CHARACTERISTICS THAT IDENTIFY SUCCESS IN THE MATHEMATICS CLASSROOM AS PERCEIVED BY ADOLESCENTS: A Q-METHOD STUDY

By

GAYLA IMLER HOWELL

Bachelor of Science
Southwestern Oklahoma State University
Weatherford, Oklahoma
1991

Master of Arts
Southern Nazarene University
Bethany, Oklahoma
1996

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Thesis Approved:

Margaret M Scott
Thesis Adviser

David Yellin

Kay Reinke

Patricia Lamphere Jordan

Diane Montgomery

Alfred Carlozzi
Dean of the Graduate College

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TABLE OF CONTENTS

Chapter			Page

LIST OF TABLES

CHAPTER I

INTRODUCTION TO THE STUDY

Sources of motivation are typically explored and viewed as an individual domain. However, research indicates motivation tends to be influenced by family, culture, and the classroom environment (Carr, 1996; Pintrich & DeGroot, 1990). Motivation is a function of a person's thoughts; it is a guide that provides people with values and means for evaluating the outcome of a task and influencing whether or not they will pursue similar tasks in the future (Ames & Ames, 1984; Middleton & Spanias, 1999). Feelings of competence, mastery, knowledge, control, and achievement occur when people initiate and cultivate goal-directed actions. These feelings largely attribute to reasons for performing (Anderson & Deuser, 1993).

Adolescence is an extremely distinctive phase of development for examining various motivational goals which can be effective motivators of behavior (Wentzel, 1991; Wentzel, 1992). Between the ages of ten and fourteen, adolescents become increasingly challenged to obtain a huge range of goals in building a foundation in learning as they cognitively mature, become more adult-like, and develop a relationship with peers. With respect to schooling, adolescents are expected to learn and internalize more advanced and complex subject content, often with some future educational or occupational aspirations in mind (Wentzel, 1991). As cognitive growth for adolescents brings about a new capacity to think in more abstract and complex ways, adolescents become more conscious of how to obtain knowledge. They begin to employ plans for learning material, monitoring understanding, and interpreting meaning (Carnegie Council on Adolescent Development, 1989; Meece, 1991). During this same period of time, adolescents are supposed to establish emotional and psychological autonomy from adults while recognizing adult values and authority. In addition, they experience an urgency to build a positive and sound friendship with their peers (Wentzel, 1991).

Research shows that goals adolescents strive to obtain in achievement situations affect patterns of cognition and problem-solving behavior (Meece, 1991). Much research has concentrated on the thoughts, beliefs, and feelings students have about themselves, other persons, and events. The perceptions students hold about themselves and others indicate that they are actively able to process information that affects classroom events and students' environments (Schunk, 1992). Current motivational learning theories suggest students use a variety of strategies to engage in activities, formulate goals, employ self-regulation strategies, utilize various motivational techniques and cognitive resources to maintain control over events or task demands, and employ parents, teachers, and peers in their attainment of accomplishing goals (Boekaerts, 1991; Maddux, 1995; Schunk, 1992).

In the classroom and at home, motivating adolescents is a challenging and difficult task. Young adults choose tasks in accordance with their interests. At times, adolescents are not motivated by a particular task. Teachers and parents want to help adolescents acquire skills and improve performance academically. Additionally, teachers and parents tend to make the search for proficiency interesting and rewarding; therefore, they use incentives as a way to motivate (Harackiewicz & Sansone, 1991). When some adolescents are given an incentive, the incentive may drive them to complete a task; yet the same reinforcement is ineffective for other young adults. In addition, some adolescents strive to outperform their classmates whereas others attempt to obtain self-mastery for the sake of learning. How young adults obtain and ascertain knowledge depends primarily on what reasons dominate their learning (Alloy, Clements, & Koenig, 1993; Covington, 1992; Kloosterman & Gorman, 1990). On a daily basis, external and internal influences convey to adolescents expectations for obtainment of academic success which are shaped by values and attitudes, and the value students place on the completion of a task indicates interest or importance (Carr, 1996; Pintrich & DeGroot, 1990).

Problem Statement

Much is known about motivation in the mathematics classroom. By exposure to various types of incentives and in combination with a variety of motivational strategies, adolescents are aroused at different levels for varying periods of time (Kloosterman, 1996). While many studies have been conducted on how teachers, parents, and society motivate adolescents in mathematics, it is the limitations of the structured information by the current literature that affect the understanding of motivations by researchers, teachers, parents, and society. While current research indicates that many factors have an effect on motivations in mathematics, much of the literature available on motivations addresses and examines motivational domains in isolation. It is therefore necessary to analyze multiple motivational factors in the mathematics classroom (intrinsic and extrinsic motivations, goal orientations, self-regulation, self-efficacy, and parental involvement) in order for researchers, teachers, parents, and society to understand how motivations are intricately linked and affect learning situations.

The perceptions and beliefs conceived by adolescents occur explicitly and implicitly and serve as a guide to assess and eventually determine what is required of them to become successful in the mathematics classroom. Understanding the basic motivational beliefs adolescents formulate from their school experiences in mathematics (intrinsic and extrinsic motivation, goal orientations, self-regulation and self-efficacy) and the significance of the capacity parents play at home in the education of their adolescent are important and may serve as a role in understanding potential successes or failures in the mathematics classroom.

Background of the Problem

For several decades, America's school children's performance has been a topic of concern (Uttal, 1996). The landmark report written by the National Commission on Excellence in Education in 1983, *A Nation at Risk*, essentially warned of a rising tide of mediocrity. The concerns addressed by the National Commission on Excellence in Education highlighted the risks of economic growth and national security that arise from our failure to educate children adequately. The significance of this report indicates "the educational enterprise has been in trouble for a long time and is continuing to fall behind industrialized nations in worldwide comparisons" (Covington, 1992, p. 4).

Achievement scores of students of all ages reflect difficulties in writing, problem-solving, understanding mathematical concepts, and constructing and reading graphs and charts (Covington, 1992). The Third International Mathematics and Science Study

(TIMSS) also confirms the difficulties faced by America's school children. In comparison to forty-one countries, America's eighth graders ranked eighteenth in mathematics achievement and fell thirteen points below the international average. Additionally, on international levels only five percent of American eighth graders reached the top ten percent in mathematics achievement (1996).

Similar studies conducted by the National Education Goals Panel indicate that only 24% of American eighth graders are able to meet the highest levels of achievement on the National Assessment of Educational Progress (1998). Likewise, many adolescents have low perceptions of their abilities and competencies in mathematics. In another research survey, the National Assessment indicates that approximately 30% of thirteen-year-old females and males did not *agree with* or *did not strongly agree with* the statement "I am good at mathematics" (Kloosterman & Gorman, 1990, p. 377). Furthermore, students also tend to believe that "learning requires a special ability, which most students do not have" (National Research Council, 1989, p. 10).

Other factors that affect students' views about mathematics are society's attitudes toward mathematics. Society, in general, has low expectations for success in mathematics. Deemed necessary, the expectation is that all people need to learn to read and to write. However, many people see little value in mathematics success, and people perceive that not everyone has the ability to learn to do mathematics (Grouws & Lembke, 1996; Kloosterman & Gorman, 1990).

The National Commission on Excellence in Education (1983) furthermore addresses the involvement of parents with their children. Parental involvement is one area that contributes to the success of many children in education. However, the traditional

American family which used to comprise of a father, mother, and children has rapidly changed in the past three decades. This type of family exists today in much smaller proportions than in the past.

Approximately half of all children under the age of eighteen will be raised in a single parent family due to separation or divorce. Around seventy percent of mothers will work outside the home during much of their child's schooling. Furthermore, the increase in mothers entering the labor force has ultimately resulted in a decreased amount of time and attention they can give to their children (Covington, 1992; Lee, 1993; Swap, 1993).

Many structural changes have occurred in the American family. Parental educational beliefs influence the value the child places on education which relates to the child's self-perceptions of ability, competence, and motivation (Carr, 1996; Grouws & Lembke, 1996; Kloosterman & Gorman, 1990; McClaslin & Murdock, 1991). Many parents consistently say, "I can't help my child in mathematics because I was never good at mathematics." When the child hears his/her parents make such a statement, parents are limiting their child's potential for success. Parents are indirectly telling their child that he or she is not expected to perform well or be competent in mathematics (Grouws & Lembke, 1996; Kloosterman & Gorman, 1990).

The educational influence that parents have on their children is further supported by a comparison study of Asian mothers and American mothers. American mothers were asked about their beliefs concerning the influences that affect the achievement of their children. The American mothers believed that their children's mathematical abilities were more strongly influenced by innate ability rather than by hard work or effort. The same beliefs were held by American children, reflecting a consistent belief with their mothers.

However, Asian mothers and their children strongly disagreed with regard to innate abilities. The focuses of the Asian mothers and their children were on hard work and persistence (Uttal, 1996).

Now more than ever, families need support and assistance from the school to help educate their children; however, schools need the support and backing of the family to help children achieve academically (Schneider, 1993). A reexamination of the motivational dynamics of learning and the identification of what and how children should be taught in the classroom in order to provide a foundation for meaning, assurance, and purpose in adulthood are necessary (Covington, 1992).

Significance of the Problem

Student motivational values and attitudes in the classroom and parental involvement with their children's learning affect mathematics achievement (Carr, 1996). There is much research that indicates the descriptors individuals use to describe their self-concept deviate with age, especially between childhood and adolescence (Boekaerts, 1991).

Students in lower elementary mathematics classrooms are usually motivated and enthusiastic about learning and see school as a place to learn. Furthermore, at this age young children have high estimates of their academic ability. Young children believe with effort they are able to achieve (McCaslin & Murdock, 1991; Middleton & Spanias, 1999). In task-involved situations, young children often focus on the task at hand rather than themselves. They believe learning and understanding is an end in itself; young children do not socially equate or make the connection of performance standards to judge their ability

(Ames & Ames, 1984; Grouws & Lembke, 1996; Nicholls, 1984). This implies that developmentally they do not have the ability to make realistic judgments about the future, and they cannot always determine between real and desirable events.

Children feel if they want something to happen then it will happen even if they have failed at a previous task (McCaslin & Murdock, 1991; Middleton & Spanias, 1999). Young children have much difficulty making predictable outcomes on ability and effort as causes of success (Kloosterman, 1996; Pintrich & Schunk, 1996). These concrete beliefs children hold are explained by the cognitive developmental theories based on Piaget's research (Osborn & Osborn, 1983). However, the type of evaluation children are given in the classroom and at home in relation to their achievement changes across the elementary years, indicating learners do begin to understand that effort will produce certain outcomes (Middleton & Spanias, 1999; McCaslin & Murdock, 1991).

By the time students reach early adolescence, they enter an interval of time when they are faced with perplexing adjustments and disquieting uncertainty. During this time, continuous and sometimes unalterable patterns of motivation, achievement, and social relations originate (Maehr & Anderman, 1993). Ten to fourteen-year-old students by now have the developmental capabilities that allow them to monitor their academic achievements (Kloosterman & Gorman, 1990). Adolescents have become adequately sophisticated to realize that their mathematics successes in the past allow them to predict their future academic performance. At this age, they are in transitional stages between concrete and abstract thinking. As a result, adolescents' perceptions of effort and ability begin to change, and they begin to view ability as fixed. Young adults understand that effort will compensate for low ability and that high ability may allow them to put forth less effort. At approximately thirteen years, adolescents often believe ability is viewed as the determining factor for success, and effort is only marginal (Covington, 1992; Boekaerts, 1991; Middleton & Spanias, 1999).

Additionally, at this volatile time in their lives, adolescents consider mathematics to be less fun and less fulfilling, and students' motivations tend to decline. The learning environment of the mathematics classroom in the middle school tends to be more formalized in instruction than that of the elementary classroom. The teacher often instructs through a lecture format with little or no interaction with students. Students quickly learn the one and only way to solve problems and obtain the correct answer; mathematics is learning in isolation; and learning mathematics is rote memorization of procedural steps which are disconnected from sense making and the world of everyday experience (DiCintio & Stevens, 1997; Grouws & Lembke, 1996; Muthukrishna & Borkowski, 1996; Silver, Smith, & Nelson, 1993).

These beliefs rigidly shape the students' views and perceptions of mathematics (DiCintio & Stevens, 1997; Muthukrishna & Borkowski, 1996). DiCintio & Stevens support these findings by saying,

> Research has associated decreases in intrinsic motivation, declines in attitude toward school, lowered academic motivation, and lowered self-concept, lack of student autonomy, impersonal student-teacher interaction, ability grouping and strict, competitive evaluation practices. (1997, p. 28)

As a result, students progress through adolescence and into high school with an already developed positive or negative motivational attitude toward mathematics. They have established a belief that mathematics is for *smart* people who succeed in mathematics while the other students satisfactorily get by or fail (Middleton & Spanias, 1999).

Motivational attitudes middle school students formulate toward mathematics have lasting effects. When students develop negative attitudes towards mathematics, research indicates there are a decreased number of students taking mathematics classes in high school and college. When positive attitudes exist within the minds of students, they tend to continue mathematics course work in high school as well as in college (Kloosterman, 1996; Middleton & Spanias, 1999). Data from the National Assessment of Educational Progress (NAEP) mathematics assessments indicate approximately 10% of the students in the United States complete four years of college preparatory classes in high school mathematics and are adequately prepared to take calculus in college (Silver, Smith, & Nelson, 1993).

As stated by Harry Lauder, "The future is not a gift, it is an achievement" (Covington, 1992, p. 2). Becoming interested in activities, putting forth effort to succeed, persisting at tasks when faced with difficulty, having self-efficacious feelings, and using a variety of cognitive strategies tend to be displayed by the student desiring to achieve (Pintrich & Schunk, 1996). These motives trigger numerous psychological events that help determine one's performance. One may also conclude that the level of discipline, organization, goal orientation, persistence, and individual risk link motivation, success, and the future together.

While many factors impact students' successes and failures in mathematics, it is important that students value what they learn and that they obtain satisfaction in mathematical learning not by rewards but by understanding. To make a difference, students, parents, teachers, administrators, and communities will have to become involved and committed to empowering children with the desire to obtain and achieve their dreams of today and the future. By altering motivational goals, students can learn for intrinsic reasons (Covington, 1992).

Purpose and Method

The purpose of this study is to describe eighth grade students' motivational beliefs about mathematics. Multiple motivational domains (intrinsic and extrinsic motivations, goal orientations, self-regulation, self-efficacy, and parental involvement) will be used to fully explore and examine students' subjective beliefs about the mathematics classroom. For this study, Q methodology is the procedure used. "Q methodology provides a foundation for the systematic study of subjectivity" (Brown, 1993, p. 93-94). Q technique attempts to hold a person's point of view constant so that it can be compared. Q methodology assumes all individual viewpoints are equally important and attempts to analyze the total person-in-action (Brown, 1997; Stephenson, 1953).

Q method does not inhibit the participant but allows one to interact and make individualized responses while sorting statements. In this Q study, adolescents sort statements that represent their perceived motivational views in the mathematics classroom. This will be accomplished by allowing the participants the opportunity to give meaning to a situation and express their opinions, values, and feelings during the Q sort (Brown, 1980).

Research Questions

The specific research questions to guide this study are:

1. What are the perceptions held by eighth grade students about their motivations in the mathematics classroom?
2. In what ways do eighth grade math students perceive themselves as differing from their perception of an ideal math student?

Assumptions

The following assumptions were made regarding this study:

1. The participants in this study are relevant to the topic under consideration and share a similar understanding of and subjectivity toward motivations in mathematics (Brown, 1997).
2. The theoretical and naturalistic construction of Q statements correspond to student subjective views about mathematics.
3. Students selected and sorted Q statements that represented their viewpoint under the two conditions of instruction: 1) How do you perceive yourself in the mathematics classroom, and 2) How do you perceive the ideal math student?
4. Students expressed their honest points of view during the pre-interview, post-interview, and Q sort.
5. All students' individual viewpoints are equally important (Brown, 1980).

Definition of Terms

To provide the reader with a better understanding of the methodology section, definition of terms are provided for a fuller interpretation of this study. Terms identified in this dissertation are mainly associated with Q methodology and classroom design.

Block – A forty-five minute period of time set aside four days per week designed to give students the opportunity to work on homework and seek one-on-one assistance from teachers.

Communicability – A term used in Q methodology to identify a specialized knowledge or understanding of a topic(s) by the participants who are being examined (Brown, 1980).

Concourse – An element of a Q study in which statements of opinions and thoughts run together and provide communicability of the topic under consideration (Brown, 1993; Brown, 1986).

Concrete Operational Stage – "A stage in development when children develop the capacity to think systematically, but only when they can refer to concrete objects and activities" (Crain, 1992, p. 102).

Condition of Instruction – The guidelines provided by the researcher to the participants in order to sort Q statements (Brown, 1997).

Engineering: Mathematics and Science Class – A class that meets once per week for approximately eighty-five minutes. Engineering class is a group oriented class that focuses on projects. Engineering class is designed to allow students to further explore mathematics and science concepts in order to show a relationship or link between the two fields.

Factors – A grouping of attitudes by a participant or participants that defines the subject's or subjects' subjective viewpoint(s) (Brown, 1980).

Form Board – A preformatted board or sheet on which participants sort their Q statements.

Formal Operational Stage – "A stage of development when young people develop the capacity to think systematically on a purely abstract and hypothetical plane" (Crain, 1992, p. 102).

Independent Math Class – Students who work through the Algebra I text at an independent rate with guidance from the teacher.

Loading - In Q methodology loading or factor loading refers to correlation coefficients. "Loadings indicate the extent to which each Q-sort is similar or dissimilar to the composite factor array for that type" (McKeown & Thomas, 1988, p. 50).

PQ Method 2.06 – A statistical computer program designed specifically for Q methodology that factors, rotates, and analyzes Q information (Schmolck, 1997).

P set – People who participate in the Q sort (Brown, 1986).

Phenomenology – "To provide an understanding of a concept from participants' perspectives and views to allow the researcher to construct a picture that takes the shape as he or she collects data and examines the parts" (Schumacher & McMillan, 1993, p. 95).

Q Methodology – A foundation for science and subjectivity that "encompasses a distinctive set of psychometric and operational principles that, when conjoined with specialized statistical applications of correlations and factor-analytical techniques, provides researchers a systematic and rigorously quantitative means for examining human subjectivity" (McKeown & Thomas, 1988, p. 7).

Q Sample – A group of statements designed from the concourse under the theory in the structure that is eventually presented to participants for sorting (Brown, 1993).

Q Statements – Individual statement items that make up the Q sample (Brown, 1986).

Q Sorting – The rank ordering of Q statements by participants along a continuum from most like to most unlike oneself (Brown, 1993).

Regular Math Class – The mathematics classroom is more structured by the teacher through assignment selection and group instruction.

Salience - A term used in Q methodology that refers to having noteworthy meaning, importance, or significance.

Subjectivity – "A person's communication of his or her point of view" (McKeown & Thomas, 1988, p. 12).

Conclusion

This chapter focused on the problem statement, background of the problem, and the significance of the problem in order to show the relationship between adolescents' perceptions of mathematics which guides their motivational beliefs. The beliefs adolescents hold about their abilities are linked to the information they receive from their environment. In the mathematics classroom, current research reports overall low levels of achievement throughout middle school or junior high. Considerable research suggests developmental age, characteristics of the classroom environment, and parents are contributory components of achievement that drive student motivations. In Chapter I, the purpose and an introduction to method for this study was also introduced as well as the research questions, assumptions, and definition of terms.

In Chapter II, motivational characteristics (intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement) are the focus. The motivations introduced outline the theoretical structure of the current research study. Q-methodology is also addressed in Chapter II and provides a foundation for the method of research. Chapter III focuses on the research questions, instrumentation, and procedures. Chapter IV discusses factor interpretations and overall perceptions of students, and Chapter V examines the results and discusses the implications of this study.

CHAPTER II

INTRODUCTION

In Chapter II, the literature review details a brief overview of motivation and the direction of motivational research. The theory in the study of motivation will be highlighted as will specific characteristics of motivation. In great detail five theoretical motivational components will be discussed which include intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement. Additionally, the literature review will discuss adolescents and how their beliefs are linked to the motivational theories. Finally, Q methodology, the method of the research, is introduced and discussed to give a conceptual understanding of the method used.

Review of Literature

Since the writings of Plato, Socrates, and Aristotle, the inquiry of *why* some people strive to obtain certain goals and other don't has been analyzed by scholars (Ames & Ames, 1984). Early motivational theorists attempted to explain behavior through the use of stimuli and reinforcement. In controlled laboratory settings, people were asked to participate in a variety of artificial tasks so researchers could isolate and control behavior in order to eliminate insignificant influences. However, much of this laboratory-based research failed to explain the complexity of what motivated people. Researchers neglected to uncover many of the different motivational processes that people use everyday for thinking, learning, and solving problems (Pintrich & Schunk, 1996).

