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THE AWARENESS AND USE OF STANDARDS-BASED
MATHEMATICS CURRICULUMS IN SECONDARY
SCHOOLS OF SOUTHERN NEW JERSEY

by
Nancy D. Ciandella

A Thesis

Submitted in partial fulfillment of the requirements of the
Master of Arts Degree
of
The Graduate School
at
Rowan University
May 1, 2002

Approved by _____
Professor

Date Approved 4/29/02

ABSTRACT

Nancy Ciandella

The Awareness and Use of Standards-Based Mathematics Curriculums in Secondary
Schools of Southern New Jersey

2002

Dr. Eric Milou

Master of Arts in Subject Matter Teaching Mathematics

The purpose of this study was to determine the knowledge and usage of specific standards-based mathematics curriculums in the southern New Jersey area.

A three-part survey was developed and sent to department chairpersons in 135 secondary schools in eight southern New Jersey counties. Part one of the survey determined the population characteristics and participant information. Part two was utilized to determine currently used mathematics curriculums. In part three, mathematical philosophy was determined from responses to Likert scale questions. An analysis of the survey included tallies of currently used curriculums, knowledge of standards-based mathematics programs, and a correlation of mathematical philosophies to these curriculums.

The analysis indicated that only 10(16.7%) schools participating in the survey use one of the five named standards-based mathematics programs. Knowledge of these curriculums varied. Of the five researched curriculums, teachers were most knowledgeable about Interactive Mathematics Program, Math Connections, and Core-

Plus. Fifty percent reported limited or no knowledge of all five curriculums. Teachers agreed with the philosophies behind standards-based mathematics curriculums. On questions that positively correlate to these curriculums, a majority of teachers agreed or strongly agreed with the statements. Negative correlations were not as strong, indicating some traditional beliefs involving calculator usage and arithmetic manipulation.

MINI-ABSTRACT

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The purpose of this study was to determine the knowledge and usage of specific standards-based mathematics curriculums in the southern New Jersey area. Although knowledge of such curriculums varies and teachers agree with their philosophy, these programs are not used in the majority of secondary schools in southern New Jersey.

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Chapter 1

Introduction and Statement of Problem

Beginning in 1989, the National Council of Teachers of Mathematics (NCTM) introduced three documents that would change the vision of mathematics education. These documents were *Curriculum and Evaluation Standards for School Mathematics* (1989), *Professional Standards for Teaching Mathematics* (1991), and *Assessment Standards for School Mathematics* (1995). In addition, in 2000, these documents were revised into a document titled *Principles and Standards for School Mathematics*. The authors of the 2000 Standards document state “the need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase” (p. 4). In 1993, Prichard and Bingaman affirmed that the first two documents “present a perspective on the teaching of mathematics that may be somewhat foreign to many teachers. Both documents call for changes in current modes of classroom instruction as well as in the roles of teachers and students alike” (p. 217). Ferrini-Mundy and Johnson(1994) and Garet & Mills (1995) agree that these changes are a departure from traditional practices of teaching mathematics. In addition, Stiff (2001) points to the Standards 2000 as a document of goals to improve the teaching of mathematics. The teaching and learning of mathematics envisioned by this document requires modifications in teachers’ pedagogy.

In 1989, when the first Standards document was published, no textbooks were available that resembled the described curriculum. In response, in 1990, the National Science Foundation (NSF) funded projects to develop curriculum and materials following the guidelines set forth by the Standards. Five projects at the secondary level were funded, for an approximate total of \$43 million (Martin, Hunt, Lannin, Leonard, Marshall

& Wares, 2001). These were Interactive Mathematics Program (IMP), Contemporary Mathematics in Context (Core-Plus), Mathematics Connections: A Secondary Mathematics Core Curriculum, Systemic Initiative for Montana Mathematics and Sciences (SIMMS), and Mathematics: Modeling Our World (ARISE). Each of these programs represents “the vision outlined in the NCTM Standards. They connect mathematical concepts, emphasize problem-solving, are interesting and challenging, motivate students to investigate, encourage different ways of communication, incorporate technology, and use varied means of assessment” (Reys, Robinson, Sconiers & Mark, 1999, p. 455). In a study by Martin, et al. (2001) which compared these five NSF-funded programs to the Standards document, all were found to contain at least 65% of the process standards (problem-solving, reasoning and proof, communication, connections and representation) listed in NCTM document, while two of the programs contain at least 85% of these process standards. In addition, each series is consistent with the 61 specific content expectations listed in the Standards. In 1999, the U. S. Department of Education named 5 secondary mathematics programs as exemplary. These programs, Cognitive Tutor Algebra, College Preparatory Mathematics, Connected Mathematics, in addition to two NSF-funded programs mentioned above, Core-Plus and IMP, “exemplify the high level and challenging mathematics called for in the National Council of Teacher of Mathematics (NCTM) Standards” (US Department of Education, p. 3).

How do these programs differ from the traditional mathematics textbooks?

Ferrini-Mundy and Johnson (1995) warn that classrooms may appear “Standards-oriented, with calculators in evidence, students working in groups, manipulatives available and interesting problems under discussion” (p. 192). It is not enough to have

students sitting in groups with calculators in hand. The intent of the Standards is for students to become mathematically literate. Students should “be able to explore, to conjecture, to reason logically, and to use a variety of mathematical methods to solve problems” (Reys, et al., 1999, p. 455). In a survey of mathematics chairpersons by Garet & Mills in 1991, “the data indicate[d] that lecture-discussion and in-class problem sets remain the dominant mode of instruction in first-year algebra” (p. 382). Students memorizing rules and doing routine exercises that use lower-order thinking skills is the most common approach to teaching mathematics today. “It is a rote approach to teaching mathematics that keeps students from making sense and meaning out of mathematics” (NCREL, 1994, p. 7). Teachers may think they are successful in teaching this way. But what students are learning is not what they need. “In 1991, the U. S. Department of Labor published *What Work Requires of Schools*, which summarize[d] recommendations of leaders of business and industry... Skills, they say[d], must be learned in the context of solving real-world problems; students must actively construct knowledge for themselves; and students must work together cooperatively as well as individually” (Ohanian, 1997, p. 26). In addition, the Third International Mathematics and Science Study [TIMSS] focused attention on the need to change how mathematics is taught in the United States. This study found that eighth-grade mathematics curricula is a full-year behind higher-achieving countries (Reys, 1999).

