student teachers that journal entries would be made a minimum of once per week under the conditions stated previously or from guidelines given by the researcher after observing teaching or assessment episodes.

Observer Field Journal

Bogden and Biklen (1992) and Patton (1990) recommend a field journal containing observer's insights, interpretations, and beginning analysis about what is happening in the field. Throughout this study, a field journal was used to contain field notes encompassing: (1) verbal portraits of the participants, (2) impressions and observations from informal interviews with cooperating teachers and/or student teachers, (3) description of the physical characteristics of the mathematics classrooms, (4) descriptions of assessment practices and classroom activities used by cooperating teachers or student teachers, and (5) the researcher's

impressions and reflections. These field notes were used to assist in the reconstruction of events that occurred throughout this study.

To acknowledge and help control observer's effect and influences, Bogden and Biklen (1992) recommend both descriptive and reflective field notes. Descriptive entries documented the researcher's best effort to objectively record detailed observations that occurred in the field. Reflective field notes documented reflections on the researcher's frame of mind and points of clarification related to this study.

Classroom Observations

The initial classroom observation was used to establish rapport, which allowed the cooperating teachers and student teachers to become comfortable with the researcher's presence and to gather general information related to this study. As the study progressed, observations focused on three areas: (1) cooperating teacher's assessment practices used during the student teacher observation period, (2) student teacher's assessment practices used during their teaching episodes, and (3) observed interaction between the student teacher and his/her cooperating teacher as it related to this study.

Informal Interviews

Informal interviews were impromptu and conversational in nature and used to further probe participant's explanations and/or clarify to researcher's misconceptions of participant's written and/or verbal comments related to this study. These informal interviews, or conversations, were less than five minutes in

duration and occurred either prior to the beginning of the lesson or immediately following the end of the classroom observation.

Formal Interviews

Each student teacher participated in three formal interviews. Interview formats and questions, which are located in Appendix C, page 95, were formulated using recommendations by Bogden and Biklen (1992) and Patton (1990), and field tested during fall semester, 1994.

The first interview occurred during the last week of fall semester, 1994, prior to student teaching. The interview format was designed to encourage the student teacher to describe beliefs about NCTM recommended assessment practices.

The second formal interview with each student teacher occurred at the completion of the student teacher's observation period, which lasted approximately three weeks. The format of this interview was designed to encourage the student teacher to describe their perceptions of the cooperating teacher's assessment practices.

The final formal interview with each student teacher occurred at the thirteenth week of student teaching. The interview format was similar to the first interview and was designed to encourage the student teacher to describe their beliefs about NCTM recommended assessment practices, as well as to self assess his/her cooperating teacher's assessment philosophy.

Each cooperating teacher participated in one formal interview held during the second week of January, 1995. The interview format was designed to encourage cooperating teachers to describe their assessment methods and uses, the

use of technology and manipulatives in the assessment process, and their willingness to allow their student teacher to experiment with NCTM recommended assessment practices.

Document File

When available, assessment instruments and rubrics used by the cooperating teachers and/or their student teachers were collected. These instruments were used in conjunction with other data collected in the data analysis.

Data Analysis

The process of constant comparison of data was used during and after the data collection. Goetz and LeCompte (1984) state the discovery of relationships, or hypothesis generation, begins with the analysis of initial observations, undergoes continuous refinement throughout the data collection and analysis process, and continuously feeds back into the process of category coding (p. 182). Patton (1990) recommends the process of constant comparison to include: (1) identifying recurring regularities or patterns in the data which relate to the research purposes; (2) collecting additional data to verify these patterns; (3) establishing priorities to determine which patterns are more important than others; (4) describing and interpreting the different patterns; and (5) testing patterns for completeness.

Initial descriptive patterns for comparison purposes were developed and categorized during the pilot study, fall semester, 1994. These categories were then altered, added, or deleted as a result of the analysis of the observer's field

journal, audio taped interviews, participant journals, and document files collected during this study.

Statement of Researcher Bias

While employed as a research assistant with the STEP project, the researcher assisted with the development and implementation of the course, Methods in Teaching Senior High Mathematics, at Montana State University-Bozeman, fall semester, 1993. After reviewing the literature on the uses of alternative assessment, this researcher became aware of the benefits of alternative assessment.