Not until the last twenty years have there been studies conducted on motivational processes in educational settings (Ames & Ames, 1984). What is known about motivation and the current body of research on motivation came from studying people through field research. The focus of motivational research has been on how individuals construct meaning, determine reasons for achievement, and use strategies in order to achieve success (Maehr & Pintrich, 1991). Through direct observations, researchers have been able to analyze how people respond to challenges, obstacles, disappointments, and setbacks when they engage in pursuing and attaining goals over a given period of time. The benefit of field research is that it is much more generalizable and can often be replicated in similar settings (Pintrich & Schunk, 1996).

Social Cognitive Theory in the Study of Motivation

A theory is a set of standards that describe a phenomenon. Theories are scientifically acceptable and provide a context for understanding environmental observations and help connect research and education. Much research has been conducted on perceptions held by individuals about their abilities. These perceptions are often positively related to motivation (Pintrich & Schunk, 1996).

Social cognitive theory is an approach to a better understanding of human cognition, action, motivation, and emotion. Social cognitive theory recognizes that people are capable of self-regulation and self-reflection. Assumptions from Bandura's research in

1986 and 1989 outline social cognitive theory which emphasizes action, goals, and cognitive behaviors that describe various human motivations.

Bandura introduced social cognitive theory by stating people use their environmental experiences to develop and to determine the course of actions necessary to predict outcomes and communicate ideas to others. Human behavior is regarded as generally purposeful, goal-directed, and guided by anticipatory or predicting forethought, and people use metacognitive behaviors to evaluate and analyze their thoughts and experiences for self-control. Also, social cognition recognizes that people compare their behaviors against others to adopt personal standards and construct incentives for motivation to guide and exercise control of their actions. Finally, through vicarious learning and observation of other people, the learning of complex skills without direct experience becomes plausible (Boekaerts, 1991; Maddux, 1995).

Social cognitive theory essentially focuses on affective information processing or cognitive characteristics which indicate that one's knowledge, beliefs, and feelings about abilities and skills attribute to learning and achievement (Boekaerts, 1991; Schiefele & Csikszentmihalyi, 1995). Thus, motivation can and does affect new learning and the performance of previously learned skills, strategies, and behaviors, which has substantial implications for schooling (Pintrich & Schunk, 1996).

Characteristics of Motivation

"Motivation is the process whereby goal-directed activity is instigated and sustained" (Pintrich & Schunk, 1996, p. 4). Research on motivation indicates motivation is a process that requires mental and physical activities. Physical activities involve task choice, persistence, effort, and verbalizations. Mental activities elicit various cognitive actions such as monitoring, organizing, preparing, making choices, problem solving, and evaluating progress (Pintrich & Schunk, 1996).

The National Council of Teachers of Mathematics (NCTM) have two motivational areas addressed in its goal for mathematics students. These goals for students are "learning to value mathematics" and "becoming confident in one's own ability" (Middleton & Spanias, 1999, p. 65). While NCTM's motivational goals for mathematics students are somewhat general in nature, more specific motivational strategies are necessary to accurately identify students' motivational beliefs that contribute to success in mathematics.

Intrinsic and Extrinsic Motivation

The fundamental phase in the action process of obtaining a goal is the activation of external or internal stimuli (Pervin, 1991). Children are born intrinsically motivated to inquire, manipulate, and understand their surroundings; they receive instruction and meaning through shared interactions from others (Ryan & Stiller, 1991). For students to possess intrinsic motivation, they must exert energy to engage in a learning task by self-initiation which comes from within. Thus, intrinsically motivated actions occur without external controls, influences, and rewards (Grouws & Lembke, 1996; Middleton & Spanias, 1999).

Current research suggests that students organize their intrinsic motivations into three categories. First, the task must stimulate the students. Next, the students must encounter personal control of the activity and believe the activity to be suitably challenging. Finally, the students must find the task both interesting and worthwhile and experience a certain level of success in order for task completion (Brehm, 1993; Middleton, 1995; Middleton & Spanias, 1999).

Middleton and Spanias (1999) also report that mathematics students who are intrinsically motivated focus more on arousal than on personal control of the activity. Furthermore, intrinsically motivated students were found to spend more time on a task, were more persistent when faced with a challenge, had higher levels of creativity, took more risks, chose self-regulation strategies while performing difficult problems, used rehearsal strategies, and opted to complete tasks without external motivators (Gottfried, Fleming, & Gottfried, 1994; Middleton & Spanias, 1999; Pintrich & DeGroot, 1990; Pintrich & Schrauben, 1992). Intrinsically motivated students tend to develop mastery goal orientations; they view learning as a worthwhile process so that they can master and understand concepts (Middleton & Spanias, 1999).

Extrinsically motivated individuals often focus on rewards. Extrinsically motivated students desire to receive money for high grades or praise for their competence from parents, teachers, or peers. Children of an extrinsic motivational orientation have been known to do their homework not to gain knowledge but to keep their allowance unaltered.

Extrinsically motivated individuals will also perform in order to avoid levels of punishment due to poor academic performance. When they are given a learning task, they often approach the task in a controlling manner rather than through arousal. These individuals tend to be more performance goal oriented, less focused on acquiring skills, and do not feel the challenge to achieve (Middleton & Spanias, 1999). Consequently, extrinsically oriented students tend to become "at risk" for academic failure. Helplessness, withdrawal from tasks, and negative cognitive states adversely affect the learner due to embracing of extrinsic learning goals (Wentzel, 1991).

Five hundred seventy-six "at risk" students of different social and cultural backgrounds were examined in an alternative learning environment. The midwest urban school district from which students were surveyed ranged from sixth graders through eleventh graders. Each participant received two questionnaires that assessed different areas of motivation and self-esteem. Findings indicate students who completed the alternative learning program had higher levels of intrinsic motivation. These students felt they could succeed academically when they returned to a "regular" school, and they highly valued learning. The students who dropped out of the alternative learning program had a high level of extrinsic motivation due to peer influences or financial needs (Nichols & Utesch, 1998).

Goal Orientations: Mastery and Performance Goals

In order to describe children's performance and learning on educational tasks in the context of the school, goal theories were created by developmental and educational psychologists (Pintrich & Schunk, 1996). Goals are defined as analytical explanations of what learners are trying to accomplish, and the function of goals is to direct behavior toward achieving outcomes (Wentzel, 1992). As such, they are considered to be the most beneficial and applicable goal theory for understanding and explaining the obtaining of knowledge and instruction (Pintrich & Schunk, 1996).

Goal orientations are clearly associated with intrinsic or extrinsic motivations; studies on goal theories have been conducted at all academic levels (elementary, middle school, high school, and college), in learning disabled classrooms, and in "at-risk" classrooms (Watkins, 1997). Goal orientations are linked to students' cognitive reasoning and explain why students choose to engage in meaningful activities (Middleton & Spanias, 1999). These motivational orientations are also excellent predictors of academic achievement as well as an avenue for improving classroom instruction (Middleton & Spanias, 1999; Miller, Behrens, & Greene, 1993; Wentzel, 1991).

Goal orientation theories recognize that human behavior is goal-directed and varies for individual students to the extent to which students characteristically appreciate and seek competence (Ford & Nichols, 1991; Harackiewicz & Sansone, 1991). Through different strategies, students with mastery or performance goal orientations choose to view, approach, and engage in achieving academic success differently. Students think about the self, the task, and the outcome of the task in a very different manner (Ames, 1992a).

Students who possess mastery goals become more involved in cognitive tasks than the students possessing performance goals (Watkins, 1997). Mastery goal oriented students are often intrinsically motivated while performance goal oriented students need extrinsic rewards (Middleton & Spanias, 1999; Nichols & Miller, 1994).

Mastery goal individuals concentrate on increasing and obtaining knowledge, improving competence level, understanding tasks, enjoying challenges, and persisting during those challenges (Ames, 1992a; Miller, Behrens, & Greene, 1993; Newman, 1990; Nichols & Miller, 1994; Nichols & Utesch, 1998; Seifert, 1995; Watkins, 1997). Mastery oriented students often are interested in problem solving and focus on learning for the sake of learning (Maehr & Anderman, 1993). They believe that success depends on hard work, interest, cooperation, and trying to understand, rather than on memorization. These students also experience a sense of belonging in the learning process and easily identify with the significance of school (Ames, 1992b; Watkins, 1997). They take responsibility for successes and failures in their learning, use self-regulated learning strategies in order to increase levels of academic achievement, and believe effort and achievement go hand-in-hand (Ames, 1992b; Nichols & Utesch, 1998; Seifert, 1995). Mastery learners who have dominant learning goals were found by Miller, Behrens, and Greene (1993) to have high levels of perceived ability and reported having a higher level of self-monitoring in comparison to performance goal learners.

Performance oriented learners approach instruction quite differently. They often avoid difficult tasks and do not persist when challenged (Middleton & Spanias, 1999; Nichols & Utesch, 1998). They perceive their ability in relationship to achievement and want to achieve success with little or no effort (Ames, 1992b). As a result, they choose easy tasks so they can receive a positive evaluation rather than a negative evaluation on a hard task (Miller, Behrens, & Greene, 1993; Newman, 1990; Watkins, 1997).

Furthermore, performance oriented learners tend to focus on surface-level strategies for learning. They do not like to engage in problem solving, reflection, or critical thinking; they tend to focus more on memorization, shortcuts, or quick payoffs in order to achieve (Maehr & Anderman, 1993). Finally, performance learners often produce negative emotions when they feel they cannot meet the demands of the task. This type of learner uses failure avoidance techniques in order to avoid feelings of incompetence (Seifert, 1995).

School provides the context in which assessment and competency are pervasive and endless. Students are evaluated numerous times each day, and in this environment, performance oriented students are able to make self-assessments and to compare their learning capabilities with others (Boekaerts, 1991). Research, however, does indicate that performance learners are interested in demonstrating their knowledge and ability, and they want to perform well but for all the wrong reasons. Performance oriented learners choose to do well in order to earn a more superior grade than one of their peers, gain acceptance on their ability, or earn a reward for their achievement (such as money or a positive evaluation from peers, family, teachers, or self) (Nichols & Utesch, 1998; Seifert, 1995). In performance oriented or competitive situations, learners often focus on the self which shifts attention away from the academic task at hand (Ames, 1992a; Meece, 1991). In turn, their behaviors undermine the learning situation, and lead to difficulties in processing more intense information; they ultimately have lower levels of performance than goal oriented individuals (Miller, Behrens, & Greene, 1993; Watkins, 1997; Wentzel, 1992).

Students' goal orientations in a large school district in Canada were evaluated. The study consisted of an equal girl/boy ratio, and all 79 fifth-grade students were middle class. Research concluded mastery oriented students had more positive emotions than performance oriented students. Mastery learners were confident in their ability to achieve, while the performance learners wanted to feel a sense of belonging (Seifert, 1995).

Research on affective and cognitive domains which focused on high school students' conceptions of mathematics and the way they engage in mathematical tasks had contradictory patterns. Two hundred thirty high school tenth through twelfth grade students were asked to complete a Likert-type questionnaire that dealt with success and failure in mathematics. All students were enrolled in an academic, college-bound track. As a whole, the data obtained from the questionnaire generally showed a majority of the students were intrinsically motivated and mastery goal oriented. The high school students claimed that they found mathematics interesting, they were learning for the sake of learning and gaining knowledge, and they had high perceptions of their capabilities in mathematics. While these students made the assertions of intrinsic, mastery oriented individuals, they had one contradiction in their beliefs about mathematics. The high school students claimed one can best learn mathematics by memorization which essentially focuses on the performance oriented learner (Schoenfeld, 1989).

While researchers often examine specific goal orientations in isolation to determine levels of motivation, DiCinto and Stevens (1997) indicate in their research that goal orientations (mastery and performance) among adolescents co-existed in many learning situations. Adolescents often are motivated to learn in order to increase their knowledge. However, they are also motivated to perform well in order to look better than their peers.

Self-Regulation

During the last two decades, the notion of self-regulation, such as goals, self-monitoring, and persistence, has become another focus in the study of motivation. Theoretical advancements in motivation and self-regulation have been further complemented by the examination of the ways behavior affects learning and achievement in educational settings (Kanfer & Kanfer, 1991). Goals dominate the activation and focus of self-regulatory endeavors. The way the learner defines and pursues goals in intentional or unspecified manners and the strategies the learner uses to organize or clarify information in order to perform a task are an important step in the self-regulatory process (Cantor & Fleeson, 1991; Zimmerman & Martinez-Pons, 1992). Not only must learners construct an explanation of how to accomplish goals, but learners must often make choices in academic and social contexts in which there are a variety of valid reasons for goal attainment (Cantor & Fleeson, 1991).

Different situations permit only certain behaviors in the process of self-regulation, and current research suggests that there are three levels of self-regulation that allow one to maintain effort toward a goal despite unexpected changes in circumstances. First, self-regulatory activities are initiated even when a task is disrupted or not available. Next, the level of challenge for the learner in accomplishing a goal should be high, and finally, the learner initially holds a marginal level of assurance that he or she has the competence to attain the goal. Each level is intricately linked; the actions of the individual at one level affect the decisions at other levels (Kanfer & Kanfer, 1991).

Self-regulatory learning is often characterized as an intrapersonal process in which individuals metacognitively take charge of their own academic achievement. Their cognitive activity is linked with personal thoughts, direction, persistence, efficacy, and regulation. Learners consciously monitor their performance and remarkably devote cognitive resources that are necessitated by the task (Kanfer & Kanfer, 1991; Newman, 1991).

Initially, self-regulated learners might seem to be self-sufficient. Research, however, suggests that there is an important and often overlooked social side of self-regulated learning. Students often must monitor and receive feedback of their cognitive activity, behavior, and performance from several sources. Direct feedback includes attention and interaction from others; self-regulated learners additionally seek out clarification and explanation of procedures and assignments from teachers, parents, and peers. Requests for help are well-planned and well-processed by self-regulated learners. Indirect methods for acquiring knowledge about others occur through observation of others with similar abilities and communicating with others in order to obtain information (Kanfer & Kanfer, 1991; Newman, 1991; Newman & Schwager, 1992).

One of the most crucial accomplishments during cognitive development is for students to know how to use strategies in order to perform well academically. Through the use of self-regulated learning strategies, learners select tasks that are often based on the learner's confidence or perceptions of self-efficacy, commitment to academic goals, and ability to accurately obtain solutions to challenging problems (Pintrich & DeGroot, 1990; Zimmerman & Martinez-Pons, 1992). Pintrich and DeGroot (1990) also have outlined three components that relate to self-regulated learning. First, students examine and assess the task; this is their level of expectancy or ability to perform the task. Secondly, students place a value or interest on the task. Finally, they react to the task in an affective manner. Self-regulated students often question themselves in accordance to the task. What can I do to understand the assignment? What is the best way to perform the task? How can I achieve success at this task? (Ames, 1992b) By using questioning techniques in the self-regulation process, learners define what tasks are worth pursuing and metacognitively assess how to pursue specific tasks (Cantor & Fleeson, 1991). Questioning techniques as a means for pursuing goals directly relates to much of the research on self-regulatory components; therefore, students' beliefs of whether or not they can complete a task are directly associated with effort and value of the task (Pintrich & DeGroot, 1990).

Self-regulated students' expectations affect involvement, learning, and effort; thus, they affect academic achievement and intellectual growth (Brookhart, 1998; Newman, 1990). Research indicates students' self-regulation strategies are also a good predictor of academic achievement. According to current research, high achieving students used self-regulation strategies and cognitive strategies in different learning situations. Such strategies included planning, monitoring, checking work, seeking help, and asking questions; these self-regulation strategies also promote cognitive strategies such as intellectual persistence during difficult task situations, understanding of material, increased long-term memory, and integration of new material with prior knowledge (Brookhart; 1998; Newman, 1990; Pintrich & DeGroot, 1990; Pokay & Blumenfeld, 1990). When students use self-regulatory strategies those strategies are linked and positively influenced by self-efficacy and task motivations (Schiefele, 1991).

Self-Efficacy

Self-efficacy theory is a construct that emphasizes the importance of an expectancy model for motivated actions. Self-efficacy theory suggests one's beliefs, confidence, or behaviors in a particular task or performance on that task are related to competence in that subject (Ewers & Wood, 1993; Hoover-Dempsey, Bassler, & Brissie, 1992; Nichols & Utesch, 1998; Randhawa, Beamer, & Lundberg, 1993; Speight, Rosenthal, Jones, & Gastenveld, 1995). Self-efficacy additionally focuses on the ability of an individual to maintain control of particular events that affect one's life. Through a form of behavioral control, the learner must mobilize various motivational techniques and cognitive resources to maintain control over events or task demands (Boekaerts, 1991; Maddux, 1995). Therefore, a student's self-efficacy is an indicator of whether or not a particular task is attempted and the amount of effort required to succeed; the student recognizes that effort and perseverance are required and must be maintained in order to succeed at a task (Pintrich & Schunk, 1996; Randhawa, Beamer, & Lundberg, 1993; Schunk, 1991).

Self-efficacy varies at different levels: magnitude, strength, and generality. At the first level of self-efficacy, magnitude refers to the number of steps a student will increasingly persevere toward in light of difficulties. Steps of magnitude revolve around one's perceived capabilities. Strength focuses on the level of confidence or persistence a person holds toward a specific behavior or task in the face of frustrations, barriers, or pain. Generality of self-efficacy refers to the extent to whether success or failure of specific behaviors or tasks extend to other comparable behaviors or settings (Maddux, 1995).

Learners also acquire self-efficacy through performance, vicarious experiences, persuasion, and physiological reactions. Through performance accomplishments, students are given a reliable guide to cognitively appraise their self-efficacy. Successes raise levels of self-efficacy whereas failures lower it; however the stronger the level of self-efficacy the less impact failures tend to have on learners. Students use vicarious experiences to evaluate self-efficacy. By making social comparisons, students often make observations of peers who have similar capabilities and have comparable accomplishments on academic tasks. Persuasive information from parents or teachers often provides feedback to students. Research implies positive feedback raises self-efficacy beliefs during given tasks.

Psychological reactions such as anxiety or sweating often are interpreted as an identifier which indicates necessary skills needed to complete a task are lacking (Schunk, 1991; Schunk, 1995).

Students with high levels of self-efficacy are more likely to participate more willingly, work harder, and continue a course or task (such as high level mathematics classes) even if the task becomes more difficult or challenging (Schunk, 1995; Speight, Rosenthal, Jones, & Gastenveld, 1995). The result of their perceived ability, effort, and persistence indicates the seeking of higher goals and the achieving of higher levels of academic success tend to increase with age and career choice (Brookhart, 1998; Ewers & Wood, 1993; Hoover-Dempsey, Bassler, & Brissie, 1992; Nichols & Miller, 1994; Speight, Rosenthal, Jones, & Gastenveld, 1995). In a study conducted by Pintrich and DeGroot (1990), research findings suggest “high levels of intrinsic value and self-efficacy are significant during seatwork, exams, and essays” (p. 34). These students also had high levels of self-regulation and cognitive strategies used in comparison with the low perceived ability students.

Students with low perceived ability often have had bad experiences in that subject; therefore, they do not see the subject as an important component of their self-concept (Middleton & Spanias, 1999). Lack of self-efficacy in mathematics may be identified as early as third grade. In a recent longitutional study of students in third and fifth grade, boys in both grades held more positive beliefs than girls about their competence in mathematics (Green, Vanayan, White, Yuen, & Teper, 1997).

As a result, students who lack self-efficacy are less likely to develop motivational techniques in order to learn and understand mathematical tasks. Students’ motivations and self-concepts are often developed from formed opinions of themselves during a mathematical task (Middleton & Spanias, 1999). Individuals with low self-efficacy will select easier tasks due to their perceived capabilities. By choosing easier tasks the individual with low perceived ability will have a greater chance at success but lower academic achievement (Nichols & Utesch, 1998).

Average ability fifth grade students were studied to determine if there are sex and ability differences in mathematics self-efficacy and prediction. Thirty-eight gifted and thirty-eight average ability students made predictions on their ability to solve problems on a twenty-item mathematics task. After predictions were made, the students completed the task. Males showed higher levels of self-efficacy toward mathematics than the females. Gifted students predicted with higher accuracy their ability to solve the problems, and the males in both groups overestimated their ability to solve the problems. This study indicated individuals who are academically successful have higher levels of self-efficacy than those who have average aptitude. Also, an individual's perceived self-efficacy affects one's beliefs about his or her performance and achievement (Ewers & Wood, 1993).

Parental Involvement

Parental involvement is a broad term used to link parents with their children's educational needs. Parents have always been recognized as an influence in education and school reform, and in schools parents have taken on various roles (Peressini, 1998). Whether the parent is volunteering at the school or in the classroom, attending parent/teacher organization meetings, or providing home instruction, the term "parental involvement" is viewed to exist along multiple dimensions.