Why should we examine standards-based programs? Ohanian (1997) contends:

The mathematics content in most secondary school curricula is 500 years old. Even calculus, the newcomer on the block, is taught today pretty much the way it was taught 50 years ago - that is, in isolation, as a distinct, separate area of formulas, one separate from another. Students learn algebra and then learn geometry, as separate, unrelated operations. Students memorize and practice a set of strategies that march along with the facts of the moment. Then they fill in this

information on test papers. And then they forget it. They forget because learning information in isolation is the least productive way to learn it. (p. 25)

In 1990, the Mathematical Sciences Education Board [MSEB] “urge[d] that school mathematics programs be revised and updated to reflect the NCTM Standards, to develop students’ mathematical power, use calculators and computers throughout, feature relevant applications, and foster active student involvement” (Edwards, 1994, p. 3).

If there is a need to change the way in which mathematics is being taught, why are schools reluctant? According to Schoen, Fey, Hirsch and Coxford (1999) schools may reject improvements in mathematics education and continue with conventional yet inadequate instruction and curricula. Mathematics teachers are asking, “What does it mean to implement to NCTM’s Standards? Do examples of implementation exist that would serve as models for others to follow? Are my current classroom practices in accord with the Standards? Where is the curriculum that is consistent with the Standards” (Ferrini-Mundy & Johnson, 1994, p. 190)? In addition, colleges may be hampering the change to standards-based curriculum. Shelly (1998) insists “first-year mathematics placement is currently based primarily on students’ knowledge of algebraic manipulation and their knowledge of procedures” (p. 3).

Research Questions

This study will attempt to answer the following questions. What curriculums are currently being used in southern New Jersey? Are teachers informed about Standards-based curriculums and how they differ from traditional curriculums? If they are informed about these curriculums, what are teachers’ opinions about them and the philosophy behind them? These programs differ from the traditional in teaching and learning practices. Students are taught to reason mathematically, to connect mathematical ideas

and to communicate mathematically. Concepts are “embedded in applications.” Teachers can appreciate the differences from traditional programs only when they understand the philosophy behind these curriculums (K-12 MCC, 1998, ¶ 2).

Need for the Study

This study is needed because of the lack of data concerning recognition and use of Standards-based curriculums, especially in the southern New Jersey area. Bybee, Ferrini-Mundy and Loucks-Horsley (1999) stress that business and industry want their employees to have “well-developed abilities to analyze problem situation[s] and [be able to] communicate ideas for solving those problems.” In a more recent article, Fey (2000) maintains that “the broad implementation of innovative curricula is being watched closely, as it should be, but there is certainly plenty of evidence justifying exploration of new approaches to school mathematics” (p. 56). Strong teacher associations and government leadership have advocated continuing professional development. Reys, et al. (1999) insists that each school district needs to make an informed decision about its mathematical curricula after being informed about Standards-based options. The K-12 Mathematics Curriculum Center, an internet site devoted to informing and assisting schools on implementation of standards-based curriculums, states that teachers need on-going in-service training on new curriculums and the current philosophies of teaching. This will help in the success of implementing these programs (1998, ¶6). Kysh (1995) also agrees by advocating that teachers need to become comfortable with Standards curriculums during workshops and discuss their concerns “as they make the shift from ‘sage on the stage’ to ‘guide on the side’” (p. 665). This study will attempt to uncover if schools are making an informed decision to shift towards a new curriculum or stay with

the status quo.

Limitations

The following limitations may have an affect on this study:

1. Time is a constraint for completing this study. There is a limited amount of time for research, compiling the data from the survey and completion of the study because of the need to complete the program by a given date.
2. The study is limited by the number of surveys that are returned by the date needed, especially by teachers who do not want to share information.
3. In addition, the study is limited by the honesty of the participants completing the survey. Respondents may feel they need to project a certain image by their answers.
4. This study is limited to secondary schools in southern New Jersey.

Definition of Terms

1) Standards-based curriculums will be limited to the following curriculums, funded by NSF and/or named exemplary by the US Department of Education, which include:

- Interactive Mathematics Program (IMP)
- Contemporary Mathematics in Context (Core-Plus)
- Mathematics Connections: A Secondary Mathematics Core Curriculum
- SIMMS Integrated Mathematics: A Modeling Approach Using Technology
- Mathematics: Modeling Our World (ARISE)
- Cognitive Tutor Algebra
- College Preparatory Mathematics (CPM)
- Connected Mathematics

2) The Standards will mean the Principles and Standards of School Mathematics as

published in 2000 by the NCTM.

- 3) Traditional mathematics will encompass the courses, Algebra I, Geometry, Algebra II, Trigonometry, Pre-Calculus and Calculus taught as separate courses with skill development and procedural methods being their main focus.
- 4) Secondary will be defined as grades 9 through 12.

Chapter 2

Research of the Literature

The current NCTM president, Lee Stiff, maintains that the “Principles and Standards for School Mathematics is a comprehensive and coherent set of goals for improving mathematics teaching and learning in our schools... The mathematics teaching and learning envisioned by the Standards require shifts in the mathematics students are asked to learn, the pedagogy teachers are required to provide, and the assessments used to inform the teaching and learning of mathematics that is taking place” (2001, p. 3). In the traditional classroom, Alper, Fendel, Fraser & Resek (1998), allege that students are given a step by step procedure which they are expected to memorize and use on similar problems. Martin (2001) agrees indicating that traditional texts generally “[teach] by telling,” presenting a concept or skill and devoting lots of pages to practice problems. Students do not have to think and develop mathematics in new situations. In addition, Silver and Smith (nd) also stress that traditionally students answer specific questions, usually having only one correct solution, without communicating with others. It is rare that students are asked to justify their thinking. Schoen, Fey, Hirsch & Coxford (1999) agree that traditional classroom assessment emphasizes “short-answer questions and computational exercises presented in formats that can be scored quickly and ‘objectively’”.