This researcher made an effort to avoid placing value judgements on statements made by the four participants in this study. Entries in the observer field journal were used as a control. Bias would be evident in statements made in the observer field journal.

Limitations and Delimitations

The following limitations restrict the generalizability of the results of this study:

1. This study was limited to those students who have passed the secondary mathematics methods course, Methods in Teaching Senior High Mathematics, at Montana State University-Bozeman.
2. The length of the student teaching experience, and thus the duration of data collection was twelve weeks.

The following delimitations restrict the generalizability of the results of this study.

1. This study was delimited to two student teachers in a restricted geographical proximity to Montana State University-Bozeman.
2. This study was delimited in that there are other factors that impact student teacher's beliefs beyond the cooperating teacher's assessment practices.

CHAPTER 3

FINDINGS

Introduction

This study investigated opportunities provided for student teachers to observe, experiment with, and implement assessment practices recommended by NCTM. Three student teachers initially participated in this study. One student teacher dropped out of student teaching six weeks into the study and subsequently rescinded her permission to be included in the study. The two remaining student teachers are identified as Paula and Mark, and their respective cooperating teachers are identified as Mary and Don.

This chapter begins with classroom profiles of the cooperating teachers followed by profiles of the student teachers in this study. Next, this chapter will present findings aligned to the four general objectives of this study. Each objective will be addressed by answering the research questions of this study pertinent to the objective. Research questions for this study are located on pages 5-6, and again in Appendix A, page 87.

One objective of this study was to describe cooperating teachers' assessment practices and student teacher's perceptions of their cooperating teacher's assessment practices. This objective will be addressed by the following topics: (1) assessment practices used by the cooperating teachers, (2) high school students' use of calculators, computers, and manipulatives in the cooperating teachers' assessment process, and (3) student teacher's perceptions of their cooperating teacher's assessment practices.

A second objective of this study was to determine the cooperating teachers' willingness to allow their student teacher to experiment with assessment practices different from what the cooperating teacher was using and his/her student teacher's interest in experimenting with assessment practices different from what his/her cooperating teacher was using. This objective will be addressed by the following topics: (1) cooperating teachers' willingness to allow their student teachers to experiment with different assessment practices, and (2) student teachers' perceptions about opportunities to experiment with assessment practices different from their cooperating teacher's assessment practices.

A third objective of this study was to describe student teachers' assessment practices during student teaching. This objective will be addressed by the following topics: (1) assessment practices used by student teachers, and (2) high school students' use of calculators, computers, and manipulatives in the student teachers' assessment processes.

The fourth objective for this study was to identify student teachers' beliefs about assessment. This objective will be addressed by the following topics: (1) student teacher's beliefs about assessment practices prior to student teaching, and (2) student teacher's beliefs about assessment upon the completion of student teaching.

Participant Profiles

Don

Don has spent all 8 years of his teaching career at Brandon High School, a small high school consisting of grades 9-12, with an enrollment of approximately 100 students. The class observed for the study was a third period Algebra II class

with 20 students. The classroom environment included six rows of five desks facing the white board with the teacher's desk off to the side. The desks were for the most part stationary. One Macintosh computer was located on Don's desk for personal use. A classroom set of TI-82 calculators were available to students upon request.

Don has taken an extended studies course, which included ten evenings of participation, involving reform mathematics. Nevertheless, he maintains a traditional environment concerning teaching and assessment practices. A typical Algebra II class period would begin with Don asking students to exchange their homework papers to be graded. Don would then state answers to the homework while students would correct their neighbor's papers. Students were then requested to write the number of incorrect responses at the top of the paper before handing it back to the owner. After questions from the homework had been addressed, students passed the homework forward for Don to collect. Once the papers had been collected, Don would lecture over the new material in the next section of the book leaving approximately ten minutes for students to work together, if they choose to, on the next day's assignment. A typical conversation involved students working together comparing answers:

John: What did you get for number 3?

Jane: Seventeen. What did you get?

John: Same. Let's go to the next problem

During the initial interview, Don discussed his thoughts about assessment and evaluation.

I feel that a teacher assesses students on a daily basis so teachers can have an idea on how kids are grasping the information. This might occur just by observing facial expressions during a lecture or how students are handling

