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Development Of A Model For First Year Algebra Instruction: The Principal'S Role In Implementation

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DEVELOPMENT OF A MODEL FOR FIRST YEAR ALGEBRA INSTRUCTION: THE PRINCIPAL'S ROLE IN IMPLEMENTATION

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ABSTRACT

The purpose of this study was to consider the most effective way to deliver first-year algebra instruction to all students above the MiMH level and to assist secondary school principals in determining their role in the implementation of the algebraic instruction. The purpose of the study was achieved by answering the following questions:

1. What type of model of algebraic instruction can be developed that specifies ways in which a body of knowledge such as first-year algebra can be structured and presented so that it includes instructional components established by recent and current literature related to instructional methodology and effective schools, and yet meets the standards as established by the NCTM?

2. What role should secondary school principals play in the implementation of the narrative/graphic model of algebraic instruction that is developed?

The study used developmental research, a form of qualitative research that combines components of a case study with related research, to develop a narrative/graphic model that related the literature on the NCTM standards, inclusion, mastery learning, cooperative learning, and team teaching along with a case study of Covington (IN) High School students. A form of mastery learning developed by the author called the Controlled Unipack Management System (CUMS) was used as the major structure of the case study in

which all ninth grade students above MiMH level studied algebra for three semesters rather than the traditional two.

On the Indiana State Test for Educational Progress (ISTEP), students in the ninth grade made a substantial gain in mathematical computation (from 14 percent to 35 percent in the upper quartile). There were limited failures and a large decrease in discipline referrals. Anecdotal records showed that self-esteem of students and faculty was improved.

It was concluded that expanding the time constraints from a traditional two-semester Algebra I course to three-semesters appeared to be effective for all students above MiMH level when combined with a mastery learning concept like CUMS. The principal serves as a leader and facilitator in the implementation of the model for first-year algebra instruction.

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INTRODUCTION

One ongoing argument in education has to do with the problem of grouping. Ability grouping, tracking, homogeneous grouping, or phasing has been with us for generations. Pressures for excellence on the one hand and pressures for equality on the other hand have added to the dilemma of homogeneous or heterogeneous grouping. There seems to be a question of whether excellence in education can be achieved without homogeneous grouping.

Much study has been conducted about ability grouping that is carried to the extreme of rigid tracking. Ability grouping and tracking, according to Persell (1977), do not appear to produce the expected gains in student achievement. Findley and Bryan (1970) found that students of low or average ability do better in heterogeneous classes than they do when tracked in average or low groups. Schafer and Olexa (1970) found that students from lower tracks had lower self-esteem, more school misconduct, higher dropout rates, and higher delinquency. Track placement was shown to affect whether or not a students plan to go to college and the probability of their acceptance, regardless of their aptitude and grades (Alexander, Cook, & McDill, 1978). Goodlad (1984) found marked differences between high and low track classes:

> Consistently, the differences in curricular content, pedagogy, and class climate favored the former. Consistently, the practices and atmosphere of the low track classes conveyed lower academic and, indeed, more modest expectations generally, as well as greater teacher reinforcement of behaving, following rules, and conforming. Consistently, students from low economic status and from minorities were disproportionately represented: high frequency of membership in low track classes; low membership in high track classes. Almost without exception, classes not tracked into levels but containing a heterogeneous mixture of students achieving at all levels were more like high than low track classes in regard to what students were studying, how teachers were teaching, and how teachers and students were interacting in the classroom. (p. 159)

Not all students will benefit equally from lessons taught regardless of whether they are heterogeneous or homogeneously grouped. Goodlad and Oakes (1988) felt that tracking prejudges how much students will benefit and results in the absence of some students from the places where academically and socially valued subjects are taught. Algebra has long been considered academically and socially acceptable. Goodlad and Oakes (1988) stated:

> Nearly all can benefit from studying the concepts of algebra. Some will learn more, some less. But tracking excludes many children from ever being in classes where these "high status" subjects are taught. (p. 19)

Fenstermacher (1983) argued that some students may not benefit equally from unrestricted access to knowledge, but this should not entitle educators to control access in ways that effectively prohibit all students from what John Dewey called "the funded capital of civilization." Oakes (1985) stated, however, that simply mixing students together will not solve the practice of tracking. In 1987, the U.S. Secretary of Education James S. Bennett (Bennett, 1987) documented the remarkable academic success of poor, disadvantaged, and minority children, when they were given a chance at a solid education. Bennett stressed that there were too many schools that failed in their teaching, rather than students who failed or were incapable of learning. According to the Secretary, too many able and eager American students were not learning enough simply because of a mistaken assumption that they could not or would not learn.

The teaching of mathematics, as well as the use of homogenous or heterogeneous grouping in the teaching of it, has been on a pendulum swing from basics of traditional mathematics to the so-called "modern math." Present day Japanese economic success has caused the U.S. to look at the effectiveness of our mathematics instruction.

The National Assessment of Education Progress survey, popularly known as the "Nation's Report Card," tested 6,473 students in grades four, eight, and twelve in about 400 schools across the nation from January to May of 1990. Only five percent of the seniors showed an understanding of geometry, algebra, and beginning statistics and probability, which are all considered the gateway courses to advanced mathematics. According to the report, the mathematical skills of our nation's children are generally insufficient to cope with either on-the-job demands for problem solving or college expectations for mathematical literacy. Albert Shanker, president of the American Federation of Teachers, noted the report confirmed that U.S. students tend to do well in basic skills, such as adding and subtracting whole numbers. He also stressed that the American public must understand that the three R's are not enough. From the factory floors to high-tech offices, U.S. workers need a higher level of knowledge and skills (Nation's Students, 1992).

Mathematics requirements for high school graduation have increased in the United States; however, if increasing the requirements simply means adding more low level mathematics courses, not much will be accomplished. Although the National Commission on Education (1983) proposed that three years of mathematics be a national goal, Bennett (1987) pointed out that even if five years of math were required, students might not complete second-year algebra. Bennett stressed that it is good to set standards, but the standards are hollow when all that is added is time rather than expectations. He felt that the key was in what was taught.

Yield was defined by the International Association for the Evaluation of Educational Achievement (McKnight, 1987) as the product of two factors:

1. the proportion of young people in advanced mathematics courses
2. how much mathematics those students learn. (p. 61)

The report concluded that, based on results at the end of secondary school:

> the mathematical yield of U.S. schools may be rated as among the lowest of any advanced industrialized country taking part in the study. (p. 61)

The quality of teaching has been questioned because of:

> Declining test scores, lack of positive findings from major evaluation studies, concern over declining productivity in American industry, and criticism of entering college freshmen and Army recruits combined with ongoing concerns about public school performance . . . however, equity and efficiency have not been abandoned as fundamental policy goals. Rather, a tension among these three educational policy goals has been created. Some policymakers and some decisions continue to give primary attention to problems of the efficient use of resources, and some continue to give primary attention to equity problems. Clearly, however, demands for improved quality in the education received by America's children has become a dominant force in most state policy systems. (Mitchell, 1984, p. 4)

The nation's governors and the President of the United States (National Education, 1991) launched a ten-year effort to improve our nation's education in 1991 by establishing six National Education Goals. These efforts were an attempt to reach for world-class standards of educational performance.

Goal number 3 states:

> By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy. (p. 8)

The objectives to accomplish goal 3 included significant improvement of secondary students in academic performance in every quartile and substantial increase in the percentage of students who demonstrate the ability to reason, solve problems, and apply knowledge. The report stated that fewer than one in five students in grades four, eight, and twelve had reached the competency standard in mathematics. Only 18 percent of American eighth graders have the math knowledge they need, while only 16 percent of twelfth graders were shown to be competent.

Goal 4 sought a more global result: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement" (National Education, 1991, p. 8). To accomplish this goal, one objective was that math education would be strengthened throughout the system. The number of teachers with a substantive background in mathematics would have to increase by 50 percent. The report stated that in a 1980-1982 study that students from 12 nations significantly outperformed U.S. 13 year olds in one or more areas of mathematics. Better information was needed about methods used to teach mathematics in this country and how those methods differ from those used in nations that outperform the U.S.

In 1983, A Nation at Risk (National Commission, 1983) established guidelines for educators by identifying risk indicators. The Commission had found that only one third of the 17 year olds studied could solve a mathematics problem requiring several steps. Between 1975 and 1980, remedial mathematics courses increased by 72 percent and constituted one-fourth of all mathematics courses taught in those institutions. Average achievement test scores of high school students was now lower than they were when Sputnik was launched. Students had migrated in large numbers from vocational and college preparatory programs to "general track" courses. In 1979, the proportion of students taking a general program of study had increased from 12 percent to 42 percent. A 1980 state-by-state survey revealed that 35 states required only one year of mathematics. In 13 states, 50 percent or more of the units required for high school graduation could be electives chosen by the student. Given this freedom to choose the substance of one-half or more of their education, many students opted for less demanding personal service courses, such as bachelor living. The majority of students were able to master 80 percent of the material in some of their subject-matter texts before they had even opened the books. The Commission recommended the teaching of mathematics in high school should equip graduates to:

1. Understand geometric and algebraic concepts
2. Understand elementary probability and statistics
3. Apply mathematics in everyday situations
4. Estimate, approximate, measure, and test the accuracy of their calculations (p. 25)

The Commission indicated that new, equally demanding mathematics curricula needed to be developed for those who did not plan to continue their formal education. Because no textbook in any subject can be geared to the needs of all students, funds should be made available to support text development in areas of the disadvantaged students, the learning disabled, and the gifted and talented. They indicated that the time available for learning should be expanded by better classroom management and organization of the school day. They stated that if necessary, additional time should be found to meet the needs of slow learners, the gifted, and others who need more instructional diversity than could be accommodated during a conventional school day or school year (National Commission, 1983).

The Second International Mathematics Assessment showed that the concerns were real about Japan's mathematics curricula compared to the United States. American students in the top half of all classes scored comparable to their Japanese counterparts. In fact, American students taking algebra scored above the Japanese average. The Japanese, however, were far superior to American students in the bottom half. Compared to the Japanese, U.S. scores had an extraordinarily large variance (Baker, 1993). A large variance of curricula has been offered in the U.S. at the ninth grade mathematics level.

Restructuring of schools or school reform has been labeled as effective. Sizer (1990) felt that the nation's schools had become "shopping malls" because of the large curricula that failed to solidly teach the basic academic subjects. He believed that all students, not just the college-intending students, can thrive on rigorous academic courses. Sizer, however, has learned that no school can be improved without the assistance of a principal that is reform-minded and able to lobby artfully for change. The principal must not only change teachers' attitudes but also teachers' behaviors.

In their standards, the National Council of Teachers of Mathematics Board of Directors (Professional Standards, 1993) used the phrase "all students." The board believed their most compelling goal was the comprehensive mathematics education of "every child." They defined "every child" as:

1. students who have been denied access in any way to educational opportunities as well as those who have not
2. students who are African American, Hispanic, American Indiana, and other minorities as well as those who are considered to be a part of the majority
3. students who are female as well as those who are male
4. students who have not been successful in school and in mathematics as well as those who have been successful (Professional Standards, 1993, p. 4)

The board did not believe that every child would have the same interests or capabilities, but they indicated that schools would accept the responsibility and goal of a mathematics education for each child. They wanted schools to examine their fundamental expectations about what children could learn and "strive to create learning environments in which raised expectations for children can be met" (Professional Standards, 1993, p. 4).

Lezotte (1992) found that there were two generations of effective schools. The original correlates were valid and essential so that the mission of "learning for all" could be accomplished. A climate of high expectations for success was needed. Lezotte (1992) stated:

> In the effective school there is a climate of expectation in which the staff believes and demonstrates that all students can attain mastery of the essential school skills and they believe that they have the capability to help all students attain that mastery. (p. 14)

In the first generation, the principal directed initial teacher behaviors. In the second generation, responsive organizational behaviors need to be developed. Lezotte (1992) believed that the principal acted as the instructional leader to apply the characteristics of instructional effectiveness in the management of the instructional program. The first generation focused on the principal with the second generation's leadership more dispersed. As teachers were empowered, the principal was more of a leader of leaders.

The first generation of effective schools research emphasized learning of lower level skills, whereas the second generation focused on a higher level curriculum with more emphasis on learning the content covered. The effective school teachers allocated a significant amount of classroom time to the instruction of the essential skills. For a high percentage of time, students would be engaged in whole class or large group, planned teacher-directed, learning activities. Time on task and opportunity for all to learn required more flexible time structures (Lezotte, 1992).

Frequent monitoring of student progress was expressed by Lezotte to a product of the effective school. The first generation of monitoring and adjustment was conducted by the teachers. In the second generation, students monitored their own behavior, which meant that educational values must be clarified.

Melvin (1991) translated Deming's 14 points for education. He indicated that internally the school system needs to "assure all students are promoted with the skills and attitudes necessary for success at the next higher level of outcomes identified" (p. 20). Slogans that asked for zero defects were eliminated by Deming. Melvin (1991) quoted Deming, "Saying that all students will learn is a waste of time unless the system is changed to allow it to happen" (p. 23). Commitment and thoroughness were the keys both Deming and Melvin thought necessary for improvement of performance.

The mandates of P.L. 94-142 have intended to force mainstreaming into the public schools. Ohanian (P.L. 94-142, 1990) believed it was necessary to find out what was meant by mainstreaming children to their maximum extent appropriate to their needs. Ohanian (1990) stated:

> Many school districts lump all children with learning problems together in a sort of academic twilight zone. The educable mentally retarded, the low normal, the learning disabled (whatever that means), and the emotionally disturbed are all sent to regular English, science, social studies, and mathematics classes - until the situation becomes too traumatic either for the child or the teacher. (p. 219)

Inclusion, rather than mainstreaming, has been the term used more often in recent literature. Friend and Cook (1992) and Bauwens and Hourcade (1991) looked at co-teaching, or collaboration, as an alternative to pulling students out of classes for special education. According to several authors (Friend & Cook, 1990; Lieberman, 1986; & Porter, 1987), collaboration is a critical factor in school reform. Cooperative learning has been used in the inclusive classroom as an instructional method. Slavin (1990) reported that he had identified 60 studies that contrasted the achievement outcomes of cooperative learning and traditional methods in elementary and secondary schools. Sherman and Thomas (1986) and Davidson (1985) found positive results in the teaching of mathematics with cooperative methods. Researchers may agree that cooperative learning can produce positive effects on achievement, but they disagree on the conditions under which they approach is effective (Slavin, 1990).

In 1892, Charles Eliot, president of Harvard University, was appointed to chair the Committee of Ten on Secondary Studies of the National Education Association. Eliot made the following profound statement concerning grouping and the ability of students:

> It is a curious fact that we Americans habitually underestimate the capacity of pupils at almost every stage of education from primary school through the university. . . . It seems to me probable that the proportion of grammar school children incapable of pursuing algebra, geometry and a foreign language would turn out to be much smaller than we now imagine. (Eliot, 1961, p. 92)

Eliot's optimism led to restructuring of different programs of study, but none of these would be designed for any particular group of students. It is ironic that the Committee of Ten was considered elitist because it did not propose a special course of study for non-college intending students. Tracking and various forms of rigid grouping have played a major role in education in the twentieth century. Was it possible that Eliot was correct that most students entering the 9th grade can learn algebra in a heterogeneous setting?

The standards set forth by the National Council of Teachers of Mathematics (1989) stated that in grades 5-8, the mathematics curriculum should include explorations of algebraic concepts and processes. The NCTM emphasized that the middle school curriculum should bridge the gap between the concrete elementary school curriculum and the more formal mathematics curriculum of the high school. "By the end of the eighth grade students should be able to solve linear equations by formal methods and some nonlinear equations by informal means" (p. 102). In grades 9-12, the NCTM said that mathematics curriculum should include the continued study of algebraic concepts for all students. They believed that all ninth graders should be involved with algebra. However, Baker (1993), Sizer (1990), and Goodlad (1984) pointed out in their research that there was a large gap in the mathematical concepts being taught. Not all students were being exposed in algebra. If Eliot's beliefs and the NCTM's standards were to be reached, organization, as well as curriculum, needed to be changed. The principal, as instructional leader or leader of instructional leaders, would have to organize the delivery of algebra so that exposure was greater.

Statement of the Problem

The purpose of this investigation was to consider the principal's role in the most effective way to deliver first-year algebra instruction that meets the standards established by the National Council of Teachers of Mathematics to all students above the Mildly Mentally Handicapped intelligence level and to develop a narrative/graphic model to express this instructional delivery system.

This study sought answers to the following questions:

1. What type of narrative/graphic model of algebraic instruction can be developed that specifies ways in which a body of knowledge such as first year algebra can be structured and presented so that it includes instructional components established by recent and current literature related to instructional methodology and effective schools, and yet meets the standards as established by the National Council of Teachers of Mathematics?

2. What role should secondary school principals play in the implementation of the narrative/graphic model of algebraic instruction that is developed?

Significance of the Study

The narrative/graphic model developed should assist secondary school principals in identifying their role in the implementation of first-year algebraic instruction that follows the standards of the National Council of Teachers of Mathematics to all students above the Mildly Mentally Handicapped intelligence level.

Procedures

The procedure to be used in this study included the following:

1. The review of related literature determined the best way to incorporate the concepts established by the National Council of Teachers of Mathematics into a narrative/graphic model which depicted first-year algebra instruction to students above the Mildly Mentally Handicapped intelligence level.

2. The review of literature analyzed recent and current research related to instructional methodology and effective schools and determined how to incorporate these concepts into a narrative/graphic model which depicted a way to provide first-year algebra instruction to students above the Mildly Mentally Handicapped intelligence level.

3. A case study described a setting, Covington (IN) High School, that changed to a three-semester Algebra I program that included Learning Disabled students and the results of that change. The case study was analyzed to determine which concepts and/or components could be incorporated into a narrative/graphic model which depicted a way to provide first-year algebra students above the Mildly Mentally Handicapped intelligence level.

4. The framework and components for the

narrative/graphic model were developed from the analysis of the literature and the case study. A narrative/graphic model was made to meet the standards established by the National Council of Teachers of Mathematics from the framework and components that were developed.

5. The review of literature determined the role of the secondary principal in the implementation of the narrative/graphic model which was developed to depict the best method to provide first-year algebra instruction to students above the Mildly Mentally Handicapped intelligence level.

Delimitations

1. The study was limited to first-year algebra and the National Council of Teachers of Mathematics standards that were applicable.

2. The case study was limited to one high school and its specific class of ninth graders.

3. The case study did not involve a teacher of gifted and talented students.

4. The study was limited to first-year algebra students above the Mildly Mentally Handicapped intelligence level.

5. The case study focused on the organization of the class rather than the instructional methods of the teachers and the content as it related to the National Council of Teachers of Mathematics standards.

Methodology

The methodology used for this study was developmental research, a form of qualitative research. Various authors have justified the use of developmental research. Cronbach and Suppes (1969) explained that the intent of developmental research is to "investigate patterns and sequences of growth or change" . . . and stated that:

> Developmental research asks . . . what are the patterns of growth, their rates, their directions, their sequences, and the interrelated factors affecting these characteristics? (p. 47)

Van Dalen (1966) offered a further clarification of developmental research and stated that:

> The hypothetical-deductive theory consists of (1) a set of definitions of critical terms, (2) a set of hypothetical statements concerning the presumptive relationships among the critical terms, and (3) a series of deduced consequences that are logically derived from the hypothetical statements. (p. 64)

Given the stated purpose of this project, which was to consider the most effective way to deliver first-year algebra instruction that met the standards established by the National Council of Teachers of Mathematics to all students above the Mildly Mentally Handicapped intelligence level and to offer insights into the principal's role in the implementation of this instruction, it was appropriate to concentrate on developmental research in contrast to hypothesis testing. The foundation of the narrative/graphic model was built upon concepts developed from a review of the literature of theory development and model construction.

Defending the use of theories and models as valuable to researchers, Blake and Mouton (1985) said that:

> The history of society and its capacity to identify and grapple with complex and interrelated problems of the physical environment, new technologies, and community development is significantly linked with the production and use of principles, theories, and models for understanding emotional, intellectual, and operational events provide the most powerful and impactful approach to the implementation of planned change. (p. 66)

Various authors have defined theory and different perspectives have emerged. Each author perceived a somewhat different view of the role of theory and its possible effect upon school management.

Theory

A model is a specialized kind of theory. Any theory will have at least four functions: unifying, guiding, linking, and predicting. Theory, as defined by Feigel (1951), incorporates a function of unifying areas. Feigel indicated that:

> (A theory is) a set of assumptions from which can be derived by purely logico-mathematical procedures, a larger set of empirical laws. The theory thereby furnishes an explanation of those empirical laws and unifies the originally relatively homogeneous areas of subject matter characterized by those empirical laws. (p. 182)

Knezevich (1970) emphasized the role of guidance in a definition of theory:

> A theory is, thus, a complete system for gaining new knowledge or giving direction to research by designing and classifying experience, creating and testing hypotheses about what was experienced, applying logico-mathematical procedures, and subsequently testing empirically the conclusion reached from deductive inferences. (p. 510)

The narrative/graphic model in this study depicted algebra teachers and school leaders in specific ways first-year algebra could be structured and implemented so that all students could experience it as recommended by the National Council of Teachers of Mathematics.

Relating theory to experience, Kaplan (1964) indicated that:

> A theory is a way of making sense of a disturbing situation so as to allow us more effectively to bring to bear our repertoire of habits . . . to modify habits or discard them altogether . . . to engage in theorizing means not just to learn by experience but to take thought about what is there to be learned. . . . (Theorizing) requires symbolic construction which can provide various experience never actually undergone. (p. 295)

The narrative/graphic model in this study related a theory of organization of instruction to experiences witnessed in the Covington case study.

Asserting that theory has a predictive function, Kerlinger (1964) stressed that:

> A theory is a set of interrelated constructs, definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables with the purpose of explaining and predicting behavior. (p. 11)

The narrative/graphic model in this study considered how the future use of the model would enhance the instructors and help most students in their pursuit of algebraic success.