How do the standards express change for mathematics curriculum? “The NCTM standards state what we should value in mathematics teaching and learning... [Curriculum] should have a broad range of content. Students should have experience with data gathering, probability and statistics, geometry and spatial thinking, the study of ratio and proportions, and algebraic thinking” (NCREL, 1994). Ferrini-Mundy &

Johnson (1994) imply that the standards are intended to direct and guide curricula. Even more recently, Schoen & Prichett (1998) indicate that students should go beyond applying mathematical procedures; they should be posing questions, making conjectures and justifying their thinking. “Calls for change in school and collegiate mathematics are in response to consistent evidence that traditional American approaches to mathematics education do not yield satisfactory student learning” professes Fey (2000). Students in traditional mathematics classes, maintains Evans (1998), observe math class as a “list of algorithms that [lead] to nothing but more mathematics having nothing to do with preparing them for adult life.” The National Assessment of Educational Progress (NAEP) has documented “...decades of poor performance...” of traditional programs (Reys, 2001, p. 7).

But how should this change take place? Ferrini-Mundy & Johnson (1994) allege teachers want to know how to implement the standards. They ask, ‘what does a standards classroom look like; and, do classrooms and curricula exist that implement the standards?’ Garet & Mills (1995) state:

The Standards document has attracted much attention as a national model of reform distinguished by the major leadership role played by the teaching profession. However, the proposed changes are a substantial departure from conventional practice, and considerable evidence suggests that reforms of this type advocated by the curriculum and evaluation standards are difficult to translate into action and hard to sustain. (p. 380)

Teachers need to create an environment that encourages students to explore and discuss mathematical ideas. Students need to be engaged in problem-solving (NCREL, 1994).

“If a district wants to change its mathematics curriculum, much more have to change than the cover on the book” asserts Ohanian (1997). Even innovative curriculum can be taught “with a layer-cake approach, emphasizing answers over processes, strategies over

understanding” (p. 27). Bybee, Ferrini-Mundy & Loucks-Horsley (1997) declare that the teaching of procedures and skills in mathematics should be embedded within problem solving instead of traditionally giving word problems as a means of showing application of particular skills. But this is not an easy task. “Change entails the construction and institutionalization of a new community of practice, which is facilitated by departmental leadership that encourages teacher collaboration, collegiality, and shared decision making and supports teachers in developing a new set of values, beliefs, and routines” (Garet & Mills, 1995, p. 387).

The role of the teacher changes in a standards-based classroom. The NCREL (1994) argues that the teacher’s role in a standards classroom “changes from dispenser of knowledge to facilitator of communication, discussion, critical thinking, and generator of alternative solutions to problems” (p. 6). New programs encourage active engagement of students in problem-solving instead of students passively watching teachers demonstrating computational techniques concurs Fey (2000). In addition, Ohanian (1997) stresses “the teacher’s role must shift away from dispensing information to facilitating learning, from that of director to that of catalyst and coach” (p. 26).

The way students learn mathematics in the classroom must also change according to the standards document. Stiff (2001) contends classrooms should be mathematical communities where students often work together, questioning and reasoning, sharing and connecting. Prichard & Bingaman (1993) researched British mathematics instructors’ observations of students working together. They found that students were forced to communicate ideas, and discussion gave students an opportunity to explore their difficulties. Arranging student desks in group settings is not enough, though. Problems

for collaborative work need to be selected carefully. These problems should allow students to construct mathematics. Students constructing knowledge is “more powerful than any mathematics they learn only through rote memorization or independent work” (Evans, 1998, p. 12).

How are each of these standards-based curriculums organized? Is there evidence of their use and success? Each of the programs mentioned here are supported by research and extensive field-testing.

Core-Plus Mathematics Project

NCREL (1994) describes the curriculum of the Core-Plus Mathematics Project [CPMP] as featuring the strands of algebra/functions, geometry/trigonometry, statistics/probability, and discrete math. These strands are studied each of three years connecting “themes of data, representation, shape, change, and chance” (p. 5). Kysh (1995) contends that the materials of CPMP engage a greater number of students and are more challenging to higher level students. In agreement, Schoen, et al. (1999) claims CPMP materials “recognize the pivotal roles played by small-group collaborative learning, social interaction, and communication in construction of mathematical ideas” (p. 448). Evans (1998) concurs, “I have never taught a mathematics program that uses such rich applications with the student at the center of learning” (p.12). CPMP was funded by a 5-year grant from the NSF. Students investigate real-life contexts which lead to a reinvention of important mathematics thus making sense to students. The thrust is on mathematical thinking and communicating. Assessment is handled differently. Instead of using only individual quizzes and tests, students are assessed by group work,

journals, take-home unit tests, extended projects and portfolios (Hirsch, Coxford, Fey & Schoen, 1995).

How are CPMP students doing? After field-testing within a broad range of environments and diverse student populations, CPMP students “illustrated better understanding of, and ability to reason in quantitative situations than the nationally representative norm group” (Schoen, Hirsch & Ziebarth, 1998, p. 38). Schoen, Fey, Hirsch & Coxford (1999) reported that each CPMP course was field tested from 1994 to 1997 in 36 high schools in 11 different states with more than 4000 students. In the Ability to Do Quantitative Thinking [ATDQT] assessment, which measures mathematical reasoning, CPMP students significantly outscored the norm group. On interviews with students, traditional students showed basic misunderstandings between verbally stated problems and mathematical models. Kysh (1995) noted that more students were continuing in the CPMP tract, and students of all ethnic groups scored better than students in traditional tracts at the same school in end of the year assessments in 1992-94. Using the 1997 results of 1292 CPMP students in 23 field test schools, NCTM revealed that the National Assessment of Education Progress [NAEP] showed these students scored over 13% higher than the national average of non-CPMP students that took the test. In addition, CPMP students were more positive about their mathematical experiences than traditional students as reported by a 1998 attitude survey of field tested schools (Schoen & Prichett, 1998).

Interactive Mathematics Program

Similarly, the Interactive Mathematics Program (IMP) is a four-year curriculum that replaces the traditional sequence. In IMP, algebra, geometry and trigonometry are

taught together in a problem-solving process. Additionally, IMP integrates probability, statistics, logic and number theory among other non-traditional subjects (Ohanian, 1997).

Alper, et al., (1995) observe that

The IMP curriculum challenges students to explore open-ended situations actively, in a way that closely resembles the inquiry method used by mathematicians and scientists in their work. Unlike some curricula of the past that have emphasized rote learning of isolated mathematical skills, IMP calls on students to experiment with examples; look for and articulate patterns; and make, test, and prove conjectures.” (p. 633)

Additionally in 1996, Alper, et al. maintains that IMP is designed to be a comprehensive high-school program and has been used in classrooms since 1989 fulfilling the vision of the NCTM standards. In IMP, mathematics has real meaning. Students do not need to do repetitive skills because they are learning and developing the mathematics in context.