Parental involvement relates to the amount of time parents invest in their children's learning (Reynolds, 1992; Watkins, 1997). Various research studies suggest efforts have been made to identify and understand how parental involvement influences academic success of children. There is clear evidence in current literature that family support and family involvement in school, home, and community positively affect children's performance, attitudes, and aspirations (Muller, 1993; Muller & Kerbow, 1993; Swap, 1993). Smith and Hausafus (1998) found among minority students that when parents emphasize the importance of taking advanced mathematics and science courses and seeking careers in math and science fields minority children tended to take more science and math courses and became more successful academically.

Parental involvement in their children's education has become a critically important component of educational reform (Peressini, 1998; Reynolds, 1992). Two national reform documents call for the involvement of parents with their children and their children's school. The United States Department of Education National Goals for the year 2000 call for increased parental participation and involvement in the school in order to boost academic and social growth of children. The United States Document of National Parent-Teacher Association prompts schools to involve parents so a partnership will develop with the school and community. This campaign attempts to provide parents, schools, and communities with a guide for reaching reform goals (Peressini, 1997).

Current research suggests family income, parental education, extra-curricular activities after school, after school supervision, and the relationships parents have with their children are factors that contribute to their children's academic success (Muller, 1995; Muller, 1993). Other variables Watkins (1997) found that indicated parental involvement in relationship to their children's achievement were frequent communication with home and school, the parents' self-efficacy and efficacy in relationship to involvement, and the academic accomplishments of their children. Much research does indicate parental involvement characteristics and the standards parents set for their children do positively influence their children's academic performance (Brookhart, 1998). A two year study investigating parental involvement among parents, teachers, and children indicated there is evidence to suggest parental influences in the home had significant positive impact on young children's academic performance (Reynolds, 1992).

In another parental involvement study, a sample of forty-one suburban schools, 11,317 parents completed questionnaires (83% response rate). Findings concluded students who have more involved parents do have higher standardized test scores. In this particular case, parental involvement with activities and schoolwork did influence academic performance (Griffith, 1996).

Randomly selected eighth-grade students completed questionnaires and cognitive tests. In this study, parents also completed a questionnaire relating to characteristics, involvement, and attitudes of their involvement with their children. Mothers who worked part-time indicated having higher levels of parental involvement as compared to the mothers who worked full-time. Children whose mothers worked part-time had higher test scores, performed better in school, and were better prepared for school each morning. Also, the mothers who worked part-time tended to have higher levels of involvement in the home. The home involvement included talking with their children and properly supervising their children so they wouldn't be left alone (Muller, 1995).

Adolescents and Motivation

On a daily basis adolescents are faced with a countless number of choices, problems, and challenges. Despite numerous emotional and behavioral dysfunctions that are prevalent in the home and classroom, adolescents are often able to effectively make decisions, work out problems, and triumph over challenges through the use of a variety of cognitive strategies (Maddux, 1995; Pintrich & Schunk, 1996). Adolescents "will act in ways that they believe will result in outcomes they value" (Schunk, 1995, p. 283). How adolescents learn and acquire knowledge and maintain a level of control in educational settings is greatly influenced by motivational patterns and orientations (Muthukrishna & Borkowski, 1996).

Adolescents who have positive motivational beliefs are those who feel that they can confidently accomplish certain tasks, believe that they are in charge of their learning and the obtaining of knowledge, approach learning through mastery orientations, focus on and value the importance of task content, and will more likely become interested in learning in an intrinsic, more self-regulating manner than students who do not possess these beliefs. Moreover, while positive motivational beliefs may not lead directly to improved academic achievement, these beliefs can lead to deeper cognitive understanding in the task which does have a direct impact on academic achievement (Pintrich & Schrauben, 1992).

Foundations of Q Methodology

Q method is a dependable way to address individuals' unique points of view (Brown, 1997). In Q technique small numbers of people participate in a study which allows the investigator a clear understanding of the participants' feelings and employs a connection or relation through the study.

> A virtue of Q technique is that it preserves those contextual and dynamic influences that serve to inform on alternative interpretations that may diverge from the investigator's original formulations. (Brown, 1980, p. 48)

In 1935, William Stephenson first introduced Q methodology in a letter to "Nature" (p. 244). He described Q methodology as a technique used to examine individual perspective views or human subjectivity (Brown, 1980). His original idea for Q method was to correlate the individual instead of tests (Brouwer, 1992-1993). Stephenson believed it was imperative to "surrender control of meaning over to the individual whose behavior was the focus of inquiry" (Brown, 1980, p. 176).

Stephenson studied and examined how physical or behavioral scientists measured the human mind and applied his knowledge of quantum mechanics and psychology to Q methodology in order to measure the human mind and achieve his goal (Logan, 1991). Consequently, "he developed the conditions for science and subjectivity" (Brown, 1991, p. 244). Stephenson believed that scientists cannot

> directly see, touch, feel or otherwise experience the inner-workings of the human mind. It is methodologically and theoretically imperative to assume all probability states are operant before one measures or applies operational definitions, empirical methods, and subsequent description. (p. 27)

He also hypothesized that quantitative methods of research such as R methodology overlooked the individual's subjective views and maintained that human subjects should be assessed through a multi-dimensional approach rather than through a one-dimensional method. "Individual intelligence, personality, and behavioral motivations" are often measured and bound by determined scales that have fixed one-dimensional explanations (p. 27). Stephenson asserted,

> an appropriate study of human behavior should examine how each individual orders his or her psychological experience within the widest range of imaginable theoretical possibilities. (Logan, 1991, p. 27)

Thus, Q technique was developed and originally grounded in psychophysics and psychology on the subjective side (Brown, 1968).

Q methodology obtained its name in July 1935. Sir Godfrey Thompson recommended in a paper he presented using the letter *q* to stand for person correlations. This way, researchers could distinguish between the correlations of tests which are expressed by Pearson's *r* (Brown, 1980). R (Pearson's r) factor analysis breaks wholes into parts for analysis and measures objective variables, such as intelligence. Q factor analysis essentially keeps the parts together, does not measure variables but states of mind, and attempts to analyze the total person-in-action (Brown, 1997; Stephenson, 1953).

Issues of concern in reference to Q methodology tend to focus on validity and generalizations. "Validity refers to the relationship of an instrument to the phenomena it pretends to measure; or, more specifically, to the uses to which an instrument is put" (Brouwer, 1992-1993, p. 3). In Q, validity is not an issue since there is no outside criterion. Q technique is based on a person's point of view and does not try to compare Q data (Brouwer, 1992-1993). Generalizations in Q are viewed of specimen and type and are relevant to persons who share communicability under the topic of consideration.

Generalizations are valid for persons of the same type or same point of view of a given factor (Brown, 1980; McKeown & Thomas, 1988).

Conclusion

Before discussion of methodology in Chapter III, it was necessary to highlight the foundations of motivations, theoretical motivational structure, and the research method for this study. The review of literature provided background information of social cognitive theory, linked intricately many motivational characteristics and adolescents, and described Q methodology.

Motivation is an important characteristic that pervades all phases of learning (Pintrich & Schunk, 1996). Current research on motivational theories (intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement) provides a large body of information on the learner's perceptions about the self and world as a contributory element in clarifying one's existence and in directing one's actions (Newman & Schwager, 1992). Understanding and exploring the relationship between adolescents' perceptions of personal competence, achievement motivations, and parental involvement gives researchers a foundation and structure to better understand how adolescents become active participants in the environment in which they live and the beliefs they hold toward mathematics.

CHAPTER III

METHOD

In this chapter, the method and procedures used to collect and analyze the data are described. The purpose of this study was to give eighth grade math students the opportunity to express a self-referent image of their motivational beliefs of success in mathematics in terms of several factors: intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement. Q methodology was used to obtain subjective opinions toward motivations in mathematics.

The specific research questions to guide this study are:

1. What are the perceptions held by eighth grade students about their motivations in the mathematics classroom?
2. In what ways do eighth grade math students perceive themselves as differing from their perceptions of an ideal math student?

This chapter includes a specific description of the pilot study, participants, instrumentation, procedures used, and data analysis.

Pilot Study

A pilot study was conducted with Institutional Review Board (IRB) approval (ED 99-099) in the spring of 1999. The purpose of the pilot study was to determine what variables might affect the outcome of the current research project and to control those variables. The concourse in the pilot study was determined through a structured theoretical approach (McKeown & Thomas, 1988). Thirty-six theoretical statement items were sampled from the concourse obtained from current literature on motivation. The Q statements characterized motivational domains in mathematics (intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement).

Student and parental consent forms were prepared to be distributed to a class of fifty-four eighth grade students and parents in the 1998-1999 school year. Students were verbally informed by the researcher about the nature of the study; twenty students with parental consent and student assent participated in the pilot study. Students sorted statements under two conditions of instruction as described in Appendix F: (1) How do you perceive yourself in the mathematics classroom? (2) How do you perceive the ideal math student in the mathematics classroom?

Once student Q sort data was obtained by the researcher, it was then factored by a statistical computer program called PQ Method 2.06 (Schmolck, 1997) which is composed of several applications. The statistical procedures included principal components factor analysis, varimax rotation of the factors, calculation of z-scores, and array positions for each item of the rotated factors. The emergent three factors were interpreted as Idealistic Perceived Ability, Realistic Perceived Ability, and Exaggerated Perceived Ability.

One conclusion from these findings was that the students may not have had a full range of options to respond to all concerns since they did not have their own language to voice their opinions due to level of readability. The bipolarity of statement items from the literature additionally was a concern. It was determined by the researcher that bipolar statements such as “I like math.” or “I do not like math.” were not necessary. A single statement item such as “I like math.” could represent all view points of students by the placement on the form board by students during the sorting process. From the findings of the pilot study, it was additionally believed that it was important to identify ability levels of participants to help in the interpretation of the theoretical factor arrays. As a result, within the same motivational characteristic framework of the pilot study, a naturalistic component was determined as necessary and students needed to be interviewed to develop a hybrid Q sample.

For the current Q study, a hybrid Q sample consisted of theory driven statements from the current literature and naturalistic statements that were constructed from oral interviews. McKeown and Thomas (1988) suggest there are two benefits to integrating naturalistic statements (statement items that come from oral interviews in order to represent student language) into conceptual framework of the current study.

> (1) They mirror the opinions of the persons performing the Q-sort, and (2) they expedite both the Q-sorting process and the attributions of meaning since their items are based upon the respondents’ own communication. (p. 25)

Further support for the use of naturalistic statements to be incorporated into the theory obtained from the current literature for the current study is provided from the same source which states,

> Naturalistic Q samples greatly reduce the risk of missing the respondents’ meanings or confusing them with alternative meanings deriving from an external frame of reference. (McKeown & Thomas, 1988, p. 25)

Participants

The population for the current study was a group of eighth grade students currently enrolled in a small, private, nondenominational, independent school district. The location of the school was in urban south central United States. This Pre-K through eighth grade school serves approximately five hundred students. The school is divided into three buildings–primary school, lower school, and middle school. Each grade houses between forty-five to sixty students. The cultural diversity of the students within the school is approximately 85% Caucasian and 15% other ethnic cultures.

Rationale for School Selection

Much of the research on motivations also focuses on the classroom arrangement and environment. Arrangement of the classroom and goals of the educational institution are believed to help influence the motivational orientations of students. Target areas in the classroom focus on the *task involvement* of students during classroom activities, giving students sense of *authority* so that they can take on leadership roles and achieve a level of autonomy. *Recognition* concentrates on individual gains rather than through social comparison and extrinsic incentives; *grouping* of students is viewed as being instrumental in order to heterogeneously provide peer interaction; and *evaluation* allows students to improve performance and progress at a rate for mastery (Ames, 1992a; Maehr & Midgley, 1991).

The goals of the academic institution where the research was conducted stress academics, responsibility, and cooperation which are closely linked to target areas of learning as described by Ames (1992a) and Maehr and Midgley (1991). The academic program encourages and challenges students to think by reading, writing, questioning, discussing issues, and supporting their own ideas. Students often have daily homework and are urged to complete all assignments in a responsible manner.

In order to give students a level of autonomy, the students are viewed as responsible adolescents. The students know the building is theirs; in turn, they are given the privileges of having no areas that are off-limits such as a teachers' lounge. The students are also given the liberty of eating during class time when hungry. The freedoms that the adolescents receive at this middle school allow them to learn how to treat property, privileges, and assignments responsibly.

Students are expected to learn and work with others. Tables instead of desks are located in every classroom. This arrangement allows four students to sit comfortably and work together. Students work in cooperative learning groups that are selected in a variety of ways. The groups may be randomly selected, peer arranged, or teacher appointed. Groups work together on a variety of projects; the projects emphasize group goals and individual accountability.

At the beginning of each year, students are placed in home groups; home groups are not the same as cooperative learning groups. Home groups consist of three to four heterogenous students who share the same schedule. Home groups are arranged so that students are not isolated or ignored; they provide each student a group to be in and a place to sit. At times, home groups do work as a cooperative learning group; however, the focus of home groups is for socialization and scheduling.

The schedule is a unique characteristic of the school. The school and teachers acknowledge the vast amount of research available on learning styles. Current research indicates that students learn better at different times during the day, in different group combinations, and for different lengths of time. Therefore, the class schedule varies daily and is not held at a consistent time nor for the same duration of time.

Finally, awards are not given at the end of the year to select students who have excelled academically. All students are recognized by their achievements and academic successes. This philosophy encourages each child to challenge himself or herself at his or her own ability level without publically acknowledging social comparisons by the academic institution.

Alternative Mathematics Classroom

At this school and only in the eighth grade, a philosophy allowing students goal-directed choices in the mathematics classroom guides their level of achievement. In the eighth grade mathematics class, two groups of mathematics students are represented. Both groups attend and are housed in the same mathematics class; yet, each group's mathematics instruction and goals differ.

The first group is called the "independent mathematics students." These students choose to work through the current Algebra I mathematics text at an independent rate and by individualized instruction. The goal for the independent mathematics student is to complete the Algebra I text by the end of the academic year with assistance from the teacher. The independent students usually bypass Algebra I in ninth grade and enter a geometry class.

The students participating in the independent mathematics group make the choice by opting to work in this type of atmosphere. At the beginning of the school year, each student takes an algebra readiness test, writes a paragraph about why he or she wants to participate in independent studies, and consults with the mathematics teacher about his or her reasons for choosing to participate in this grouping. Under a variety of circumstances, students may choose at any time throughout the school year to drop out of the independent mathematics curriculum and rejoin the group of regular mathematics students.

The second group is considered to be "regular mathematics students." These students use the same text as the independent students. However, the classroom atmosphere is more structured by the teacher through assignment selection and group instruction. The goals of the regular mathematics students differ from the independent students. These students are in an Algebra I preparatory class. The regular mathematics class will not finish the Algebra I text and therefore will take Algebra I in ninth grade.

Student Selection

Students opting to participate in this Q study were relevant to the topic under consideration. Each subject shared communicability or specialized knowledge with motivational issues in mathematics (Brown, 1997). In accordance with federal regulations and Oklahoma State University policy, a required review which elicits human subjects must be approved to ensure human rights and welfare are protected. For this study, the Institutional Review Board (IRB) was submitted and approved (ED 00-166) in the Fall of 1999 (Appendix A).

The eighth grade class of 1999-2000 consisted of forty-seven students, twenty-six females and twenty-one males. Each student was solicited to take part in this study. Parents were asked to sign a consent form that gave their child permission to participate (Appendix B, Table B-I); in addition, the students were also asked to sign a consent form in order to participate (Appendix B, Table B-II). From an overall population of forty-seven students, thirty-three students returned parent and student consent forms. However, by the time the study was conducted one female student dropped out of the research study due to a long-term illness. The students solicited for this study represented a different population sample than that of the pilot study; however, both groups of students were representative of the same educational institution. The students for the pilot study attended eighth grade in 1998-1999. For the current study, the population of students attended eighth grade in 1999-2000.

Instrument Development

The structured framework of the pilot study focused on five motivational areas which included intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement. The concourse for the current Q study was determined from the same structured framework of the pilot study, current literature, and excerpts from oral interviews. The literature from the pilot study was combined with extensive interviews to expand and provide greater meaning to the concourse. The entire expanded population of statements was sampled to yield the current Q sample.

The thirty-two students consenting to participate in the current study were categorized by high ability, average ability, and low ability by the mathematics teacher.

For each participant, the mathematics teacher examined current student rankings in mathematics, reviewed past standardized test scores as well as past levels of achievement in mathematics, and looked at current achievement in mathematics to determine ability levels. Categorization by ability level was necessary in order to get a valid representation of all ability levels and genders during pre-sort oral interviews.

Of the twelve males participating, five represented high ability, five average ability, and two low ability. Of the twenty females participating, eight represented high ability, six average ability, and six low ability. In order to develop the Q sample, pre-sort interviews were conducted using randomly selected students from the population consenting to participate in the current Q study. Two students were randomly selected (one male and one female) from each ability level (high, average, and low) for oral pre-sort interviews resulting in a total of six students. The six students who were interviewed provided the researcher with the opportunity to obtain naturalistic statement about motivations in mathematics.

Interview guidelines incorporated the domains of the research project (Appendix C). One student was interviewed before school and five students were interviewed during a regularly scheduled forty-five minute block session. A block session is comparable to study hall. Students often work on the following day's homework and seek individualized assistance from teachers on assignments. By using a block session for research purposes, regularly scheduled classroom instruction and activities were uninterrupted.

Each pre-sort interview took approximately twenty minutes. Each naturalistic session was recorded, and the researcher noted salient information as the interview was conducted. All six students were asked twenty-one questions about mathematics.

Questions were structured from the theory driving the study. A sample of the questions students were asked include: “What do you like most about your math class? Explain.” “What do you hope to accomplish this year in math class? Explain.” “How do you study for a math test? Explain.” All twenty-one questions may be further examined in Appendix C.

Student interviews were completed in two weeks. Of the six interviews, one session that was recorded was not audible. The five audible interviews were transcribed by a professional secretary, and the Q statement items coming from the individual on the inaudible tape came from the researcher’s notes. In order to maintain student privacy during the interview session, the students were referred to as letters of the alphabet. Student identification ranged from A through F.

Q Sample

All possible raw data of the interviews are part of the concourse in Q methodology (Brown, 1993). From the six pre-sort interviews, approximately two hundred twenty statements emerged. Forty-five statements were selected by the researcher to develop the Q sample (Appendix D). Statements were selected using specific criteria. Selected statements represented stratified views that were guided by the theory; statements had to be non-redundant with high saliency. Statement items were selected to represent the language of the students and all ability levels. Additionally, some two-statement items that were similar in meaning were combined by the researcher to make a single relevant statement item. Statements were then categorized by the theory driving this study and examined to ensure all structured areas (intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement) were represented.

Statements were reexamined in the characteristic framework of the theory to confirm that one perspective was differentiated from another perspective.

Procedure

The drive of Q methodology for the current study was to discover the types of meaning the students were trying to convey through the Q sort. By the way each eighth grade student selected statements of importance or lack of importance, the participant had the opportunity to express meaningful, self-referent images from the specific motivational stimuli, a perception, or an understanding of motivational situations which reflect an attitude or point of view toward mathematics (Brown, 1980). With the Q sorting information, analysis of a particular participant or group of participants occurred.

Q sorting procedures were completed by the students in school during four block sessions. For the students to complete the Q sorting, approximately forty minutes was allotted for each session, and approximately eight students were in each group setting per session. One female student was not able to participate during one of the four block sessions; therefore, she completed her sort after school during a designated period of time.

Before the sorting session began, each student was assigned a number for identification purposes only. Numbers ranged from one to thirty-two. This ensured the identity of the student was protected, and the principle investigator was the only person with access to student identification numbers. Student identification was necessary since post-sort interviews were conducted.

During each session, the students were handed a large manila envelope that contained four items. Each envelope contained a set of Q statements, a form board, a sort record sheet, and a demographics sheet. The participants were asked to locate all four items. First, the students were asked to complete a demographics sheet and turn it over where the record sort sheet would be visible (demographics sheet and sort sheet were printed as a two-sided copy).

A demographic sheet was developed in order to solicit specific information about each student (Appendix E, Table E-I). The students were asked questions about age, gender, and current mathematics grade. The adolescents also answered questions as to whether or not they were an independent mathematics student, the amount of time spent at home doing mathematics homework and doing homework on the computer, and the number of hours, on average, spent watching television.

Next, students were asked to get the form board out and also count statements to ensure the correct number of statement items were present. Students sorted statement items under two conditions of instruction (Brown, 1997). During the first condition of instruction, the students were asked, "How do you perceive yourself in the mathematics classroom?"

Oral sorting instruction was given during each block session (Appendix F). The students began sorting by placing statements into three categories and by making three general piles. On the right of the form board in one pile, the student individually selected the statements that were most like him or her in mathematics. On the left of the form board, the participant made a second pile. In this pile, he or she put statements that were most unlike himself or herself in mathematics (Brown, 1997). The third pile was placed in between the right and the left pile. This pile represented neutrality statements or statements that had no meaning to the student.