Since theories have been defined as having various functions according to their intended applications, the justification of theories as a basis of research in educational administration is subject to interpretation. Halpin (1958) defended the use of theories in research by urging that they not automatically be discarded. Halpin indicated that:

> Theories do not come in a standard brand; we find them in packages of different size and shape, wrapped in different ways, and labeled differently. One must respect those differences and must recognize that theories like human beings who create them, follow different courses of development and grow at different rates. We must avoid rejecting a theoretical proposal simple because it still has a few rough edges. . . . The crux of the problem is that the term theory carries the burden of too many meanings. (p. 5)

The Case Study

A case study is a detailed explanation of one setting, a single subject, a single depository of documents, or one particular event that provides for the "thick description" thought to be so essential for enabling transferability judgments (Merriam, 1988; Lincoln & Guba, 1985; Geertz, 1973). The description specifies everything that a reader may need to know to understand the findings. The findings were not part of the thick description; they must be interpreted (Lincoln & Guba, 1985).

This case study focused on the three-semester Algebra I program at Covington (IN) High School. Bogdan and Biklen (1992) reported that "some researchers enter an organization with a very specific idea of what they want to study--a new reading program." The study did not determine whether the program was successful or not, but rather made a description or documentation of the program. The position of a case study should not preclude evaluation of a program's impact (Bogdan & Biklen, 1992; Everhart, 1975).

Case studies provide utility in assisting reader understanding by inducing naturalistic generalizations (Stake, 1980; Lincoln & Guba, 1985). Naturalistic generalization is based on a more intuitive empirical approach that is based on personal, direct, and vicarious experience. Lincoln and Guba (1985) emphasized that the case study was the form most responsive to the axioms of naturalistic paradigm that will provide a vehicle to the consumer with a vicarious experience of the inquiry setting. The results of the case study are known form of applied research. The researchers describe and assess a program of change to improve or eliminate it (Guba, 1978; Lincoln & Guba, 1981; Patton, 1987; Fetterman, 1984, 1987). This study, however, did not assess the program but led to grounded theory and a narrative/graphic model.

Grounded Theory

Glasser and Strauss (1967) defined grounded theory as a process of collecting and analyzing descriptive data in order to develop theory, an effort that clearly illustrated that qualitative research was not merely a descriptive undertaking. Grounded theory emerges from the bottom up, rather than from the top down, from many disparate pieces of collected evidence that are interconnected (Bogdan & Biklen, 1992). Grounded theory follows from data rather than preceding data (as in conventional inquiry). It is a necessary consequence of the naturalistic paradigm that posits multiple realities and makes transferability dependent on local contextual factors (Lincoln & Guba, 1981). Elden (1981); Glasser and Strauss (1967); Lincoln and Guba (1981) looked at grounded theory as one that would fit a local situation being researched and the categories would be readily, not forcibly, applicable to the data under study.

The concept of grounded theory leads to model development. Reason (1981) described Deising's account of how pattern models of explanation emerge, a description that seemed to fit the concept of grounded theory. Reason (1981) found that:

> The information that is gathered in the field situations is used by the holist to build a model which serves both to describe and explain the system. The model is built by (quoting Deising) connecting themes in a network or pattern . . . the connections may be of various kinds, but they are discovered empirically rather than inferred logically . . . the result of this is an empirical account of the whole system. (pp. 155-156)

Models

Although a review of the definitions of theory reveals no uniform suggestion for their utilization, their application to the development of models is relevant. Theories are fundamental to model building. Models are meant to explain the relationships between identified components. Narrative/graphic models explain the relationships both in written and graphic form.

Van Dalen (1966) postulated that models and theories, while interrelated, should not be judged by identical standards, he stated that:

> Both theories and models are conceptual schemes that explain the relationships of the variables under consideration. . . . But models are analogies (this thing is like that thing), and therefore can tolerate some facts that are not in accord with the real phenomena. A theory, on the other hand, is supposed to describe the facts and relationships that exist, and any facts that are not compatible with the theory invalidate the theory. In summary, some scholars argue that models are judged by their usefulness, and theories by their truthfulness. (pp. 65-66)

Castetter (1986) further clarified the relationship between theories and models by stating that:

> A model is viewed as a theory designed to isolate key factors in the phenomena in which we are interested, as well as to show how these elements are related to and influence each other. As such, models . . . are conceptual representatives of reality designed to translate general theory into practice. (p. 9)

Defining a model in terms of its usefulness as an analytical instrument, Lippett (1973) indicated that:

> A model is a symbolic representation of the various aspects of a complex event or situation, and their relationships. A model by nature is a simplification and thus may or may not include all the variables. I should include, however, all of those variables that the builder considers important. . . . The true value of a model lies in the fact that it is an abstraction of reality that can be useful for analytical purposes. (p. 2)

Other authors such as Corwin (1974), Goodlad (1966), and Glasser and Strauss (1967) have investigated the relationship between models and theories and have directly linked them to conceptual systems and organizations. The model definitions reference generalize about development of a model for integrating the identified components to assist principals in their role in a better design of instruction in algebra.

Definitions of Terms

Algebra: Algebra is the language through which most of mathematics is communicated. Algebra also provides a means of operating with concepts at an abstract level and applying these concepts, a process that often fosters generalizations and insights beyond the original context (Curriculum Standards, 1989, p. 150).

Collaboration: Collaboration is a style for interaction between at least two co-equal parties voluntarily engaged in shared decision making as they work toward a common goal.

Cooperative learning: Cooperative learning is students working together in groups (often following a teacher-presented lesson), with group goals but individual accountability. Advocates of cooperative learning contend that it improves students' academic achievement and social skills, helps students from different backgrounds become friends, and smoothes the mainstreaming of students with disabilities. Cooperative learning is also touted as a viable alternative to ability grouping and tracking.

Controlled Unipack Management System (CUMS): CUMS is a system of management that involves a mastery mid-test. Those passing at this point go on to an advanced learning group, while the remaining students are recycled through the material as a group in a remedial learning group (Ford, 1972).

Curriculum: A curriculum is an operational plan for instruction that details what mathematics students need to know, how students are to achieve the identified curricular goals, what teachers do to help students develop their mathematical knowledge, and the context in which learning and teaching occur (Curriculum Standards, 1989, p. 1).

Gifted/Talented (GT): GT are students who have been identified by professionally qualified persons that who by virtue of outstanding abilities are capable of high performance (Feldhusen, 1989).

Grouping: Grouping is the organization of classroom groups in the same grade or subject by putting together those students most nearly equal in estimated learning ability (Findley & Bryan, 1975).

Indiana Statewide Test for Educational Progress (ISTEP): ISTEP is a criterion norm-reinforced test that assesses achievement in reading, mathematics, writing, social studies, and science at grades 2, 4, 6, 8, and 9 on an annual basis.

Learning disability (LD): LD affects all levels of intelligence. It is almost universally defined as a set of psychological conditions in children at or above a so-called normal IQ. A perceptual and cognitive processing deficit would be a more accurate term than learning disability.

Mildly Mentally Handicapped (MiMH): MiMH is the intellectual range that falls between the Moderately Mentally Handicapped (MoMH) and the Borderline intellectual range. The Intelligence Quotient (IQ) range of the MiMH is

55-70.

Narrative/graphic model: A narrative/graphic model explains the relationships between identified components of theory both in written and pictorial form.

National Council of Teachers of Mathematics (NCTM) Board of Directors: NCTM Board of Directors is a working group of professional mathematics educators who, as a function of leadership, create a set of standards to guide the revision of school mathematics curriculum and its associated evaluation toward this vision (Curriculum Standards, 1989).

Peer-tutoring: Peer-tutoring is the practice of having students helping other students who are having difficulties mastering concepts or lessons (NASSP, 1989).

Principalship: The principalship, like any professional knowledge base, does not represent simply a body of subject content. It consists of knowledge and skill organized in a useful way, preferably into work-relevant patterns that make expert knowledge functional (National Policy, 1993, p. xi).

Standards: A standard is a statement that can be used to judge the quality of a mathematics curriculum or methods of evaluation. Thus, standards are statements about what is valued (Curriculum Standards, 1989, p. 2).

Team-teaching: Team-teaching is more than one teacher assigned to a course. Co-teaching and collaboration are done by the team.

<u>Theory</u>: Theory makes sense of organizational occurrences by providing explanations of thoughts into patterns or habits of thinking.

<u>Three-semester Algebra</u>: Three-semester Algebra I is traditional algebra taught over a three-semester period rather than the usual two semesters.

<u>Tracking</u>: Tracking is the process whereby students are divided into categories by abilities so that they can be assigned in groups to various levels of classes. Sometimes students are classified as advanced, average, or remedial learners and placed into fast, average, or slow classes on and placed into advanced, average, or remedial classes on the basis of their scores on achievement or ability tests and previous performance. Often teachers' estimates of what students have already learned or their potential for learning determine how students are identified and placed. Sometimes students are classified according to what seems most appropriate to their future goals (Oakes, 1985).

<u>Track System</u>: Track system, described in Hobson v. Hansen, 1967, included the four following separate curricular programs: Basic or Special Academic, for slow learners or the academically retarded; General, a terminal program of vocational preparation for students who were not expected to continue their education beyond high school graduation; Regular, a college-preparatory program for students expected to continue their education at the college level; and Honors, an accelerated program for

gifted/talented students (Hobson v. Hansen, 1967).

Chapter 2

REVIEW OF LITERATURE

National Council of Teachers of Mathematics

Professional Standards

In 1989, the Commission on Professional Teaching Standards was established by the Board of Directors of the National Council of Teachers of Mathematics (Professional Standards, 1991). The commission produced a set of standards that promoted a vision of mathematics teaching, evaluation of mathematics teaching, the professional development of mathematics teachers, and the responsibilities for professional development. The NCTM spelled out what the teachers needed to know about teaching to new goals for mathematics education and how the teaching should be evaluated for the purpose of improvement. The commission stated that:

> We challenge all who have responsibility for any part of the support and development of mathematics teachers and teaching to use these standards as a basis for discussion and for making needed change so that we can reach our goal of a quality mathematics education for every child. (Professional Standards, 1991, p. vii)

The Professional Standards Commission (1991) wanted to develop mathematical power for all students, and they believed that the current practices needed to be changed.

The commission emphasized the image of mathematics teaching needed teachers that were more proficient in selecting mathematical tasks that were engaging students' interests and intellect. Algebra fell within the intellect parameters. The Standards Board said that teachers needed to orchestrate classroom discourse in ways that promote the investigation and growth of mathematical ideals. Teachers should be able to guide individual, small group, as well as whole class work. Commenting on previous practice, Welch (1978) pointed out that:

> In all the math classes I visited, the sequence of activities was the same. First, answers were given for the previous day's assignment. The more difficult problems were worked on by the teacher or the students at the blackboard. A brief explanation, sometimes none at all, was given of the new material, and problems (were) assigned for the next day. The remainder of the class was directed to working on homework while the teacher moved around the room answering questions. The most noticeable thing about math classes was the repetition of this routine. (Welch, 1978, p. 6)

Ten years after this observation, little indication of change (NCTM, 1989; National Research Council, 1989; Weiss, 1989) was evident. The routine described by Welch (1978) continued. The organization of the classroom had not changed, however, the Professional Standards (1991) believed that teachers were the key figures in changing the ways in which mathematics were taught and learned in schools. The changes the Standards wanted required that teachers have long-term support and adequate resources from the administration.

The Professional Standards (1991) related that major shifts in the practice of mathematics teaching were needed, and that classrooms needed to be mathematical communities. The framework would emphasize setting goals and selecting or creating mathematical tasks to help students achieve these goals. Organization of the classroom would create an environment that would support the teaching and learning of mathematics. To make ongoing instructional decisions, the teacher would analyze student learning, the mathematical tasks, and the environment. The nature of the mathematical task posed (such as algebra) and what student were considered the critical aspects that would be used to judge the effectiveness of any lesson.

Throughout their standards, the NCTM Board of Directors used the phrase "all students" (Professional Standards, 1991). The board's most compelling goal should be saw a comprehensive mathematical education of every child. By "every child" they specifically meant:

> 1. Students who have been denied access in any way to educational opportunities as well as those who have not.
> 2. Students who are African American, Hispanic, American Indian and other minorities as well as those who are considered to be part of the majority.
> 3. Students who are female as well as those who are male.
> 4. Students who have not been successful in school and in mathematics as well as those who have been successful. (Professional Standards, 1991, p. 4)

Ability grouping of children has contributed to the denial of access to mathematical education, especially in algebra, for "every child." The Professional Standards (1991) did not feel that every child would have the same interests or capabilities in mathematics but that the educator would have to examine the fundamental expectations about what children could learn and do. Learning environments had to be created that would raise expectations for children.

The Professional Standards (1991) found expectations to be low in our society and that it was socially acceptable to take pride in not being good in mathematics. Other societies made the assumption that all students can learn mathematics and that learning is a matter of effort. The Professional Standards (1991) expectations had a great deal to do with how teachers would respond to students and consequently to what students believed they could do. Teachers, counselors, parents, and school administrators, as well as the students, needed to have the high expectations that every student could learn mathematics (Professional Standards, 1991).

These high expectations led to the development to a new set of standards that would guide the revision of the school mathematics curriculum. The standards (Curriculum Standards, 1989) were divided into four distinct sections: K-4, 5-8, 9-12, and Evaluation. The first consideration in preparing each standard was its mathematical content. Although the NCTM did not suggest that all students were alike, the content outlined in the standards was what they believed all students would need if they were to be productive citizens in the twenty-first century. They stated that:

> If all students do not have the opportunity to learn this mathematics, we face the danger of creating an intellectual elite and a polarized society. The image of a society in which a few have the mathematical knowledge needed for the control of economic and scientific development is not consistent either with the values of a just democratic system or with its economic needs. (Curriculum Standards, 1989, p. 9)

Ability Grouping

Many concepts exist concerning classroom management or school organization. Ability grouping is the predominant form of instructional organization in U.S. public high schools (Trimble, 1988). "It has been estimated that 60 percent of all elementary schools and 80 percent of all secondary schools track students even though no empirical research in the past twenty-five has substantiated its effectiveness" (Oakes, 1992, p. 16). Tracking has been viewed as a legitimate technique to be used by educators for classifying students for educational purposes. No cases are on record in which academic ability alone has been held as unconditional for classifying students educationally (Goodlad, 1981). When disproportionate classification and placement of both poor and minority were found in a track system in Washington, D.C. in 1967, however, the Supreme Court declared the tracking system used by Superintendent Hansen as unconstitutional (Bowles & Gintis, 1977).

Ability grouping and tracking have been used because it has been assumed that tracking promotes overall achievement because students' needs are better met when they learn in groups with similar capabilities or prior levels of achievement (Oakes, 1985). Tracking is the inevitable result of grading on a curve, and it enables students in the lower tracks to get higher grades (Wiggins, 1989). Oakes also stressed that most teachers and administrators content that tracking greatly eases the teaching task and is the only way to manage student differences.

Johnson and Johnson (1981) stated that "there is no consistent evidence that ability grouping increases student achievement at any ability level" (p. 22). Braddock (1990) reports that there is little disagreement that rigid tracking produces stable groups of poor achievers. Borg (1966) found that students of average and low ability achieve less when tracked into middle or low rather than heterogeneous groups. Findley and Bryan (1975) concluded that:

> Ability grouping, as practiced, produces conflicting evidence of usefulness in promoting improved scholastic achievement in superior groups, and almost uniformly unfavorable evidence for promoting scholastic achievement in average- or low-achieving groups. (p. 13)

Haderman (1976) believed that there were several reasons that grouping, in spite of the negative effects, survived. Haderman maintained that:

> Since those who have taught longest usually have first choice of the classes they are to teach, ability grouping provides the experienced teacher with a way of avoiding "difficult" classes. Grouping also provides the teacher with a rationale for preparing instruction for the group and not dealing with individual learning abilities and styles. Individual differences can be submerged and the teacher can teach the group rather than individuals. (Haderman, 1976, p. 85).

Veteran teachers expressed their enjoyment with grouping.

Not only did they view grouping as efficient, but a smaller gap of ability meant less preparation. It was easier to prepare lessons where individual differences were not as prevalent. Veteran teachers were able to teach the elite students, which provided less disciplinary problems and more enthusiasm for learning. Low-ability groups were taught by the new, less-experienced teachers because the veterans could avoid these classes (Haderman, 1976).

In his Study of Schooling, Goodlad (1984) found there were marked differences between high- and low- track classes in regard to the content and quality of instruction, teacher-student and student-teacher relations, the expectations of teachers for their students, and the affective climate of the classroom. According to Goodlad:

> Consistently, the differences in curricular content, pedagogy, and class climate favored the former (high track). Consequently, the practices and atmosphere conveyed lower academic and, indeed, more modest expectations generally, as well as greater teacher reinforcement of behaving, following of rules, and conforming. . . . Almost without exception, classes not tracked into levels but containing a heterogeneous mixture of students achieving at all levels were more like high- than low- track classes in regard to what students were studying, how teachers were teaching, and how students and teachers were interacting in the classroom. (Goodlad, 1984, p. 159)

Goodlad (1981) examined the teaching practices associated with tracking. He found that higher track classes spent a greater proportion of class time on instruction and that their teachers expected students to spend more time learning at home than was the case of the lower track pupils. Oakes (1985) stated that academic learning time, time-on-task, or student engaged time has been found to have a strong and consistent relationship with student learning. Bowles and Gintis (1976) maintained that the aspects of classroom climate that appear to lead to socialization for lower-class occupations seem to be found in classes where students learn less. It appears that low-track classes may experience a greater variety of materials and high-track classes a greater variety of experiences (Oakes, 1985). Goodlad (1981) found that students in high-track classes saw their teachers as more concerned about them, and the low track pupils viewed their teachers as punitive toward them. Teachers spent more time on student behavior and discipline in low-track classes.

Students bring differences with them to school. Students viewed as different are separated into classes and then provided with vastly different kinds of knowledge and with markedly different opportunities to learn. Oakes (1985) stressed that it is in these ways that schools exacerbate the differences among the students that attend them. Tracking is a method that these educational differences are most blatantly carried out. Oakes (1985) stated that:

> Low-track students are placed in an educational bind. Within schools, students cannot learn concepts, topics and skills fully if they are allocated less time than they need. Further, if the time needed is longer for students who are usually placed in classes where the learning time is less, the chances for these students to achieve at a rate comparable to their peers are diminished. In fact, these circumstances are far more likely to widen the achievement differences than to narrow them. (p. 105)

Not all students benefit equally from lessons. Goodlad and Oakes (1988) stated that tracking prejudges how much children will benefit from lessons and results in the absence from some children being exposed to academically and socially valued subjects. Goodlad and Oakes (1988) expressed that:

> Nearly all can benefit from studying the important concepts of algebra. Some will learn more, some less. But tracking excludes many children from ever being in classes where these "high status" subjects are taught . . . when errors in judgment are made they are more likely to underestimate what children can do. (p. 19)

Oakes and Lipton (1988), Oakes (1985), Goodlad (1981), Kitchen (1990), and Slavin (1987) all reported that children assigned to low-ability classes are taught different, less socially valued knowledge and skills. Oakes and Lipton (1988) found that:

> Emphasis is placed on rote learning, workbooks, kits and easy material. Regardless of ability or motivation, these students' academic mobility is constrained. They stand little chance for an improved school placement because those in low-track classes are usually denied access to the knowledge necessary to participate in more rigorous and interesting work. (p. 8)

Fenstermacher (1983) argued that:

> It is possible that some students may not benefit equally from unrestricted access to knowledge, but this fact does not entitle us to control access in ways that effectively prohibit all students from encountering what Dewey called "the funded capital of civilization." (p. 83)

Hodgkinson (1991) and Gainey (1993) noted that the bottom third of our nation's young people, our "non-college" students, tend to be regulated to general curriculum courses to learn "life survival skills" which results in their exposure to less-qualified teachers, less time devoted to instruction, less extensive and less challenging content, and a less positive classroom learning environment. In response to the America 2000 Goal that the United States will be first in the world in mathematics and science achievement, Gainey (1993) reported that "few of us would contend that all students receive the same quality of science and mathematics instruction within the same school" (p. 21). Kitchen (1990) in his study of the effects of ninth grade grouping in mathematics concluded that enrollment in low-track classes increases the chances that a student will fail to complete the high school course of study. Trimble (1988) in her study of ability grouped classes concluded that:

> The findings of this study suggested that teachers in classes from the three ability levels examined in this study did not effectively alter curricular content and instructional methods to meet student needs. These findings add to the mounting evidence that calls for a change in the present grouping practice in American public schools. (abstract)

Advocates for gifted students have upheld the tracking and rigid ability grouping. Some of the strongest support for ability grouping comes from the Council for Exceptional Children, a 55,000 member advocacy organization for special education and gifted and talented programs (Gursky, 1990). Gursky described the efforts of an assistant superintendent in San Diego who had tried to reform the tracking system by simple mainstreaming. Gursky explained that the assistant superintendent ran into heated controversy when:

> As a high school principal, he had seen that students tracked into remedial courses were flunking the lowest-level math classes his school offered, so he figured it could do no harm to enroll them in higher-level more stimulating courses such as algebra. He did and found that most of these low-achieving students performed just as well in the tougher classes, and some performed better. But when he became an assistant superintendent in San Diego and tried to make similar changes in the entire school system, he ran head-on into vigorous opposition from some of the community's more outspoken, influential members-the predominantly white, middle-class parents of high-achieving students. (Gursky, 1990, p. 43)

The San Diego system preserved its high-track programs but tried to increase the number of minority students in the honors courses (Gursky, 1990).