Cuoco, Goldenberg & Mark (Ed., 1995) discovered that within the IMP curriculum “electronic technology [is]...allowing teachers and curriculum designers to focus more on mathematical ideas and to devote less classroom time to students’ mastery of mechanical and computational skills” (1995). IMP begins with a motivating problem, too difficult to solve. Students learn mathematics in order to solve the central problem.

Traditionally, programs have tried to shield students from failure. The developers of IMP feel that all students are capable of thinking about mathematics and conceptual understanding. Students need to be immersed “in thought-provoking situations” (Alper, et al., 1995, p. 635).

College Preparatory Mathematics

Likewise, College Preparatory Mathematics (CPM) is a 1989 Eisenhower funded project. Its goals are “1) to develop a rich, integrated mathematics curriculum, which enables more students, especially those groups historically underrepresented in

mathematics, to succeed in a college-preparatory mathematics sequence, 2) to base this curriculum on the best current wisdom of how people learn and the mathematics needed in an era of computers, and to fit these topics into the context of current school programs with course titles Algebra I, Geometry, and Algebra 2, and 3) to involve teachers fully in planning, developing, using, revising, and introducing to their colleagues the new materials and new teaching techniques” (Kysh, 1995, p. 660). In addition, Kysh insists that although the changes in content and problem-solving emphasis are substantial, the biggest changes are in teaching methods and assessment. CPM is one of the programs named exemplary by the U.S. Department of Education (1999). In determining this status, nine separate studies were examined. CPM students achieved significantly better in responses to open-ended questions utilizing problem-solving skills, in algebra and geometry examinations, and in SAT scores. In addition, as reported in the CPM On-line Newsletter (November 2001), CPM students scored 6-10% above the California average in the Stanford Achievement Test (SAT9) during the first 3 years(1998, 1999 and 2000) of its use. Hoey, ed. (November, 1999) advises that within the CPM curriculum “focus [is] on core threads like graphing, functions and mathematical reasoning, [these are] then develop[ed] throughout a course and over several courses...Most of the procedural skills and related topics will then arise in context and in relation to the ‘bigger ideas’ of mathematics” (p. 8).

Systemic Initiative for Montana Mathematics and Sciences

Furthermore, the Systemic Initiative for Montana Mathematics and Sciences [SIMMS] was developed through a 5 year project funded through the NSF and the state of Montana. The SIMMS curriculum is organized into six levels. Students can focus on

a math/science sequence or on statistical concepts. Students are encouraged to develop and test mathematical models (Martin, et al., 2001). Martin also asserts that the SIMMS curriculum incorporates all of the content standards named in the Standards. In a report by the NCTM of results of a 4-year field test, SIMMS students scored significantly better on a standardized End-of-Year Test. In 1997, 40% of SIMMS students scored in the top two categories of Exemplary and Satisfactory, while only 18% of non-SIMMS students scored in this range. Students in SIMMS use spreadsheets to gather and organize data, graphing calculators to solve problems visually, and geometry software to explore fractals, trigonometry, conic sections and other geometry topics.

MATH Connections

In addition, MATH Connections is a three-year secondary mathematics core curriculum that focuses on algebra, geometry, trigonometry, statistics and probability. Built around connections between mathematics and the real world of people, business and everyday life; mathematics and science; mathematics and other subjects such as history, geography, language and art, MATH Connections follows the recommendations of the National Council of Teachers of Mathematics' Standards for excellence in mathematics" (NCTM, 2001, ¶ 1). In a study reported by the NCTM in 2001, Crosby High School, an inner-city school in Waterbury, Connecticut placed 1/2 of their Algebra 1A1B students randomly in MATH Connections. Teachers said this program involved students and emphasized practical applications. Students outperformed peers on state test, Connecticut Achievement Performance Test (CAPT). 73% of MATH Connections students scored in the top two scoring bands, while only 48.5% of Algebra 1A1B students

scored in this range. Mean and median scores were remarkable higher, by at least 20 points on a test whose range of scores was 100-400.

Critics of Reform

The reform movement and standards-based curriculums have not been accepted whole-heartedly by all. One of the most significant anti-reform movements occurred in California. In 1995, in response to what politicians saw as 'failed reform', a law was passed "requiring the state board to adopt instructional materials that [were] 'based on the fundamental skills...including basic computational skills'" (Becker & Jacob, 2000, p. 530). In 1987, the state had published a document, *Mathematics Model Curriculum Guide*, which had teaching for understanding as its basis. This policy has all but vanished from curriculums as procedural skill mastery has taken its place. Another example of anti-reform took place at a February 2000 congressional hearing "Federal Role in Mathematics Reform". Reys, in a 2001 *Mathematics Teacher* article states that one speaker at this hearing "alleged that children were being used as guinea pigs for untried curricula." On the contrary, he continues, "the NSF programs that receive the most intense criticism have undergone unprecedented field-testing over at least three years" (p. 6).

Summary

As shown by the research, the standards-based secondary curriculums mentioned have been thoroughly researched, field-tested and shown to be successful. However, these programs are yet to be used on a broad scale. Ferrini-Mundy, et al. (1997) state that "If the ... mathematics education community can support standards-based approaches to reform, we will have common frameworks, views, language, and perspectives, as we

systematically confront the challenges of improving ... mathematics education” (p. 332). Fey (2000) states that “implementation of innovative curricula is being watched closely...but there is certainly plenty of evidence justifying exploration of new approaches to school mathematics” (p. 56). So why are teachers and administrators not embracing these programs? Reys (2001) reminds educators to work together to develop “mathematics programs that help all students engage in learning relevant and challenging mathematics” (p. 7).