Once each student completed the statement sorting, he or she picked up the statements that were most like him or her. Those statements were on the right side of the form board. Each participant selected two statements he or she believed to be most like himself or herself. One-by-one, the student placed those two statements on the form board in Column 1 in the boxes provided (Appendix E, Table E-II). The participant then moved to the left of the form board. The student selected two statements that were most unlike him or her, and place them one-by-one on the left of the form board in Column 11 in the boxes provided. The student continued this pattern (two most like/two most unlike, four most like/four most unlike, etc.) until he or she had placed all statements in the appropriate boxes on the form board that were most like and most unlike himself or herself. Lastly, the participant picked up the neutral statements. Those statements were located in the middle pile. He or she placed the Q statements on the form board accordingly by importance (to the right) or lack of importance (to the left). Truly neutral items were ideally placed down the center row of the form board. The final step in the Q sorting process was recording the results on sort sheet one (Appendix E, Table E-III). Each participant used his or her writing utensil to record the appropriate number that corresponded with the statement item on the form board and the box on sort sheet one.

The participant then cleared his or her form board and completed a second sort under new conditions of instruction. Each student was asked to sort statements as he or she previously did but to categorize the statements by the following instruction, "In what ways do you perceive the ideal math student?" The participant followed the same format for sorting as previously described in the first sort. Upon completion of the second sort, he or she again recorded the number that corresponded with the statements on the form board and the box on sort sheet two (Appendix E, E-III).

The sorting and recording of the results by the participant reflected the amount of importance of a statement item by its final placement on a form board (Brown, 1980). Once all statements were rank-ordered by the students, the array of statements are called a Q sort. Brown (1980) describes a Q sort as

> a miniature experiment, a literary maze through which the subject's attitude wanders, attaching itself to some items and rejecting others, the resulting scores for each person being subject to analysis. (p. 203)

Brown continues to describe a Q sort by saying,

> The major underlying dynamic of the Q sorting is psychological significance. Statements at the extremes of the distribution are most salient (significant) for a person operating under a specific condition of instruction; those toward the middle are relatively neutral. This is important conceptually for both phenomenological and statistical reasons. Phenomenologically, it matches the way most people appear to function: those things which are uncharacteristic of us are just as important, in a negative sense, as those that apply to us in a positive sense. (Brown, 1980, p. 198)

<u>Post-Sort Interviews</u>

Post-sort interviews were conducted after the final statistical report was generated and provided the investigator with the opportunity to clarify points that may have been vague. Post-sort interviews are the "skeleton of the subject's attitude" and also provides a "basis for a structured or focused interview" (p. 200). The interview may also test assumptions of the Q sorting procedure itself or may affirm the extreme and neutral item arrangement (Brown, 1980).

Seventeen students on the factor from which they loaded were selected to participate in the post-sort interview. The students whose sorts loaded the highest either positive or negative on each factor were interviewed. Naturalistic interviews were conducted during nine regular block sessions. Oral interviews took approximately ten to fifteen minutes, and each interview session followed an interview format (Appendix G). Students were identified by a letter of the alphabet (ranging from A through S) in order to maintain anonymity. Student responses were recorded and transcribed, and during the interview the researcher noted on the interview sheet the responses that tended to be most salient.

Data Analysis

Once Q sort data was obtained, it was then factored by a statistical computer program called PQ Method 2.06 (Schmolck, 1997) which is composed of several applications. The statistical procedures included principal components factor analysis, varimax rotation of the factors, calculation of z-scores, and array positions for each item of the rotated factors. Using PQ Method 2.06 (Schmolck, 1997), statements were entered into the computer. For this study, there were forty-five Q statements that the students sorted. Rank-ordered values were entered on the computer for each item from sort sheet one and two for individual students. Once all data was entered statistical procedures were conducted.

Principal components factor analysis first computed the correlation matrix and then computed the unrotated factor matrix file (Schmolck, 1997). Participant two was non-compliant resulting in the participant's two sorts being discarded; therefore, a 62 x 62 correlation matrix resulted from two conditions of instruction instead of a 64 x 64 correlation matrix. The correlation matrix represented a transitional stage between the raw measurement and factor analysis. The correlation matrix additionally provided a reference point for indicating which pairs or groups of Q sorts paralleled one another.

Factor analysis classified the variables; in this study, the variables were the participants performing the Q sorts (Brown, 1980; McKeown & Thomas, 1988). Factor analysis provided the researcher with information on how each participant in this study classified himself or herself in relation to motivational characteristics in mathematics. If the subject shared similar motivational views, he or she emerged into a natural grouping or factor. Factors were determined by significant loads on Q sorts, and the size of a factor was determined by the variables (students) that were in the study. The factor scores were associated with statements in Q methodology which are based on experimental principles and are grounded in the participant's subjective beliefs and human behaviors (Brown, 1980).

Varimax rotation of the factors takes the unrotated factor matrix file and rotates the number of factors requested by the researcher (Schmolck, 1997). For this study, three, four, and five factor final statistical reports were generated for interpretation. Factor loadings of significance were flagged with an *X* by the default in the statistical computer program. The statistical default computer program calculated significant loads if more than half of the common variance was explained by that factor and a loading was significant at the $p > .05$ level (Schmolck, 1997). Varimax is additionally a "way to maximize the saturation of reference variates on the factor with which it was associated" (McKeown & Thomas, 1988, p. 69). Varimax enhances orthogonality or bipolarity of factor loadings. "Q sorts will have high loadings on one factor with near-zero loading on the other(s)" (McKeown & Thomas, 1988, p. 52). Orthogonality determines a natural state of subjectivity in a common sort, and bipolarity uses that information to diagnose conflict with other sorts. The statistical information calculated by the computer's statistical default program provided the factor solutions, defining factors, and factor scores (Schmolck, 1997).

The four and five factor final statistical reports were rejected by the researcher. The correlation between factors revealed moderately high correlations among the fourth and fifth factors that were accounted for by factors one, two, and three. Final statistical reports for factors four and five did not strengthen or reveal a significant point of view that was not already explained by the three factor solution. Additionally, the four and five factor solutions were not significant, nor did the result explain variance or sorts that were accounted for with the additional factors. Furthermore, extending the factor solution to four or five factors increased the number of Q-sorts that loaded on more than one factor bringing about confounded or split loads. Therefore, the three factor solution provided the study with a statistically stronger factor for interpretation and explanation.

CHAPTER IV

RESULTS

The current study used Q methodology to describe the perceptions of eighth grade mathematics students.

The specific research questions to guide this study were:

1. What are the perceptions held by eighth grade students about their motivations in the mathematics classroom?
2. In what ways do eighth grade math students perceive themselves as differing from their perception of an ideal math student?

The structured theoretical framework of the motivational characteristics as described in Chapter II included intrinsic and extrinsic motivation, goal-orientations, self-regulation, self-efficacy, and parental involvement. The Q statements, referred to in Chapter III, that were sorted by the participants in this study were of hybrid origin and allowed the participants to express meaningful, self-referent images within the specific theoretical motivational framework of this study. Chapter IV describes the findings of the study. This chapter discusses the specific characteristics of the participants, gives a description of factors as revealed by computer generated factor analysis, and offers an interpretation of the factors in response to the research questions.

Description of Participants

Description of selected eighth grade mathematics students included gender, ability level, enrollment in independent mathematics (works through the current Algebra I text at own rate), age, current mathematics grade, hours spent each night doing mathematics homework, hours spent on computer doing homework, and hours spent each evening watching television. In Table I, demographics of gender, independent mathematics student, and ability level are provided and broken down into a male/female ratio. This study included thirty-one eighth grade mathematics students from a non-denominational, independent private school located in south central United States. Twelve males and nineteen females opted to participate in the current study.

TABLE I

DEMOGRAPHICS OF EIGHTH GRADE MATHEMATICS STUDENTS

Demographics	Male	Female	Total
Gender	12	19	31
Type of Mathematics Student			
Independent	7	9	16
Regular	5	10	15
Ability Level			
High Ability	5	9	14
Average Ability	5	4	9
Low Ability	2	6	8

Of the thirty-one participants, seven males and nine females reported participating in independent mathematics while five males and ten females participated in the regular mathematics class. To get a valid representation of all ability levels for both genders, the eighth grade mathematics teacher provided assistance. To determine ability level for each participant, the mathematics teacher examined current student rankings in mathematics, reviewed past standardized test scores, and past levels of achievement in mathematics, and looked at current achievement in mathematics. Ability levels ranged from high, average, to low ability. Five males and nine females represented high ability, five males and four females were of average ability, and two males and six females were identified as low ability.

The demographics of Table II depict age, current mathematics grade, average number of hours per evening: doing mathematics homework, completing homework on the computer, and watching television. Furthermore, information in Table II (math homework, completing homework on the computer, watching televison, and male/female ratio) is not used in the interpretation of the factors for this study. No trends or patterns were noticed by these characteristics of the mathematics students.

The students ranged in age from thirteen through fifteen years. Four males and six females were thirteen years of age, seven males and thirteen females were fourteen years of age, and one male was fifteen years of age. Current mathematics grade ranged from A through F. Nine participants reported having an A in mathematics (four males and five females), fourteen participants said they had a B in mathematics (five males and nine females), a total of seven participants recorded that they had a C in mathematics (two males and five females), and one male reported having an F in mathematics. On average, the male participants believed that they spent approximately two hours and female participants reported spending approximately one hour per evening completing

TABLE II

DEMOGRAPHICS OF EIGHTH GRADE MATHEMATICS STUDENTS

Demographic	Male	Female	Total
Age			
13	4	6	10
14	7	13	20
15	1	0	1
Current Math Grade			
A	4	5	9
B	5	9	14
C	2	5	7
D	0	0	0
F	1	0	1
Math Homework	2	1	-
Computer Homework	1.25	1	-
Television	1.25	1	-

mathematics homework. The male participants felt they spend on average one hour fifteen minutes and female participants reported spending an average of one hour doing research or homework on their computers at home each evening. Males averaged one hour fifteen minutes and females averaged one hour watching television at home per evening.

Description of Factors

The purpose of the first research question was to describe the perceptions held by eighth grade students about their motivations in the mathematics classroom. Under the two conditions of instruction, participants were asked to sort statements that were reflective of their perceptions of the actual self and the ideal student in the mathematics classroom. The three factor solutions that emerged were identified by significant factor loadings and interpreted by normalized factor z-scores (highest and lowest ranked statement items), distinguishing statement items (statement items that are the most different from the other factors), factor array positions (positions on the form board where the z-scores fall), and post-sort interviews. A frequency table (Table III) is included in order to display the Q sort continuum from the form board for the number of columns (1 through 11), Q sort distribution (statement items allocated during sorting process for each column), and array positions (positions on the form board where z-scores fall).

TABLE III

COLUMN NUMBER, STATEMENT FREQUENCY, AND ARRAY POSITIONS ON FORM BOARD

Column Number	11	10	9	8	7	6	5	4	3	2	1
Statement Frequency	2	2	4	5	6	7	6	5	4	2	2
Array Positions	-5	-4	-3	-2	-1	0	1	2	3	4	5

Each of the three factors provided information for interpretation on how each participant in this study classified himself or herself in relation to motivational characteristics in mathematics. The subjects who shared similar motivational views emerged into a natural grouping or factors (Table IV). Characteristics of the natural groupings were used to identify and name each factor. Factor One was representative of the Math Oriented Mathematics Student; Factor Two was characterized by Achievement Oriented Mathematics Student; and Factor Three was described as the Effort Oriented Mathematics Student.

TABLE IV

FACTOR MATRIX WITH AN X INDICATING THE DEFINING FACTOR

Subject	Factor 1	Factor 2	Factor 3
1MACTUAL	.1478	.5556X	-.0771
3FACTUAL	-.2515	.5361X	.3477
4MACTUAL	.4353X	.3059	.2817
5FACTUAL	-.0245	.1032	.2248
6MACTUAL	.4916X	.3187	.3596
7FACTUAL	.1514	.2202	.6964X
8MACTUAL	.5468X	.3951	.1776
9FACTUAL	.5795	.6007X	.1025
10FACTUAL	.1762	.6447X	.1474
11FACTUAL	.4406	.6093X	-.1326
12FACTUAL	-.5066	.5155	.3704
13FACTUAL	-.3763	-.1271	.4009X
14MACTUAL	-.6576X	-.1239	.2158
15MACTUAL	.2124	.7185X	-.0860
16FACTUAL	-.6989X	.2254	.3675

TABLE IV - Continued

Subject	Factor1	Factor 2	Factor 3
17MACTUAL	.6094X	.1384	.1329
18MACTUAL	.3928	.5624X	.1305
19MACTUAL	-.2949	.0470	.5513X
20FACTUAL	.1330	.1509	.4886X
21FACTUAL	.2371	-.0529	.4600X
22FACTUAL	.2987	.4631X	.1387
23FACTUAL	-.0884	.0765	.6656X
24FACTUAL	.1784	.4426	.4403
25MACTUAL	.3746	.4478	.2860
26MACTUAL	.3805	.5641X	.0321
27MACTUAL	-.3166	.8028X	-.1343
28FACTUAL	.6767X	.2668	.4362
29FACTUAL	.0694	-.1226	.6483X
30FACTUAL	.1512	.8113X	.1040
31FACTUAL	-.1820	-.0750	.7669X
32FACTUAL	.4589	.5615	.3623
1MIDEAL	.8387X	.0589	-.0360
3FIDEAL	.7587X	.1507	-.0521
4MIDEAL	.7330X	.1364	.2230
5FIDEAL	.3961X	.0242	-.1549
6MIDEAL	.7685X	.0020	.0425
7FIDEAL	.7919X	.2607	-.2557
8MIDEAL	.8406X	.2682	-.0244
9FIDEAL	.7489X	.3060	-.1867
10FIDEAL	.6718X	-.1397	.4066
11FIDEAL	.8236X	.3790	-.1099
12FIDEAL	.8414X	.2333	-.1673
13FIDEAL	.6334X	.0597	.0462
14MIDEAL	.6856X	.1997	.1139
15MIDEAL	.8686X	.0472	.1692
16FIDEAL	.8587X	.1184	-.1196
17MIDEAL	.8610X	.1680	-.0403
18MIDEAL	.8194X	.1737	.0865

TABLE IV - Continued

Subject	Factor1	Factor 2	Factor 3
19MIDEAL	.2515	.1246	-.1345
20FIDEAL	.6427X	.1576	.2999
21FIDEAL	.8109X	.1943	-.0888
22FIDEAL	.7514X	.3407	.1644
23FIDEAL	.7317X	.1439	-.0386
24FIDEAL	.7191X	.2898	-.0146
25MIDEAL	.7471X	.2828	.1600
26MIDEAL	.8406X	.1507	.0182
27MIDEAL	.7668X	.2334	-.0419
28FIDEAL	.8036X	.1262	.3858
29FIDEAL	.7296X	-.1464	.0865
30FIDEAL	.6711X	.3584	.2256
31FIDEAL	.8183X	.2134	.1458
32FIDEAL	.8246X	.2419	-.0778

Note: X is determined at the .05 level of significance

Factor One: Math Oriented Mathematics Student

The Q sorts of seven students for the first condition of instruction of the actual self loaded on Factor One which included five males and two females; however, of the seven students, one male and one female had negative loadings. Of the seven students loading on Factor One, two students were of high ability, three average ability, and two low ability. Three students were independent math students, and four students were in the regular math class. All Q sorts (30 students) for the second condition of instruction of the ideal self loaded on Factor One: Math Oriented Mathematics Student which included eleven males and nineteen females.

The Math Oriented Mathematics Student tends to mobilize a variety of motivational strategies to learn and understand the processes of mathematics. This type of student enjoys mathematics and realizes much effort is required; therefore, a level of perseverence is maintained for studying and doing homework.

Interpretations from the common beliefs the students held were extracted from post-sort interviews and rank statements of normalized factor z-scores for each of the three factors (Appendix H). The statements that were most like the adolescents' beliefs were placed in the Column 1 on the right side of the form board, and statements that were most unlike the adolescents' beliefs were placed in the Column 11 on the left side of the form board for each of the three factors. For Factor One, Appendix H, Tables H-I, H-II, and H-VII show z-scores for all forty-five statements, arrangement of statement items on the form board, and array positions. Table V identifies the five rank ordered statements for Factor One: Math Oriented Mathematics Student in three areas. The table categorizes statements that were most like, the five rank ordered statements that were most unlike, and the five distinguishing statement items which are further supported by z-scores and array positions for each statement item. The five distinguishing statements represent statement items that are the most different from the other factors.

TABLE V

FACTOR ONE: MATH ORIENTED MATHEMATICS STUDENT

Statement Number	Statement	Z-Score	Array Position
Five Highest Ranked Statements			
4	I like math.	1.736	+5
33	I try to work as hard as I can in math.	1.281	+5
20	I really concentrate on making good . . .	1.243	+4
11	I like math because it makes me think.	1.205	+4
23	I will take a good deal of math in . . .	1.134	+3
Five Lowest Ranked Statements			
16	I will take the least amount of math . . .	-1.984	-5
26	Math is the same problems over . . .	-1.775	-5
35	I struggle at taking tests in math.	-1.597	-4
24	I put forth only as much effort that I . . .	-1.539	-4
40	Math has too many rules about . . .	-1.530	-3
Most Distinguishing Statements			
4	I like math.	1.74	+5
20	I really concentrate on making good . . .	1.24	+4
11	I like math because it makes me think.	1.20	+4
23	I will take a good deal of math in . . .	1.13	+3
39	Math is one of the easier subjects . . .	1.04	+3

Student L (high ability, male, independent math student, actual loading on Factor One) supported the actual and ideal beliefs held by the Math Oriented Student by stating, "I try to work hard in math. I have to work really hard to teach myself algebra." Student

L responded to the amount of time he spends doing homework and studying for tests by replying, "I work hard on the weekend. I try to devote a whole morning on a Saturday doing math homework, and then I study really hard for tests."

Student S (high ability, female, independent math student, actual loading on Factor One) further validated the actual and ideal beliefs of Factor One. She stated, "I like math. It's easy for me to do. And I like science, and math has to do a lot with that."

The Math Oriented Student is perceived as self-efficacious and employs intrinsic motivational orientations, mastery and performance goals, and self-regulation strategies for learning. The Math Oriented Student values mathematics and finds it personally challenging. The Math Oriented Student sets short-term and long-term goals. The view of and perceptions of this student type recognizes that one must have a direction and reason for learning. For the Math Oriented Student, performance orientations in learning situations are guided by effort in the obtaining of knowledge and understanding of mathematics. The Math Oriented Student has linked mathematics with the real world and has recognized the many applications of mathematics to the future.

Student S (high ability, female, independent math student, actual loading on Factor One) responded to the importance of mathematics by stating, "I don't think grades matter as much as understanding math and I know what I'm doing." She also reported, "Next year, I hope to get to geometry. In the future, I hope it'll help me some and actually help me in what I choose to do."

This view point is additionally supported by the following positively ranked statements on the form board with array positions and z-scores (Appendix H, Table H-II & H-VII).

- 22. I want to complete the whole book by the end of the year so I can take more math in high school. (array position, +3; z-score, 0.982)

- 19. I want to get better at math this year. (array position, +2; z-score, 0.931)

- 13. I try to understand the purpose and procedure so I can go further in math. (array position, +2; z-score, 0.961)

- 12. The formulas in math help me build a foundation of what most of life is based on. (array position, +2; z-score, 0.926)

- 15. Math is one subject I can use in almost all my classes and it can be used in so many fields. (array position, +1; z-score 0.721)

Student L (high ability, male, independent math student, actual loading on Factor One) furthermore clarified the actual and ideal beliefs held by the Math Oriented Student. Student L stated, "In high school, I will probably take four years of math." Student L was asked about the importance of math in his life. He replied, "It is pretty important. I know that I'll be using it later on in life no matter what profession I choose." He continued by saying, "I try to really make good grades in math and understand it."

The Math Oriented Student has high perceived capabilities. This student holds high levels of confidence about his or her abilities in mathematics, and the activation of short-term and long-term goals are characterized by the strategies he or she uses. These strategies allow the Math Oriented Student to maintain control of academic achievements by persisting, regulating, and pursuing learning when faced with difficulties. Agreement on the positively ranked statements with array positions and z-scores further validate the actual and ideal beliefs held by the Math Oriented Student.

- 39. Math is one of the easier subjects for me. (+3, 1.038)

- 36. I feel good when I do well in math, but I expect it. (+1, 0.650)

- 31. When I am working on a difficult math problem, I try to do two or three different ways and make sure that I get the same answer no matter how I set it up. (+2, 0.766)

- 32. When I look at the answer to a math problem, I make sure it makes sense and it sounds reasonable. (+1, 0.712)

Student L (high ability, male, independent math student, actual loading on Factor One) described what he focuses on the most in order to solve challenging problems. He stated, "If it is a word problem, I'll focus on certain key words to help me out. Or if it's like a problem, I'll try to refer back to some ideas I've already learned."