Testing, especially the high stakes type has always led to decisions about tracking and sorting of students (Bowles & Gintis, 1976). Shepherd (1991) wanted maintenance of high standards without reinstating tracking. Shepherd maintained that:

> It is easy to foresee that challenging tests, especially those administered in high school, will lead to tracking if admission to test-preparation courses is restricted to those students who are thought to be capable of handling the material. Such a situation exists now with Advanced Placement courses and, at the bottom end, with special remedial courses designed to help students pass minimum-competency exams. (p. 237)

Opposition to eliminating tracking and rigid ability grouping appeared to come from the advocates of gifted and talented. Feldhusen (1990) stated, "We do know that students in high-track classes will learn less in heterogeneous classes" (p. 7). Silverman (1990) maintained that eliminating programs for the gifted would be as unethical as removing programs for the low mentally handicapped. Lund (1990) stated that a regular classroom environment can meet the needs of the gifted under certain circumstances. Lund said that:

> In a regular classroom, the teacher must modify curriculum and employ effective teaching strategies to meet all students' needs--including those of the high-ability or gifted students. For too many gifted children in regular classrooms, the level and pace of instruction do not match their ability, and expectations are not sufficiently challenging. (p. 7)

In the standards for evaluation (Curriculum Standards, 1989), equity for all students is an indication of the program's consistency with the Standards. Equal access was considered a critical component of any mathematics program. It was stated in the Curriculum Standards (1989) that:

> The consequences of dealing with students with different talents, achievements, and interests have led to such practices as grouping and tracking and to special programs for the gifted or handicapped students who need and deserve special attention. However, we believe that all students can benefit from an opportunity to study the core curriculum specified in the Standards. This can be accomplished by expanding and enriching the curriculum to meet the needs of each individual student, including the gifted and those of lesser capabilities and interests. . . . We believe the current tracking procedures are inequitable, and we challenge all to develop instructional activities and programs to address this issue directly. One reviewer of the Working Draft of the Standards suggested the establishment of some pilot school mathematics programs based on these Standards to demonstrate that all students-including women and underserved minorities-can reach a satisfactory level of mathematical achievement and urged that the success of these students be widely publicized. (p. 253)

<u>Inclusion</u>

Public Law 94-142, the Education for All Handicapped Children Act, enacted by Congress in 1975, requires that every handicapped child receive at public expense, an education specifically designed to meet his/her unique educational needs. The law also states that the student be placed in the least restrictive environment and be educated, whenever possible, with non-handicapped peers (Hasazi, Rice & York, 1979). It is generally accepted by most educators, that public schools should provide equal educational opportunity for all students (Oakes, 1986). Ohanian (1990) stressed that many schools lump all children together in a sort of academic twilight zone. Goodlad and Oakes (1988) stated that "simply mixing students together will not solve the problems of tracking. Far more revolutionary changes are needed" (p. 11). Ohanian (1990) feared that many youngsters were drowning in pure mainstreaming. This problem might be due to the fact that most classroom teachers have not acquired the skills and knowledge to effectively teach children with learning disabilities. Classroom teachers need the assistance of specialists in designing, implementing, and evaluating instructional procedures. Special education teachers who have previously operated in self-contained classrooms will function as consultants to regular classroom teachers. The previously used self-contained classroom will serve as a resource center (Hasazi, Rice & York, 1979).

Inclusion is not mainstreaming (Wilcox & Nicholson, 1990). Students with severe handicaps were not to be indiscriminately placed in all classes without support or resources. However, eighty-five percent of all special education students were reported to have mild disabilities (Cook & Friend, 1990). With collaboration between special and general education teachers, special education students can participate in regular class activities with adaptations and support (McLeskey, Skiba, & Wilcox, 1990; Adkins, 1990; Gersten & Woodward, 1990; Wilcox & Nicholson, 1990).

The special education teacher should be involved as a "co-teacher" (Cook & Friend, 1990, 1992; Larson & LaFasto, 1989). Special education teachers should not be relegated to the role of an assistant in the general education classroom. The special education teacher has equal accountability for the outcome of any activity that occurs in the classroom. There should be planning, interaction, problem-solving, and ownership of all students and programs (Cook & Friend, 1990). The special education teacher will need to acquire effective consultation skills as they begin to share their skills and knowledge with general education teachers (Hasazi, Rice, & York, 1978; Kratochwill & Bergan, 1990; Phillips & McCullough, 1990). Reading skill is an important part of a student's problem-solving ability. "Algebra teachers, trained in reading instruction, can help their students become better problem solvers" (Dessart, 1983, p. 37). Giffune (1979) concluded that:

> The teaching of reading strategies to algebra students significantly improved their ability to write correct equations on the post-test, to obtain correct solutions on the post-test, and to write correct solutions on the retention-test administered several weeks after instruction was completed. (p. 36)

Most special education teachers teach reading skills. The use of these reading skills can be collaborated with general education teachers just as subject matter skills can be shared by the classroom teacher. Team teaching will be necessary for inclusion to be successful (Cook & Friend, 1990; Hasazi, Rice, & York, 1979).

Peer tutors could assist not only with inclusion of handicapped students, but with regular education students that have problems. Wilcox and Nicholson (1990) said that "the role of a peer tutor is to be a friend and advocate for students and an instructional assistant to the teacher" (p. 15). Peer tutors received credit and were guided by a comprehensive curriculum. They did not have to come from the top academic students in their class.

In childhood, self-esteem is developed through competence and social acceptance. Children are at-risk for developing low-esteem when they are unable to learn any one new skill. Adults with low self-esteem most often acquired this image in childhood (William Gladden Foundation, 1990). Labeling, tracking, and streaming all have been shown to produce negative effects on self-esteem (Clark, 1962; Tanner, 1965; Schafer & Olexa, 1971; Oakes, 1985; Youngs, 1993). Braddock (1990) reported that:

> There is little doubt that rigid tracking that produces stable groups of poor achievers is not a good idea because of the negative image that accompanies placement in the low tracks. (p. 446)

Maher (1989) concluded that heterogeneous grouping did not appear to have a detrimental effect on self-concept and there was no difference in target and non-target students' levels of satisfaction with heterogeneous grouping. Slavin (1988) believed that if ability grouping was necessary, there should be a regrouping process so the labeling effects would be reduced and any errors in assignment can be more easily remedied. Youngs (1993) reported that:

> The higher a student's self-esteem, the better he/she is able to take on the challenges and frustrations associated with the learning experience. (p. 61)

When students are included into meaningful activities their self-esteem should improve (Youngs, 1993).

Students need to be enrolled in meaningful classes. Goodlad (1984) found that students enrolled in lower track mathematics classes like general mathematics knew eighty percent of the material before they started the class. Disciplinary problems followed as was reported by one of Goodlad's observations of a student in a ninth grade mathematics class: "Nothing we haven't learned before, and he's always writing referrals" (p. 234). Yates (1966) stressed that slow learners become stagnated and therefore develop into disciplinary problems. "Studies have shown there to be lower self-esteem, more school misconduct, higher drop-out rates, and higher delinquency among students in lower tracks" (Goodlad, 1984). Davis, Jockusch, and McKnight (1978) observed algebra classes and interviewed students. They concluded that "most children can learn far more mathematics than schools try to teach team and many of these students can take pleasure in developing skill in mathematics" (p. 259). Goldberg, Passau, and Justman (1966) concluded that pupils of low ability could achieve quite successfully in classes where expectations are high and suggested that teachers generally underestimate the capabilities of pupils in lower ability classes. If teachers expected less, the pupils learned less. Davis (1978) further noted that the goal of mathematics teachers they observed was to provide mathematical activities that would keep students content and quiet rather than to present material that would challenge them. The goal of a quiet classroom was felt to inhibit a great deal of mathematical growth. In trying to identify the quality school curriculum, Glasser (1992) said that:

> We must face the fact that a majority of students, even good ones, believe that much of the present academic curriculum is not worth the effort it takes to learn it. No matter how well the teachers manage them, if students do not find quality in what they are asked to do in their classes, they will not work hard enough to learn the material. The answer is not to try to make them work harder; the answer is to increase the quality of what we ask them to learn. (p. 691)

Of the thirteen curriculum standards NCTM had for grades 5-8, algebra was listed as number nine. Algebra, however, was to be taught as part of an integrated whole, not as an isolated topic. Connections between algebra and a broad range of topics that include number concepts, computation, estimation, functions, statistics, probability, geometry, and measurement should be a prominent feature of the curriculum. Generalized arithmetic that was part of Goodlad's (1984) vision of algebra classes was to be a standard for grade eight students to have accomplished.

Curriculum Standards (1989) stated that:

> By the end of the eighth grade, students should be able to solve linear equations by formal methods and some nonlinear equations by informal means. (p. 102)

Ninth grade standards were raised to a higher level. The curriculum moved away from a tight focus on manipulative facility to include a greater emphasis on conceptual understandings, on algebra as a means of representation, and on algebra as a problem-solving tool. The NCTM realized there must be a core program. For the core program, the emphasis represented a trade-off in instructional time for greater emphasis in reaching the core objectives. For college-intending students, appropriate levels of proficiency remained a goal. Standard five of the Curriculum Standards (1989) stated that:

> In grades 9-12 the mathematics curriculum should include the continued study of algebraic concepts and methods so that all students can--
> 1. represent situations that involve variable quantities with expressions, equations, inequalities, and matrices;
> 2. use tables and graphs as tools to interpret expressions, equations and inequalities;
> 3. operate on expressions and matrices, and solve equations and inequalities;
> 4. appreciate the power of mathematical abstraction and symbolism. (p. 150)

General mathematics was not to be taught at the ninth grade level. The increasing use of quantitative methods had made algebraic processing an important tool for applying mathematics in both natural and social science (Curriculum Standards, 1989).

Standard thirteen (Evaluation) on instruction (Curriculum Standards, 1989) stated that in order for mathematics programs to be consistent with the Standards it should have an environment in which there were opportunities to learn. There should be sufficient opportunity to learn the specified content. The amount of time devoted was considered important. Goodlad (1984) pointed out that time on task varies. The NCTM felt that an hour a day, barring disruptions, was a reasonable expectation at all grade levels.

Mastery Learning

Mastery Learning has been traditionally defined as "both a philosophy of school learning and an associated set of specific instructional practices" (Anderson & Block, 1977). The philosophical premise of mastery learning is that all children can learn when provided with conditions that are appropriate for their learning (Bloom, 1981). Guskey (1987); Bloom (1981); Block (1974); and Bloom, Madaus, and Hastings (1981) said that the essence of mastery-learning strategy was group instruction supplemented by frequent feedback and individualized corrective help as each student needed it. Traditional norm-referenced programs assured failure in the bottom sixteen percent (Bailey, 1984). Mastery learning was not relative to a national norm or compared to other students within the class or school. Cohen (1987) reported that standardized tests test only the mundane and have limited, if any, correlation with what is taught in the classroom.

Several different approaches for the implementation of mastery learning were found (Block & Anderson, 1975; Burns, 1987; Guskey, 1987; Bloom, 1976; Block, Efthim, & Burns, 1989). All of the different approaches, however, included feedback, correctives, and enrichment at regular intervals. There was also congruence among instructional components, the learning objectives and instructional activities to achieve the objectives.

Research on mastery learning has been conducted at various levels of education. Most of the subject courses have been shown to yield excellent results under mastery methods (Block, 1974; Block & Anderson, 1975; Block & Burns, 1976; Bloom, 1976; Jones, Gordon, & Schecterman, 1975; Mevarech, 1986; Guskey, 1987). In the research, mathematics was one of the most frequently used subjects. Anderson (1988) found the effects of group-based mastery learning enhanced algebra achievement. Studies (Bloom, 1981) revealed that as many as ninety percent of the students could learn school subjects up to the same standard that only the top ten percent had been learning under usual conditions.

Mastery learning's major strength lies in helping teachers become organized both prior to instruction and afterward (Guskey, 1990). Chaiklin (1989) stated that:

> We still face the important challenge of how to organize material to capture and sustain interest so that students can engage in the intellectual processes identified by cognitive analysis as necessary or sufficient for acquiring knowledge of algebra. Similarly, we must develop units of study that correspond to manageable units for both the teacher and the student. (p. 23)

Evertson, Anderson, Anderson, and Brophy (1980) reported on their observations of 68 teachers that the effective mathematics teachers were active, well-organized, and strongly academically oriented. Guskey (19990) found that mastery learning did help teachers with organization, but it did not offer any prescriptions as to how lessons are to be taught or how students should be involved in learning.

Bloom (1981) offered the following three constructs about students and their learning capabilities for mastery learning:

> 1. There are good learners and there are poor learners.
> 2. There are faster and there are slower learners.
> 3. Most students become very similar with regard to learning ability, rate of learning, and motivation for further learning when provided with favorable learning conditions. (p. 21)

Goodlad (1984) felt the key to mastery learning's success rate depended on the establishment of appropriate learning conditions. Bloom, Madaus, and Hastings (1981) stated that:

> A student's presence in the mastery class is no guarantee of improved learning unless the student can be motivated to make the extra effort needed to correct learning difficulties at the end of each learning unit. (p. 34)

For Carroll (1963), time spent on learning was the key to mastery. If learning time is fixed, as in traditional classes, Bloom (1984) stated that students with greater aptitudes will perform better. Differentiating learning time would alleviate these aptitudinal differences. Traditional classes have rarely manipulated time to remediate students to overcome their deficiency. Bloom, Madaus, and Hastings (1981) showed that students in mastery classes need ten to fifteen percent more time so that corrective work can be completed. Goodlad (1984) found that only one percent of class time is devoted to reinforcement. Time spend on homework does not seem to be a very good predictor of achievement in the subject (Husen, 1984). Time-on-task, however, was related to mastery (Pifer, 1981). Goodlad (1984) found that time-on-task was not effective as it could be, especially in low-track classes. Bloom (1981) reported that studies showed that time-on-task was largely determined by the quality of instruction and to the extent that students "have the cognitive prerequisites for each new learning task." Bloom (1981) stated that:

> We are convinced that it is not the sheer amount of time spent in learning (either in school or out of school) that accounts for the level of learning. We believe that each student should be allowed the time he needs to learn a subject. . . . The task of a strategy for mastery learning is to find ways of altering time individual students need for learning as well as to find ways of providing whatever time is needed by each student. (p. 124)

A critic of mastery learning, Slavin (1987) said, "mastery learning provides no advantage to students apart from the extra time allocated through corrective procedures" (p. 175). On the other hand, Anderson and Burns (1987), pointed to research evidence that mastery learning's advantage comes more from the improvements in the quality of time rather than from increases in quantity. Block (1974) and Guskey and Pigott (1988) found that the need for additional time diminishes over a series of instructional units.

Just adding time was questioned by Goldberg (1971) and Waitland (1976). They found that there is little advantage in a three-semester algebra curriculum. These classes were taught in a traditional manner.

Bloom and Madaus (1981) wanted most of the students to reach mastery levels within the regular term, semester, or calendar period in which the course was normally taught. They reported however, that the amount of time that students need for a particular kind of learning has not been thoroughly researched. They conceded that some students would spend more time than others in learning the subject, but "if the majority reach mastery levels at the end of the time allocated for the subject, this will have affective as well as cognitive consequences" (p. 60).

Pipho (1991) conducted a yearlong study that identified building-level changes that were time-related. Some of the recommendations included the following:

> 1. Time for team planning, team teaching, and cooperative education at the building level;
> 2. Time to learn about and deploy new technologies that improve teaching and boost productivity for students and teachers;
> 3. The redesign of instructional time to include a wider variety of teaching strategies, such as discovery and guided discovery, so that teaching styles can be matched with learning styles;
> 4. Relief from distracting intrusions into both instructional time and the learning environment. (p. 21)

<u>Team Teaching</u>

Large-group instruction followed by small-group instruction is a method of team teaching. Yates (1966) called this method of team teaching the associate form. The Trump plan emerged from the Commission on the Experimental Study of Utilization of the Staff in Secondary Schools. This associate form of team teaching had:

> Approximately forty percent of the students' time will involve large-group instruction in a team teaching situation. Twenty percent will be devoted to discussion or seminar groups of about twelve to fifteen students. The remaining forty percent will be devoted to independent study in which the student, alone or in groups of two or three, will read, listen to records and tapes, view, question, experiment, examine, consider evidence, analyze, investigate, think, write, create, memorize, record, make visits, and self-appraise with a minimum of teacher supervision. Extensive use is made of instructional devices of many kinds. Few schools have adopted the entire plan as put forward by the Commission although parts have been implemented by many-especially large-group instruction, team teaching, and extensive use of television and audio-visual devices. (p. 71)

Geiz, Sachs, and Wendt (1968) reported success with the associate method of team teaching in algebra, advanced algebra, and trigonometry. They believed one advantage to team teaching was that each teacher could present topics about which they felt most qualified.

One of the alternatives to tracking, according to Gursky (1990), was team teaching. He cited that team teaching students of varying ability has proved a mixed blessing for Roene Cammack of Cedar Rapids, Iowa. With team teaching, the students were thriving, but Cammack lost some of her individual identity as a teacher. Gursky (1990) explained that:

> Cammack believes the team setup makes for more effective teaching; while one of the two teaches a

> large group, the other can walk around the room and work with students alone or in small groups. "I think it helps everyone," she says, "Some of the slow kids for years just thought they were slow, but now they're really starting to contribute." (p. 47)

Gursky also reported that Cammack said that many teachers in the district seemed threatened by the experiment.

Cooperative Learning

Cooperative Learning is usually defined as students working together in groups (often following a teacher-presented lesson) with group goals but individual accountability. Slavin (1990) felt that cooperative learning had an excellent research base with "many viable and successful forms and hundreds of thousands of enthusiastic adherents" (p. 3). Slavin (1989) identified 60 studies that contrasted the achievement results of cooperative learning and traditional methods. The studies had to be at least four weeks long and the experimental and control classes were measured with the same achievement tests and identical conditions. There was a consensus among reviewers of the cooperative learning literature that cooperative methods had a positive effect on student achievement.

Slavin (1983, 1989), Johnson and Johnson (1981), Newman and Thompson (1987), and Davidson (1985) all concluded that cooperative learning can be an effective means of increasing student achievement, but only if group goals and individual accountability are incorporated in the cooperative methods. Newman and Thompson (1987) concluded that:

> A review of the research on cooperative learning and achievement in grades 7-12 produced 27 reports of high quality studies, including 37 comparisons of cooperative versus control methods. Twenty-five (sixty-eight percent) of these favored a cooperative learning method at the .05 level of significance. . . . The pattern of results supports the importance not only of a cooperative task structure, but also of group rewards, of individual accountability, and probably of group competition as well. (pp. 11-12)

Davidson (1985) reviewed research on cooperative learning in mathematics. He supported Slavin's (1983) conclusions that if group rewards and individual accountability were used with cooperative learning methods, student achievement would increase more than control methods in secondary classrooms. Davidson (1985) wrote:

> If the term achievement refers to computational skills, simple concepts, and simple application problems, the studies at the elementary and secondary levels support Slavin's (1983) conclusions. (p. 24)

Newman and Thompson (1987) questioned whether cooperative learning was effective in grades 10-12 in the senior high school. They felt that there was ample evidence that cooperative methods were instructionally effective in grades 2-9, but there had been relatively few studies that had examined grades 10-12.

Several distinct structures have been developed for cooperative learning (Kagan, 1989). Different structures have different functions. Teachers could use multi-structural cooperative lessons to reach a wide range of mathematical objectives (Andrini, 1989). Whereas it could be overwhelming to master cooperative learning at one time, it was a relatively easy task to master one structure at a time (Kagan, 1990). Kagan (1990) stated that:

> Many schools and districts have adopted a "structure of the month" strategy in which site-level trainers introduce the structure, provide demonstration lessons, and lead participants in planning how to adapt the structure to their own classroom needs. When many teachers at a site are all working to learn the same structure, there is a common base of experience, promoting formal and informal collegial coaching and support. (pp. 11-12)

Team Assisted Individualization (Slavin, 1985) was a structure that was specifically developed for mathematics. It combined the motivational power and peer assistance of cooperative learning and individualized materials that allowed students to progress at their own rate. It was hoped that the management and individual incentive problems that had developed in the 1960s with individualized instruction would be alleviated by this combination of methods. Slavin, Madden, and Stevens (1990) reported that "in five out of six studies Team Assisted Individualization students significantly exceeded control students on standardized (California Test for Basic Skills or California Achievement Test) math computational scales" (p. 24). There were also found that there were positive effects of Team Assisted Individualization in the outcomes of self-concept in math, liking for math, classroom behavior, race relations, and acceptance of mainstreamed academically handicapped students (Slavin, 1985).

Good, Reys, Grouws, and Mulryan (1990) reported they found the following two types of grouping used in mathematics:

> homogeneous achievement-groups because the primary purpose is to sort students according to achievement rather to allow for extensive social interaction. . . . heterogeneous work-groups, teachers want students to work cooperatively to promote social and academic outcomes. (p. 57)

They found that the effectiveness of a work-group depends on students' mathematical knowledge and their experience in cooperative settings, as well as the teacher's instructional goals. Their findings concluded that "students in work-groups are more active learners and more motivated and enthusiastic about mathematics than students who work in achievement-groups" (Good, Reys, Grouws, & Mulryan, 1990, p. 62). They felt that work-groups could be combined with large-group and individualized instruction to promote greater learning.

One of the most accepted outcomes of cooperative learning is in the effective area. Slavin (1990) wrote that:

> There is agreement that these methods have positive effects on a wide array of affective outcomes, such as intergroup relations, acceptance of mainstreamed students, and self-esteem. (p. 54)

Schultz (1990) found there was negative feedback from low achievers that were taught by traditional methods. High achievers were not being stimulated by these teaching methods. These items caused Schultz to consider cooperative methods. He found that there was significant improvement in students' attitude toward learning. Sapon-Sevin and Schiedwind (1990) found that cooperative learning teaches the intrinsic values of cooperation that improve interpersonal relations and create a "society in which people really do work together for shared equitable goals" (p. 65).

Mevarech (1985, 1989) tried combining mastery learning concepts with cooperative learning methods. Achievement of both low and high achieving students was enhanced. The combining of cooperative learning and mastery learning appeared to synthesize these strengths. Maravech (1989) stressed that:

> The use of cooperative mastery learning strategies fostered gains in mathematics in both higher-level skills (comprehension) and lower-level skills (computations). (p. 203)

Guskey (1990) maintained that the basic elements of cooperative learning and mastery learning complemented each other. He stated that:

> Recent research suggests that when cooperative learning and mastery learning are used together, results can be more positive than those typically achieved through the use of either strategy along. (p. 10)

Maravech (1985) wrote that "most cooperative activities lack a systematic feedback and corrective procedure" (p. 372). This is the strength of the mastery learning process. Guskey reported that "mastery learning offers teachers using cooperative learning a systematic feedback and corrective procedure that can bring greater focus to the work of student teams" (p. 13). Research on cooperative learning and mastery learning (Bloom, 1984; Guskey, 1990; Marzano, Pickering, & Brandt, 1990; Walberg, 1984) made clear that educators have a strong influence on how well students learn as well as how they view themselves as students. They maintained that it would take more than one strategy to take full advantage of this influence. Combinations of strategies that focus on different aspects of the teaching and learning process were what Bloom (1984) predicted as potentially additive.