Chapter 3

Methodology

Southern New Jersey includes the counties of Gloucester, Camden, Salem, Burlington, Cumberland, Atlantic, Ocean and Cape May. According to the 2000 Census, southern New Jersey contains 3631 square miles with a population of 2,263,486. Compared to the state of New Jersey, these eight counties comprise 49% of the area and 27% of the population. The 1997 median family income for this area varies from a low of \$34,935 in Cumberland County to a high of \$52,543 in Burlington County. This compares to a median family income of \$47,903 in the state of New Jersey and \$37,005 in the United States. The ethnicity of these counties varies from 66% to 93% white, with minority populations the highest in Cumberland (34%) and Camden (29%) counties. The southern New Jersey area is a mixture of urban, suburban and rural. The most populated county is Camden with 2292.5 people per square mile, whereas Salem is the least dense with only 190.2 people per square mile. Both income and population in southern New Jersey have risen since the 1990 census.

Mathematics department chairpersons in 135 secondary schools in southern New Jersey were asked to participate in the survey. Participants were sent a self-addressed stamped envelope in which to return the survey. The survey was sent on January 15, 2002 and asked to be returned by February 15, 2002. To expedite return of surveys, participants were asked to return an index card with name and address. Two of these cards were selected to receive a silver edition TI-83+ graphing calculator. Information on index cards was kept separate from the survey.

The survey of 27 questions was divided into 3 parts: 1) demographic information, 2) questions on standards-based curriculums, and 3) philosophical questions. The work

of Markward (1996) was used in part to develop the survey. Part 1 of the survey determined the population characteristics and participant information. Part 2 was utilized to determine what curriculums were currently being used. Likert scale questions were asked in part 3 to assist in determining mathematical philosophy.

Specific questions on the survey corresponded to each research question. Each research question is listed below along with the survey questions that correlate to it.

Research Question #1: “What curriculums are currently being used in southern New Jersey?” was answered with questions 15 – 17 in part 2 by the participant writing the name of the current curriculum used. A tally was done to determine the curriculums most widely used.

Research Question #2: “Are teachers informed about Standards-based curriculums?” was answered with questions 13 and 14 in part 2. In question 13, the participant was asked to identify known standards curriculums. From this information, a tally of each curriculum listed was calculated. A 4-point Likert scale was used in question 14 to determine extent of knowledge for each listed program. The responses were very knowledgeable, somewhat knowledgeable, limited knowledge and never heard of. The mean was calculated from these responses.

Research Question #3: “If teachers are informed about standards-based curriculums, what are their opinions about them and the philosophy behind them?” was answered by the 11 questions in part 3 of the survey. A 5-point Likert scale was used with responses being strongly agree, agree, neutral, disagree and strongly disagree. Questions 17, 19, 21, 22

and 25 correlate positively to the philosophy of standards curriculums; while questions 18, 20, 23, 24, 26 and 27 correlate negatively to the philosophy of standards curriculums. The mean and standard deviation for each question was calculated to determine philosophy of participants.

Chapter 4

Results of the Study

A total of 135 surveys were sent to mathematics department chairpersons in eight counties in southern New Jersey. Participants were sent a self-addressed stamped envelope for return of survey. To expedite return, participants were entered into a drawing for one of two TI83+ graphing calculators if they returned an index card with their name and address. Sixty surveys were returned for a return rate of 44.4%. Forty-seven index cards were returned for a return rate of 34.8%. Table 4.1 summarizes the demographic information from Part 1 of the survey.

Table 4.1 *Demographics*

Professional Membership			Gender		
	#	Percent		#	Percent
NCTM	37	61.7%	Male	30	50%
AMTNJ	31	51.7%	Female	30	50%
School Location			County		
Rural	13	21.7%	Atlantic	4	6.7%
Suburban	36	60%	Burlington	9	15%
Urban	11	18.3%	Camden	19	31.7%
School Enrollment			Cape May	2	3.3%
less than 500	12	20%	Cumberland	3	5%
501-1000	23	38.3%	Gloucester	8	13.3%
1001-1500	11	18.3%	Ocean	9	15%
greater than 1500	14	23.3%	Salem	6	10%
Years Teaching Mathematics			Degrees Earned		
less than 5	7	11.7%	BA in math/math ed	27	45%
5 to 10	5	8.3%	BA in another field	12	20%
11 to 15	7	11.7%	MA in math/math ed	22	36.7%
16 to 20	4	6.7%	MA in another field	16	26.7%
more than 20	32	53.3%	Other	5	8.3%
Administrative Responsibilities			Control of Math Curriculum		
Yes	48	80%	None	0	0%
No	12	20%	Little	4	6.7%
			Some	16	26.7%
			Very Much	37	61.7%

In Table 4.1, where the totals in any category are greater than 60, respondents gave more than one answer in that category. As indicated in Table 4.1, there was an even split in gender of department chairpersons, with exactly 30 (50%) male and 30 (50%) female answering the survey. Thirty-two (53.3%) of the survey participants have been teaching for more than 20 years. Forty-eight (80%) of the respondents reported having administrative responsibilities. Thirty-seven (61.7%) of those surveyed stated very much control over the math curriculum.

Analysis of Research Questions

Research Question #1: What curriculums are currently being used in southern New Jersey?

Questions 15, 16 and 17 in Part 2 were used to answer research question 1. In question 15, participants were asked yes or no if their school used one of five listed standards-based curriculums. Question 16 asked what percent of students used this curriculum. The information is summarized in Table 4.2. Of the 60 surveys returned, 10 participants (16.7%) reported use of one or more of the five standards-based curriculums, i.e. Core-Plus, IMP, Math Connections, SIMMS, or College Prep Math. Five respondents stated the use of the Core-Plus curriculum. Of the five, two schools reported use of Core-Plus with 0-25% of the students, while one school reported using this curriculum in each of the other 3 other percent categories: 26-50%, 51-75% and 76-100%. Two participants reported use of the IMP curriculum with one school using IMP with 0-25% of its students and one school reporting use with 26-50% of its students. Four participants reported use of the Math Connections curriculum. One of the schools reported use with 0-25% of the students and three reported use with 26-50% of the

students. Two of the curriculums listed, SIMMS and College Preparatory Math, was not listed as being used by any of the schools that responded.

Table 4.2 *Frequency of use of selected Standards-based Curriculums*

Standards Curriculums Used					
Standards-based Curriculums	Q15	Q16			
	# of schools listing use	Percent of student use in school			
		0-25%	26-50%	51-75%	76-100%
Core-Plus	5	2	1	1	1
IMP	2	1	1		
Math Connections	4	1	3		
SIMMS	0				
College Prep Math	0				
Total In Use	11	4	5	1	1

Question 17 asks what major curriculum or textbook series is being used in their district. A listing of the publishers of the textbooks used is listed in Table 4.3 and the number of times participants listed its use. Some districts stated the use of more than one series. As indicated in the table 4.3, 17 (28%) of the participating schools use textbooks published by McDougal/Littell.