Student S (high ability, female, independent math student, actual loading on Factor One) felt that math was challenging and in order to solve difficult problems she responded by saying, "Well, I try to apply it to a real situation or something. That makes it sound easier so it is easy to figure out."

For the Math Oriented Student, parental involvement was not a significant motivator in mathematics. Placement of neutral or negative statement items, array positions, z-scores, and post-sort interviews clarified the actual and ideal perceptions held by the Math Oriented Student.

- 41. My parents say very little to me about what they expect of me in math. (-1, -0.682)

- 42. My dad and/or mom expects a lot out of me in math. (0, -0.066)

- 43. My dad and mom know that I am capable because they have seen how well I have done on past tests and in past grades. (0, -0.293)

- 44. My dad or mom usually helps me at home on math when I need it. (-1, -0.482)

Students who loaded on Factor One: Math Oriented Mathematics Student were questioned about parental expectations and how their parents help them in math. Both students interviewed responded in a similar manner. Student L (high ability, male, independent math student, actual loading on Factor One) elaborated by stating, "My parents don't expect me to make perfect scores in math or even an 'A' in math every time." Student L described how his parents help him in math by saying,

> My parents don't necessarily help me with the homework part but help me with certain concepts I'm having trouble understanding. They will help me study them so that I can understand before the test. And they might help make a pre-test. It's hard to make a test for yourself and be unbiased.

Student S (high ability, female, independent math student, actual loading on Factor One) believed parental expectations were communicated to her in the following manner. "They don't say they expect much. They just expect me to get my work done and try and understand," she replied. The researcher then asked her if her parents expected "A's" from her in math. She stated, "It's not grade-wise, it's whether or not I'm understanding." When asked how her parents helped her in math she said, "My mom and dad will help if I am having trouble with a problem, but they don't have to help me a lot. They'll help me if I ask them."

In an opposite view of mathematics, two students (one male and one female) negatively loaded on Factor One: Math Oriented Mathematics Student. Both students were identified as low ability and neither participated in independent math.

The Math Oriented Student with negative factor loadings does not take an interest in mathematics. This student type approaches mathematics quite differently than his or her counterparts. The negative factor loading Math Oriented Student sees mathematics as repetitious and not intrinsically challenging, and problem solving is not enjoyable. This student avoids mathematics by putting forth little effort. The goals the negative factor loading Math Oriented Student has set in mathematics tends to be non-existent (Table IV).

Student E (low ability, male, regular math student, actual loading on Factor One) supported the negative loading views of the Math Oriented Student by stating, "I don't like math. I don't do well with numbers." He also articulated, "I like addition. It is the easiest part of math."

Student D (low ability, female, regular math student, actual loading on Factor One) stated, "I really don't like math that much. I don't really try my hardest and I don't do that good." Student D was asked what tasks she found interesting in math. Student D replied by saying, "I'd have to say probably the simple problems. Those are the ones that are easiest to figure out." She was also asked to describe the importance of math. Student D said, "Math is not incredibly important. I mean, I think it's important to add and subtract and multiply, but the stuff we're doing right now I just don't think I'll ever use it."

The Math Oriented Student with negative loadings reported not having positive emotions toward mathematics. This student relies heavily on extrinsic rewards for achievement purposes. The actual beliefs of this type of student are supported by the following negative statement items, array positions, and z-scores.

- 34. When I do well on a math test, I get excited and surprised. (-2, -0.872)
- 6. I would like to receive money for good grades in math. (-3, -1.111)
- 7. As a reward for making good grades in math, I don't get grounded. (-3, -1.151)

- 8. I want more privileges from my parents as a reward for good grades in math. I want to do more things and have more space. (-2, -0.905)

Student E (low ability, male, regular math student, actual loading on Factor One) continued his interview by saying, "I expect to do poorly in math. I am not at all surprised by a bad grade on a test." He believed he would like a reward for good grades and stated, "Money is always useful and I can spend it."

The Math Oriented negative loading student continues on his or her quest to academically achieve by employing strategies for learning at the surface-level. This student type tends to use memorization techniques and ineffective strategies to obtain knowledge. As a result, the self-regulation strategies used in order to academically achieve causes this student type to fall behind in the learning process.

- 40. Math has too many rules about numbers and I can't always remember them. (-3, -1.530)
- 30. I rely on my calculator as much as possible when I get to a hard math problem. (-2, -1.105)
- 29. When I am working on a hard math problem, I guess and check. (-1, -0.511)

The negative loading students' post-sort interviews further confirmed the perceptions and beliefs held toward mathematics. Student D (low ability, female, regular math student, actual loading on Factor One) responded to solving hard math problems by saying, "I work the problem backwards. I usually work with the answer and pick numbers out and try to work the problem."

Further interview data highlights the support of the ideal math student who is viewed as Factor One: Math Oriented Mathematics Student. Students viewing Factor One: Math Oriented Mathematics Student as the ideal image loaded on one of the three factors for the actual self or had split or confounded loads. Students from other factors who loaded on Factor One with an ideal student image were interviewed in order to further examine placement of Q sort statements for Factor One: Math Oriented Mathematics Student to gain a better understanding of this type of image. Findings suggest that the thirty students viewing Factor One: Math Oriented Mathematics Student strongly acknowledged the fundamental characteristics of the ideal math student image.

When asked to describe and give characteristics of the ideal math student, Student P (high ability, male, independent math student, actual loading on Factor Two) described the ideal image (Factor One: Math Oriented Mathematics Student) by saying,

> The ideal math student is someone who always gets good grades, usually above 95, and they always work really hard. When they get home, math may not be the first thing they do but they always make sure to get it done. They always do maybe just a little bit extra so that they can get ahead.

Student Q was asked to name five characteristics of the ideal math student. She (average ability, female, regular math student, actual loading on Factor Three) replied by saying, "They have to be smart and have to devote their time to math. They have to like math and think it is interesting. They would also have to have a basic understanding of math." Student N (average ability, female, regular math student, actual loading on Factor Two) replied,

> They try. Always, like. . . to do their best. They don't stop if they don't get it. They keep on trying to learn. They ask for help from the teacher if they need it and they study for tests. They never, never turn in an incomplete assignment. And they get good grades in math.

The placement of statement items on Q sorts furthermore communicated that future goals tend to be an important motive for obtaining knowledge. Visualizing the self in the future and the importance of taking more math in high school was perceived as a characteristic of the ideal math student (Factor One: Math Oriented Mathematics Student) and was further validated by the views of Student M.

Student M (average ability, male, regular math student, actual loading on Factor One) felt the ideal math student would continue math education in high school by stating, "The ideal math student would take honors, just like a high algebra, Algebra II instead of Algebra I. They would also take as much math as possible. If they can do well in math, I think that it's a big factor in their life."

Enjoying challenging math tasks is believed to be a must for the ideal math student (Factor One: Math Oriented Mathematics Student). The ideal math student wants to be stimulated and aroused by difficult math problems. The perceptions of students indicate the ideal math student has an intrinsic desire to learn.

Student Q (average ability, female, regular math student, actual loading on Factor Three) believed the ideal math student would be stimulated in math by saying, "Twister problems. They involve more creative thinking and they are harder than any other math task we do in class." (Twister problems require the learner to use higher level thinking strategies and involve making connections and applying previous learned mathematics skills.) Student N (average ability, female, regular math student, actual loading on Factor Two) stated, "Complicated problem solving. Because then they think about it and apply what they know to solve problems in actual situations. And it's sort of challenging."

To clarify the placement of the highest ranked statement items on the Q sorts, students were asked,

> Which statement do you think would be more like or more important to the ideal math student (perceived as Factor One: Math Oriented Mathematics Student)? 1. I like math because it makes me think. 2. I will take a good deal of math in high school. 3. I really concentrate on making good grades in math. 4. I like math. 5. I try to work as hard as I can in math.

Student P (high ability, male, independent math student, actual loading on Factor Two) immediately replied,

> Probably just I like math. Or I like math because it makes me think. It's not as much as they get math done just because they think it's a hassle or something. They really like it and that's one of those things that they don't do because it is assigned by the teacher or the teacher says to do it. They do math because they want to.

Student O (low ability, female, regular math student, actual negative load on Factor One) said, "Statement 4. I like math. No matter what you do, you have to like what you do best and so you should like math."

Students were asked to respond to the amount of effort the ideal math student (Factor One: Math Oriented Mathematics Student) expends in mathematics. Student P (high ability, male, independent math student, actual loading on Factor Two) responded by saying, "Well, they probably don't have much interaction with everybody else. They sit there and do as much math as they can possibly get in, in the time they have." Student Q (average ability, female, regular math student, actual loading on Factor Three) perceived effort by replying, "Probably very hard. They like doing their math homework and they ask questions. They make sure they understand everything."

Students in the current study perceived the ideal math student (Factor One: Math Oriented Mathematics Student) as being self-efficacious. The ideal math student was believed to be aware of his or her abilities in mathematics and recognizes that he or she is highly capable of doing well.

Student O (low achieving, female, regular math student, actual loading on Factor Three) addressed the beliefs about abilities of the ideal math student by stating, "They probably think they were smart and they did very well in math. They should probably go on with math later in life. They have every reason to because they are confident." Student R (high ability, female, independent math student, no load on actual self) simply said, "I would say they think they are pretty good at math." Student M (average ability, male, regular math student, actual loading on Factor One) summed up his beliefs by saying,

> I guess they feel pretty good about their abilities because they know they can strive to do well in class and they know they can do well. So I mean they work as hard as possible. They know they're capable of doing all the work that they're given.

The researcher asked the students who were interviewed how they saw themselves in comparison to the ideal math student. Student R (high ability, female, independent math student, no load on actual self) stated, "Sometimes, I'm kind of ideal but lots of times I don't take math as seriously as I think the ideal math student would." Student P (high ability, male, independent math student, actual loading on Factor Two) responded by saying,

> Well, when I sit down to do math, I usually get distracted. That's one of the differences. I do like math but it's not because it makes me think. Math's fun and all but it's not something that I would do on a regular basis and that I would love trying to get ahead in as much as I can.

Student O (low ability, female, regular math student, actual negative load on Factor One) responded to the comparison and said,

> I'm nothing like the ideal math student. But I think when I try my hardest I think I'm just as equal as they are when I try my hardest in math. I do have confidence just not really in math. When I do well, I want to keep the good thing going, you know. They'll probably wind up pursuing math.

Student Q (average ability, female, regular math student, actual loading on Factor Three) explained, "I think that I don't try as hard as I could and I don't ask as many questions sometimes. And I focus more on getting the answers than understanding." Finally Student M (average ability, male, regular math student, actual loading on Factor One) responded by saying,

> I like math and stuff; I like to try to get good grades; I try to do as well as possible; but, sometimes I might not be able to put as much work as I want in to it. I sometimes kind of get overwhelmed in work if I have to be somewhere. I might have a game or something like that. Then I have to get history homework done and that's like two or three pages. So, by the time I get finished with that I might have to go to bed and I'm not able to finish.

<u>Factor Two: Achievement Oriented Mathematics Student</u>

Of the actual self, eleven students viewed Factor Two as the defining factor that represented their points of view. Five male and six females loaded on this factor; eight students were of high ability and three represented average ability. Five students were thirteen years of age and six were fourteen years of age. Nine students were currently enrolled in independent math and two participated in the regular mathematics classroom. No ideal perceptions were represented by this view.

Factor Two students were identified as the Achievement Oriented Mathematics Student. This student type employs many different motivational strategies but tends to do so for achievement purposes. The Achievement Oriented Student too has set high goals in mathematics and feels the challenge to achieve; however, this student's performance is directed by external motivators or controls which appear to by influenced by parental expectations, peers, and high school class choice. The Achievement Oriented Student does not report spending a lot of time studying or putting forth much effort studying, and this student type believes many math tasks are pointless.

The following table (Table VI) charts statement items, z-scores, and array positions for Factor Two: Achievement Oriented Mathematics Student. Statements are ordered by the five highest ranked statements that are most like the participants, the five lowest ranked statements that are most unlike the participants, and the most distinguishing statements.

Student A, a high ability, male, fourteen year old, independent mathematics student, further supported the views held by students loading on the Performance Oriented factor by saying, "I feel proud of myself when I do well on a math test. I sometimes don't study, and I get a good grade. It makes me feel really good about it." Other times, he continued by stating, "If I do poorly on a math test, I don't feel very well. I feel more like I've let myself down, let my parents down, my dad especially, in not doing well." The same student was also questioned about what he wanted to accomplish in mathematics this year. He responded by saying,

> I feel that if I can complete the whole book then I might be able to go to geometry in high school. My parents say that geometry might be a little advanced, but I think if I complete this whole book then I will at least get into honors algebra, maybe not geometry.

TABLE VI

FACTOR TWO: ACHIEVEMENT ORIENTED
MATHEMATICS STUDENT

Statement Number	Statement	Z-Score	Array Position
Five Highest Ranked Statements			
23	I will take a good deal of math . . .	1.845	+5
42	My dad and/or mom expects a lot . . .	1.717	+5
39	Math is one of the easier subjects for me.	1.713	+4
22	I want to complete the whole book . . .	1.499	+4
43	My dad and mom know that I am . . .	1.477	+3
Five Lowest Ranked Statements			
9	I receive money for good grades in math.	-2.000	-5
16	I will take the least amount of math . . .	-1.772	-5
25	I spend a lot of time studying for tests . . .	-1.746	-4
1	In engineering, the math things we do . . .	-1.624	-4
44	My dad and mom usually help me at home . . .	-1.278	-3
Most Distinguishing Statements			
23	I will take a good deal of math in high school	1.84	+5
42	My dad and/or mom expects a lot out . . .	1.72	+5
39	Math is one of the easier subjects for me.	1.71	+4
22	I want to complete the whole book by . . .	1.50	+4
43	My dad and mom know that I am capable . . .	1.48	+3

In an interview with Student B, a high ability, female, thirteen year old, independent mathematics student, the researcher asked what she least liked about mathematics. She replied, “I least like the homework. I don’t enjoy having to write out all of the steps. I just want to get it over with and get the answer and make sure that I'm knowing what I'm doing." When questioned about what her parents expected of her in mathematics, she stated,

> They always are proud of me and usually when I get good grades they put money in my bank account so that I'll have it later. They usually don't talk to me about my grades. They're just like, good job, you got straight A's, we're proud, we knew you could.

Student B was also asked about her goals in mathematics this year. She explained,

> I want to finish the book so I can go on to geometry next year. All my friends that are freshmen now, they'll be in geometry next year and I want to be in geometry with them. Plus, I want to get done with calculus before I go to college.

The researcher continued by asking her if she felt as if she should receive money as a reward for her grades. She stated,

> Not really because I think that you shouldn't do things just for money. You should take pride in that you're smart and that you can do stuff and that you work hard for you.

Student H (high ability, female, independent math student) continued to support and confirmed the beliefs of the Achievement Oriented Student by stating, "Well, I work hard enough so that I get the stuff that I'm required to get done completed but not any harder." She was asked how important her grades were to her in mathematics. She replied, "It's very important because my parents expect it of me. They expect me to get high grades."

The Achievement Oriented Student tends to be highly self-efficacious but in a cautious, unsure manner. This student type feels the need for internal positive strokes yet tends to possess an element of surprise for doing well. Post-sort interviews and array positions of statement items revealed the surprise for doing well was linked to spending little time on studying for tests and quizzes. The Achievement Oriented Student's actual perceived beliefs are representative of the placement of statement items, array positions, and z-scores (Appendix H, Tables H-IV, & H-II).

- 38. I like the good feeling I get from being able to figure out math problems that seem kind of hard. (+3, 1.026)
- 37. When I do well on a math test, I feel proud. (+2, 0.705)
- 36. I feel good when I do well in math, but I expect it. (+2, 0.846)
- 34. When I do well on a math test, I get excited and surprised. (+1, 0.294)
- 25. I spend a lot of time studying for tests and quizzes in math. (-4, -1.746)

Student B (high ability, female, thirteen year old, independent math student) was asked how she feels when she does poorly on a math test. She responded and said,

> Well, I usually don't do that poorly on math tests. I don't very often go into anything unprepared and usually if I do poorly it is okay. I keep everything else high enough so that it will even out. It may drop my grade a little bit but hopefully not enough that it hurts me. I understand math pretty well, and I am good at it.

The Achievement Oriented Student has demonstrated his or her capabilities by opting to participate in independent mathematics. This student type makes up a large percentage of the high and average ability students. The Achievement Oriented Student does tend to regulate his or her learning. The Achievement Oriented Student understands the importance of mathematics and likes mathematics but to a lesser degree than the Math Oriented Student as represented by statement items with array positions and z-scores.

- 28. If I am paying attention, I can get most of my math homework done in class. (+3, 1.084)
- 19. I want to get better at math this year. (+2, 0.894)

- 2. Math is pretty important (+2, 0.844)
- 4. I like math. (+2, 0.679)

Student A (male, fourteen year old, independent student) was also asked about the amount of time he spends on math, what he tries to understand when working a math problem, and the effort he expends in math class. He replied by stating, "I spend an hour and thirty minutes working on math each day." "Well," he continued,

> I don't try to understand the purpose, but I do try to understand the procedure . . . I think that the procedure may be used in later years, just more advanced. So I think it's good to know the procedure so that you can know how to expand on it.

Additionally, student B (female, thirteen year old, independent student) was questioned about her goals in math and the importance of math. She responded,

> Math is important. I really think of everything as what I do now is going to affect what I do in the future. If I don't do good now, the high school's going to see it. I'm not going to get into good classes in high school so I'm not going to get in good classes in college so I won't get a good job.

The Math Oriented Student and the Achievement Oriented Student use a variety of motivators and goal directed strategies in obtaining knowledge. Both groups generally agree and believe that math is important and is one of their easier subjects; due to ease of learning mathematics for the Math and Achievement Oriented Student, both groups felt that they would take more mathematics in high school.

Unlike the Math Oriented Student, the Achievement Oriented Student is more focused on the external, performance motivator of making good grades. The Achievement Oriented Student is strongly externally influenced and motivated by the expectations of parents, peers, grades, and being academically placed in higher level mathematics classes in high school. Parents and friends tend to be the driving force behind the desire to excel in mathematics and complete the Algebra I text by the end of the year.

The Achievement Oriented Student does not have an inherent love or intrinsic enjoyment for mathematics. This student type is not intrigued by the concept that "Math makes me think." As Student A stated, he really didn't focus on the purpose of mathematics, and Student B replied she really disliked the homework and showing procedural steps. Unlike the Achievement Oriented Student, the Math Oriented Student tends to be learning for the sake of learning. Statements such as, "In engineering the math things we do are interesting." or "I like the story problems. They make math more meaningful." were positive loads in the array positions for the Math Oriented Student but negative loads in the array positions for the Achievement Oriented Student (Appendix H, Table H-VII).

The Math Oriented and Achievement Oriented Students have many similar beliefs in the way they view themselves in mathematics. However, the motivational strategies both student types mobilize and the focus or reasons for activation of the strategies cause them to engage in learning and academically achieve through different methods. They tend to view the learning process in two different manners, and the beliefs they hold toward learning may affect their future successes in mathematics.

Factor Three: Effort Oriented Mathematics Student

Of the actual perceptions, eight students loaded on Factor Three. Of those adolescents, one male and seven females identified Factor Three as the factor that represented their beliefs about mathematics. One student was of high ability, two students represented average ability, and five students were of low ability. Ages ranged from thirteen to fifteen; one student was thirteen, six students were fourteen, and one student was fifteen. Seven students were representative of the regular classroom and one student participated in independent mathematics. No ideal perceptions were represented by this view.

Factor Three students were identified as the Effort Oriented Mathematics Student. In general, these adolescents represent a group of individuals that struggles with mathematics. The self-efficacious feelings the Effort Oriented Student receives is due to unexpected performance accomplishments. This student type highly rated feelings of pride and excitement when doing well in mathematics. The Effort Oriented Student works hard and wants to improve his or her math skills and mainly draw upon self-regulatory techniques to maintain a level of competency in order to persevere in the mathematics classroom (Table VII).

In Table VII, statements that are most like, most unlike, and most distinguishing are represented for Factor Three: Effort Oriented Mathematics Student. All forty-five z-scores, placement of statement items on the form board, and array positions for Factor Three may be examined in Appendix H, Tables H-V, H-VI, and H-VII.