Role of Secondary School Principal

Leadership

Leaders were defined as individuals who facilitated the development of shared visions and thus created changes in cultures and values (Deal & Peterson, 1990; Sergiovanni, 1991). Today's leaders are visionaries. Principals were cited as the school's leaders. Schlechty (1990) stressed that principals were "leaders of leaders." Hall and Hord (1987) said that vision defined the desired state that a school was working toward. Leadership was defined as a direction-setting task for leaders to engage in "visioning" (Kouzes & Rosner, 1988; Sashkin, 1988), "purposing" (Sergiovanni, 1990), and "agenda-setting" (Kotter, 1988). All students above MiMH taking algebra would have been considered to be part of such a vision. The principal was the facilitator for change (Egan, 1988; Hall & Hord, 1987). Principals had the vision clear in their minds before they facilitated others for change.

National Policy (1993) stressed that an effective principals should be skilled at creating and gaining commitments to broad long-ranged visions for their individual schools. Effective principals shared the vision of students, the community, and the staff. This shared vision provided the force that could bond students, teachers, and others together for a common cause (Sergiovanni, 1990). Not only should principals have a personal belief that their school can achieve this vision, but they should also project this vision into the hopes and dreams of the staff, parents, and students (National Policy, 1993). A vision such as all students above MiMH taking algebra should not only be acceptable, but it should be a school vision. The principal should be able to inspire the staff, parents, and students and should encourage them to articulate the dream. The National Policy Board for Educational Administration (1993) maintained that the principal should "create a climate in which people can express their ideas without fear of being criticized or ridiculed" (p. 19).

Implementation of Programs

Managing transition into any program change would require the leadership of the principal. Management strategies and developing interpersonal relationships helped the principal manage the stages that developed as the program was implemented (National Policy, 1993). Communication mechanisms were to be created to remove roadblocks that hindered the change. National Policy (1993) stressed that parent involvement be means of committees or personal contact should be included. Also, the vision was to be constantly shared through school publications. The principal was to be sure that the changes the transition would make in the total system would be communicated and shared with all affected parties (National Policy, 1993). The principal determined the people who would be most affected by the change if a new program such as all students above MiMH taking algebra and the principal would be responsible for development of strategies for working with key players.

The principal was to ensure that plans were implemented properly within a climate that allowed for problem-solving and learning. In the implementation process, monitoring, coordinating, and clarifying were the categories of management behavior thought to be most important for a principal to possess (Luthans, Hodgetts, & Rosenkvantz, 1989; Yuki, 1989). Flexibility to modify plans when necessary, securing cooperation among implementors, and evaluating implementation efforts in order to learn from mistakes and successes were emphasized by National Policy (1993) as important roles for the principal. The roles that various staff members would play in the elimination of present programs as well as the implementation of new ones were to be clarified. National Policy (1993) stressed what should be expected and what consequences might occur as a result of the actions planned were to be identified. As progress was made, it was to be rewarded so that a positive and productive climate was maintained.

During the implementation of the program, principals served as effective instructional leaders (McCleary & Thompson, 1979; Keefe, Clark, Nickerson, & Valentine, 1983; Pellicer, Anderson, Keefe, Kelly, & McCleary, 1988, 1990; Smith & Andrews, 1989). Principals held teachers and students to high expectations. For a major program change, the principal spent a major portion of the day working with teachers to improve the educational program. The principal worked to identify and diagnose the instructional problems with the program. Bird and Little (1985) and Hallinger, Murphy, Weil, Mesa, and Mitman (1989) maintained that the principal should be deeply involved in the school culture and climate to influence student learning in positive ways. Smith and Andrews (1989) indicated that time and attention should be focused on instructional rather than routine matters. Effective instructional leadership was a collegial, collaborative process that involved all of the significant members of the school community (National Policy, 1993). According to the National Association of Secondary School Principals (NASSP) study of high school leaders and their schools (Pellicer, Keefe, Kelly, & McCleary, 1990):

> Instructional leadership is the initiation and implementation of planned changes in a school's instructional program, through the influence and direction of various constituencies in the school. Instructional leadership begins with an attitude, an expressed commitment to student productivity, which emanates values, behaviors, and functions designed to foster student satisfaction and achievement. (p. 57)

For cognitive-based improvement of teaching and learning, effective principals provided direction, resources, and support to teachers and students, as well as information to parents. The principal worked with the staff to set the program's instructional objectives, develop a data base, implement desired changes, and evaluate the program's effectiveness (National Policy, 1993). Research (Letteri, 1988; Dunn & Dunn, 1978; Gregoic, 1979; McCarthy, 1987) has shown that the principal should understand and have working knowledge of dominant learning-style models and instruments. An algebra program including all students above MiMH involved many different learning styles. Staff development was necessary for teachers to recognize different learning styles so that their instructional activities could be modified. If improved achievement was to be realized, knowledge of learning had to be translated into specific teaching practices that would address student skill deficiencies and assessed learning proficiencies (National Policy, 1993). Not only were the learning styles of the lower-level student considered, but also the learning styles of the upper-level student. Principals understood and helped teachers design learning resources and flexible environments to support the education of students with average or higher cognitive skills (National Policy, 1993).

Scheduling

National Policy (1993) stressed that scheduling of any new program involved the mastery of scheduling by the principal. If students of different learning styles and abilities were scheduled, the principal identified how various forms of scheduling or organizational structure incorporated different teaching strategies such as team teaching, large group/small group instruction, and cooperative learning, as well as the different learning styles. The principal related various types of learner outcomes to scheduling and organizational practices and indicated which would be constrained or improved as a result (National Policy, 1993).

Principals understood the role their buildings play in reinforcing specific types of human responses (National Policy, 1993). They were able to take a traditional building and convert and modify the school learning environment to facilitate a program, team-teaching, cooperative learning, and large group/small group instruction.

Staff Development

If educational missions were enhanced, principals played active and key roles in staff development programs (Fuller, Rotherson-Bennett, & Bennett, 1989; Little, 1982; Rosenholtz, 1989). Most authorities emphasized that improved instruction was the ultimate goal of staff development (Landon & Shirer, 1986; Bradford, 1986; Sheerin, 1991). Impressive designs in student outcomes have been linked to well-designed, ongoing staff development programs (Stallings, 1989; Joyce, Murphy, Showers, & Murphy, 1989; Pink, 1989). To be considered useful, staff development programs were to be diverse yet specific to the needs of the school and staff and incorporated at the school level (Showers, Joyce & Bennett, 1987; McLaughlin & Berman, 1982; LaRosa, 1987). A new program enhanced the professional and personal lives of teachers and support staff. New skills, however, could not be implemented without school-level support (Firth, 1982; Joyce, 1991). To be implemented successfully, staff development programs had to have an operational plan spearheaded by the principal (Caldwell, 1988; Fullan, Rolheiser-Bennett, & Bennett, 1989; Grossnickle & Layne, 1991; Joyce, 1991; Landon & Shirir, 1986; Pink, 1989; Rosenholtz, 1989; Sagor, 1991; Showers, Joyce, & Bennett, 1987). The implementation plan included activities required to adopt new knowledge and skills for improved teaching of the new program. Staff participation was used in the planning and performance of these activities as well as the follow-up. The principal was active during the training (National Policy, 1993).

Effective schools had motivated staffs that were committed to excellence. To implement an effective program, principals served as role models, "practiced what they preached," and motivated others to achieve equally high work standards. Motivation was achieved by creating conditions that enhanced the staff's desire and willingness to focus energy on achieving educational excellence. The principal treated the staff as professionals, supported innovation, and recognized and rewarded effective performance (Blase &

Kirby, 1991; Hoy & Miskel, 1982; Sergiovanni, 1987). The National Policy Board for Educational Administration (1993) set up the following 13 performance standards that principals were to be competent in so as to effectively motivate others:

1. provide staff with job challenges and intellectual stimulation;
2. encourage teamwork and collegiality among teachers;
3. articulate the positive impact staff are having on the children;
4. practice participative decision making;
5. be aware of the amount of autonomy various staff members need;
6. encourage close teacher-parent relationships;
7. provide face-to-face and written performance feedback;
8. be aware of various types of feedback systems;
9. understand their impact as role models;
10. enhance individual productivity;
11. articulate performance expectations;
12. be aware of the rewards that staff members value; and
13. provide tangible and intangible rewards for good performance. (p. XIV 13)

If a program was to be successful, individuals needed to be valued. Peters and Waterman (1982) stated that the principal should support the philosophy, "respect the individual--make people winners." The principal was found to be the key factor for success when attempting to affect positive change in school programs.

Chapter 3

THE CASE STUDY

Setting

Covington, Indiana is the county seat of Fountain County. It is located in west central Indiana near I-74. Covington Community High School has a first-class commission for the State of Indiana. The high school has been continually accredited by the North Central Association since 1941.

The mission of Covington High School as stated in the Performance Based Accreditation School Improvement Plan (PBA, 1991) was:

> The mission of Covington High School is to provide a balanced, student-centered program that develops the individual academically, vocationally, socially, physically, and creatively to the maximum of his potential. The student is challenged to develop his own life-style and sense of self-worth. This program guides the student in areas of academic success, social growth, citizenship, individual development, goal setting and career education.
>
> The total education of the Covington High School student is a joint effort among the student, his family, and the faculty. Support for this cooperative effort comes from other school personnel and the community. (p. 5)

The Student Body

The racial backgrounds of the 321 high school students enrolled in the fall of 1989 was 100 percent white, and it was the same as when polled in 1984. The student population was stable, which was indicated by the fact that 89 percent of the seniors have been in school for four years. At Covington, the average Scholastic Aptitude Test (SAT) scores for college entrance was 850 (410 verbal, 440 math). The highest number of students withdrawing was in the ninth grade, which had four withdrawals. Two students withdrew from the tenth, and two withdrew from the eleventh grade. No students withdrew while in the twelfth grade.

Review of PBA Curriculum, Instruction, and Evaluation Correlates

Having the mission statement reflected in the written curriculum was listed as a strength; however, the written curriculum in some areas did not state what students were expected to learn. New curriculum guides were developed in science, mathematics, and English; however, written curriculum guides for some subjects areas were nonexistent.

Curriculum development within the school was not coordinated with other units of the corporation. Interdisciplinary instruction was not part of the curriculum. A strategy was stated for the faculty to develop plans for interdisciplinary instruction. In-service days were to be scheduled to share interdisciplinary ideas. The faculty was to develop a calendar containing information concerning possible interdisciplinary projects.

One of the strengths of the mathematics program was that students were offered elective courses beyond those required. At the time, the state required two years of mathematics. Algebra was not required by state, nor was it required by Covington High School. Another strength listed was that application of mathematics was evident in other areas of curriculum.

A weakness in the mathematics curriculum was reported to be that no courses existed that stressed consumer mathematics and vocational technical skills. There were no courses offered that provided students an opportunity to use computers. Strategies were stated so that software would be provided for subject areas. All students would be required to take a nine-week course in keyboarding, but no school tutorials were available.

High standards of learning were expected. It was noted, however, that a need existed for a uniform grading scale for students. There was no system for student accountability and responsibility in instructional classes.

Mastery of basic skills was emphasized by the instructional staff as a strength; however, a need for mandatory minimum competency testing was listed as a weakness. The curriculum was being reviewed and updated to reflect societal changes and test results.

There was a school-wide commitment to assessment and accountability. The Indiana State Test for Educational Progress (ISTEP), Preliminary Scholastic Aptitude Test (PSAT), and SAT tests were used to compare the performance of Covington students with national and state performance. As part of good teaching, students were regularly diagnosed to assess their skill levels in respect to the objectives. Student test information was used to improve teaching practices. Educators reviewed and analyzed test results to plan curricular and instructional modification. Summaries of student performance, however, were not shared with the staff to assist in developing action plans and alternatives. Another weakness states was that students did not have to pass a practical skills competency exam prior to graduation. A strategy was developed so that programs would be revised to reflect the needs revealed through program evaluations (PBA, 1991).

Review of North Central Mathematics Section

There were no additional expectations formulated for the mathematics program. In fact, it was noted in the NCA self-study report that the expectations for the mathematics program met the school standards and "exceeded the characteristics" of the community. The philosophy and goals of the total program, it was felt, met the needs of the intermediate student, but not the "lower or higher student and vocationally oriented student" (NCA, 1991, p. 230). The commitment seemed to be only adequate to cover basic requirements, but did not go beyond this. The NCA self-study report stated "These expectations are very appropriate for our students" (NCA, 1991, p. 230). It was noted, however, that no class time was available to organize and support data.

Based on a recommendation made in a previous site visitation evaluation (1983), a calculus class had been added to the curriculum. Curriculum guides had been written and were in evidence. The enrollment in higher level mathematics had risen.

Certain items, however, that had been recommendations for more than three years standing were shown not to have been implemented. Regardless of recommendations, there was no computer lab in the mathematics department, no department chairmen or budgets, and no procedure established to assign freshmen to proper mathematics classes. The reason given for all the deficiencies was "administration has not acted on this" (NCA, 1991, p. 231).

In the area of organization for instruction, it was noted most descriptive criteria received a good or (4) rating. These areas were ones controlled by staff such as "Teachers work together to implement the program at a grade level" and "The central theme of the curriculum is the development of problem-solving strategies" (NCA, 1991, p. 231). It was noted that "a minimum of two years of study in mathematics is encouraged" (NCA, 1991, p. 231) received an excellent or (5). It is a state requirement that students complete two years of mathematics.

The areas of organization that received a satisfactory (3) rating were curricular areas. The report showed that courses were satisfactory "to suit the students' abilities and to meet their academic, vocational, and everyday life needs" (NCA, 1991, p. 230). The institutional provisions for students with special academic also received a satisfactory rating or (3). It was felt that many students elected courses beyond those that were required. The report did cite that there was a problem because the ability level of some students did not "match the course they are enrolled in" (NCA, 1991, p. 232).

The "description of offerings for the scope and content of the offerings" (NCA, 1991, p. 233) was considered to be better than acceptable. The staff, in the NCA self-study report, rated this good or (4). The staff felt that the school was offering a well rounded curriculum of mathematics selection for the student. A description of the mathematics offerings is shown in Table 2.1 (NCA, 1991, p. 231).

Table 2.1

Description of Mathematics Offerings

Title of Course	Grade	# Males	# Females	Sections	Class Size
Advanced Math	11-12	9	15	2	9-15
Calculus	12	2	2	1	4
Algebra II	9-12	23	24	3	14-17
Geometry	10-12	14	22	2	16-20
General Math	9-11	4	9	1	13
Algebra I	9-11	41	42	3	24-31
Business Math	9-12	16	10	2	12-14
Intro to Algebra	9-12	16	9	1	25

Each of these mathematics classes are offered for 50 minutes everyday or 250 minutes per week. Each class was considered to be an elective even though there was a two year state and local requirement.

The descriptive criteria indicated that the mathematics curriculum to be good or (4) as far as consistency with the philosophy and goals of the school. Courses in the vocational-technical area however, were considered to be poor (2), and honors/advanced placement courses were considered to be satisfactory or (3). Course work in the are of one, two, and three-dimensional relationships was considered only satisfactory or (3). Since no computer labs were available, courses that provided students an opportunity to use a computer was rated poor or (2). Courses that included the use of a calculator as an appropriate action, however, were rated excellent or (5).

There were no plans to review the present offerings. The report (NCA, 1991), however, maintained that the following offerings should be provided:

1. a class teaching probability and statistics,
2. an additional period of Algebra I, and
3. a computer in each math room. (p. 233)

During the five years previous to the report, the sequence of math courses had been changed to Algebra I, Algebra II, and Geometry. Calculus, which was added to the curriculum because of a recommendation made in a previous evaluation, was considered to be less appropriate in the 1991 NCA self-study report. The calculus course was cited as less appropriate because of present-day mathematical needs of individuals and society, and because the course had an enrollment of only eight students in two years. The program required that a student take calculus in order to earn a fifth year of mathematics credit. Over a two-year period, only eight students progressed enough to take the fifth course, calculus. The on-site visitation team believed that the enrollment numbers would rise if there were alternatives other than calculus.

Instructional activities were basically rated good or (4). Computer activities incorporated into the program were cited as missing, but needed. Provisions made for the instruction of groups of varying sizes were considered poor or (2). It was indicated in the report that students were not encouraged to supplement classroom activities by using the school library. No mathematics resource center was provided for these activities. Only satisfactory provision made for students' individual differences. Access to counseling for students with mathematics aptitude for continuing post-secondary study was found to be only satisfactory or (3). Overall, the planning for delivery of instruction was reported to be excellent or (5). The faculty reported they had to work together to find the best methods of teaching critical material.

Instructional materials and media were found to be satisfactory or (3). The organization, maintenance, and utilization of materials were reported as good or (4).

Computer hardware and software were rated as missing, but needed. Models, charts, transparencies, and slides were found to be poor or missing. A professional library of current publications and periodicals was not accessible to the teachers; however, the report stated that the "scope of instructional materials and media is adequate for a good math education. However, we fall short on the expectations involving computers and visual math aides" (NCA, 1991, p. 236). Budgeting for consumable supplies and resource materials was found to be poor or (2). Likewise, the methods used for ordering and keeping an inventory of materials and media was reported to be poor. Guidelines for establishing the selection of new instructional materials was found to be missing, but needed. Materials were not provided for different levels of student ability and diverse cultural backgrounds. Storage areas for available materials available were found to be poor or (2).

The facilities and equipment conducive to the achievement of the major expectations, goals, and objectives generally were found to be poor or (2). The facilities themselves were found to be from satisfactory (or 3) to good or (4). Furniture with regard to being appropriate for the instructional program was reported to be poor or (2). No provision was made for equipment inventory and maintenance records. Also missing were budget provisions for replacement and addition of equipment. The educational equipment and supplies available to carry out the instructional program was found to be poor or (2), especially in the areas of recorders, visual aides, geometric models, computers, and mathematical games. Again in the area of computers, the report stated that "the push is to educate about and with computers, yet we don't have any in the math rooms. Just one in each room would help" (NCA, 1991, p. 239).

Overall, the learning climate was cited as good in supporting the attainment of the program's major expectations, goals, and objectives; however, the students, parents, and community reported only a satisfactory perception of a positive learning climate. The teachers and administrators listed a good degree of positive perception of the learning climate. All groups saw the importance of mathematics in today's society.

The student assessment program to provide for individual differences was found to be inadequate. The report indicated, "At present, we have no program for means of evaluating grade level weaknesses, but a program such as this is needed" (NCA, 1991, p. 238). However, the Covington SAT math scores (440 average) were listed and found to be below state (460) and national (470) averages. Also, it was noted that the math scores on ISTEP, were above the expected level projected for this area. The report stated:

> Testing is done only on request. the primary instruments used for student assessment in math is the ISTEP. A proposal is being considered to assess all Algebra I students at the end of the second semester to help determine their ability to be successful in Algebra II. We are unaware of any formal evaluation of

> individual students by guidance or math department to determine strengths, weaknesses and yearly growths of math students. Individual student's math abilities are evaluated by the guidance department, by evaluation of math grades, and discussion among individual students and their math teachers. Grade level weaknesses are not assessed. (NCA, 1991, p. 237)

The report did indicate that nine weeks grades were set by the teachers and met each quarter.

The overall strengths listed by the North Central Association (NCA) on-site visitation team regarding the mathematics program were:

1. Small classes in the advanced level
2. Rooms located in the same hallway
3. Young energetic and qualified staff
4. Rooms are designed with ample blackboard space. (p. 242)

Aspects of the mathematics program that needed the most improvement were:

1. Use of computers which does not now exist
2. The high numbers in lower level math classes
3. The lack of textbooks in some classes
4. The absence of a department head
5. The absence of a budget
6. The regulation of inventory of supplies
7. Departmental unity
8. The offerings for 5th level math students
9. The method of placement into math classes
10. The use of shared staff. (NCA, 1991, p. 242)

To correct the limitations, the NCA on-site visitation team made the following recommendations in order of their priority:

1. A better system for placement of students into high school math courses.
2. Purchase a computer for each math room.
3. Set up a math department budget. Name a paid department head with a written job description.
4. Limit the number of students in each low-level math class.
5. Add another math course as an alternative to calculus.

6. Additional staff member to alleviate shared staff members and help with addition of computers.
7. Set up five year goals for purchasing of equipment
8. Add an eighth grade intro-algebra class. (NCA, 1991, p. 242)

The total curriculum was rated good or (4) by the curriculum committee. Mathematics was listed as a strength in those aspects of the total curriculum that were considered most satisfactory. It was stated that "the curriculum is appropriate in most areas in fulfilling the needs and interests of the students" (NCA, 1991, p. 60). However, it was reported that fifty-four percent of the senior class would complete three years of mathematics. The guidance records, however, showed that less than fifty percent of the students completed both Algebra I and Geometry (NCA, 1991).

Discipline

The major source of disciplinary problems came from the basic, or general, grouped classes. Disciplinary records from 1990 and 1991 indicated that eighty-six percent of the referrals came from the general mathematics, English, and science classes, and from the self-contained LD classes. From the mathematics classes, ninety-seven percent of the referrals came from the basic math, general math, and pre-algebra classes. A total of seventy-four referrals from the mathematics department during the year of the North Central evaluation (Administrative notes, 1991).

Organization of Mathematics Classes

The organization of the mathematics classes at Covington High School was very traditional. One teacher was in each classroom. Since students were supposedly homogeneously grouped, usually only one learning style was addressed in each classroom. Lecturing was the primary method of instruction; however, some work at the chalkboard and supervised homework were observed by administrators.

Tests were given after the completion of a chapter in the textbook. Mastery was "expected," and a new chapter was begun almost immediately after the test from the previous chapter was reviewed. Students who did not master the minimum objectives were expected to review on their own and hopefully master the previous chapter's material while they attempted to master the present chapter's objectives.

The organization of instruction in the Algebra I classes followed the objectives listed in the curriculum guide. However, it was apparent that the objectives followed the Algebra I textbook.