Table 4.3 *Frequency and Percent of curriculums in use by South Jersey Schools*

Textbook Series Used		
Publisher	# used by	Percent
Addison/Wesley	2	3.3%
Glencoe	8	13.3%
Holt	6	10%
Houghton/Mifflin	3	5%
Key Curriculum	4	7%
McDougal/Littell	17	28%
Merrill	3	5%
Prentice/Hall	5	8.3%
UCSMP	1	1.7%
"Several"	2	3.3%
Other Responses	6	10%

Research Question #2: Are teachers informed about Standards-based curriculums?

Questions 13 and 14 of Part 2 of the survey were used to answer this question. Table 4.4 summarizes the information. Of the 60 respondents reporting, the most recognizable standards-based curriculum is University of Chicago School Mathematics Project (UCSMP) with 43 (71.7%) reporting recognition. Interactive Mathematics Program (IMP) was recognized by 40 (66.7%) of those surveyed. Contemporary Mathematics in Context (Core-Plus) and Mathematics Connections were both recognized by 32 (53.3%) of respondents. Only 3 (5%) of those responding reported recognition of either of the curriculums Cognitive Tutor or I Can Learn.

Table 4.4 *Frequency and percent recognition of Standards Curriculums*

Knowledge of Standards-based Curriculums		
	#	Percent
Core-Plus	32	53.3%
IMP	40	66.7%
Math Connections	32	53.3%
SIMMS	10	16.7%
College Prep Math	18	30%
Discovering Algebra	29	48.3%
Cognitive Tutor	3	5%
Connected Geometry	19	31.7%
UCSMP	43	71.7%
Mathematics Modeling Our World	7	11.7%
I Can Learn	3	5%

Question 14 asks how knowledgeable respondents were with each of five named standards-based curriculums. This information is summarized in Table 4.5. Respondents had the most knowledge about Interactive Mathematics Program (IMP). Twenty-five (41.6%) of those surveyed reported being somewhat or very knowledgeable about IMP. Twenty-one (35%) stated being somewhat or very knowledgeable of the Math

Connections program, while 18 (30%) of the survey participants reported being at least somewhat knowledgeable of Core-Plus. Respondents conveyed the least amount of knowledge with SIMMS and College Prep Math. Thirty-six (60%) stated no knowledge of SIMMS, while twenty-nine (48.3%) reported no knowledge of College Prep Math.

Table 4.5 *Frequency, Percent, Mean and Standard Deviation of Standards-Based Curriculum Knowledge*

Range of Knowledge of Specific Standards-Based Curriculums						
	1	2	3	4	Standard	
	Very knowledgeable	Somewhat knowledgeable	Limited knowledge	Never heard of	Mean	Deviation
Core-Plus	3 (5%)	15 (25%)	23 (38.3%)	18 (30%)	2.95	0.88
IMP	5 (8.3%)	20 (33.3%)	21 (35%)	13 (21.7%)	2.71	0.91
Math Connections	8 (13.3%)	13 (21.7%)	20 (33.3%)	16 (26.7%)	2.77	1.02
SIMMS	0 (0%)	4 (6.7%)	17 (28.3%)	36 (60%)	3.56	0.63
College Prep Math	6 (10%)	8 (13.3%)	15 (25%)	29 (48.3%)	3.16	1.02

Research Question #3: If teachers are informed about standards-based curriculums, what are their opinions about them and the philosophy behind them?

The 11 questions in part 3 of the survey were used to answer this question. A 5-point Likert scale was used to analyze the responses. Table 4.6 summarizes the questions that correlate positively to standards-based curriculums.

Question 19: *It is important for students to work with data and make decisions early in their mathematical experience.* Fifty-five (91.7%) of those surveyed responded agree or strongly agree with this statement. The mean of the Likert scores was a 1.55 (1 being assigned to a response of strongly agree) with a standard deviation of 0.70.

Question 21: *Mathematics is more about conceptual ideas than about memorizing rules for computation.* Forty-seven (78.3%) of respondents answered with agree or strongly

agree to this statement. The mean of responses to this question was 2.12 with a standard deviation of 1.04.

Question 25: *Mathematics should be presented to students in such a way that they can discover mathematical relationships for themselves.* Forty-six (76.7%) of survey participants responded with agree or strongly agree with this statement. The responses to this question had a mean of 2.12 with a standard deviation of 0.69.

Table 4.6 *Frequency, mean and standard deviation of positively-correlated questions*

	1	2	3	4	5	Mean	Standard Deviation
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree		
Q17	20 (33.3%)	24 (40%)	14 (23.3%)	2 (3.3%)	0 (0%)	1.97	0.84
Q19	33 (55%)	22 (36.7%)	4 (6.7%)	1 (1.7%)	0 (0%)	1.55	0.70
Q21	17 (28.1%)	30 (50%)	3 (5%)	9 (15%)	1 (1.7%)	2.12	1.04
Q22	21 (35%)	20 (33.3%)	3 (5%)	14 (23.3%)	2 (3.3%)	2.27	1.26
Q25	9 (15%)	37 (31.7%)	12 (20%)	2 (3.3%)	0 (0%)	2.12	0.69

Table 4.7 summarizes the questions that correlate negatively to standards-based curriculums.

Question 18: *Students should be competent in working with numbers and operations prior to studying higher level content.* Forty-seven (78.3%) of those surveyed gave the answer of agree or strongly agree to this statement.

Question 20: *The study of mathematics is best when it is isolated from other curriculum areas.* Fifty-four (90%) of respondents disagreed or strongly disagreed with this statement. The mean for responses was 4.38 on the Likert scale of 1 to 5 (5 being assigned to the response of strongly disagree) with a standard deviation of 0.87.

Question 23: *It is important for students to realize that it is more valuable to master mathematical skills than it is to understand mathematics.* Fifty (83.3%) of survey

participants responded with disagree or strongly disagree to this statement. The mean for responses to this question was 4.15 with a standard deviation of 0.88.