TABLE VII

FACTOR THREE: EFFORT ORIENTED
MATHEMATICS STUDENT

Statement Number	Statement	Z-Score	Array Positions
Five Highest Ranked Statements			
37	When I do well on a math test, I feel . . .	2.183	+5
19	I want to get better at math this year.	1.926	+5
27	When I am working on a hard math . . .	1.684	+4
34	When I do well on a math test, I get . . .	1.549	+4
33	I try to work as hard as I can in math.	1.500	+3
Five Lowest Ranked Statements			
9	I receive money for good grades in math.	-1.833	-5
39	Math is one of the easier subjects for me.	-1.741	-5
36	I feel good when I do well in math, but . .	-1.603	-4
31	When I am working on a difficult math . . .	-1.417	-4
22	I want to complete the whole book by . . .	-1.163	-3
Most Distinguishing Statements			
37	When I do well on a math test, I feel . . .	2.18	+5
19	I want to get better at math this year.	1.93	+5
27	When I am working on a hard math . . .	1.68	+4
34	When I do well on a math test, I get . . .	1.55	+4
17	I compare grades in math but I don't . . .	.92	+3

Student F, a female, fourteen year old, regular math student, supports the actual beliefs held by participants loading on Factor Three. She responded to doing well in mathematics by saying, "Well, I feel good about myself, and I feel like I can really actually do my work." She was also asked if she did poorly on a math test how she felt. "I feel disappointed but I know that I can help myself to understand better," she replied.

Student I (average ability, female, regular math student) responded to her feelings about mathematics by saying, "I like math. I like to solve problems, I work hard, and I try to do my best."

The Effort Oriented Student does not tend to spent much time on reflection in respect to goal obtainment in mathematics. This perception is addressed on Table VII for statement 22; however, other statements items, array positions, z-scores, and post-sort interviews tend to also support the lack of goal orientations for the Effort Oriented Student (Appendix H, Tables VI & VII).

- 23. I will take a good deal of math in high school. (-2, -0.885)
- 12. The formulas in math help me build a foundation of what most of life is based on. (-3, -1.017)

When asked to expand on what her future holds in math, Student K (high ability, female, independent math student) stated, "It's just there. I don't know. I've never thought about that. I want to stick with math, but I don't want it to be really, really frustrating."

Unsure of her future endeavors in high school, Student I (average ability, female, regular math student) hesitantly replied, "I guess, as far as I can. I guess I'll try four years but I am not sure."

The Effort Oriented Student does perhaps have good intentions and is conscious of learning and regulation techniques necessary in achievement situations. Grade comparison is used to compare one's level of achievement against others in order to make self-assessments. These actual views are further validated by the statement items, array positions, and z-scores.

- 28. If I am paying attention, I can get most of my homework done in class. (+3, 1.350)
- 32. When I look at the answer to a math problem, I make sure it makes sense and it sounds reasonable. (+2, 0.790)
- 44. My dad or mom usually helps me at home on math when I need it. (+2, 0.789)
- 13. I try to understand the purpose and procedure so I can go further in math. (+2, 0.720)
- 17. I compare grades in math, but I don't try to boast about doing well. (+3, 0.922)

Student F (low ability, female, regular math student) supported the placement of the statement items for the actual self when asked about the strategies she uses in solving a hard math problem. She responded, "I try to remember the material and go back to where the teacher was talking about it and I can usually remember it that way." She continued by stating, "I ask my dad and he will guide me through what to do. He'll look back at the beginning of the chapter and kind of go over the other material, so that helps me."

Student J (low ability, female, regular math student) had similar perceptions and beliefs as other students loading on Factor Three about strategies used in mathematics. When asked how she solves a hard math problem she replied,

> I usually try to do the problem different ways. I get a piece of paper and start thinking about one way I could do the problem and think about a different way. Then if I get two different answers, I try to figure out another way to do it and see if the answers match.

She was also asked how her parents help her study or do homework. She stated,

> My mom's an accountant so she works with math all the time. If I did a problem and I wasn't sure if it was right, she'd tell me it wasn't right and tell me how I could do it. She wouldn't tell me the answer or anything. She would guide me through it.

When challenged, the Effort Oriented learners' regulatory techniques do tend to falter. Additionally, self-efficacy levels drop and levels of competence and perseverance begin to decline which is supported by array positions and z-scores of statement items.

- 40. Math has too many rules about numbers, and I can't always remember them. (+1, 0.719)
- 30. I rely on my calculator as much as possible when I get to a hard math problem. (+1, 0.336)
- 26. Math is the same problems over and over and over. I sometimes slack off. (+1, 0.324)

Student F (female, fourteen year old, regular math student) responded when challenged in math by saying, "Sometimes, I don't get it and I'm just out there. Then, I don't like math. There are also so many rules about numbers that I can't always remember them. Then, if I can't do a problem, I skip it because I don't know what I am doing."

Student H (average ability, female, regular math student) responded by saying, "Math is challenging. When I get to a hard problem, I guess and check, and I have trouble memorizing certain formulas I need."

Student J (low ability, female, regular math student) elaborated on the challenges and struggles she faces in mathematics. She explained,

> It is difficult for me to understand how all the numbers fit together in math, and there's so many different rules and regulations about math that it's hard to remember all of it. I have trouble figuring things out. Math is not at all easy for me.

The Effort Oriented Mathematics Student has some similar characteristics but largely differs in many areas from the Math Oriented Mathematics Student and Performance Oriented Mathematics Student. All participants loading on all three factors shared the intrinsic belief of the importance of math, the need to understand math for mastery purposes, and the necessity to better their knowledge of math. In this respect, all participants value mathematics and acknowledge a level of significance for the understanding of mathematical processes, as reflected in statements 2, 13, and 19 (array positions and z-scores for Factors 1, 2, and 3, respectively - Appendix H, Table VII).

- 2. Math is pretty important. (+2, 0.923; +2, 0.844; +1, 0.265)
- 13. I try to understand the purpose and procedure so I can go further in math. (+2, 0.961; +1, 0.473; +2, 0.720)
- 19. I want to get better at math this year. (+2, 0.931; +2, 0.894; +5, 1.926)

Additionally, for the Effort Oriented Student (Factor Three), statement 19 represented a stronger, more compelling need for improving in mathematics. While the Effort Oriented Student does put forth much energy to excel in mathematics, this student type does tend to struggle and finds mathematics, in general, more academically challenging than the Math Oriented or Achievement Oriented Student. Therefore, the Effort Oriented Student believes one has more room for improvement.

For the overall population from which the participants loaded, parents do not tend to give their children monetary rewards for doing well nor do they punish them for doing poorly. Parents evidently recognize their children's capabilities and have an understanding of the negative affects of extrinsic motivators such as money or punishment. Students participating in post-sort interviews did, however, remark that their parents often said, "good job" or "we are proud of you." The students did perceive verbal support or praise as being a form of a reward. Placement of statement items, array positions, and z-scores support the actual beliefs of all three factors and ideal beliefs for Factor One: Math Oriented Mathematics Student.

- 9. I receive money for good grades in math. (-3, -1.272; -5, -2.000; -5, -1.833)
- 7. As a reward for making good grades in math, I don't get grounded. (-3, -1.515; -1, -0.479; -1, -0.445)

The Math Oriented and Achievement Oriented Students enjoy and have a general liking for mathematics. Both groups see mathematics as one of their easier subjects, and they have overall high expectations for doing well. The Effort Oriented Student opposes the views held by the Math and Achievement Oriented Student about mathematics. The Effort Oriented Student does not tend to view the actual self as high achieving. Math tends to be a difficult and highly complex subject, and the Effort Oriented Student type does not hold an intrinsic enjoyment for math. The Effort Oriented Student's self-efficacious beliefs about the self are somewhat lower than the Math Oriented or Achievement Oriented Student. These actual beliefs are further validated by the array positions and z-scores for Factors 1, 2, and 3 for statements 39, 4, and 36.

- 39. Math is one of the easier subjects for me. (+3, 1.038; +4, 1.713; -5, -1.741)
- 4. I like math. (+5, 1.736; +2, 0.679; -2, -0.632)
- 36. I feel good when I do well in math, but I expect it. (+1, 0.650; +2, 0.846; -4, -1.603)

The Effort Oriented Student seems to additionally differ from the Math Oriented and Achievement Oriented Student in the domain of present and future performance orientations. The goals for the Effort Oriented Student in mathematics tend to be nonexistent. The Effort Oriented Student does not anticipate completing the text by the end of the year and will probably only take the required amount of mathematics in high school and college.

- 22. I want to complete the whole book by the end of the year so I can take more math in high school. (+3, 0.982; +4, 1.499; -3, -1.163)
- 23. I will take a good deal of math in high school. (+3, 1.134; +5, 1.845; -2, -0.885)

Self-regulation strategies and mastery goal orientations between the Math Oriented and Effort Oriented Student are conflicting. The Math Oriented Student tends to believe that persistence is essential when faced with a difficult mathematics problem. This student type does enjoy being challenged in mathematics because challenges in mathematics are believed to help build a foundation for life. The Effort Oriented Student, however, seems to be a population of students as revealed by Q sorts and oral interviews who become confused and baffled by numbers and have much difficulty making sense out of mathematics. Ability levels for the Effort Oriented Student tends to be much lower than the Math Oriented Student. In turn, frustration and aggravation occur more quickly when faced with challenging problems, and the Effort Oriented Student easily gives up. Placement of statement items 31, 12, and 11 and array positions and z-scores reflect the contradicting beliefs of the Math Oriented (Factor One) and Effort Oriented (Factor Three) Student.

- 31. When I am working on a difficult math problem, I try to do it two or three different ways and make sure that I get the same answer no matter how I set it up. (+2, 0.766; -4, -1.417)

- 12. The formulas in math help me build a foundation of what most of life is based on. (+2, 0.926; -3, -1.017)

- 11. I like math because it makes me think. (+4, 1.205; -1, -0.528)

The Effort Oriented and Math Oriented Student do agree with one another in that effort will help in the learning process and possibly improve one's understanding of mathematics. In this respect, much effort is expended by both groups, as reflected in statement 33 (scores in parentheses are in array positions and z-scores for Factors 1 and 3).

- 33. I try to work as hard as I can in math. (+5, 1.281; +3, 1.500)

The Effort Oriented and Achievement Oriented Student do have conflicting views about parental expectations. The Effort Oriented Students reported in oral interviews that their parents want them to do the best they can; however, by no means do they feel the pressure of performance in doing well as the Achievement Oriented Student reports. This actual belief was representative of array position and z-score for statement 42, for Factor Two and Factor Three.

- 42. My dad and/or mom expects a lot out of me in math. (+5, 1.717; -2, -0.840)

Five adolescents did not load on any factor for the actual self; four of the adolescents were female and one was male. Three of the students were identified as high ability participated in independent math, and two of the three participants were fourteen and one was thirteen years of age. The other two subjects participated in the regular math class, one was average ability, one was low ability, and both were fourteen years of age.

Four of the five adolescents who did not load on any factor had split or confounded loads which indicated they shared the opinions or beliefs of at least two factors. One participant did not share the perceptions or beliefs for any factor.

Second Research Question: Perceptions of the Ideal Math Student

The second research question was designed to explain ways eighth grade math students perceive themselves as differing from their perception of an ideal math student. Students' responses were determined by a comparison of their actual self with those of the ideal student by significant factor loadings. Interestingly, all but one student had an ideal Q sort with a significant load on Factor One: Math Oriented Mathematics Student. This means there is phenomenal consensus about what is required to be successful in math. However, of the thirty-one students, only seven students believed their view of the actual self represented the Math Oriented Mathematics Student. Of those seven, two students had negative factor loadings. The Math Oriented Student was described as an intrinsically oriented learner who has an inherent love for math. Eleven students viewed the actual self as Factor Two: Achievement Oriented Mathematics Student who has some similar beliefs about mathematics as Factor One: Math Oriented Mathematics Student. The major difference, however, between the two factors was that the Achievement Oriented Students' learning tended to be guided by external, performance motivators. Eight students viewed the actual self as Factor Three: Effort Oriented Mathematics Student. These students were very different from Factor One: Math Oriented Mathematics Student in that their struggles with mathematics has lead them not to hold high levels of intrinsic values for mathematics. Five students had confounded or split loads which indicated they shared views of the actual self with one or more factors or did not share the view of the actual self with any factor.

Summary

The findings of the current study indicated there are three subjective beliefs held by eighth grade mathematics students about motivations of the actual self and ideal mathematics student in the mathematics classroom. Q Methodology provided the researcher with a method that allowed the participants the opportunity to rank order hybrid statement items through Q sorting under two conditions of instructions that were theoretically structured. The five structured motivational theories included intrinsic and extrinsic motivation, goal orientations, self-regulation, self-efficacy, and parental involvement.

The data obtained from the thirty-one participants in the current study were described and interpreted in Chapter IV. The three factors that emerged indicate that adolescents do hold unique points of view about perceptions and beliefs in relationship to motivations of the actual self and ideal mathematics student. From the patterns in which the views are perceived and the reasons underlying adolescents' beliefs, theory as well as findings from the current study recognized that adolescents view areas of agreement and disagreement about success and motivational influences on success in mathematics.

The three factors in the present study represented three distinct views. Participants loading on a factor held similar views and perceptions with other participants loading on the same factor about motivations in mathematics. Under the two conditions of instruction (perceptions of the actual and ideal self in mathematics), three factors emerged. The Factor One: Math Oriented Mathematics Student is an intrinsically oriented student type that chooses to complete mathematics tasks for oneself. This individual additionally employs a variety of motivational strategies to obtain knowledge in mathematics in order to be successful. The Factor Two: Achievement Oriented Mathematics Student is an individual who chooses to learn for external purposes. Parents, grades, peers, and placement in higher level mathematics classes tend to be the external factors that are utilized to motivate or initiate one to learn and attain a level of competence in mathematics in order to be successful. The Factor Three: Effort Oriented Mathematics Student tends to be a struggling math student who adopts managerial skills in order to maintain a level of proficiency in mathematics. This individual puts forth much effort and works hard in mathematics but does not always feel as if the regulatory strategies used in obtaining knowledge allows one to be successful.

For the second research question, thirty of the thirty-one students perceived Factor One: Math Oriented Mathematics Student as the factor that accurately described the ideal math student. In Chapter V, a summary of the current study is included. Implications for theory, practice, and further research are also addressed.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of the study was to describe eighth grade students' motivational perceptions of the actual self and the ideal mathematics student in the mathematics classroom. This chapter gives a summary of the study and discusses the implications. Implications for theory, practice, and further research as well as concluding comments are addressed in this chapter.

Summary of the Study

This study examined beliefs held by adolescents in relationship to motivations in mathematics. The participants in the study represented a sample of eighth grade mathematics students in a small, non-denominational, private school. Thirty-three adolescents (twelve male and twenty-one female students) with parental consents and student assents agreed to participate in this study. Student ages ranged from thirteen through fifteen years. The participants agreed to complete two Q sorts and participate in pre-sort and post-sort interviews.

Through the use of a phenomenological approach, Q methodology provided the researcher with a method to examine eighth grade students' subjective beliefs about mathematics. The theoretical framework for this study examined five motivational domains. The motivational theories included intrinsic and extrinsic motivation, mastery and performance goal orientations, self-regulation, self-efficacy, and parental involvement and are set in the literature of Chapters I and II. These theories provided a template from which to structure the hybrid Q sample and conduct oral interviews.

The statement items from the Q sample were developed from six naturalistic in-depth interviews with eighth grade students. From the interviews, several hundred statements about students' beliefs in mathematics were obtained. Forty-five statement items were selected to represent students' beliefs within the structured motivational theoretical categories. The students were given the opportunity to select statements during the Q sort and to express self-referent images, attitudes, perceptions, and understandings of motivational situations in mathematics. Additionally, through post-sort interviews, student beliefs about motivational stimuli in mathematics were further clarified and tested assumptions made through interpretation (Brown, 1980).

In this study, thirty-two of the thirty-three participants completed a demographic questionnaire and performed two Q sorts under two conditions of instruction (a set of instructions given to the student in order to sort statements). One female student dropped out of the study due to a long-term illness. After the sorting process, another female participant was non-compliant. Her two Q sorts were thrown out.

Adolescents' motivational perceptions about the actual self and ideal math student guided the research questions for this study.

The specific research questions to guide this study were:

1. What are the perceptions held by eighth grade students about their motivations in the mathematics classroom?

2. In what ways do eighth grade math students perceive themselves as differing from their perception of an ideal math student?

The statistical procedures used to analyze the data included principal components factor analysis, calculation of z-scores, and array positions for each item of the rotated factors. The data obtained were analyzed, interpreted, and further clarified through post-sort interviews. The structured theoretical framework, statistical measures, and oral interviews characterized different patterns of motivational beliefs held by adolescents about the actual self in mathematics and the ideal math student. The significance of these beliefs are supported by much of the current literature on motivational theories. The three factors solutions that emerged were examined, classified, and named. Each factor name was representative of a pattern or belief held by the participants loading on that factor. The following interpretations reveal three distinct beliefs about the self and ideal person in relationship to motivational characteristics in mathematics.

<u>Math Oriented Mathematics Student</u>

From the two conditions of instruction of the actual self and ideal mathematics student, student Q sorts and oral interviews revealed perceptions of Factor One: Math Oriented Mathematics Student. The Math Oriented Mathematics Student values and has a strong inherent love for mathematics. In order to learn mathematics, the Math Oriented Student acknowledges that a variety of motivational strategies are necessary and must be used in order to build a foundation for mathematics and become successful. Students of this type are intrinsically motivated; they hold high levels of self-efficacy about their abilities; they link performance and mastery goal orientations together in order to achieve; and they use a variety of self-regulation strategies in their obtainment for knowledge in mathematics. The Math Oriented Student likes complicated mathematics problems, enjoys thought provoking mathematical situations, and accepts a challenge which in turn gives this student type a sense of accomplishment. This student type values mathematics and recognizes that effort is required. The Math Oriented Student also believes that mathematics has many applications in a variety of disciplines, and mathematics will be a field of study that will be pursued in the future.

Achievement Oriented Mathematics Student

The Achievement Oriented Student has high expectations for the self in mathematics. This student type does well in math, but learning is dominated by extrinsic performance motivators. These external motivators tend to be influenced by parents, peers, grades, and being academically placed in higher level math classes in high school. The Achievement Oriented Student tends to be intellectually capable of doing quite well and being highly successful in mathematics; however, this student type does not tend to use his or her innate abilities to one's full potential. The Achievement Oriented Student does not find all mathematics tasks interesting and does only what is necessary in mathematics to satisfy external controls.

Effort Oriented Mathematics Student

The Effort Oriented Student views mathematics as a subject which is highly challenging. The Effort Oriented Mathematics Student wants to do well and improve his or her understanding of mathematics. This student type works hard and uses several self-regulatory techniques in order to be successful in mathematics; however, the effort expended and managerial practices used for learning do not always produce positive results. Periodically, the Effort Oriented Student will do well on quizzes or tests and efficacious feelings of pride, excitement, and surprise are displayed intrinsically and extrinsically toward peers and parents. As the difficulty in mathematics increases, the Effort Oriented Mathematics Student begins to show decreased levels of self-efficacy, and regulation strategies for learning begin to decline. Mathematics becomes confusing and complicated, and the Effort Oriented Student begins skipping problems or reaches one's height of frustration and gives up.

Perceptions of the Ideal Math Student

For the second research question a comparison of the actual and ideal Q sort loading was analyzed. Thirty of the thirty-one students' Q sorts defined Factor One: Math Oriented Mathematics Student as the perceived ideal mathematics student which has already been described.

Implications

> Children's perceptions of attitudes within the classroom affect their strategy used and mathematics achievement. In order to truly understand the impact of the individual, it is therefore necessary to understand the multiple contexts that influence the individual's motivation. (Carr, 1996, p. v)

Students' perceptions and beliefs about mathematics in achievement situations tend to be a concern in the classroom, at home, and nation-wide. Due to these beliefs in recent years, numerous documents have been published pertaining to America's mathematics achievements from kindergarten extending through high school and college levels (Covington, 1992; TIMMS International Study Center, 1996).

Much research implies that motivation and the motivational strategies children possess greatly influence mathematics achievement and their future goals in mathematics. Furthermore, adolescence is cited in Chapters I and II by current literature as being a stage of development where positive and negative patterns toward motivation in mathematics tend to originate (Maehr & Anderman, 1993).

Implications for Theory

Discussion of the Math Oriented Mathematics Student – Much of the theory cited in the literature about motivations characteristically describes that of the Math Oriented Mathematics Student. As described by social cognitive theorists, the Math Oriented Mathematics Student uses many of his or her cognitive abilities for motivational purposes to become successful in the mathematics classroom (Boekaerts, 1991). The Math Oriented Student holds an intrinsic value for mathematics. The significance of the statement "I like math" is indicative of the literature review and current research findings.

One can say this student type finds mathematics stimulating yet challenging to a degree in which math tasks are interesting and worthwhile (Middleton & Spanias, 1999).