Teachers expressed that they felt pressured by the school board to complete the sequence, regardless of whether the majority of students had or had not mastered the body of knowledge. Teachers felt that all of the material in textbooks must be completed. Individual differences were not considered in the sequence of material presented. Few alternatives to the sequence of the curriculum were encouraged or permitted.

In the fall semester of 1990-91, the Pre-Algebra classes had enrollments of 15 and 18 students. The General Math class started the fall semester with an enrollment of 12 pupils. The high school Algebra classes had enrollments of 28 and 29 students. The philosophy behind the difference in class sizes was that the basic classes needed a smaller teacher-pupil ratio. By the end of the first semester, the enrollments had reversed. Algebra classes had been reduced to 15 and 16 students. Pre-Algebra enrollment had increased to 24 and 25 students, and the General Math class increased to 19 pupils. If a student was failing, appeared to be failing, or wanted "something easier," they were permitted to change classes to a lower level of mathematics.

Comparison of Covington Mathematics Program to National Council of Teachers of Mathematics Standards

Before the elimination of the general mathematics and the implementation of the three-semester Algebra I program, the National Council of Teachers of Mathematics (NCTM) Standards were not considered or mentioned in the development of the Covington mathematics program. They were not considered in the development of the three-semester program. The initial Standards were not published until 1991; however, there were some definite areas of comparison that could be identified as "current practice" (Professional Standards, 1993).

The Professional Standards (1993) reported five major shifts in the environment of mathematics classrooms. They stated that there was a need to shift:

1. toward classrooms as mathematical communities--away from classrooms as simply a collection of individuals;
2. toward logic and mathematical evidence of verification--away from the teacher as the sole authority for right answers;
3. toward mathematical reasoning--away from memorizing procedures;
4. toward conjecturing, inventing, and problem solving--away from an emphasis on mechanistic answer-finding; and
5. toward connecting mathematics, its ideas, and its applications--away from treating mathematics as a body of isolated concepts and procedures. (p. 3)

The Covington mathematics program, especially in the general mathematics area, fell mostly in the area that needed to be shifted (Anecdotal records, 1991). The classes of Business Math, General Math, and Pre-Algebra were in this area. The higher level courses (Algebra I, Geometry, etc.) came closer to meeting the new Standards, because the courses were more rigorous.

The NCTM Board of Directors (Professional Standards, 1993) indicated that the critical component to the Standards was the mathematical education of every student. By every student the Professional Standards (1989) meant specifically "students who have been denied in any way to educational opportunities as well as those who have not" (p. 21). NCTM stressed that students should have access to the full range of mathematics courses offered. At Covington it was obvious that students were either taking advantage of this access, or they were being denied access because of limited ability.

If instruction was to result in the student outcomes specified in the Curriculum Standards (1989), a student needed to have a sufficient opportunity to learn the specified content. In the Covington program, students were given two semesters to learn algebra with no consideration for individual differences. NCTM believed the core curriculum specified in the Standards was what all students could benefit from learning. Covington had not specified a core curriculum for all students.

Standard thirteen (Curriculum Standards, 1989) emphasized instruction. Not only were opportunities to learn recognized, but also instructional resources and classroom climate. Covington, as stated in the NCA (1991) report, lacked computers, calculators, and manipulative materials and this determined the extent to which the classroom environment was conducive to the attainment of program goals and student outcomes suggested by the Standards.

Standard nine (Curriculum Standards, 1989) for grades 5-8 had algebra and the exploration of algebraic concepts as part of the middle school curriculum. Standard nine stated "By the end of the eighth grade, students should be able to solve linear equations by formal methods and some nonlinear equations by informal means" (Curriculum Standards, p. 108). Only one section of eighth grade algebra existed at Covington. The vast majority of students were not exposed to any linear equations and very few algebraic concepts.

Standard five (Curriculum Standards, 1989) for grades 9-12 stated that the mathematics curriculum should include the continued study of algebraic concepts. The NCTM Board of Directors indicated that the algebra curriculum should move from a tight focus on manipulative facility to include a greater emphasis on conceptual understanding, on algebra as a means of representation, and on algebraic methods as a problem-solving tool (Curriculum Standards, 1989). Covington students, as a whole, had no focus on algebraic manipulative skills, much less a readiness for conceptual understanding (Anecdotal records, 1991).

The absence of a department head (NCA, 1991) and the turnover in administration (PBA, 1991) were factors in the organization of the Covington mathematics department. Support, resources, environment, as well as structure, could have been affected by these factors. The NCTM (Professional Standards, 1993) stated, "At the present time teachers are often faced with trying to teach mathematical inquiry in time periods that are entirely inappropriate" (p. 190). Organization and structure, especially in regard to time, had not been discussed by the mathematics department or the administration (Anecdotal records, 1991).

Needs Assessment

At the first School Board meeting of 1990-91, the Covington School Board prioritized five areas for consideration with one-year goals. The five areas were the following:

1. The math program.
2. Emphasis on non-college bound course work.

3. Teamwork between faculty and administration at student and parent level.
4. Engaging students, i.e., motivation.
5. The building project. (Board Minutes, August 27, 1990)

At the next school board meeting, mathematics was on the agenda under new business. At the meeting, Terry Field, the only veteran mathematics teacher returning to the staff, indicated that the mathematics department could improve their communication among staff members. Field also indicated a need to consider an Algebra II and Geometry section for non-college intending students. This new section might incorporate a three-year program instead of the traditional two-year program.

Kip White, President of the Board, wanted to be sure that all factions of the corporation, including faculty, were represented on the committee, and that they all had input into the recommendation. The author indicated that he would be willing to chair a math committee, and that he would bring back a list of math department improvements or considerations for improvements to the board. The author was assistant principal and acting principal during the time span of the case study. He assumed the role of principal in the implementation of the needs assessment and the program changes that resulted from it. In the case study, when the principal is mentioned it is the role the author played in administration of the changes (Board Minutes, September 10, 1990).

It was decided to have a needs assessment of the entire school corporation's math curriculum. At the November Board meeting, a math curriculum update was presented by the author. Meeting dates had been established in each of the buildings. The meetings would be used to gather information regarding what was being taught and how it was being taught. This information was to be used to establish continuation/improvement/enhancement criteria for the math curriculum in Covington Community Schools. Bret Lewis, Superintendent, requested that math teachers (a minimum of one from each grade level) attend the November 12, 1990 Board meeting to discuss their findings (Board Minutes, October 22, 1990).

Substitute teachers were assigned at each of the schools so that meetings could take place with each of the elementary, junior high, and high school faculty that were involved to any degree in the mathematics program. A substitute secretary was also hired to keep notes of the meetings for the principal. Each of the faculty members interviewed by the principal were asked to evaluate how they were meeting the instructional objectives that had been established previously for their grade level or subject area. They were also asked to give suggestions about the improvement and enhancement of the mathematics program at their level.

One of the problem areas that evolved from the needs assessment was in the Algebra, Pre-Algebra, General Math area. Even though the philosophy was to keep the enrollment smaller in lower level classes like General Math and Pre-Algebra, this was not being accomplished. The high school mathematics teachers, Jean Mundy and Todd Talbert, felt that the students were "copping out" and enrolling in lower level courses when they were capable of higher level work. The students in those classes had become disciplinary problems because the "homogeneous" grouping was putting together groups of disinterested students. Students who felt challenged by the material were inhibited by pupils who were disruptive because the material was either too easy or uninteresting.

Mundy and Talbert both agreed that they would have trouble finishing the text and all of the objectives within the school year. The School Board had previously stated that every teacher should "finish the book in every class" (Interviews, November, 1990). Both teachers expressed concern since they were new to the system; however, both teachers had previous teaching experience.

At the time of the needs assessment, teachers felt that the objectives were being met only between fifty percent and seventy percent of the time. The students were not achieving a sufficient degree of mastery, and in the process, some dropped out of the class before the end of the first semester. Many of those who stayed struggled because of the pace demanded in order to meet all the objectives (Interviews, November, 1990).

The meetings with the high school math staff revealed that change was not only necessary, but the conditions for change were present. The principal kept track of what was transpiring in regard to the overall action plan. If changes were to be made, they needed to be verified to the mathematics staff first through related literature and personal experience of the principal and the staff. Once the mathematics staff, especially those who were going to teach the new methodology, were convinced that the changes would work, then a broader scope of promotion would be attempted.

It was obvious to the principal that through the use of the related literature, especially Oakes (1985) and Goodlad (1984), tracking was not accomplishing what was needed educationally in the American schools. Other researchers, such as Johnson and Johnson (1981), pointed out that ability grouping and tracking did not help the overall achievement of students. This is why heterogeneous grouping of mathematics students was chosen. This research was presented to the mathematics teachers as part of staff development.

Because students need to be enrolled in meaningful classes and researchers like Goodlad (1985) found that the lower track mathematics students knew eighty percent of the material before they started the class, algebra was chosen as the heterogeneous class for the ninth grade students. Other researchers, such as Goldberg, Passau, and Justman (1966); Davis (1978); and Glasser (1992), felt that curriculum needed to be updated and that students of low ability could successfully achieve in classes where expectations were high. Algebra was considered not only meaningful, but it was expected if a student enrolled in college.

A mastery learning approach was selected because of the basic premise that "all children can learn when provided with conditions that are appropriate for their learning" (Bloom, 1981). A mastery approach was needed because of the heterogeneity of the group. Mathematics was one of the most frequently used subjects for mastery learning, especially algebra (Anderson, 1988). Many approaches were possible for the implementation of mastery learning. Since the principal was familiar with the Controlled Unipack Management System (CUMS) (Ford & Wheatley, 1972), this material was to be introduced to the staff who were going to teach the mathematics, both in the pilot and case studies, as part of the staff development program. The mastery learning structure was necessary to help teachers and students be organized for instruction (Guskey, 1990; Chaiklin, 1989: Everton, Anderson, Anderson, & Brophy, 1980).

Controlled Unipack Management System

Under CUMS, a month long unit, for example, is divided into two, two-week periods. The minimum performance objectives are defined for the basic unit. Large group instruction is used to present the objectives to the basic learning group (BLG). The minimum objectives are covered on a daily basis, usually one objective per day. A mastery/mid-test is given after the minimum objectives have been covered once. Those "passing" at this point go on to the advanced learning pack (ALP), or the advanced learning group (ALG). The remaining students are recycled as the review learning group (RLG) through the minimum objectives, but individual attention is given to special problems identified by the mid-test item analysis or by the teacher. Those in the ALG are guaranteed at least a "C," while others who would ordinarily fail are given a second chance to earn a passing grade.

The class is not working in two "groups," the ALG and the RLG. The ALG contains higher level problems on the same unit as well as enrichment material. The ALG receives both horizontal and vertical enrichment. The RLG studies the same concepts again, but used different materials and resources. If team-teaching is used, one teacher teaches the ALG and the other teaches the RLG. At the conclusion of the second phase, a final test is given to each group. The tests contain some questions similar to the mid-test in addition to problems unique to each learning group. Because a B- is the highest grade RLG students can earn, students have an incentive to wish to be in the ALG.

CUMS provides for continuous progress, but on a controlled basis. The idea of continuous progress, while ideally appealing, was fraught with problems when uncontrolled. Students were at so many levels of instruction, teachers found it difficult to provide the individual attention necessary for adequate progress. When uncontrolled, it was difficult to have small group interaction. Since students are studying material with others, it is easier in CUMS to provide for discussion groups, cooperative learning, and other forms of small group instruction. These interactions are a valuable phase of learning.

Three-Semester Algebra Program

The principal had experienced difficulty with time and management in previous encounters with both individual and group mastery approaches. Students in individualized mastery programs became so spread out it was difficult to help them and evaluate them. Cheating on tests occurred when individual tests were not properly monitored and when test forms were not frequently changed. Motivation, also, became a problem when individualized programs were used as the only method of teaching. When heterogeneous groups were used, adequate time was not available to remediate students. This concept was confirmed by Bloom, Madous, and Hastings (1981). When CUMs was last used (1989) by this author in a two-semester approach, it was effective; however, all course objectives were difficult to cover. Much of the material was rushed during the latter part of the second semester.

Prior to the "Sputnik-New Math" era of the 1960s, many schools had the following curriculum:

Ninth Grade - Algebra

Tenth Grade - Geometry

Eleventh Grade - Intermediate Algebra/Solid Geometry

Twelfth Grade - College Algebra

All students were required to take algebra and geometry. Students desiring more math completed the eleventh and twelfth grade courses. The essentials of algebra and geometry were the important math items.

After "Sputnik," a tremendous push occurred in math and science. Because this "rocket scientist" need was pushed, some calculus became a part of the high school curriculum. The curriculum was revamped to accommodate the addition of calculus. The intermediate algebra concepts were integrated with the first year algebra text along with abstract linear algebra notions. The geometry textbooks were also expanded not only to include the basic Euclidean concepts of plane geometry, but added solid geometry, logic, and some coordinate geometry. Unfortunately, not all students became rocket scientists, and an increasing number of students were not being exposed to algebra and geometry. Students now found it difficult to comprehend these concepts in the time that was allocated. Students who could not achieve a passing grade, chose an easier math course or opted not to take additional math courses. Bloom (1981) pointed out that it may take some students more than a year to master algebra. Even though Goldberg (1971) and Waitland (1976) found little advantage in a three-semester algebra program, it was decided to use this approach because it was nontraditional and because originally the three semesters of algebra were combined into two (Intermediate Algebra and Ninth Grade Algebra). Also, the Goldberg (1971) and Waitland (1976) traditional single teacher methodology was used rather than a mastery approach like CUMS that also used team-teaching. The principal presented this information in staff development meetings to help facilitate the change.

Because it was decided to eliminate General Math, Basic Math, and Pre-Algebra, inclusion or self-contained classrooms were the choices for learning disabled (LD) students. At Covington High School, the decision was made to include all students above MiMH because two teachers, one a regular education mathematics teacher and the other a LD teacher, were already collaborating in a sixth grade class and research was positive toward inclusion. CUMS was developed with a team-teaching approach. The research of Cook and Friend (1990) and Husazi, Rice, and York (1979) supported team-teaching for inclusion. The special skills of the LD teacher in learning styles, reading, etc., and knowledge of algebra of the regular education mathematics teachers was believed to provide a good basis for team-teaching. Guskey (1990) had cited that team-teaching students of mixed abilities was a positive alternative to tracking.

The mathematics teachers indicated that the students in the lower track classes had low self-esteem. The staff felt that using heterogeneous grouping in algebra would improve their self-esteem. The staff was convinced that students who were previously in lower tracks would feel better about being algebra students. The negative effects of tracking on self-esteem had been reported by Clark (1962), Tanner (1965), Schafer and Olexa (1971), Oakes (1985), and Braddock (1990).

The staff and the principal felt that students in General Math were not performing to their capabilities; therefore, disciplinary problems resulted because of their lowered self-esteem. The staff was convinced that most of their students could learn the basics of algebra. This was supported by Goldberg, Ponsau, and Justman (1966); Davis, Jockusch, and McKnight (1978); Goodlad (1984); and Glasser (1992).

Research by Slavin (1983, 1989), Johnson and Johnson (1981), Newman and Thompson (1987), and Davidson (1985) all concluded that cooperative learning can be an effective means of increasing student achievement, providing that goals and individual accountability are incorporated into the cooperative methods. Through the staff development program, it was decided to use cooperative learning with the mastery approach of CUMS.

Mevarech (1985, 1989) and Guskey (1990) worked successfully with combining mastery learning concepts with cooperative methods. The staff decided to use cooperative methods, not only as the only methodology, but to incorporate cooperative activities within the BLG, ALG, and

RLG of CUMS.

At the November 12, 1990 School Board meeting, information regarding the first meeting of the K-12 Math Curriculum Committee was presented. It was indicated that the teachers appreciated the opportunity to have time allotted to discuss the curricular concerns and program involved in the math program in the Covington Community Schools. Items presented for consideration and further development were:

1. Three-semester Algebra I course for 1991-92 school year.
2. Three-semester Geometry course for 1992-93 school year.
3. The Algebra I and Geometry (three-semester courses) would replace the General Math and Pre-Algebra courses.
4. Mastery versus proficiency was a major topic of discussion at the elementary level.
5. Team teaching would be piloted with the sixth grade teacher and LD teacher during the 1990-91 school year.
6. Ability grouping (heterogeneous and homogeneous) was discussed and considerations for changing the ability make-up of classes was inspected.
7. Concerns about the Indiana Statewide Test of Educational Progress (ISTEP) were expressed.

The Board gave encouragement to the principal and the

Math Curriculum Committee to continue their efforts. They expressed a desire for the committee to report back to the Board prior to any finalization of plans being implemented in the curriculum (Board Minutes, November 12, 1990).

At this time it was suggested that the Controlled Unipack Management System (Ford, 1972) might be used to help master the objectives. CUMS had been used by the principal in other systems as recently as 1989 with a degree of success.

Because this was definitely an innovation in regard to both curriculum and credit, the Indiana Department of Education was consulted. A non-standard curriculum request form was sent to the principal from the Center for School Improvement and Performance. The rationale for the program was given. The instructional objectives, a brief course description, instructional materials, staffing, and method of evaluation were listed in the waiver application (Department of Education, 1991).

The Department of Education approved the waiver request for three credits; however, they would give only two credits in Algebra and one credit in Pre-Algebra. This system of credits would work fine if the three-semester Geometry course of study was also approved. It was decided to pursue the program.

Pilot Program

The teachers showed interest in CUMS, but were somewhat skeptical of the idea. Since Jean Mundy, math teacher, and

Nancy Ford, the high school's LD teacher, were already scheduled to work with a mainstreamed sixth grade low level math class, the Board decided to pilot CUMS in this class. Ford was already familiar with the CUMS process, and the teachers were looking for a solution to the discipline and learning problems in the class.

The sixth grade class was labeled Section Four and contained almost the identical roster of the fifth grade Section Four ability-grouped lowest level math group. The students as sixth graders covered mostly addition and subtraction. According to the needs assessment, the students were not considered ready for much more.

The teachers used a team-taught CUMS method of instruction. When Mundy was teaching the basic learning group (BLG), Ford would move around the room to be sure that all students were on task. The amount of "note-writing" and whispering were virtually eliminated because one teacher was free to move around the room to check students. Disciplinary problems in the class seldom needed administrative assistance because they were taken care of in the classroom. It was unnecessary for the teacher conducting the class to stop for a disciplinary problem, and the class as a whole was on task for longer periods of time.

The teachers used the objectives for the Section Four class as the minimum objectives. The material that was being used for the advanced learning group (ALG) was the same subject matter used in regular sixth grade classes.

These students had already been labeled Section Four. However, when they were told they had advanced to the ALG, their self-esteem improved. The teachers noticed that students desired to be in the ALG. Most of these students, because of their tracking, had not received must recognition. "Next time I'm going to be in the advanced group," said one the students (Anecdotal records, 1991). Teachers noticed a change of attitude in students about homework as well as in the daily recitation. The principal provided frequent encouragement for the teachers' efforts.

The pilot study was considered a success. The Board decided to promote the use of CUMS in Algebra I and to extend the length of time to three semesters.

Promotion of the Program

To promote the program, teachers needed to have a degree of ownership in it. The principal knew that he could not promote the program alone. The pilot program had convinced Mundy that this method would work. Meetings with the principal, Mundy, and Mr. Todd Talbert, the other teacher who was to be on the Algebra I team, were held to provide the ownership. Even though Talbert was not thoroughly convinced that CUMS would work, he made a commitment to the program. He was convinced that all of his students he had taught in General Math and Pre-Algebra could learn algebra if the pace was right and they were kept on task.

Since it was known that Talbert was initially skeptical of the CUMS program, the principal chose him to be the major spokesperson at the February School Board meeting. A schematic of the proposed changes of the math curriculum was presented to the Board. A three-semester Algebra I class would be followed by a three-semester Geometry course. Business Math, General Math, and Pre-Algebra were to be eliminated. To achieve the implementation of the program, a concession was made to keep one section of two-semester Algebra I in the curriculum:

> Talbert's presentation reduced some Board Members' fears that the traditional four- and five- year math program which is currently in place, to be disturbed, [sic] it will remain in tact, this program is strictly addressing the lower level math classes. (Board Minutes, February 11, 1991)

Even though some of the heterogeneity would be lost, the concession was necessary to initiate the program. If the three-semester Algebra I program proved successful, proponents of the CUMS process hoped that the freshman two-semester Algebra I section later would be dropped.

Some Board members expressed concerns about students who might wish to change tracks during their high school years. For example, a student might wish to change from a non-college track to a college track. These Board members indicated that it would take an exceptional student to make this transition. Teachers of the CUMS program explained that this program would ease transition because all Covington students would have the algebra and geometry requirements for college entrance. It was the responsibility of the principal to entertain these concerns and provide viable solutions.

The Board also expressed a concern for General Math students who could not handle algebra. What would happen if a student failed? Proponents of the CUMS program explained that summer school would be available for those students who failed, but that the review learning group (RLG) and additional remediation would eliminate failure by students who were trying. Those at the meeting also expressed concerns about motivation, such as whether students would be sent into life with the appropriate skills and at appropriate skill levels? Another concern was about whether non-college intending students needed algebra and geometry. They also discussed the difficulty of motivating non-college intending students toward academic progress or improved academic progress. After discussion, the Board indicated that they felt better about the proposed curricular changes in the math program. The Board also wanted to hear from the middle and elementary schools to see if the new high school changes would have any trickle-down effects on the total K-12 curriculum (Board Minutes, February 11, 1991).

It was not time to get the community involved. The principal made himself available to any group who expressed an interest. The principal spoke at church groups, sororities, and school functions about the proposed curriculum changes. The community needed to have a positive feeling toward the program for the School Board to completely accept it. A great deal of one-to-one discussion was held with the community members.

At the April Board meeting, a motion was made to drop Business Math, General Math, and Pre-Algebra at the high school. Three-semester Algebra I would be introduced in the 1991-92 school year, and three-semester Geometry would be added in the 1992-93 school year. The motion was passed unanimously. The Math Committee was surprised by the Board's approval of the three-semester Geometry. The committee expected that three-semester Geometry would pass at a later date only if the three-semester Algebra I proved successful.