Question 24: *Problem-solving should be a separate distinct part of the mathematics curriculum.* Fifty-five (93.2%) of those surveyed answered with disagree or strongly disagree to this statement. The mean of this questions response was 4.44 with a standard deviation of 0.73.

Table 4.7 *Frequency, mean and standard deviation of negatively-correlated questions*

	1	2	3	4	5	Mean	Standard Deviation
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree		
Q18	27 (45%)	20 (33.3%)	7 (11.7%)	6 (10%)	0 (0%)	1.87	0.98
Q20	1 (1.7%)	2 (3.3%)	3 (5%)	21 (35%)	33 (55%)	4.38	0.87
Q23	1 (1.7%)	2 (3.3%)	7 (11.7%)	27 (45%)	23 (38.3%)	4.15	0.88
Q24	0 (0%)	2 (3.4%)	2 (3.4%)	23 (39%)	32 (54.2%)	4.44	0.73
Q26	3 (5.2%)	18 (31%)	10 (17.2%)	22 (37.9%)	5 (8.6%)	3.14	1.12
Q27	3 (5.2%)	16 (27.1%)	19 (32.2%)	17 (28.8%)	4 (6.8%)	3.05	1.02

Chapter 5

Summary and Recommendations

The authors of NCTM's *Principles and Standards of School Mathematics* profess that "learning mathematics without understanding has been a common outcome of school mathematics instruction" (pg. 20). Should schools be concerned about this lack of student understanding in math classrooms? Reys (2001) acknowledges that "we must use our collective energies and wisdom to elevate our efforts to work together in developing mathematics programs that help all students engage in learning relevant and challenging mathematics throughout their K-12 experience (pg 7). The standards-based programs, IMP, Core-Plus, Math Connections, SIMMS and College Prep Math, many funded by the National Science Foundation, address the need to change. These programs emphasize problem-solving, make use of technology, encourage students to communicate ideas and vary assessment (Reys, Robinson, Sconiers & Mark, 1999, pg. 455). Many traditional textbooks have attempted to address the standards by including technology lessons and more applications. Most teachers, it seems, are still using these new-looking but traditional textbooks.

Standards-based instruction replaces the predominant teaching methods of drill and practice with investigation, group discussion, and oral and written justification of ideas (Schoen, Fey, Hirsh & Coxford, 1999, p. 446). According to the research of Alper, et. al. (1998), Schoen, et. al. (1999), Martin (2001), and Silver and Smith (nd), the traditional methods of teaching mathematics do not encourage students to think about the mathematics they are doing. Students are usually expected to memorize procedures, and then regurgitate these procedures on a multitude of problems. Teachers must believe in the philosophy behind the standards-based programs for success to occur in the

classroom. Kysh (1995), Ohanian (1997) and Fey (2000) all agree that the teacher must become a facilitator within the classroom where students are “self-directed learners rather than people who wait for instructions” (pg. 26).

In chapter 2, five programs were introduced. These are Core-Plus Mathematics Project, Interactive Mathematics Program, College Preparatory Mathematics, Systemic Initiative for Montana Mathematics and Science, and MATH Connections. In comparing these programs with the *Standards*, Martin, et. al. (2001) found that each series is consistent with the expectations of the NCTM *Standards*. Not only is the content consistent, but the pedagogy envisioned by the authors of the *Standards* is reflected in these 5 programs. In addition, these programs have also been thoroughly field-tested and proven to be successful (Hirsch, et. al., 1995) (Schoen, et. al., 1999) (NCTM, 2001). Students have done as well, if not better, on standardized tests, including the SAT. More importantly, students are staying with mathematics longer (Alper, et. al., 1995), have a better understanding of the use of mathematics, and a better attitude towards math class and their role as math students (Schoen & Prichett, 1998).

To determine knowledge and use of standards-based curriculums, a survey of 28 questions was developed with the aid of work by Markward (1996) and sent to 135 department chairpersons in school districts in southern New Jersey. A return rate of 44.4% was received. The demographic information finds that 52% of department leaders have more than 20 years experience. In addition, 62% stated having very much control over the curriculum. The return rate per county was not significant; larger populated counties returned more surveys.

What curriculums are currently being used in southern New Jersey? Most schools

in southern New Jersey are using a traditional textbook series with their classes. Only ten schools out of 60 use one of the five listed standards-based curriculums with any of their students. Of these ten, only two schools use these curriculums with more than 50% of their students. Therefore, the standards-based curriculums are not being used by teachers in southern New Jersey.

There are a number of possible reasons for the low infusion of these curriculums. As shown in the survey results, teachers are not informed or knowledgeable about standards-based curriculums. Only four of the 11 standards-based curriculums were recognized by more than half of those answering the survey. Teachers seemed to have slightly more knowledge of the five curriculums that were researched in chapter two. Although two of those listed, SIMMS and College Prep Math were not recognized at all by the majority. Most survey participants had at least limited knowledge of Core-Plus, IMP and Math Connections. Having limited knowledge, though, may not be enough to understand the difference these curriculums can make in the classroom.

Teachers seem to agree with the philosophy of standards-based curriculums. According to part three of the survey, most department chairpersons agree with the following statements:

- *It is important for students to work with data and make decisions early in their mathematical experience.*
- *Students learn mathematics best by listening to the ideas of others, asking questions, making mistakes, and summarizing their discoveries.*
- *Mathematics is more about conceptual ideas than about memorizing rules for computation.*

- *Mathematics should be presented to students in such a way that they can discover mathematical relationships for themselves.*

The above statements are consistent with the philosophy of the NCTM's *Standards* document and with the philosophy of the standards-based curriculums researched in chapter two. Teachers seem to agree about the most effective way students learn. Their teaching methods, though, as shown by the choice of textbook, do not reflect this thinking. I believe teachers may be hesitant to change because the standards-based programs may seem radical compared to traditional methods. Teachers are used to using textbooks with lessons broken into neat, compartmentalized units. Development of skills outnumbers lessons with applications. The problem is that students rarely see a connection between math and anything else in their life. Students should feel that math is useful. They should be able to connect it to other subjects and appreciate its value.

Likewise, those answering the survey disagreed with questions that do not correlate to the standards and the researched curriculums:

- *The study of mathematics is best when it is isolated from other curriculum areas.*
- *Problem-solving should be a separate, distinct part of the mathematics curriculum.*
- *It is important for students to realize that it is more valuable to master mathematical skills than it is to understand mathematics.*

Over 83% of department chairpersons disagreed with the above statements. Yet, traditional textbooks for the most part teach skills, do not integrate, and keep problem-solving separate. How can teachers disagree with these statements, yet use textbooks that still “do it the old way?”