The high levels of interest the Math Oriented Student holds for mathematics has led to set goal orientations. Much of the research base on motivations systematically plots mastery goals against performance goals. The findings for the current study suggest the Math Oriented Student has intricately linked mastery and performance goals together and these goal beliefs do tend to co-exist. Similar findings linking mastery and performance goals were described by DiCintio and Stevens in 1997 with a population of adolescents. Their findings suggested adolescents wanted to increase their knowledge, but they were also motivated to perform well to look better than their peers.

In the current study, the Math Oriented Student did believe that challenging situations are important in mathematics and mathematics enables them to build a foundation for life situations. Interviews additionally revealed this student type did want to gain an understanding and seek competence in mathematical processes, indicating mastery goals do tend to be a significant guide for the Math Oriented Student in mathematical situations. However, performance goals linking the present and future together were perceived by the Math Oriented Student to be just as important. Good grades, completing the text by year's end, and taking more mathematics classes in high school were representative of their performance orientations.

Much research on performance goal orientations suggests the negative impact of this type of goal on the learner. For the current study, the performance goal orientations that the Math Oriented Student has selected do not tend to be as detrimental to the learner as the current literature on performance goal orientations suggests. This explanation exists due to the justifications the Math Oriented Student has selected for learning mathematics and the intrinsic values the student holds for mathematics.

The belief that mastery and performance goals can co-exist and become beneficial to the learner in many learning situations is also supported by the mobilization of the beliefs the students hold about themselves and the use of environmental influences to predict and anticipate challenging mathematical situations. The Math Oriented Student not only holds an intrinsic value for mathematics and uses goal orientations for learning and obtaining knowledge, the Math Oriented Student is highly self-regulated and is confident about his or her ability in mathematics. This student type works hard, is persistent, puts forth much effort, seeks help when needed, and activates numerous cognitive strategies that are necessary in order to be successful in his or her learning environment and to perform well in mathematics. According to Pintrich and DeGroot (1990), the use of and the diversity of motivational strategies in learning situations tend to be an important and beneficial feat employed during cognitive development.

The parents of the Math Oriented Mathematics Student tend to influence their children in a positive manner. From oral interviews, the students revealed their parents offered much verbal support to them academically. The parents of the Math Oriented Student have instilled in and expressed to their children that they (the parents) expect them (the children) to do their best. Interestingly enough, the parents did not link a letter grade such as an "A" with doing their best. This confirms to the adolescents that the expectations of their parents are real and sincere. The Math Oriented Student additionally acknowledged that "good job" and "we are proud of you" was the only reward they received for doing well from their parents. According to Watkins (1997) and further validated by the current study, frequent communication with parent and child confirms that parents can positively influence their children's academic performance if the right messages are sent to the child.

The processes of adolescents' motivations are generally analyzed by behaviors and beliefs they hold. The current study suggests the Math Oriented Mathematics Student is highly motivated and physically and mentally activates a variety of motivational strategies in the mathematics classroom that improves learning and understanding. Through the use of mental activities, adolescents are able to plan, monitor, make decisions, and solve problems in order to obtain goals. Physically, overt actions such as persistence and effort allow adolescents to gear toward their set goals and sustain their efforts in light of difficulties or challenges. In his or her desire to achieve and the valuing of mathematics, the Math Oriented Mathematics Student as described by the current literature on motivations suggest that the adolescent does tend to be learning for the sake of learning and intrinsic reasons (Pintrich & Schunk, 1996).

<u>Discussion of the Achievement Oriented Mathematics Student</u> – Mathematics is reported to be one of the easier subjects for the Achievement Oriented Student; as a result, the student holds high self-efficacious beliefs about one's abilities and intends to take more mathematics classes in the future. Superficially, the views of the actual self and the future tend to indicate that the Achievement Oriented Student is similar to and has many of the same perceived beliefs about mathematics as the Math Oriented Mathematics Student. However, the Achievement Oriented Mathematics Student is guided by external controls in the obtainment for success in mathematics. As cited by Nichols and Utesch

(1998) in the literature review and furthermore supported by the current study, the extrinsic, performance oriented mathematics students are interested in demonstrating their knowledge, and they do want to perform well in mathematics. However, they choose to do well for external reasons. For the current study, the reasons for learning according to the Achievement Oriented Mathematics Student theoretically exists for performance reasons which are significantly influenced by parents, grades, acceptance to higher level mathematics classes, and peers.

Since the parents of the Achievement Oriented Student have seen from past performances their children's capabilities, they have high expectations for their children in mathematics. Post-sort interviews with students revealed the parents are communicating to their children expectations which are linked to grades. Many students stated their parents expected them to bring home grade reports with no late or unsatisfactory assignments and within a designated grade range. For most, the range was no less than a "B" average but preferably an "A" average.

Parental expectations were not the only extrinsic explanations the Achievement Oriented Student gave as a reason for desiring to make good grades. The Achievement Oriented Student said he or she wanted to complete the mathematics text by year's end in order to take geometry or Honors Algebra I the following year. Taking a higher level mathematics class as a freshman in high school would allow the Achievement Oriented Student the opportunity to at least take calculus as a senior; furthermore, the student would additionally be in classes with his or her peers. Nonetheless, the Achievement Oriented Student felt the need to maintain an "A" or "B" average in his or her current mathematics studies in order to participate in a high level mathematics class in high school.

The Harvard Education Letter recently published an article about grades and the focus of grades on learning. Emphasis on grades by students or parents cause interest in learning to decline, higher level thinking skills to decrease, and the avoidance of difficult tasks (Birk, 2000). As a result, the current study and cited literature go hand-in-hand by suggesting that the Achievement Oriented Student is focusing on mathematics in more of a controlling manner rather than through arousal (Middleton & Spanias, 1999).

Maehr and Anderman (1993) report performance oriented learners tend to focus on surface-level strategies for learning. They do not like to engage in problem solving, reflection, or critical thinking. The focus is more on memorization, shortcuts, or quick payoffs in order to achieve. The findings for the current study are similar to those of Maehr and Anderman. The Achievement Oriented Student reported through Q sorts and in post-sort interviews he or she did not like writing out steps in mathematical equations, wanted to quickly get the work completed, did not enjoy story problems, did not work hard in mathematics class, and were easily bored with mathematics tasks and repetitious problems. If the Achievement Oriented Student continues to undermine the learning situation and neglect critical thinking strategies in mathematics, theory suggests as subject matter increases in difficulty the Achievement Oriented Student will begin to struggle in processing more intense information. As a result, lower levels of achievement will prevail (Miller, Behrens, & Greene, 1993; Watkins, 1997; Wentzel, 1992).

Discussion of the Effort Oriented Mathematics Student – The Effort Oriented Mathematics Student can be described as a group of students who generally struggle in mathematics. The Effort Oriented Student puts forth much effort in order to obtain knowledge in mathematics. Usually, this student type works hard, does homework satisfactorily, indicates studying as much or more than the Math Oriented and Achievement Oriented Students, values math, but still tends to do poorly in mathematics. Hard work and effort are not producing positive results in mathematics.

Now and then, the Effort Oriented Student will do well on a test; furthermore, self-efficacious beliefs tend to elevate. Pride, excitement, and even surprise results from being academically successful in mathematics, but for the most part, the student's perceived capabilities about his or her competencies in mathematics tend to be quite low. Much of the cited literature examined on motivations does not address this type of learner. The current literature focuses on the able, potentially successful students' motivations but not on the challenged, low ability students' motivations.

The Effort Oriented Student tends to be working at or above his or her cognitive abilities. This belief is supported by the reported grades, amount of time spent on homework, Q sorts, and oral interviews which suggest this student type does employ many motivational strategies. The Effort Oriented Student uses numerous regulatory strategies in order to do well. Q sorts and oral interviews indicate that this group is working hard, seeking help from the teacher and parents, looking over similar problems in the book in order to solve challenging problems, and looking at the answer of a solved problem to make sure it makes sense. The Effort Oriented Student reports through oral interviews that he or she is doing quite well on homework and getting most of the easier problems correct in the mathematics text, but as difficulty increases this student type begins to struggle and becomes frustrated. Q sorts additionally revealed that tests were quite difficult, and often the mathematical connection to problems and the real world tend to be non-existent for the Effort Oriented Student.

The Effort Oriented adolescent knows what it takes to do well in mathematics (indicated by Q sorts for the ideal math student) and sees the self using many of the same strategies as one's peers who are successful. However, the Effort Oriented Student is not achieving success and understanding mathematics at the same level or rate as his or her peers. This current study does reveal similar findings by Brookhart (1998) for the Math Oriented and Performance Oriented Student but not for the Effort Oriented Student. According to Brookhart (1998), self-regulations are good predictors of academic achievement. The self-regulatory strategies used by the Math Oriented and Achievement Oriented Student do tend to predict academic achievement. From the view of the struggling Effort Oriented Student, self-regulation is not an effective predictor of this group's academic achievement.

Middleton and Spanias (1999) found in a recent study that students with low levels of self-efficacy often have bad experiences in mathematics and do not see mathematics as an important component of their self-concept. Additionally, the students do not develop motivational techniques necessary for learning and understanding mathematical tasks. Finding by Middleton and Spanias (1999) tend to be somewhat accurate for the Effort Oriented Student, but in a different sequence and not for the same reasons.

For the current study, the Effort Oriented Student feels he or she does poorly in mathematics which perhaps may be related to low achievement levels. This group's cognitive abilities, in turn, affect self-efficacious beliefs about one's capabilities. However, the Effort Oriented Student believes it is important to learn and understand mathematics, and the student holds a strong belief concerning the need to do better in mathematics. This belief was reflected from the students' Q sorts. For obvious reasons, it seems to be difficult for the Effort Oriented Student to have an intrinsic enjoyment for mathematics or to have high levels of self-efficacy if motivational strategies are not seen as being effective. This student experiences continual frustration every time his or her mathematics text is opened.

As indicative of the demographics questionnaire, Q sorts, and oral interviews, the potential capabilities of the Effort Oriented Student in mathematics rests in a *hopeful* low "B" but usually in the "C" range or below. In society and by parents, such an average is not viewed as doing one's best. Therefore, the cognitively challenged children do not see themselves as successful. Nonetheless, their levels of self-efficacy are quite low even when they are putting forth much effort and working up to or above their capabilities. In light of all the knowledge they have obtained in mathematics and school, school is perceived as a place that possesses a threat to their self-concept due to the judgments placed upon their abilities.

Goal theory cited in the literature suggests goals individuals hold about the self and the future are centralized around mastery or performance goals, learning or ego goals, etc. The literature reviewed does not tend to address the views the Effort Oriented Student holds toward goals. The Effort Oriented Student does not tend to have set goals for the future. Oral interviews revealed that this student type is concerned with the here-and-now. The Effort Oriented Student has to spend much time focusing on "today" and managing class work loads and life on a day-by-day basis; furthermore, the student has not taken the time to think about "tomorrow" and the future through reflective practices.

Implications for Practice

The findings of the current study described motivational perceptions of the actual self and ideal person in mathematics. Through classroom instruction, parental involvement and guidance, and societal influences, the messages sent to children by adults, parents, and teachers on a daily basis could benefit from the implications of these findings. The students in the current study revealed three views about motivations in mathematics. First, the mathematics experience is driven by intrinsic, meaningful desires to learn and obtain knowledge. Secondly, the learning of mathematics is for achievement purposes and is controlled by external, performance motivators. Finally, mathematical literacy is essential, but concealed behind the necessity for literacy exists challenge and frustration despite motivational strategies used.

From social comparison, teachers, parents, other adults, the media, environment, and vicarious experiences, the adolescents in the current study have developed an image of an ideal mathematics student. The ideal mathematics student image according to thirty of the thirty-one participants suggests the ideal mathematics student is intrinsically motivated, possesses mastery and performance goal orientations, is highly self-regulated and self-efficacious, and at times requires parental assistance and parental support. Above all the ideal mathematics student was considered to be a person who intrinsically enjoys and likes to think and be challenged in mathematics.

Much of the current literature on motivation theoretically describes that of the ideal mathematics student image. From the findings of the current study, perceptions of the ideal math student are real and exist in the minds of a majority of the participants; as a result, one can conclude that the participants in this study do know what it takes to be successful and do well in mathematics. However, only five of thirty-one participants under the first condition of instruction (perceptions of the actual self in mathematics) believed that they resembled the Math Oriented Mathematics Student who was identified as the ideal math student.

Middleton and Spanias (1999) report that adolescence tends to be the age in which motivational views toward mathematics become decided. The beliefs students hold about mathematics affect continued mathematics course work into high school and well into college. The findings of the current study suggest that adolescents can distinguish their attitudes and behaviors from others and even from that of the ideal image. If the ideal perception exists, that in itself suggests that adults, parents, and teachers must do more to guide children and students in ways of optimizing and cultivating reasons for learning.

On a daily basis, students in all academic areas are asking teachers, "Why do we have to do this?"or "When am I ever going to use this?" Educators often say, "I don't know," or dismiss the questions altogether. As a result, students are not getting the answers that necessitate continual purposeful learning. They tend to believe if adults don't know *why* then the information taught and assigned isn't necessary to learn. Covington (1992) writes that adolescents need to be provided with a foundation for meaning, assurance, and purpose. They need to make connections with today and link it to the future so they know how both intricately fit together. By giving students answers to their *whys*, they begin to understand that there are worthwhile reasons to learn for understanding and obtaining knowledge. Furthermore, the ideal mathematics image is not just a superficial image. The ideal image can become real, and students can obtain many of the characteristics of the ideal student if the rationale for learning exists.

The image of the ideal mathematics student is that of a focused, persistent, hard working, self-regulated individual. For an adolescent to recognize the motives of the ideal image suggests that the student is aware of and is using many cognitive resources to make assessments or judgments. While society, parents, and teachers want their employees, children, and students to do well, distractions are abundant. Video games, computers, television, sports, lessons, and homework are tugging at adolescents from all directions. Adolescents are so involved that their lives become too busy with extra-curricular activities. As a result, the ideal image is just that, an image.

At an early age, parents need to teach, guide, and model to their children so that they can better manage time and their lives. While adolescents want to gain a sense of independence from adults, adolescents still need structure and support from their parents. Adolescents need to be monitored and guided so that they are able to make good choices. Extra-curricular activities which encourage well-roundedness of individuals are important; however, adolescents need direction (reasons to prioritize academics) in order to bypass distraction. Productive choices can positively affect goal choice and additionally enhance reasons for obtaining knowledge. Parents could collaborate with their children in order to organize or develop a daily homework schedule. Having a set schedule could increase academic productivity. In order to prioritize academics, parents and children could agree upon specific limitations. Boundaries are necessary in order to limit the number of extra-curricular activities adolescents can be involved in and to limit the number of hours using the computer, playing video games, and watching television.

Pre-sort and post-sort oral interviews revealed that the adolescents in the current study have not developed skills necessary for studying and learning mathematics. The participants reported studying for mathematics tests by looking over the chapter, reviewing concepts, and memorizing formulas. Only a few of the participants revealed putting pencil to paper and actually working problems so that they can understand concepts and practice procedural steps. Studying is a learned behavior. Teachers must give students ample opportunities to assimilate information and provide a variety of constructive learning strategies and situations in order for students to learn mathematics. Through professional development teachers can learn to enhance the study skills of their students. Teachers can learn to structure their classroom in order to create an environment that is open to questions of inquiry and exploration. Teachers can also provide help sessions to students before and after school to guide their students in the learning process. At home, parents must convey to their children that time must be spent on doing homework and studying. Again, scheduling and set limitations are necessary guidelines in order for children to obtain success in mathematics.

Other areas that may affect success in mathematics involve goal choice. Wentzel (1992) describes goals as analytical explanations of what learners are trying to accomplish, and the function of goals is to direct behavior toward achieving outcomes. Additionally, motivational orientations are excellent predictors of academic achievement (Middleton & Spanias, 1999; Miller, Behrens, & Greene, 1993; Wentzel, 1991). As described in Chapter IV, short-term and long-term goals tended to be non-existent for Factor Three: Effort Oriented Mathematics Student. The Effort Oriented Student tends to be a manager of today and may not have a rationale for purposeful learning. The Effort Oriented

Student needs much guidance from parents and teachers in selecting goals for short-term and long-term purposes. Teachers or parents could assist their students or children by having them list five of their strengths and weaknesses in mathematics and five goals they would like to reach in mathematics. Next, students or children could write up a plan of action for achieving their goals. Periodically, these strengths, weaknesses, and goals would be revisited by the students or children. At this time, the students or children could mark off obtained goals or add to their lists. Through instruction, the students' or children's reflective and visionary cognitive skills can be developed or further enhanced in order to set goals and achieve goals. Goals guide and aid individuals in the learning process. Understanding that learning has a rationale, individuals will discover that the significance for setting goals affects them throughout their lifetime.

Furthermore, this study suggests that extrinsic motivators are not effective motivators for obtaining knowledge. These findings are supported by the students' Q sorts and oral interviews. Statement about extrinsic rewards were placed in the negative or neutral array positions for all three factors. Additionally, in oral interviews students recognized that they are able to perform without incentives. Teachers and parents need to realize that students and children do not need rewards in order to academically achieve. Instead of giving stickers or candy as an incentive to learn, teachers can use portfolios so that students can see their progress from start to finish. Students will discover through portfolios that their achievements are governed by knowledge gained, not by extrinsic rewards.

Parents need to realize that grade expectations and pressures put upon their children to obtain specified grades do not always improve performance. As described by

Maehr and Anderman (1993), when adolescents are pressured to achieve by external influences the students tend to focus on superficial strategies for learning. They do not enjoy problem solving, reflection, or critical thinking; they tend to focus more on memorization, shortcuts, or quick payoffs in order to achieve. Grades are a tool for assessment, yet grades do not always indicate whether children are obtaining knowledge and learning for purposeful reasons. Students and children will achieve for intrinsic reasons (as indicated by the Math Oriented Mathematics Student) if the message of doing one's best and working to obtain knowledge and understanding is reinforced on a regular basis. Schools can provide parents with such information or reminders through weekly fliers, open houses, and parent/teacher conferences.

The implications for practice highlight the National Council of Teachers of Mathematics (NCTM) goals for mathematics students. Those goals are "learning to value mathematics" and "becoming confident in one's own ability" (Middleton & Spanias, 1999). Other implications for practice reveal that the home and school must have a partnership in order to boost academic and social growth for students (Peressini, 1997). While much learning does occur within the walls of the school, that learning must continue at home. Purposeful learning must be a joint effort in the home and school, and adolescents must know and see that learning is pervasive. An open line of communication is very important for parents from the school in order to make learning a shared effort. Open houses designed for parents, children, and teachers to interact for the enjoyment of learning could enhance student desires to obtain knowledge. An example could include a Math Game Night. Children, parents, and teachers could spend the evening playing games that relate to math. While boosting academic and social growth, mathematics can be learned and valued by all.

Implications for Further Research

The current study examined and revealed motivational patterns of beliefs in mathematics of eighth grade students. While the population sample is somewhat small, the findings of the study suggest implications for further research. As adolescents socially and cognitively grow and develop, changes do tend to occur in the learning environment. The cited literature in the current study suggests that by the time children reach adolescence beliefs tend to be fixed (Covington, 1992; Boekaerts, 1991; Middleton & Spanias, 1999). For the current population sample, a longitudinal study could reveal how or if the perceptions of the participants towards motivations in mathematics do change or develop in high school and college which in turn affect career choice.

This study recognized and affirmed the belief that students do know what is required and necessary to do well and learn for purposeful reasons. Further exploration of the ideal image needs to be examined. How can parents and teachers further develop the ideal into reality? What do children perceive as barriers which do not allow them to develop into the ideal mathematics student? How can those barriers be conquered to optimize understanding and the learning of mathematics?

To get a better representative sample of adolescents, the study could be replicated and expanded into the public domain. A comparative study of public and private school students' beliefs about motivations in mathematics could offer valuable insights to teaching practices. Do private and public school students hold similar or different beliefs about motivations in mathematics? Where do the differences occur? What changes need to be made in the private and public schools in order to better serve student populations?

School location and district size could be an important variable in students' perceptions about motivations in mathematics. For the current study, participants represented a south central, inner-city, small, private educational institution. Urban, suburban, and rural school districts as well as different geographical regions within the United States could be additional areas where students' motivational beliefs are examined.

The findings of the current study additionally suggest that parents and teachers need to be aware of how children think and that their subjective motivational beliefs should be recognized and acknowledged. Children's beliefs have serious implications in learning situations. Further research could include how ability level or learning styles affect the attainment of knowledge and how motivational beliefs are linked to the learner's ability or style of learning.

Much of the cited literature suggests that young children, due to cognitive development, are not able to socially equate or make performance standards to judge their ability (Ames & Ames, 1984; Grouws & Lembke, 1996; Nicholls, 1984). Further research under the same theoretical structure of the current study could examine multiple grade levels in order to gain a sense in understanding the belief structures held by students of different ages. Pinpointing significant changes in beliefs at specific ages or grades could provide parents and teachers with a reference point at which guidance toward goal directed and self-regulatory actions should be reinforced.