Throughout the summer, the CUMS program was promoted and structured. The principal organized and encouraged teacher participation in the development of the program. Teachers met to discuss the scope and sequence of the three-semester Algebra I program. They knew that some flexibility was needed in the structure to provide for individual student differences. The more the teachers became involved with the planning, the better prepared and more excited they became about promoting the program.

Implementation of the Three-Semester Algebra Program

The learning experiences that the teachers planned were directly related to the objectives that were already in place in the Algebra I curriculum. The teachers, however, had to plan for the minimum objectives they wanted each student to achieve. This put control over the objectives in the hands of the teachers involved. The LD teacher was directly involved in this phase of planning. The principal had to facilitate the planning. The experiences that were planned were to provide mastery of minimum objectives so that students would be prepared for the next unit.

The textbook (Holt, Algebra I) contained algebra problems that were divided into three levels of difficulty; "A," "B," and "C." The "A" problems were prepared for minimum level of performance; therefore, they were used as the major source of experience for the BLG and the RLG. The odd numbered "A" problems were used as homework for the BLG or large group sessions and the even numbered problems were given to the RLG. This eliminated much of the confusion about homework assignments for these groups. If, however, students in the review learning group (RLG) did not demonstrate sufficient mastery in a specific unit, additional "A" problems were added to the next unit.

Experiences in the RLG were determined to a great extent by the mid-test. Mid-test analysis was used to place emphasis on the objectives not reached by the majority of the RLG. Mid-test results also influenced the experiences of the ALG.

The ALG experiences were basically unlimited. The "B" and "C" textbook problems were used for much of the ALG's homework assignments. However, Algebra II, Trigonometry, and Analytic Geometry problems were experienced by some of the students as individual programs were developed. Since some of the students barely qualified for the ALG, they needed to experience some of the RLG's "A" textbook problems. The mid-test analysis revealed weaknesses in members of the ALG and "A" text problems were assigned. Both ALG and RLG students were given computer experiences, but the ALG had more enrichment in the area of programming. The test for the ALG was an average collection of problems experienced by the entire advanced group.

A variety of learning styles were used in all three groups (BLG, RLG, and ALG). Cooperative learning was also used in all three groups. Teachers felt that if any one style dominated, individual student differences would not be addressed. For example, if cooperative learning was used too much, then the individual who had high ability in that section might not reach their potential in that particular algebra unit.

Cooperative learning was used a great deal in the RLG when a specific problem was identified in the mid-test analysis. The mid-test analysis also often showed that members of the ALG had some difficulty on a basic section of the unit. If this occurred both groups were brought back together for a cooperative learning session on the identified section.

Many hands-on experiences were planned, some after the unit was in progress. Manipulatives were used whenever appropriate. The variety in learning styles also appeared to add to the interest level of the daily routine.

Planning was difficult for the team teachers because they did not have a common preparation period. Because teachers coached more than one sport, after school planning was difficult or impossible. The principal, therefore had to substitute for one of the teachers when a team meeting was necessary. Ford, the LD teacher, arranged her self-contained class so that her aide could handle the LD class during her team meeting. Some meetings were held before school so that everyone could be present.

Since all the lower level math classes were dropped, the initial enrollment in three-semester Algebra I was slightly larger than anticipated in the future. Indiana law requires two years of mathematics for graduation. The initial classes contained students with varied backgrounds in mathematics. Some had mastered Pre-Algebra, some had successfully completed General Math, and some had not passed a math course while in high school.

The incoming freshmen in the class of 1995 had been divided into the following three groups: fifteen students who had passed Algebra I in the eighth grade and who were to be enrolled in Algebra II, twelve students who were selected to take the two-semester Algebra I, and the remaining students who were to be enrolled in the new three-semester Algebra I. The group of twelve who were enrolled in the old two-semester Algebra I were expected to complete four years of mathematics. The School Board would not approve the new program unless this class was adopted. Some administrators made reference to arguments that this incoming freshman class, as a whole, "did not have a good reputation and some parents did not want their children in class with those kids. They suffered with their bad behavior all during junior high" (Administrative Notes, 1991).

The total enrollment of the three-semester Algebra I program was 101 students in two sections. All but one of the LD students were mainstreamed together into one section, and the LD teacher was assigned to that section. The one LD student who was assigned to the other section had a scheduling conflict. He received LD services during a study hall.

Scheduling was not difficult because Pre-Algebra and General Math had already been scheduled during the same period. Pre-Algebra and Algebra I had been given the same period at another time during the day and Talbert and Mundy were already listed as the instructors. Ford's LD schedule had to be adjusted slightly, but she was already slated to teach the LD Math. Actually, scheduling was easier because singletons of Basic Math and General Math were eliminated and the two sections of Pre-Algebra and Algebra I were combined. This gave the principal more flexibility in developing the schedule.

Since CUMS was used to structure the learning experiences, the classes were scheduled heterogeneously. Students in each section came from varied backgrounds. Doubts surfaced about the success of the program because some believed that the classes were too heterogeneous to succeed. One comment was recorded stating that "if this group succeeds, then any group can" (Administrative Notes, 1991).

The large body of content that had been covered in Algebra I was now to be taught in three semesters instead of two. The content was not to be a "watered-down" version. Since there were nine units in the course objectives, the basic guideline was to teach three units per semester. Adjustments to this structure would be made as necessary, but the goals would be to master the minimum objectives of all nine units and to take every student as far as possible in mathematics (Algebra II, Trigonometry, etc.).

The sequence of instruction was not changed from the two-semester Algebra I course. The new course was not changed in the basic sequence, just lengthened to three semesters. The minimum objective experiences, however were "repeated" to the RLG. The ALG had success with these minimum objective experiences first instead of having them intertwined with some advanced items as was "normally" taught in two-semester Algebra I. The ALG mastered the BLG before they were enriched.

Although many positive comments were made, the new program had its skeptics. Some educators outside the community made statements such as "If this thing works, let me know about it." Because many students, parents, and even faculty members expected the program to fail, teacher praise was extremely important at the beginning of the program.

There were comments such as "Most of these kids could not do eighth grade math. How are they going to do algebra? One eighth grade teacher allegedly said to these students on an obviously frustrating day, "I hear they are requiring all of you take algebra next year. That's a mistake. You just can't make it because you are all so stupid" (Anecdotal Records, 1991). The students had been susceptible to these comments. They were unsure of their abilities and a many of them had low self-esteem. Perhaps, their low self-esteem resulted because they had been rigidly tracked in math since the fourth grade. The CUMS teachers worked extremely hard to encourage all students that they were capable of achieving in algebra.

All students were encouraged to use calculators in class and on their homework and on tests. Previously, many of these students had become frustrated when they made arithmetical mistakes. The use of a calculator helped them obtain the answer and feel a sense of accomplishment. This was necessary because "answers" had always been the items that they had been "graded upon" in the past. The CUMS teachers were going to make a transition to process and "grade" on that, but students had been indoctrinated to the concept that they "must" get the answer. The CUMS teachers, therefore, helped them through the process and the calculator assisted them with the answer. Once they started getting correct answers, the process was used enough so that they were able to comprehend as well as compute.

Many of these students were used to failing, and whenever they became frustrated, they were used to quitting. Because they were at first assigned only the minimum objectives, the degree of difficulty was kept at a minimum, and they were able to complete assignments. As they became accustomed to success in the completion of homework, they became more habitual about its completion. In the beginning of the program, students were given more praise for completion of homework. In the second semester, homework was just expected to be completed.

At the start of the program, students were encouraged, asked, and given an opportunity to receive help with their homework. This was done before school, during study hall, at lunch time, and after school. Each class was videotaped and students were able to take the tape home. If more than one student wanted the tape, copies were made. Because lessons were presented by using an overhead projector, copies of class notes were available to all students. Students often asked for the class notes, especially those who had been absent.

Students who were absent for extended periods of time were usually frustrated when they returned to school because they had fallen behind in their work. They were encouraged to "catch-up;" however, if this was impossible, then the CUMS teachers encouraged the students to comprehend whatever they could and to avoid worrying because they would review the basics again before moving on to the next unit. This approach seemed to relieve a student's frustration about being absent. Because the pressure was removed, the returning student often succeeded during the mid-test.

After the second semester began, some students started to slip back into old habits like not completing their homework. To reinforce that homework was import in the mastery of algebra, an after-school tutoring program was established. This program was somewhat of a punishment for students not completing their homework on time. If a student failed to have his/her homework completed, he/she was required to have both the next day's assignment and the missed assignment. If a student failed to have both assignments the next day, he/she was assigned after-school tutoring. Late homework assignments earn a grade, but a student could avoid after-school tutoring by turning in both assignments the next day. The student's name was sent to the office if he/she was assigned to the after-school tutoring session. If, however, the student completed his/her homework within twenty minutes, he/she was required to stay only that length of time instead of the normal forty-five minutes. Many students arrived at after-school tutoring with their homework completed, but they were still required to stay and study for twenty minutes. At first some students complained about the after-school tutoring session; however, when they found that the principal backed the concept, the complaints came to a halt.

Parents did not complain about the after-school tutoring session when it was explained. "Keep him there 'till he gets it done," said one parent. Most students did not explain to their parents why they were being kept after school. Once informed, most parents were supportive about the after-school requirement. Most of the complaints were handled by the principal.

Covington administrators noticed a significant drop in the number of disciplinary referrals. There were only two from the math department for the entire year (one from the algebra program), compared to the seventy-four referrals the previous year. Discipline was dealt with in the classroom. When a disciplinary problem occurred in the BLG, one of the teachers who was not lecturing took care of it. According to the CUMS teachers, the increase in hands-on activities also may have contributed to reduced referrals. When one of the students who had received many referrals from low level English and science classes was asked why he had no referrals from algebra, he replied, "They make me work in there" (Anecdotal Records, 1991).

The best reward was that every student received a passing grade at the end of the first semester. The teachers' enthusiasm was understandable, but both students and teachers were somewhat amazed at this result. This statistic was one of the reasons for the apparent increase in self-esteem.

Self-esteem was one of the intrinsic rewards that was indirectly planned for by the staff. The case of student

"A" is one example of improvement in self-esteem. "A" was an LD student who was also labeled emotionally handicapped (EH). In the junior high, "A" was extremely disruptive on several occasions and had numerous disciplinary referrals. He was one of several students that some believed made this class "one of the worst to come out of the junior high in years." "A" had walked down the hall with a lead pipe as he screamed obscenities and threatened others. The high school principal was unsure about whether "A" should enter the ninth grade. "A" did not have a high opinion of himself (Anecdotal Records, 1991 and Student Discipline Files, 1990-91).

When "A" was enrolled into the Algebra I program, concern was voiced that if "A" became frustrated he would disrupt. The LD teacher felt that if "A" were encouraged and kept on task, he would succeed. "A" amazed the staff by making the ALG the majority of the time, and he received As both semester of the case study.

"A" was no longer a disciplinary problem. He had no referrals during the year and he tried out for the football team. The students also changed their opinion of "A." As "A's" success continued to grow, so did his self-esteem. Other students showed respect for "A's" ability in math. One of the teachers said, "I wonder how many LD students have had this said to them by a regular education student, "A," you're smart. How do you do this problem?" Being asked for his help obviously helped "A's" self-esteem. "A" felt so good about himself that he even tried out for the school's academic team.

"B," another example of individual success, was a senior LD student. "B" had already completed his math requirement, but without algebra. He wanted to enter a technical school that had a algebra prerequisite. "B" voiced his concern about his ability to pass a course as difficult as algebra. After some encouragement from his LD teacher, "B" decided to try it, especially after he heard about the new program. "B" was never out of the ALG and many times he "set the curve." "B's" LD teacher felt that he would have not survived the pace of a two-semester Algebra I course. He completed the new program and received an A grade.

A former eighth grade "section four" student found success in the three-semester Algebra I program. Previously, she was told that she was "too dumb" to understand algebra. She finished the year with a C average, including some experiences in the ALG.

Since there were no failures at the end of the first semester, there were many individual success stories. In fact, there were only three failures at the end of the second semester. All three who failed had serious attendance problems. The CUMS teachers believed their chronic absenteeism to be the sole reason for their failure. These same students lost interest in all of their subjects and remained ninth graders because they were deficient in credits. The successes completely overshadowed the failures.

Indiana Statewide Test for Educational Progress

During the spring of each year, Covington students were tested at each grade level through the ninth grade. Table 3.1 represents the Indiana Statewide Test for Educational Progress (ISTEP) for the ninth grade students at Covington High School for 1992, 1991, and 1990 school years.

Table 3.1

Covington Community School Corporation-ISTEP
Percentage of Students in the Highest Quartile
Comparison (Spring 1990, 1991, and 1992)

GRADE/YEAR	READ VOCAB	READ COMP	LANG MECH	LANG EXPR	MATH COMP	MATH C&A
Ninth-'92	21.9	29.7	35.9	42.9	35.9	31.3
Eighth-'91	29.7	26.6	39.1	39.1	14.1	35.9
Seventh-'90	37.3	32.8	32.8	29.9	14.9	17.9

The substantial gain in math computation was the most significant statistic that the new three-semester Algebra I program had provided the Covington School Board. No other changes had been made in the math curriculum so the Board concluded that the new algebra program had made the difference. Because changes in the upper quartile are part of the Performance Based Accreditation (PBA), an increase of 21.8 percent was obviously pleasing. It was the responsibility of the principal to interpret and promote these results. Every student in the new program had passed the first semester, and now their progress was substantiated by a state test. The change was even more significant because these ninth graders had almost the same math computation when the group was in the seventh and in the eighth grades. This statistic seemed to bring the most positive response when the program was presented to various professional groups (Administrative Notes, 1992).

Summary of Principal's Role

The principal was a visionary. He recognized that there were problems in the mathematics department and knew that there were solutions. Instead of forcing CUMS and three-semester algebra upon the staff and community, he developed a plan for change through the natural flow of change. The school had seen a need for improvement in the mathematics program because of low ISTEP scores and discipline problems. When the opportunity to head a needs assessment arose, he seized it.

The principal organized the needs assessment. He developed the questions rather than selecting a prepared assessment. He made sure that proper records were kept by having a secretary take notes to aid in the evaluation of the assessment. The principal was in charge of the evaluation of the assessment.

In order to make the change, the principal found the "change-masters." The school board, especially the president, needed to be convinced that change was necessary. The teachers, especially Mundy and Talbert, were recognized by the principal to have the conditions ready for change.

He concentrated his efforts for change toward these two teachers.

A staff development program was organized by the principal to initiate the change. He had the knowledge of methodology (CUMS, cooperative learning, inclusion, and mastery learning) that would work to make the change. Staff development meetings were also used to support the change.

The principal facilitated the change. He investigated the scheduling and made sure the changes would work. Since the program was innovative, the Non-Standard Curriculum Request was prepared by the principal and sent to the Department of Education. A presentation was prepared by the principal to convince the school board that the change would be easy as well as beneficial. The pilot program developed by the principal and staff was one of the keys to the success of the change.

Promotion of the program was led by the principal. He worked with individuals as well as small groups before promoting the program to the public. The school board was one of the small groups that was contacted both individually and as a group. Public relation problems were limited because of promotion of the program by the principal to the various public organizations. Individual problems that included both parental and school board concerns were handled by the principal.

The actual implementation of the program needed planning and continued development. The principal facilitated team planning. Staff development of the program was continued for not only the participants but for the rest of the staff. The principal provided continued encouragement not only to the staff but the students as well.

Evaluation of the program was led by the principal. He made sure through teacher evaluations that objectives were being taught. This insured the school board that a "watered-down" program was not producing the results. The interpretation of the results of ISTEP was part of the principal's responsibility. The keeping of records of discipline, in addition to the discipline, was the job of the principal.

Summary of Case Study

Covington High School was a typical rural Indiana small town high school setting. It was a stable community. Prior to the case study, the school had experienced little change. Not much had changed in facilities, staff and curriculum, nor was any change predicted for the future. The faculty was stable, despite one of the lowest salary schedules in the state. There was, however, a frequent turnover of administrators.

Mathematics was listed as a strength, yet less than fifty percent of graduates had taken algebra and geometry. Lower-level mathematics classes were initially limited in class size; however, by the end of the fall semester, many students had dropped more difficult mathematics courses and enrolled in easier ones. Discipline was a problem in the mathematics area, especially in the lower-level classes.

The CUMS three-semester Algebra I team-teaching program emerged from a mathematics needs assessment of the total school corporation. The idea of including all ninth graders into a demanding algebra class was a major change for this community. Restructuring of any nature had not been attempted. The positive experiences of the pilot program led to positive results, not only in achievement but also in self-esteem. Use of a mastery technique like CUMS helped confirm the premise that "All children can learn." Although there were only anecdotal records concerning self-esteem, these records all indicated that it had improved. It improved not only in the students, but also in the faculty. The gains made in the ISTEP, the limited number of failures, and the vast reduction in the number of discipline referrals were the most frequently used descriptive statistics of the program.

Chapter 4

FRAMEWORK AND COMPONENTS OF THE MODEL

Introduction

This study thus far has given a review of the recent and current literature concerning effective ways to deliver first-year algebra instruction to all students above the MiMH level that meet the Standards developed by the National Council of Teachers of Mathematics (NCTM). A case study described in a setting, Covington (IN) High School, that changed to a three-semester Algebra I program that included learning disabled (LD) students was given. The results of the case study were presented.

This chapter presents the components of the current review of literature, applicable standards of the NCTM, and the case study that was the framework for the narrative/graphic instructional model. It is anticipated that the model of algebraic instruction developed will specify ways that a body of knowledge such as first-year algebra can be structured and presented so that it includes instructional components established by recent and current literature related to instructional methodology and effective schools, and yet meets the Standards as established by the NCTM. Furthermore, the components of the current literature and the analysis of the case study that depict the role of the secondary school principal in the implementation of the model of algebraic instruction are given.

Components of NCTM Standards Related to First-Year Algebra Instruction Incorporated into Model

This study previously reviewed the Professional Standards (1991) and the Curriculum Standards (1989) of the NCTM as they related to algebraic instruction. The NCTM (Professional Standards, 1991) advocated mathematical power for all students above MiMH. The NCTM proposed that every child should have a comprehensive mathematical education that included the components of algebra. The learning environment of the model should raise expectations of all students. The Curriculum Standards (1989) stated that a society in which a few have the mathematical knowledge needed for control of economic and scientific development is not consistent either with the values of a just democratic system or with its economic needs. Therefore, the model will follow the algebraic standards in an heterogeneous setting so that the danger of creating an intellectual elite and polarized society is lessened.

The NCTM has algebra as a part of an integrated whole for grades 5-8. Curriculum Standards (1989) indicated that by the end of grade 8, students should be able to solve linear equations by formal methods and some nonlinear equations by informal methods. The Standards are based on the articulation of all students through grades K-8. The ninth grade standards were raised to a higher level. Until all students have articulated through the Standards, a gap will exist for present day students who do not meet the core standards. Therefore, the model will allow more time to reach the Standards. Three-semesters will be used to complete the algebra course.

The NCTM established not only a core program, but standards for the college-intending student. The increasing use of quantitative methods has made algebraic processing an important tool for applying mathematics in both natural and social science so that the Curriculum Standards (1989) stated that general mathematics was not to be taught at the ninth grade level. Therefore, in the model all ninth grade students are placed in algebra.

Standard 13 (Curriculum Standards, 1989) stated that the need for an environment in which there were opportunities to learn. The model will use a mastery learning approach that enables students to have feedback and corrective help on the core standards while permitting college-intending students to enrich themselves in areas they have shown competence. The model will use the core standards of the NCTM as the basis for its minimum standards.

Components of Recent and Current Literature Related to Instructional Methodology and Effective Schools Incorporated into the Model

Lezotte (1992) indicated that essential skills were part of an effective school. Algebra is an essential skill that an effective school will expect all students to master. The model will place all students above MiMH in algebra. Goodlad (1981), Bowles and Gintis (1976), Johnson and Johnson (1981), Oakes (1985), Goodlad and Oakes (1988), Trimble (1988), Kitchen (1990), and Sheperd (1991) indicated that ability grouping, even though it is a predominant form of instructional organization in U.S. public high schools (Trimble, 1988), was not the best organizational form for teaching all students. The model will use heterogeneous grouping to teach the core standards.

Feldhusen (1990), Silverman (1990), and other advocates of gifted and talented (G&T) were in favor of rigid ability grouping because they felt students in high-track classes would learn less in heterogeneous classes. Lund (1990) found that if the teacher in the regular classroom would modify curriculum and employ effective teaching strategies to meet all students' needs, that the G&T students would have instruction to match their ability. The model will incorporate a G&T teacher to assist the team in providing strategies to meet high-ability students' needs.

The behaviors of the high-track class will be employed in the model. Goodlad (1981, 1984), Oakes (1985), Bowles and Gintin (1976), Slavin (1987), and Kitchen (1990) expressed that students in low-track classes were taught differently than high-track students. Teachers in the model will provide more time on a greater variety of experiences and less time on student behavior and discipline. The model will employ a strong emphasis on time-on-task.

Inclusion is a school restructuring issue focused on providing an appropriate support system for special students including LD students. The NCTM standards (Professional Standards, 1991) expressed that the most compelling goal should be to provide a comprehensive mathematical education for every student including students with learning disabilities. Just mainstreaming students is not the answer to effective education. Classroom teachers lack the skills and knowledge to effectively teach students with learning disabilities. The special education teacher in the model will be a "co-teacher" (Cook & Friend, 1990, 1991; Larson & LaFasto, 1989). Collaboration between the special education teacher and general education teachers will provide adaptations and support not only to the LD student, but to general education students who ordinarily would not receive these benefits. When difficulty in a skill like reading occurs, the general education teacher can consult and collaborate with the special education teacher. The special education teacher in the model will possess effective consultation skills (Hasazi, Rice, & York, 1979; Kratochwill & Bergan, 1990; Phillips & McCullough, 1990; Cook & Friend, 1990). Collaboration will be an important factor of the model.

Research on mastery learning, especially in mathematics, has shown enhanced achievement. Block (1974); Bloom (1976); Block and Burns (1976); Mevarech (1986); Guskey (1987); Burns (1987); Block, Efthim, and Burns (1989) stated that the feedback, correctives, congruence among the instructional components, and enrichment elements of a mastery approach yielded excellent results. The teachers involved in mastery learning are better organized (Everton, Anderson, Anderson, & Brophy, 1980; Chaiklin, 1989; Guskey, 1990). A mastery approach to teaching algebra will be used in the model.