This study begins to answer the questions of knowledge and use of standards-based curriculums. A similar survey needs to be expanded to a broader geographic area, perhaps to the state of New Jersey or to the Delaware Valley which encompasses southern New Jersey, eastern Pennsylvania and Delaware. In addition, follow-up studies should be done to understand the implications of districts that adopt standards-based curriculums and those that do not.

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Appendix

Standards-Based Mathematics Curriculum Survey

January 15, 2002

Dear Mathematics Department Chairperson:

I am a 20-year veteran mathematics teacher. I have worked diligently researching a topic I believe is extremely important to mathematics education. As part of my thesis research, I am conducting a survey regarding Standards-based mathematics curriculums. Mathematics department chairpersons in southern New Jersey have been invited to participate in this study. I am working in association with Dr. Eric Milou of Rowan University as a student in the Mathematics Education master's degree program.

I ask for your assistance in filling out the accompanying Standards-Based Mathematics Curriculum Survey. It should take ten minutes or less of your time. When you have finished, please return the survey in the pre-addressed stamped envelope. Please return the survey by February 15, 2002. I assure you that the information will be kept confidential; individual respondents will not be identified in any manner.

Thank you for taking the time to complete this survey. I know you are busy and possibly receive many surveys, but I feel that this information can be very useful to school districts in our area. If you have any questions you may contact me by phone at (856) 468-1445 X2218 or e-mail me at tterpdd@aol.com. Dr. Milou can be contacted by phone at (856) 256-4500 X3876 or e-mailed at milou@rowan.edu.

When you return the survey, please complete the separate card with your name and address. Two schools, from the surveys returned, will be chosen to receive a TI-83+ Silver Edition graphing calculator. This information will be kept separate from the survey.

Sincerely,

Nancy D. Ciandella

Standards-Based Mathematics Curriculum Survey – PART 1 – Demographics

Please complete Part 1 of the survey by marking the appropriate box(es).

1. Are you a member of :
 - a. The National Council of Teachers of Mathematics?
 yes no
 - b. The Association of Mathematics Teachers of New Jersey?
 yes no
2. What is your sex?
 male female
3. Describe your school location:
 rural suburban urban
4. What county is your school located in:
 Atlantic Burlington Camden Cape May

 Cumberland Gloucester Ocean Salem
5. School enrollment:
 less than 500 501- 1000 1001-1500 greater than 1500
6. Number of years teaching mathematics:
 fewer than 5 5-10 11-15 16-20 more than 20
7. Which best describes your professional degree(s)? Check all that apply:
 BA in mathematics or mathematics education
 BA in another field
 MA or MED in mathematics or mathematics education
 MA in another field
 other _____
8. Do you have mathematics administrative responsibilities in your school?
 yes no
9. How much control do you have regarding what mathematics curriculum you teach?
 none little some very much

Part 2 – Standards-based Curriculums

10. Have you heard of the *Principles and Standards for School Mathematics* (NCTM Standards)?
 yes no If no, skip to item 13
11. To what extent have you read the *Standards*?
 read it completely read it in part skimmed it

12. To what extent do you feel that the *Standards* have changed your teaching?
 greatly changed moderately changed changed very little not changed at all

13. Which of the following curriculums are you aware of? (check all that apply)

- Contemporary Mathematics in Context (Core-Plus)
- Interactive Mathematics Program (IMP)
- Mathematics Connections: A Secondary Mathematics Core Curriculum
- Systemic Initiative for Montana Mathematics and Sciences (SIMMS)
- College Preparatory Mathematics
- Discovering Algebra
- Cognitive Tutor
- Connected Geometry
- University of Chicago School Mathematics Project (UCSMP)
- Mathematics Modeling Our World
- I Can Learn

14. How knowledgeable are you with each of the following curriculums:

a. Contemporary Mathematics in Context (Core-Plus)

- very knowledgeable somewhat knowledgeable limited knowledge never heard of

b. Interactive Mathematics Program (IMP)

- very knowledgeable somewhat knowledgeable limited knowledge never heard of

c. Mathematics Connections: A Secondary Mathematics Core Curriculum

- very knowledgeable somewhat knowledgeable limited knowledge never heard of

d. Systemic Initiative for Montana Mathematics and Sciences (SIMMS)

- very knowledgeable somewhat knowledgeable limited knowledge never heard of

e. College Preparatory Mathematics

- very knowledgeable somewhat knowledgeable limited knowledge never heard of

15. Is your school currently using any of the curriculums listed in question 14?

- yes, list the one(s) using: _____
 no, skip to question #17

16. What percent of students use the curriculum listed in question 15?

- 0-25% 26-50% 51-75% 76-100%

17. If your school is not currently using one of the above mentioned curriculums, or if your school is using curriculums in addition to those above, list the major curriculum or textbook series used? _____

Part 3 – Philosophy

Please respond to each question in Part 3 by circling the appropriate letter.

- SA=strongly agree A=agree N=neutral D=disagree SD=strongly disagree
- SA A N D SD 18. Students learn mathematics best by listening to the ideas of others, asking questions, making mistakes, and summarizing their discoveries.
- SA A N D SD 19. Students should be competent in working with numbers and operations prior to studying higher level content?
- SA A N D SD 20. It is important for students to work with data and make decisions early in their mathematical experience.
- SA A N D SD 21. The study of mathematics is best when it is isolated from other curriculum areas.
- SA A N D SD 22. Mathematics is more about conceptual ideas than about memorizing rules for computation.
- SA A N D SD 23. Appropriate calculators should be available to all students at all times.
- SA A N D SD 24. It is important for students to realize that it is more valuable to master mathematical skills than it is to understand mathematics.
- SA A N D SD 25. Problem-solving should be a separate, distinct part of the mathematics curriculum.
- SA A N D SD 26. Mathematics should be presented to students in such a way that they can discover mathematical relationships for themselves.
- SA A N D SD 27. Mathematics consists of step-by-step procedures for solving equations and simplifying expressions.
- SA A N D SD 28. Mathematics is best taught in separate courses such as algebra and geometry.