Although research (Block, 1974; Bloom & Madaus, 1981; Guskey & Pigott, 1988) on mastery learning had been conducted on regular term, semester, or calendar periods in which the course was normally taught, it was reported that the time that students needed for a particular kind of learning had not been thoroughly researched. The research by Goldberg (1971) and Watland (1976) that found little advantage in a three-semester algebra curriculum was a curriculum taught in a traditional manner. Their work did not observe mastery or team-taught curriculums. Bloom and Madaus (1981) conceded that some students would spend more time than others in learning the subject, but if mastery is reached, affective as well as cognitive consequences would result. Pipho (1991) stated that time was not only important for the student but also for the teacher. Time was needed for team planning, to improve teaching, and to boost productivity. The model will use three semesters rather than the traditional two semesters to teach algebra.

Gursky (1990) cited that team teaching was a viable alternative to tracking. Geiz, Sachs, and Wendt (1968) reported success with team teaching in algebra. They believed that one advantage of team teaching was that each teacher could present topics in which they felt more qualified. Inclusion provides collaboration or team teaching with the special education teacher. Two general education teachers can provide the advantages of large-group and small-group instruction, which compliments the corrective-enrichment phase of mastery learning. The model will employ team teaching.

Cooperative learning was also found to be an effective method for increasing student achievement (Slavin, 1980, 1983, 1985, 1989; Johnson & Johnson, 1981; Davidson, 1985). Several structures exist for cooperative learning (Kagan, 1989, 1990; Slavin, 1985; Good, Reys, Grouws, & Mulryan, 1990). Guskey (1990) and Mevarech (1985, 1989) combined mastery learning concepts with cooperative methods. The mastery learning process provided systematic feedback and corrective procedures that most cooperative activities lacked. Research on mastery learning and cooperative learning indicated that it would take more than one strategy to take advantage of the strong influence that teachers have over how effectively students learn as well as how students view themselves (Bloom, 1984; Walberg, 1984; Guskey, 1990;

Marzano, Pickering, & Brandt, 1990). The model will combine the strategies of mastery learning and cooperative learning.

Components of the Case Study Incorporated into the Model

The model should be helpful to traditional high schools, such as Covington, who have not developed their mathematics programs to meet NCTM standards and still offer curriculum at the secondary level below the quality of algebra. The model will use many of the characteristics of the case study.

Prior to the case study, Covington did not have inclusion in any form at the secondary level. The model will use inclusion of all students above the MiMH level of ability into algebra. Heterogeneity will be used similarly to the way that it was used in the case study.

The principal in the case study was involved in a needs assessment of the mathematics department prior to any implementation of the program. A needs assessment should be conducted in all cases of any change, especially to establish continuation, improvement, or enhancement criteria for a mathematics curriculum as was done in the case study. The model will include a needs assessment completed by the principal prior to attempting to implement the program.

One of the components of the case study was the Controlled Unipack Management System (CUMS). The system was a mastery learning approach to instruction in algebra. Three semesters of instruction was used in the case study to overcome time and management problems. Time was also extended because of the difference in the amount of material expected to be mastered at the present time compared to expectations prior to the "Sputnik-New Math" era of the 1960s.

CUMS used team teaching in a large-group and small-group instruction method. In the case study, an LD teacher collaborated with two general education teachers to form the team. The model will use the same type of team.

A pilot program using CUMS was established in the case study prior to implementation with the total algebra curriculum. A sixth grade class, taught by two of the three teachers on the team, was chosen for the pilot because LD students were already included in the class. The principal in the model will establish a pilot program in some area of the mathematics department involving as many staff members as possible and will include LD students in the program.

Results of the pilot program showed success not only in the cognitive area, but also in the affective area. From the results of a successfully promoted pilot program, the school board in the case study gave permission to the principal and Math Curriculum Committee to continue their efforts. To set up an innovative program in Indiana, the Department of Education (DOE) had to be contacted for a non-standard curriculum request for the case study program. The principal in the model will apply for the waiver. After the DOE had approved the case study program, further promotion was still necessary to convince the school board, community, and the rest of the staff that this innovative approach would work. Staff development was necessary as well as community promotion. After these preliminary stages were completed, the school board approved the program at a spring meeting. Continued promotion occurred during the summer. In the model, it will be the principal's responsibility to organize the staff development as well as coordinate the promotion of the model to the community.

Scheduling for the case study program was completed in the spring following the school board approval and implemented in the following fall. Planning time was scheduled by the principal so that the teachers could do the necessary team planning to implement the program. Only two of the teachers had preparation periods at the same time so the principal arranged time so that all three of the team members could meet at one time. Scheduling was actually easier because some singletons were eliminated. Students were combined by previously scheduled, tracked classes to form heterogeneous algebra classes. The sequence of instruction was not changed from the two-semester Algebra I course of study. Differences from previous instruction included videotaped lectures, handouts of overhead projection notes, CUMS mastery learning approach, and an after-school tutoring program. The model will use all of these differences to enhance the program and will include the Standards of the NCTM. The principal will schedule the model using the present master schedule and form large-group sections by integrating the low-track mathematics classes into algebra.

Components and Framework of the Narrative/Graphic Instructional Model

The first component of the model is the basic learning group (BLG) unit of instruction. All students above MiMH ability will heterogeneously placed in algebra classes. There is a team of teachers just as in the case study; however, the model team has four members rather than three. The four members include two general education teachers, a LD teacher, and a G&T teacher. The team is responsible for setting up the minimum objectives for the unit. The core standards from grades 9-12 for algebra developed by the NCTM (Curriculum Standards, 1989) will be used as the minimum objectives for the BLG.

The BLG is taught by one of the general education teachers. S/he is the primary lecturer/planner/teacher of the unit. The other general education teacher assists during this time. This is not to be considered "turn-teaching." If large-group or BLG, instruction is being conducted, then the tasks of the non-lecturing teacher may be: take attendance, set up equipment like the videotaping unit, handle any disciplinary problems, keep students on-task, critique the lecturer, or supervise independent study. Both of the general eduction teachers can lecture during the same period. These duties are determined at the team meetings prior to instruction of the BLG. The LD teacher and the G&T teacher are resource personnel and may not be present during part of the BLG instruction. Although they may not be present, this does not mean that they are not collaborating with the general education teachers. The LD and G&T teachers may be involved directly with the lecture, cooperative learning, or other experiences set in the BLG instruction. Through adequate planning, the special education teachers may be working with other students in other disciplines during part of the class period or even part of the unit. Efficient use of both teachers' and students' time in school should always be considered in the planning. Goodlad (1984) pointed our the individual school staffs need to become self-conscious about efficient use of students' time in school, and that individual teachers need to become more aware of how class time is utilized. More class time for instruction is gained if all the tasks surrounding the instruction are completed so the teacher is free to "teach" the lesson.

Valuable class time is gained when the assisting general education teacher of the BLG is responsible for discipline. Disruptions are held to a minimum because disruptions are recognized and handled before they become a disturbance to the teacher and the rest of the class. The disruptions of a large-group can be less than the disruptions in a self-contained classroom because the general education teacher can concentrate on the task of teaching the lesson while discipline is the concern of the assisting general education teacher. Time-on-task is increased because there is an increased emphasis on discipline. The case study reported a marked difference in the number of disciplinary referrals. Because of heterogeneous grouping and positive role models, the teachers in the case study reported that this may have been an additional factor for better discipline (Ford, 1990-92).

The assisting general education teacher is responsible for the videotaping of each BLG session. Although a student assistant may do the actual taping, the assisting general education teacher is accountable for the results. The videotapes will provide instruction for absent students and also serve as feedback for improving lecture techniques. Goodlad (1984) said that teachers who use videotaping in the process of self-examination can improve in a process that is neither threatening nor punitive when school staffs agree to take their teaching out of the closet and work together on improving it. The model provides each teacher an opportunity for self- and peer-formative evaluation.

The goal of the BLG is mastery of the minimum objectives of the unit. This does not mean that the students will become mathematicians. Bloom (1981) stated, "What any person in the world can learn, almost all persons can learn if provided with appropriate prior and current conditions of learning" (p. ?). The teachers must choose the sequence of the objectives so that the student will have the knowledge to proceed to the next unit because that knowledge is necessary to advance. Anderson and Block (1977) looked at mastery learning both as a philosophy of school learning and an associated set of specific instructional practices. The instructional practices are designed to make the philosophical premise a reality in the classroom.

Small-group instruction is used in the BLG. Cooperative learning should be utilized if conditions of the objectives, personnel, etc. are appropriate for instruction. An eclectic approach should be the rule rather than the exception to appeal to the different learning styles of all students. Programmed materials, if appropriate to the objectives of the unit, may also be used.

After the BLG has been taught, mastery is checked. The mastery mid-test is given to all students. Teachers decide the level of mastery necessary before the student is advanced to the next unit. Bloom, Madaus, and Hastings (1981) indicated that the essence of mastery learning strategies is to use group instruction followed by feedback and corrective help for each individual as needed. The mastery mid-test helps to provide the diagnostic information which indicates what students have learned from the basic objectives and what they still need to learn. An item analysis is conducted to aid in the diagnosis. Bloom called this the use of systematic feed-back corrective procedures in the mastery-learning class.

After the mastery mid-test, students are grouped into one of two groups: the advanced learning group (ALG) and the review learning group (RLG). The ALG have shown mastery on the mid-test, the RLG have not.

The RLG are taught formative material which is relevant to the diagnosis from the mid-test. However, the BLG is retaught in the RLG. This will aid students who were absent during certain portions of the BLG. Workbooks, programmed materials, BLG lecture notes, BLG videotapes are examples of sources of learning materials that are used in this eclectic approach. Some textbooks have homework problems grouped according to difficulty, type A, B, or C. Usually the RLG works the A type problems. Sometimes the odd numbered A problems are the BLG problems and the even-numbered problems are completed in the RLG. Additional problems may need to be assigned from other resources to guarantee that the core Standards of the NCTM are mastered by the RLG and that the ALG are exposed to the standards for college-intending students.

The curriculum of the ALG may go beyond the type B or C problems. Care must be given so all students find the material challenging, yet not beyond their capabilities. The mid-test item analysis may point out areas that ALG students need to remediate even though they scored at a mastery level.

Instead of the traditional two-semester time frame to complete the algebra course, three semesters will be used. This additional semester will help provide time for the RLG to master the core standards and time to expose the ALG to the standards for college-intending students. The additional time helps students who have difficulty grasping the material during the two-semester time frame, while providing ALG students an opportunity to advance to a higher level of mathematics than would have been possible in a traditional two-semester class.

Components of Recent and Current Literature Related to the Role of the Secondary Principal in the Implementation of the Model

The principal should be the inspirational leader of the model. The principal should have the vision that all students above MiMH can succeed in algebra. The principal should project this vision (Kouzes & Posner, 1988; Sashkin, 1988) by being the facilitator for change (Egan, 1985; Hall & Hord, 1987). The principal should facilitate change for all students, staff, and community and encourage them to articulate the dream. To ensure success of the model, the principal should create a climate in which individuals can express their ideas without fear of being criticized (National Policy, 1993).

National Policy (1993) emphasized that the principal should develop the management strategies and interpersonal relationships as a program is implemented. The principal should not only determine the people who will be most affected by the change but should also determine who will be responsible for development of strategies for working with key players. National Policy (1993) maintained that the principal should clarify the roles that various staff members will play in the elimination of present programs as well as the implementation of new programs. The principal should determine the members of the team as well as the roles of the model's team members.

The principal should be an effective instructional leader (McCleary & Thompson, 1979; Keefe, Clark, Nickerson, & Valentine, 1983; Pellicer, Anderson, Keefe, Kelley, & McCleary, 1988, 1990; Smith & Andrews, 1989). Research has shown that the principal should understand and have working knowledge of dominant learning-style models and instruments (Letteri, 1988; Dunn & Dunn, 1978; Gregoric, 1979; McCarthy, 1987). In the model, the learning styles of both low-track and high-track students should be a part of the principal's knowledge.

National Policy (1993) stressed that scheduling of any new program involved the principal's ability to master scheduling. The principal should identify how to incorporate different teaching strategies into the master schedule. The principal of the model program will need to incorporate inclusion of all students above MiMH into a team-taught, algebra program that involves both mastery and cooperative learning for a period of three semesters.

Principals should understand their physical building(s) must be adapted to reinforce specific types of human responses (National Policy, 1993). The principal in the model program will have to take his/her building(s) and adapt it and/or them to facilitate inclusion, large-group and small-group instruction, team teaching, mastery learning, and cooperative learning.

Staff development programs should be developed by the principal to enhance educational missions (Fullan, Rolheiser-Bennett, & Bennett, 1989; Little, 1982; Rosenholtz, 1989). Firth (1982) and Joyce (1991) indicated that new skills could not be implemented without school-level support. To be implemented successfully, staff development programs should have an operational plan spearheaded by the principal (Caldwell, 1988; Fullan, Rolheiser-Bennett, & Bennett, 1989; Grossnickle & Layne, 1991; Joyce, 1991; Landon & Shirir, 1986; Pink, 1989; Rosenholtz, 1989; Sagor, 1991; Showers, Joyce, & Bennett, 1987). The principal will develop programs that enhance the strategies and the new skills that the staff needs to implement the model.

The principal will serve as the role model for the new program. S/he should motivate the staff to achieve high work standards and help focus the staff and students on achieving educational excellence. Blase and Kirby (1991), Hoy and Miskel (1982), and Sergiovanni (1987) stressed that principals should treat their staffs as professionals, support their innovation, and recognize and reward effective teaching performance.

Chapter 5

THE DEVELOPMENT OF THE NARRATIVE/GRAPHIC MODEL

In the 1880s, algebra was a required course of study in the first year of high school (Kieran and Wagner, 1989). Since that time, problems have surfaced regarding the teaching of algebra. Fey (1989) reported that there is a broad agreement that most students do not meet expected levels of proficiency in algebra. As a prerequisite for study in every branch of mathematics, science, and technology, algebra is the first high school mathematics course. Despite the development of many weaker high school mathematics courses (because algebra was too difficult), the Curriculum Research and Development Group (Rachlin, 1989) reported that little has changed over the years in what has been taught as algebra in the high schools.

The Professional Standards (1991) and the Curriculum Standards (1989) of National Council of Teachers of Mathematics (NCTM) sought to upgrade the level of instruction of algebra to all students at the ninth grade. Recent literature has shown that essential skills, effective schools, ability grouping, inclusion, mastery learning, team teaching, and cooperative learning affected instruction of ninth grade algebra. The case study at Covington (IN) provided additional insights on algebraic instruction of ninth grade students. This study has developed a model from these components.

Flowcharts and Models

One function of a model is to tie concepts together that appear on the surface to be disarrayed. A model should be ideally constructed so that insight and choice are not limited. A flowchart is a pictorial plan showing what is planned and in what sequence it is to be accomplished. The purpose of a flowchart is to improve communications between individuals. Through the technique of flowcharting, a plan is not only drawn for the author to use, but also as a communication of that plan to others.

In Figure 1, the rectangular-shaped symbols indicate instructional units, or process; the diamond-shaped symbols represent decision-making, or course of action; and the circle symbols show inputs. Flow lines are used to represent the progression of steps in the sequence. The arrowhead on the flow line indicates the direction that the process flows.

The Instructional Model

For the purpose of developing a model that represents the activities and grouping of algebra students during a unit of study, it is necessary to combine concepts as presented throughout the study. Figure 1 illustrates a suggested instructional model which satisfies most of the concepts developed in the study. This narrative/graphic flowchart:

1. Allows for heterogeneous grouping while providing for individual differences by regrouping for a short period of time;
2. Provides for inclusion of LD student while providing resource personnel to assist their individual needs;
3. Integrates cooperative learning, peer-tutoring, and allows for integration of other techniques to meet the Standards developed by the NCTM; and
4. Provides mastery learning theory to the model.

Following the process represented in Figure 1, all students are initially grouped in the basic learning group (BLG) for the study of the basic unit, which includes core standards developed for algebra by the NCTM. Various teaching techniques can be used to teach the basic unit. Because of the size of the BLG, large-group instruction with lecture is primarily used. However, as Figure 1 shows, cooperative learning can be an input in the basic unit. The degree used depends on the needs of the students as determined by a collaborative decision made by the teachers.

The major factor in determining who is assigned to which group is the mastery mid-test. Students are grouped according to their mastery of the minimum objectives of the basic unit. The percentage of mastery for the basic unit can be determined by the teachers. This provides for flexibility for teachers in regard to the grouping process.

According to Figure 1, now the students are divided into two instructional units, the advanced learning group (ALG) and the review learning group (RLG), for the remainder of the basic unit. The case study showed that although there was regrouping, student self-esteem still improved. The item analysis of the mid-test helps determine the experiences each group should have. It also helps to determine the cooperative learning experiences provided in each group. Individual mastery mid-test results, along with past experiences, determine the degree of resource necessary to be input by the LD and G&T teachers. However, these special education teachers, along with the general education teachers should be available for any of the students. Collaboration between the special education and general education teachers determine the class activities and adaptations necessary to make the groups successful (McLeskey, Skiba, & Wilcox, 1990; Adkins, 1990; Gersten & Woodward, 1990; Wilcox & Nicholson, 1990; Cook & Friend, 1990).

The adding of the gifted and talented (G&T) teacher should provide for even better teacher-pupil ratio than was shown in the case study. Those students who are "approaching" the level of G&T should benefit at this stage of instruction. Teachers and students have more flexibility at this stage. If it becomes evident that a student has

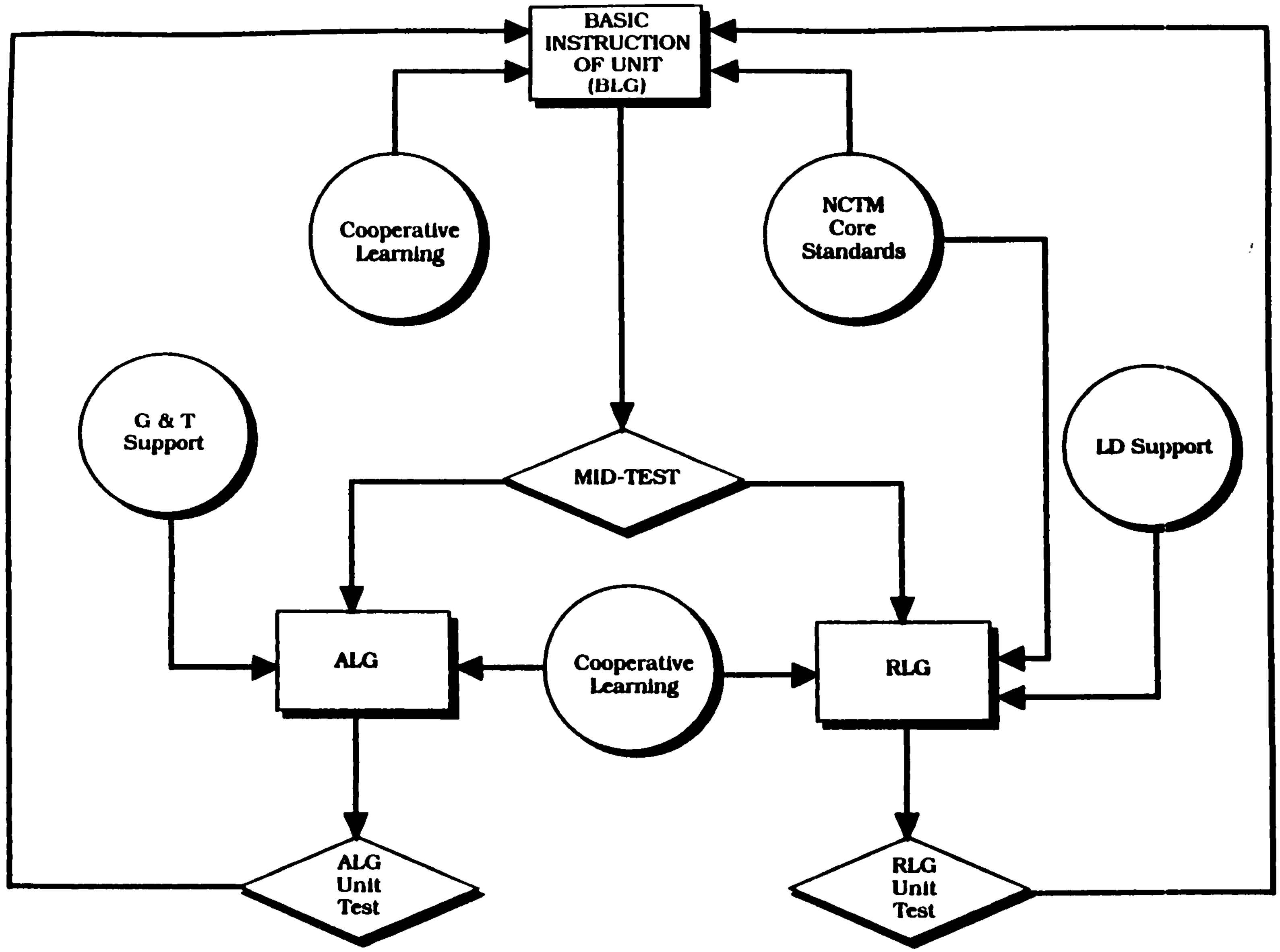

Figure 1. Model for First Year Algebra Instruction

been misplaced by the mastery mid-test, instruction at a higher or lower level can be given. Given the worst case scenario, the student is only "misplaced" for a short period of time. Since the related research showed that the opposition to eliminating tracking and rigid ability grouping came from the advocates of G&T students and the Council for Exceptional Children, the model program should provide for these students (Gursky, 1990; Feldheusen, 1990; Silverman, 1990; & Lund, 1990).

When the RLG is ready for the unit final exam (usually about the same period of time spent when all students were in the BLG), the final exams (one for the RLG unit and another for the ALG) were given. Regardless of their degree of success, all students return to the BLG to repeat the process for another unit. The three-semester time frame provides more time for remediation and enrichment; however, there still needs to be a time frame. The model should be much better than the original CUMS described in the case study because the time frame helps to provide more time for individual differences.

The Model for the Principal's Role in the Implementation of the First-year Algebra Instructional Model

To incorporate the model for first-year algebra instruction, the principal must assume the leadership role for the implementation of the program. Figure 2 is a narrative/graphic model that follows the principal's role in the implementation of the model for first-year algebra instruction which was shown in Figure 1. In Figure 2, the rectangular-shaped symbols indicate processes performed by the principal; the diamond-shaped symbols represent decision-making, or course of action; the square-shaped and octagon-shaped symbols show an output; and the circle symbols indicate inputs.

To implement the program, the principal must serve as a leader and facilitator. Leaders provide purpose and direction for individuals and groups, formulate goals, set priorities, and help plan change efforts with the staff (National Policy, 1993). Key personnel will also serve as leaders to incorporate the model program. The principal is the "leader of leaders" (Schlechty, 1990). Key personnel will look to the principal for leadership when they have difficulty performing their leadership roles. Facilitators make tasks easier to perform. The principal has been defined in the literature (Egan, 1988; Hall & Hord, 1987) as the facilitator for change. The principal helps develop shared strategies to assist key personnel to complete their tasks. The principal creates a climate in which people can express their ideas without fear of criticism or ridicule (National Policy, 1993).

As indicated in Figure 2, knowledge of the standards stressed by the NCTM and related research are necessary inputs for developing the vision that is shared by the principal and key personnel who are creating the model for first-year algebra instruction. A needs assessment is

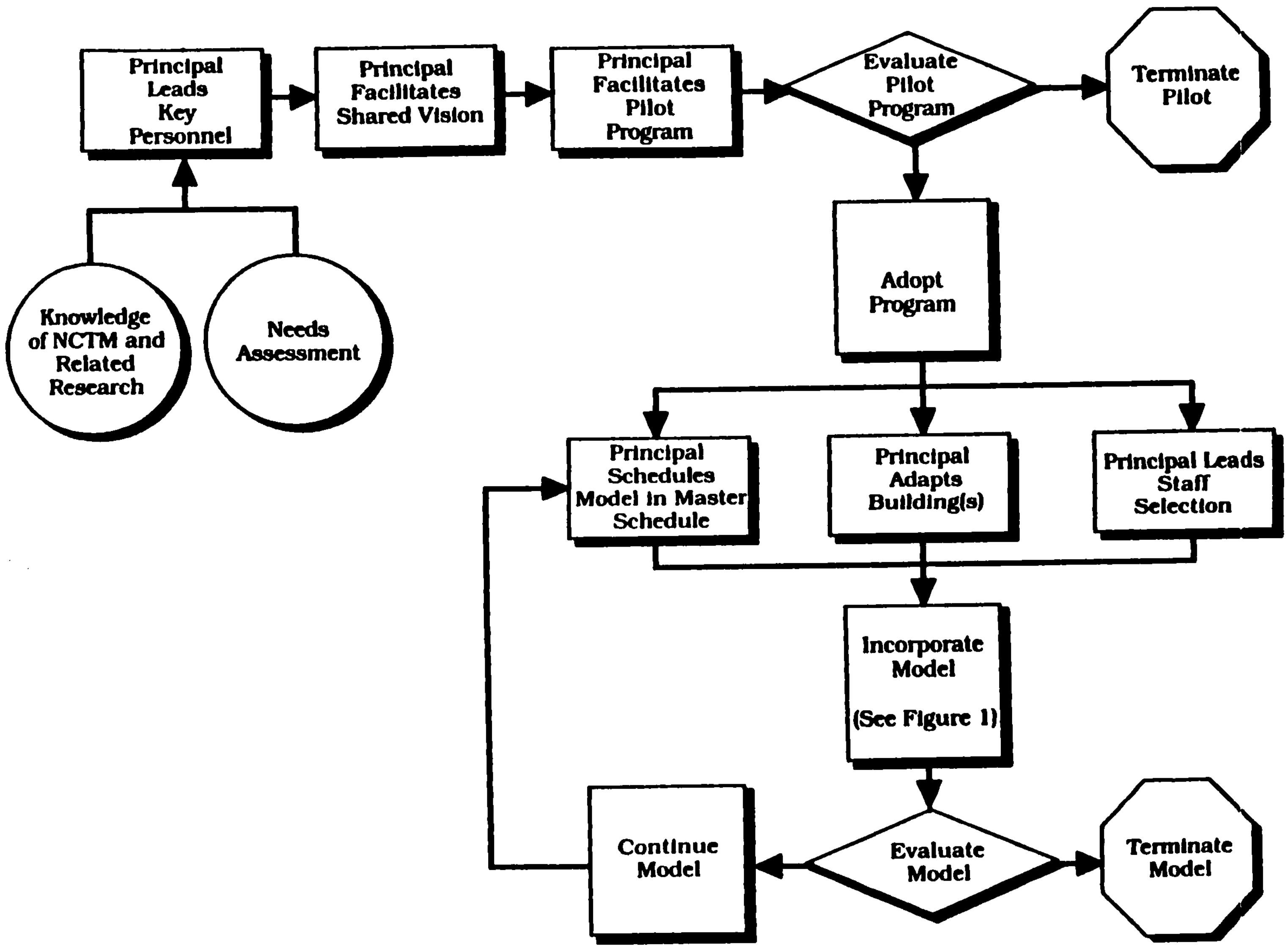

Figure 2. Model for the Principal's Role in Implementation of the Model for First-Year Algebra Instruction

essential input for the principal and key personnel to determine the necessity for the changes. The extent of the needs assessment must be determined by the principal and key personnel. The assessment could be as simple as a checklist to see if NCTM core standards are being met, or the assessment can be an extensive, formal mathematics needs assessment.

The principal facilitates this shared vision. He/she is skilled at creating and gaining commitments to broad, long range vision for his/her school (Professional Standards, 1993).

The principal and key personnel will help in determining who will be involved in the pilot study. As in the case study, there may be a situation that more readily will adapt to the model than another. Some staff members are more flexible than others. Staff development concerning NCTM core standards and related research that precedes the selection of personnel for the case study may be needed. The teachers involved in the pilot must share the vision.

Involvement with the special education personnel, especially teachers of LD and G&T students, will make the pilot study more meaningful. A collaborative effort in the pilot program will make the evaluation of the pilot more meaningful.

The principal will need to look at the master schedule as well as classroom and building adaptivity to determine the least disruptive method of incorporating a pilot program. If key personnel have back-to-back classes during a period of the daily schedule, this would be an obvious choice for the pilot. If a number of LD students in the ninth grade mathematics class are currently being serviced by an LD teacher, this class period would be a good choice for the pilot, providing the teachers are compatible.

Promotion of the pilot must accompany and precede the model program. Parents and students involved in the pilot must be convinced that the pilot program will be advantageous for all students. Research about inclusion must be presented in a positive manner so that any special education students included in the pilot will encounter an environment that guarantees their success. Meetings with parents and students should be conducted with leadership provided by the principal to quell any fears that may result from the proposed pilot. Positive publicity should be sought from the media before, during, and after the pilot.

There should be ongoing staff development during the pilot. The principal should meet with the pilot's personnel on a regular basis to provide support and input for a successful program. The principal may need to provide time for staff planning (for example, providing substitute teachers who cover classes).

According to Figure 2, the pilot program is then evaluated to determine continuation of the model. Teachers, as well as the program, are evaluated. Success or failure may be determined by the compatibility of the teachers involved. The effects of inclusion should be evaluated. The difficulties encountered by upgrading to the NCTM core standards should be evaluated. Before further implementation of the program, adjustments should be made from pilot evaluation. The principal should coordinate the evaluation. As indicated in Figure 2, at this point the decision is made to adopt the program or terminate the pilot.

After the program has been adopted, the principal must plan the master schedule to include the model program. Since three semesters are used to complete the program, plans must include the fourth semester for all tenth graders. Either another required three-semester course (perhaps geometry) should be available or a single semester course (for example, health or speech) should be planned for the fourth semester. Projections for the next two years must be made if a single semester course is to follow the three-semester algebra class. Projections for three years must be completed if a three-semester geometry course follows the model three-semester algebra program. The principal must have the skills necessary to make adjustments in the master schedule to implement the model program. Scheduling should be easier because some singletons like basic math, general math, and pre-algebra are eliminated.

In addition to scheduling the model program, the principal must be responsible for adapting the building to implement the program. Knowledge of the Controlled Unipack

Management System (CUMS) will assist the principal in the areas that need adaptation. Classrooms that accommodate large-group instruction should be available. Equipment, supplies and assistants are necessary to effectively run the model program. Teachers should have access to a video-camera, videotapes, and student assistants to operate the camera. The principal and key personnel are now involved with the selection of staff for the new model program. Factors determining who is selected will include knowledge of mastery learning and cooperative learning, ability to collaborate with special education teachers, and a commitment to this shared vision.

Total staff development is necessary at this time. The principal must organize and prepare the entire staff for the new model program. Any spillover effects that affect existing programs must be properly presented to the staff. Schedule changes and room changes may need to be dealt with on an individual or group basis. Teachers directly involved in the model instructional program who have not been involved with CUMS may not be available for visitation to schools that utilize team teaching, inclusion, mastery learning, peer tutoring, and cooperative learning. Literature is available in the fore-mentioned areas that make up CUMS for teachers to prepare for the program. The principal and key personnel should research to find schools for visitation and literature that the staff can use as a preparation for implementation of the model. If visitations are feasible, the principal should aid in the scheduling of those visitations.

As indicated in Figure 2, at this point, the instructional model (See Figure 1) is incorporated. Meetings with involved staff during the implementation of the instructional model should be scheduled by the principal with assistance from key personnel. In the meetings, the principal serves as a trouble-shooter. He/she should inform the school community about the new program. With the implementation of the instructional model, newsletters, press releases, speaking engagements, and personnel meetings by the principal with key personnel in the school community should be ongoing. A pre-test should be given to all students involved in the model program to help aid in the evaluation. The pre-test can be a standardized test that has been researched by the principal or a teacher-developed test. The case study did not include a pre-test, which was a definite limitation.

Anecdotal records should be kept by the teachers and the principal. The principal should coordinate these records.

The next stage in the model for the principal's role in the implementation of the model for first-year algebra instruction (see Figure 2) is evaluation of the model. Evaluation is ongoing throughout the implementation of the instructional model. Not only should the direct effects of the model be evaluated, but the spillover effects of their programs should also be evaluated. An evaluation similar to the pilot program should be completed to consider the success of the program. If there are any plans for elimination of the program, a final evaluation must be completed before scheduling takes place for the third semester. This evaluation determines if the three-semester algebra course is continued the following fall and if a three-semester geometry course is developed. A post-test should be given and compared with the pre-test. Comparison with any standardized testing (such as ISTEP) should be completed by the principal and key personnel. Anecdotal records should be included in the total evaluation. According to Figure 2, after the model is evaluated, a decision is made to continue or terminate the model. If the model is continued, results of the evaluation will help to determine changes in the master schedule, adaptation of building(s), and alterations of staff selection.

Promotion of the model instructional program is ongoing. Results of the post-test, standardized testing, grades, and affective items such as self-esteem should be publicized. The school public should be aware of the successes and how failures are being treated. Local media, school newspapers, newsletters, speaking at local civic organizations, and simply talking within the community are some of the ways the principal and key personnel can aide in promoting the model program.

Summary

Chapter one dealt with the problems that educators face in regard to mathematics achievement and the problems that may have been produced by tracking and rigid ability grouping. The mathematical skills of our nation's children were reported to be insufficient to compete with on-the-job-demands. Students were not being taught, or in many cases not even exposed to, higher level mathematics courses, especially algebra.

The National Education Goals set some high standards for the year 2000. Requirements to meet these goals cannot be reached by simply adding a time requirement for mathematics. A great influx of "general" courses were added when a two-year requirement of mathematics was introduced. General Math I, II, III, and IV could be the result of just adding time. The key is what is taught. It may take more time to teach algebra to a heterogeneous group, but if we believe all children can learn, this is a better option than more "applied" courses.

"Give me something easy." "Get me out of here because they are going too fast." These are common comments quoted from the Covington case study anecdotal records. They are comments that are heard far too often. Students are given too many choices (Sizer, 1990). If we are going to upgrade the mathematics curriculum, then algebra, one of the gateway courses to advanced mathematics, must be required.

Restructuring schools was found to be an effective method to improve curriculum. From the two generations of effective school reform, we have found that the mission of "learning for all" can be accomplished. The mandates of P.L. 94-142 have forced schools to look at alternative methods to include all children in the learning process. The NCTM set standards (Curriculum Standards, 1989) that indicate that all ninth graders should be schooled in algebra. Research indicated not only a large gap in the mathematical concepts being taught, but also that not all students were being exposed to algebra.

In both generations of effective school reform, the principal was depicted as a leader. In the first generation, the principal acted as the instructional leader. In the second generation of teacher empowerment, the principal served more as a leader of leaders. If the NCTM core standards, which have all ninth graders learning algebra, are to be implemented, the principal has to play a key role in the organization and implementation. Development research involving the related literature and the case study was used to develop a pilot model of algebraic instruction for students, including those who had previously not been given the opportunity. The study was also to offer insights into the principal's role in the implementation of first-year algebra instruction, which meets the standards established by the NCTM, to students above the MiMH level.

Chapter two dealt with the related literature. The

NCTM produced a set of standards (Professional Standards, 1991) for mathematics teaching and teachers as well as curriculum (Curriculum Standards, 1989). The Standards Boards stressed that teachers needed to orchestrate classroom discourse in ways that promoted the mathematical growth of all students. The expectations needed to be set high so that every student could learn mathematics. Algebra was considered to be an acceptable expectation for all ninth grade students (Curriculum Standards, 1989).

There are volumes written on the pros and cons of ability grouping. Mathematics students have been tracked by course titles and the subject matter taught. This form of tracking exempts many students from being exposed to high-track subjects like algebra. Teaching methods, discipline, and proportions of time spent on instruction were also shown to be different in the low-track classes. Research indicated that tracking and rigid ability grouping needs to be changed.

Inclusion was shown to be different than mainstreaming. The effects of collaboration and team teaching were taken into consideration when the case study was developed. Total inclusion may be difficult to sell to the school community; however, students above MiMH appeared to be in areas where most inclusion programs were already in practice. The inclusion worked well at Covington. Not much research was given in preparation of secondary special education teachers for inclusion. Covington was fortunate to have a special education teacher that had a good mathematics background. Some special education teachers may fear team teaching an algebra class. This area needs to be studied.

Inclusion alone was shown not to be the answer to improving student self-esteem; however, competence and social acceptance could be improved by having students enrolled in meaningful classes like algebra. Students were shown to have the ability to master far more mathematics skills than educators were demanding. Because they already knew most of the material and were bored in low-track courses, many students demonstrated disciplinary problems. In addition, this writer maintains that when these low self-esteem, bored students are tracked into the same classes, they "feed" on each other's attention and cause major disciplinary problems in class.

Mastery learning was found to be a method that could combine faster learners with slow learners and still achieve progress for all students. The key to mastery learning is that appropriate learning conditions must be established so that all students are motivated for achievement gain. Rather than simply lengthening the course to cover material, reinforcement, time-on-task, and the quality of instruction are prerequisites for improvements in achievement. The controlled time basis of CUMS provided an opportunity for the teachers to cover the basics of the algebra unit, reinforce, enrich, and regroup students so that inclusion did not deter any student from reaching their potential during the unit of instruction.

Team teaching not only benefits inclusion, but also had positive effects on the general education student. Although team teaching was reported as an alternative to tracking, it was also successfully used in the high-track courses like advanced algebra and trigonometry. Perhaps some teachers may feel threatened by team teaching, but this writer believes that when teachers "perform" in front of their peers, they tend to teach with more quality. A teacher's weaknesses are more noticeable in front of a peer than a student. This "threat" may need to be studied for a wider acceptance of team teaching. This writer also maintains that weaker teachers can gain ability from working with stronger colleagues. The same benefits that are gained from cooperative learning can be gained from cooperative teaching.

The positive effects of cooperative learning were reported in numerous studies. Positive studies were also reported concerning cooperative mastery learning. Group goals and individual accountability had to be incorporated if cooperative learning was to be effective. In a large number of studies, mathematics was used with considerable success. The major complaint with cooperative learning comes from advocates of the G&T students. Politically, this is a powerful group. This writer believes that this group, especially at the secondary level, is most involved in school politics. If their children are spending too much time "helping weaker students achieve," they are likely to complain that their child is being deprived of an opportunity to excel. However, if the pilot program model uses a management system like CUMS, G&T students are used in cooperative learning situations on a limited basis. If used on a limited basis, the complaints would be lessened. Further study is needed in this area.

Chapter three dealt with the setting of Covington (IN) High School and the case study that was conducted there. covington High School was shown to be a typical rural town setting which had not been exposed to a great deal of curriculum change. Because turnover was so high, administrators were not employed long enough to institute change, and the majority of the staff realized this fact. If the staff remained patient, they believed the administration would "turnover" and no change in curriculum would be necessary. The case study may have been successful because the three teachers involved were new to the system. They could readily see that there were problems in the high school mathematics structure and curriculum. Involving new personnel may be a key to restructuring because they may be more open to change. The pilot program may have had an advantage because these "new people" were also very experienced. They were not novices to education, only to Covington High School. However, one of the pleasing results was that although one of the teachers involved was not initially sold on the idea of inclusion and the elimination of general math, etc., he became one of the strongest advocates of the program. Once teachers gain ownership in a program and empowerment from it, they seem to become advocates, especially if they have some input into the development of the experience.

The case study would have been improved by some form of pre-test/post-test evaluation. The testing results would have added to the body of research in the field. A follow-up on the ISTEP testing to determine if results of future ninth grade classes have similar success, would also have been of value in the case study. A larger quantity of qualitative material such as anecdotal records would have added to the evaluation of the case study.

The mastery approach of CUMS developed as an outcome of Bloom's work in the 1950s. A great deal of emphasis at that time (1970) was also placed on individualized progress. The problems that developed because students were being scattered throughout a course of study brought about a more structured form of mastery learning. The regrouping aspect still has elements of ability grouping, but the negative self-esteem effects of tracking appear to have been eliminated or at least lessened by the use of CUMS. There were only anecdotal records to verify improved self-esteem. This regrouping and improved self-esteem may need further study.

The pilot program model was easy to incorporate because there was a degree of team teaching taking place before the pilot was established. The LD teacher was in the classroom "aiding" in the instruction, but not really team teaching until the pilot was established. The LD teacher taught basic, review, and advanced groups. It may be difficult to convince the LD teacher to accept this role as the curriculum becomes more difficult. This problem needs to be studied for all secondary levels of inclusion.

Programs need to be promoted, and one individual needs to be responsible for the public relations. Not only does the school board need to be convinced that the program is a success, but the students, parents, and community as well need to be informed. In the pilot at Covington it was fortunate that an administrator who had experience with promotion of programs was involved directly with the pilot program.

The Covington School Board wanted to see if there would be any trickle-down effects to the elementary and junior high. A follow-up of trickle-down effects should also be studied.

Chapter four dealt with the model itself and the role of the principal in implementing it. The major difference between the instructional model and the case study was the addition of a G&T teacher. A G&T teacher could eliminate many of the fears of the G&T advocates plus upgrade the advanced group to higher levels. Just as the LD teacher provided the general education teachers with help in learning styles of the disabled, the G&T teacher can also help with the learning styles of the gifted/talented.

Additional problems may develop as the model is implemented. Questions have surfaced as to whether this model would work in subjects other than mathematics. This possibility needs to be studied. Most mastery work has been implemented in the area of mathematics; however, CUMS has the control aspect that might prove effective in science and the humanities.

The role of the principal in the pilot model was similar to the role of the principal in the case study. The needs assessment could be extensive and use any number of needs assessment models. The principal in the case study did not investigate this area, and further investigation should be conducted.

Teacher selection for the pilot model was not difficult in Covington. This could be a problem in some schools where any inclusion has yet to be implemented. More in-services and promotion would be necessary. The pilot model was not formally evaluated in Covington, and a pre-test/post-test was not given. This ia an area that could be improved.

Adapting the building for the model could present several problems. If the building(s) is/are not designed for large-group instruction (basic learning group [BLG]) and/or the building(s) is/are overcrowded, the size of the BLG may be affected. The program could come to a halt at the pilot stage if the principal cannot adapt the building for the program.

A larger degree of qualitative information could be accumulated during the evaluative process of the case study. More anecdotal records could have been compiled for use in the evaluation of the Covington program.

Conclusions and Recommendations

1. Mastery learning combined with CUMS concepts was found to be a method that could combine faster learners with slower learners so that all students could learn.
2. Team teaching proved to be not only beneficial to special education students, but also produced positive effects for the general education student.
3. The positive effects of cooperative learning cited in the research in numerous studies, proved to be effective in the case study.
4. The principal has the key role in the implementation of the model. S/he must have a clear vision of the desired outcomes to promote, provide staff development, adapt the building, and evaluate the model.
5. Avoiding the time constraints associated with the traditional two-semester Algebra I course by expanding to the three-semester model appeared to be effective when combined with a mastery learning concept like CUMS.

Recommendations Based on This Study

Recommendations based on this study are as follows:

1. courses like general math, pre-algebra, applied math should be eliminated in the ninth grade and that all students above the mildly mentally handicapped level be enrolled in algebra,
2. rigid ability grouping that leads to tracking should be eliminated, and
3. the core standards set up by the National Council of Teachers of Mathematics should be used as standards for any mastery learning units in algebra.

Recommendations for Further Study

Further study is recommended for the following:

1. the effects of cooperative learning on G&T students on a limited basis like CUMS;
2. the effects that weaker teachers might gain from working with stronger colleagues in a team teaching situation;
3. the fears/problems special education teachers have in team teaching in a highly academic field like algebra;
4. the self-esteem effects of including all students above MiMH in a mastery learning course such as the one described in the case study;
5. the trickle-down effects to the elementary and junior high schools that would follow the

implementation of the model in the case study; and

6. the areas other than algebra within the mathematics curriculum in which this model might be effective by applied, or the application of this model to other disciplines of instruction.

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