This study did not provide a representative sample of a culturally diverse population. In a recent study described in Chapter I, Uttal (1996) found that Asian mothers and their children did not share similar beliefs with American mothers and their children about innate abilities in learning situations. Findings, as such, suggest that the motivational beliefs of students from other cultures need to be examined and further investigated. Research questions could explore the similarities and differences of cultural beliefs on motivations in mathematics and how the similarities or differences affect goal choice, self-regulatory strategies used, parental involvement, and levels of self-efficacy.

Concluding Comments

Adolescence is often described as a volatile time in individuals' lives when many physical and mental changes occur. While the changes may be numerous, this stage of development tends to be a critical time when adolescents begin to set goals and employ plans for their future (Wentzel, 1991; Wentzel, 1992). The impact of and patterns behind the changes that occur in adolescence are often driven by motivations (Meece, 1991). The current study suggests similar findings about motivations in mathematics.

The adolescents participating in the study hold significant beliefs about the actual self and the ideal mathematics image in relationship to perceptions of motivations in mathematics. During pre-sort interviews, it became apparent the adolescents held strong interests about the self and wanted to address and discuss their motivational views. Q sorting also confirmed, through the deliberate manipulation by rank ordering statement items under two conditions of instruction, that the individuals in this study were cognitively aware of their affective behaviors. Furthermore, post-sort interviews authenticated and further clarified adolescents' beliefs about motivations in mathematics. In the processes of obtaining information about motivational beliefs in mathematics, it became apparent that adolescents need to be acknowledged; they want to share their views with others; and their views have great value for research purposes. Their opinions and subjective beliefs about motivations through the use of Q methodology provided a phenomenological approach for interpretation and gaining insights into the awareness and reality of adolescents' views in mathematics.

While patterns of beliefs reflected three different views, all three factors shared similar expectations and commonalities in mathematics. All participants loading on one of the three factors revealed: 1) Mathematics is deemed necessary for all individuals. No matter how challenging mathematics may seem, it is important that knowledge is gained and that a level of understanding has transpired. 2) A variety of self-regulatory strategies must be employed and maintained in order to academically achieve and be successful in mathematics. 3) Goal orientations affect and guide one's reasons for learning. 4) Parental involvement exists in a variety of forms but is a necessary component in learning situations. Support and guidance on mathematical tasks tended to be two of the most important needs from parents by the adolescents. 5) External rewards are not necessary for achievement purposes. Adolescents will learn without incentives.

As the participants in the current study continue to take required and higher level mathematics classes, it is believed that continual development of abstract processing will occur. The ideal image suggests that a majority of the participants are very conscious of how to obtain mathematical knowledge. Through further cognitive growth and the commonalities of the three factors, it is hoped that the ideal image will additionally develop. While some students already have an intrinsic enjoyment for mathematics, it appears that many of the students may be building a foundation for learning mathematics, and with time it is hoped that each and every participant will attain and feel a level of success in mathematics.

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APPENDIXES

APPENDIX A

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date:	November 17, 1999	IRB #:	ED-00-166
Proposal Title:	"CHARACTERISTICS THAT IDENTIFY SUCCESS IN THE MATHEMATICS CLASSROOM AS PERCEIVED BY ADOLESCENTS"		
Principal Investigator(s):	Margaret Scott Gayla Howell		
Reviewed and Processed as:	Expedited (Special Population)		

Approval Status Recommended by Reviewer(s): Approved

Signature:

Carol Olson

Carol Olson, Director of University Research Compliance

November 17, 1999
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX B

CONSENT FORMS

Table B-I
Parental Consent

Dear Parent/Guardian:

I am the eighth grade science teacher at [redacted] School. I am also continuing my education at Oklahoma State University. As part of my class requirements at OSU, I am conducting a study on characteristics adolescent students feel represent success in the mathematics classroom.

I would appreciate your assistance in my project; I would like to ask your eighth grade child to rank statements he or she believes are most like and least like a successful adolescent in mathematics and characteristics that are most like and most unlike your adolescent. Your child may also be asked to participate in interviews before and after the study.

The research will be conducted during a regular block session and will take approximately forty minutes. All responses will be kept anonymous; there will be no identifying information linking students to data records. After two years, your child's responses will be destroyed. At any time during the forty-minute activity, your child may choose to stop, and there will be no negative consequences.

This study will help educators and myself develop a more accurate understanding of student beliefs and characteristics as they relate to success. Please return this form to the school with your child. If you have any questions or concerns about the research, I can be reached at school [redacted] or at home [redacted]. Thank you.

Respectfully

Gayla Howell
Eighth Grade Science

I understand that participation is voluntary for my child and he or she will not be penalized if he or she chooses not to participate. I also understand that I, as a parent, am free to withdraw my consent and end my child's participation in this project at any time without penalty after notification has been made to Mrs. Howell.

I have read and fully understand the consent form. I sign it freely and voluntarily.

Name of child___________________________

Check one:

Yes, my child may participate _____

No, my child may not participate _____

Parent/Guardian Signature________________________________

Date__________________

Table B-II
Student Consent

Dear Student,

This is to ask if you will participate in a research project I am conducting for a college class at Oklahoma State University.

I would like to know what you believe represents success in the mathematics classroom. You will be asked to sort through a set of statements. You will rank the statements that you feel are most like and least like a successful mathematics student and put the statements on a sort board. I may also ask you to participate in an interview before and after the study.

Your part in the research study will be anonymous. Also, you may decide not to participate at any time. I will answer any questions you may have about this study. If you would like to participate during a designated block period some time this month, please sign the line below.

Thank you,

Mrs. Howell

I understand that participation is voluntary, and I will not be penalized if I choose not to participate. I also understand that I am free to withdraw my consent and end my participation in this project at any time without penalty after notification has been made to Mrs. Howell.

I have read and fully understand the consent form. I sign it freely and voluntarily.

Student's signature ___________________

Date___________________

APPENDIX C

PRE-SORT INTERVIEW GUIDELINES

Pre-Sort Interview Guidelines

1. Do you like or dislike mathematics? Explain.

2. What do you like most about your math class? Explain.

3. What do you like least about your math class? Explain.

4. When you are involved in working on a hard math problem, what are some strategies you use to complete it? Explain.

5. Explain your feelings when you do well on a math test?

6. Explain your feelings when you do poorly on a math test?

7. At home, how do your parents help you with your math homework if you need help? Explain.

8. What do you hope to accomplish this year in math class? Explain.

9. Sometimes students compare their grades. Do you compare your math grade with other students in the class? Explain.

10. How much math do you think you will take in high school and college? Explain.

11. Is learning math important or unimportant to you? Explain.

12. When you are doing a math problem, do you try to understand the purpose and procedure? Explain.

13. How much effort do you expend in math class? Explain.

14. What do your parents say to you about what they expect of you in math? Explain.

15. What kinds of math tasks do you find interesting or worthwhile? Explain.

16. How do you study for a math test? Explain.

17. Do you receive rewards for good grades? What types of rewards do you receive? Explain.

18. What do you tell your parents when you do poorly on a math test or paper? Explain.

19. Are you good at math? Explain.

20. How do you set goals for yourself in school? Explain.

21. If you were given a reward for good grades, what would you like to receive? Explain.

APPENDIX D

CATEGORY STRUCTURE FOR Q SORT

Category Structure for Q-Sort

Intrinsic:
1. In engineering, the math things we do are interesting.
2. Math is pretty important.
3. I like the story problems. They make math more meaningful.
4. I like math.
5. The only math tasks I find interesting are the ones where I am trying to figure something out.

Extrinsic:
6. I would like to receive money for good grades in math.
7. As a reward for making good grades in math, I don't get grounded.
8. I want more privileges from my parents as a reward for good grades in math. I want to do more things and have more space.
9. I receive money for good grades in math.

Mastery Goals:
10. I try hard, work hard, and get everything done in math. That, in itself, is an accomplishment for me.
11. I like math because it makes me think.
12. The formulas in math help me build a foundation of what most of life is based on.
13. I try to understand the purpose and procedure so I can go further in math.
14. I like to work math problems that sound complicated to most people. Really they aren't complicated. They are pretty simple to figure out if you understand what the problem is talking about and asking.
15. Math is one subject I can use in almost all my classes, and it can be used in so many fields.

Performance Goals:
16. I will take the least amount of math possible in the future.
17. I compare grades in math but I don't try to boast about doing well.
18. I only compare grades in math so I can get the right answer to the problems I missed.
19. I want to get better at math this year.
20. I really concentrate on making good grades in math. That is one of my top priorities.
21. I don't want to look stupid at a store if I am buying something and I don't have enough money. That is why I need to know math.
22. I want to complete the whole book by the end of the year so I can take more math in high school.
23. I will take a good deal of math in high school.

Self-Regulation:
24. I put forth only as much effort as I need to get my math homework done.
25. I spend a lot of time studying for tests and quizzes in math.

26. Math is the same problems over and over and over. I sometimes slack off.
27. When I am working on a hard math problem, I try to remember what the teacher told us in math class.
28. If I am paying attention, I can get most of my math homework done in class.
29. When I am working on a hard math problem, I guess and check.
30. I rely on my calculator as much as possible when I get to a hard math problem.
31. When I am working on a difficult math problem, I try to do it two or three different ways and make sure that I get the same answer no matter how I set it up.
32. When I look at the answer to a math problem, I make sure it makes sense and it sounds reasonable.
33. I try to work as hard as I can in math.

Self-Efficacy:

34. When I do well on a math test, I get excited and surprised.
35. I struggle at taking tests in math.
36. I feel good when I do well in math, but I expect it.
37. When I do well on a math test, I feel proud.
38. I like the good feeling I get from being able to figure out math problems that seem kind of hard.
39. Math is one of the easier subjects for me.
40. Math has too many rules about numbers, and I can't always remember them.

Parental Involvement:

41. My parents say very little to me about what they expect of me in math.
42. My dad and/or mom expects a lot out of me in math.
43. My dad and mom know that I am capable because they have seen how well I have done on past tests and in past grades.
44. My dad or mom usually helps me at home on math when I need it.
45. When I do poorly on a test, I tell my parents that I couldn't remember and I couldn't apply what we learned in class to the test.

APPENDIX E

Q SORT PACKET

Table E-I
Demographics Sheet

Circle the appropriate letter that best represents you.

1. Gender a. male b. female

2. Age a. 13 b. 14 c. 15

3. My current math grade is:
   a. A b. B c. C d. D e. F

4. I am an independent math student. (Independent refers to working in the book at one's own rate.)
   a. yes b. no

5. The average number of hours I spend each night doing math homework is:
   a. 0 b. 1 c. 2 d. 3 or more

6. The average number of hours I spend on the computer each night doing homework or research is:
   a. 0 b. 1 c. 2 d. 3 or more

7. The average number of hours I watch television each evening is:
   a. 0 b. 1 c. 2 d. 3 or more

Table E-II

FORM BOARD

MOST UNLIKE **NEUTRAL** **MOST LIKE**

11 10 9 8 7 6 5 4 3 2 1

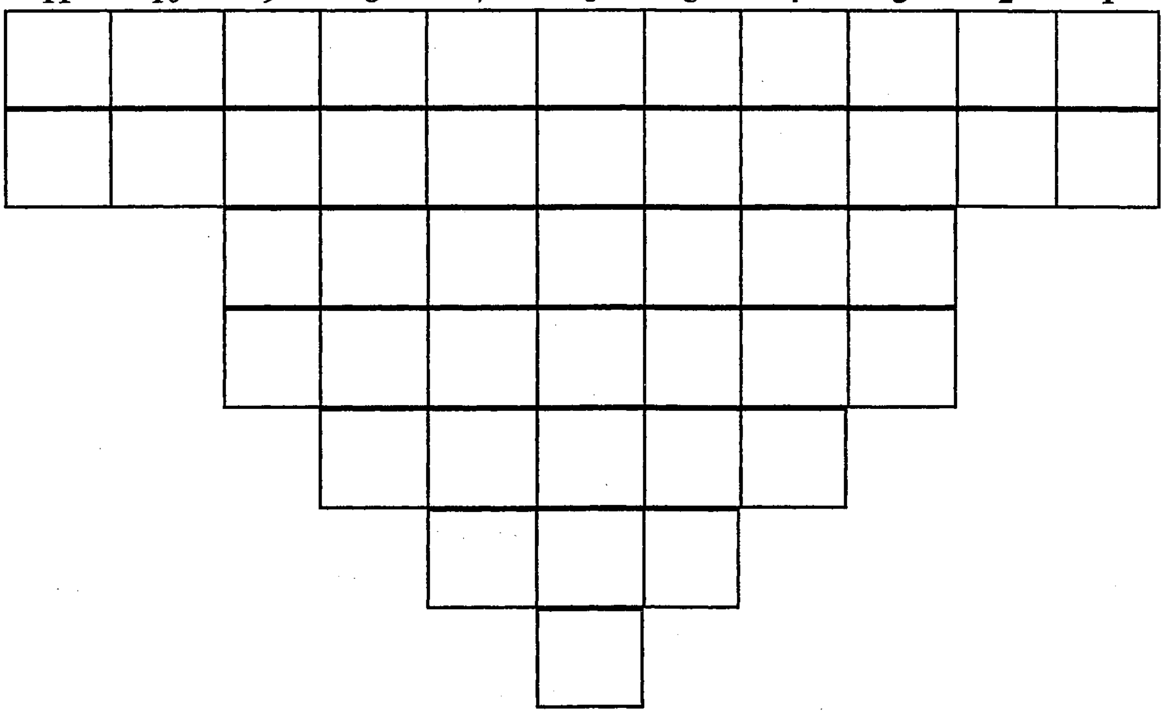
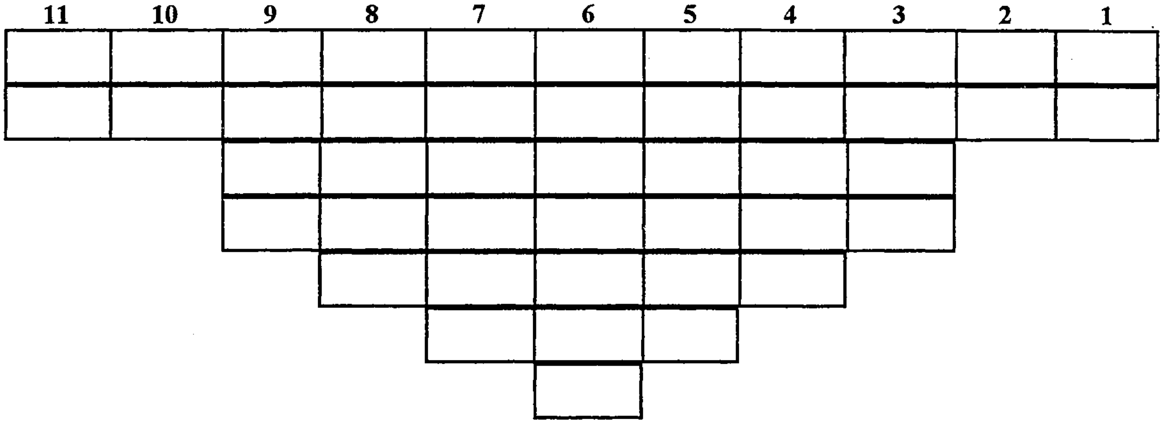


Table E-III

SORT SHEET ONE

MOST UNLIKE **NEUTRAL** **MOST LIKE**

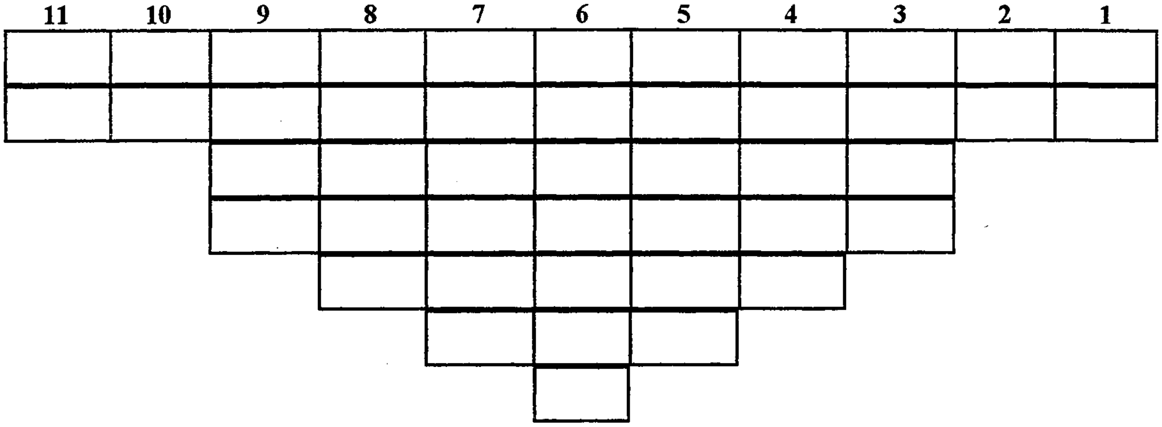
11 10 9 8 7 6 5 4 3 2 1



SORT SHEET TWO

MOST UNLIKE **NEUTRAL** **MOST LIKE**

11 10 9 8 7 6 5 4 3 2 1



APPENDIX F

STUDENT Q SORT INSTRUCTIONS

Student Instructions for Q-sort

First Sort - Sort items that are most like you (the actual self) in mathematics.

Researcher will say:

1. Please open the envelope in front of you. You will find four items, a set of statements, a form board, a sort sheet and a demographics sheet (blue - copied double sided). The demographic sheet will ask some questions about you. With your writing utensil, please complete this sheet.

2. Now, put the form board and statements in front of you. Open the statement envelope and count those statements. You should have forty-five statements. Let me know if you do not have the correct number of statements.

3. I would now like you to sort these statement items into three categories and make three general piles. In the first pile, sort the items according to those you believe are most like you in mathematics and put them on your right side. In the second pile, sort the items according to those you believe are most unlike you in mathematics class and put them on your left side. Finally, in the third pile, sort the items that represent neutrality or fall in the middle of the two extreme ends and put them in between the left and right piles.

4. Now that you have finished sorting statements, pick up the statements that are most like you (on your right side). Select the first two statements that are most like you. Put those statements one-by-one on the right of the form board in the boxes provided in Column 1. Set the remaining statements down and pick up the statements that are most unlike you (on your left side). Select the two statements that are most unlike you and put those statements one-by-one on the left of the form board in the boxes provided in Column 11. Continue this pattern of sorting until you have put all the statement items that are most like you and most unlike you in the appropriate boxes on the form board. When you have finished sorting the statements that are most like you and most unlike you, pick up the neutral statements (the middle pile) and sort them accordingly by placing them in the remaining boxes.

5. With your writing utensil, record your results on the top part of the sort sheet labeled sort sheet one (blue) by writing the appropriate number that corresponds with box and statement items.

Second Sort - Items I believe are most like an ideal mathematics student.

The researcher will say:

1. Now, that you have finished sorting items that are most like you, please take them off the form board, mix them up, and put them in one pile. This time I want you to sort the statement items again as you previously did but categorizing them by what you ideally believe represents a successful mathematics student.

2. I would now like you to sort these statement items into three categories and make three general piles. In the first pile, sort the items according to those you believe are most like the ideal mathematics students and put the statement items on your right side. In the second pile, sort the items according to those you believe are most unlike the ideal mathematics students and put the statement items on your left side. Finally, in the third pile, sort the items that represent neutrality or fall in the middle of the two extreme ends and put them in between the left and right piles.

3, Now that you have finished sorting statements, pick up the statements that you believe are most like the ideal mathematics student (on your right side). Select the first two statements that you believe represent a successful mathematics student. Put those statements one-by-one on the right of the form board in the boxes provided in Column 1. Set the remaining statements down and pick up the statements that are most unlike the ideal mathematics student (on your left side). Select the two statements that you believe are most unlike a successful mathematics student and put those statements one-by-one on the left of the form board in the boxes provided in Column 11. Continue this pattern of sorting until you have put all the statements that are most like and most unlike the ideal mathematics student in the appropriate boxes on the form board. When you have finished sorting the statements that are most like and most unlike the successful mathematics student, pick up the neutral statements (the middle pile) and sort them accordingly by placing them in the remaining boxes.

4. With your writing utensil, record your results on the bottom part of your sort sheet, labeled sort sheet two, by writing the appropriate number that corresponds with box and statement items.

Once you have finished recording your results, return all items to the envelope, raise your hand, and I will pick up your envelope.

APPENDIX G

POST-SORT INTERVIEW GUIDELINES

Table G-I

Post-Sort Interview Guidelines for Factors
Factor __________
Student __________

1. How do you feel about this statement? "I like math."

2. What does this statement means to you, "I try to work as hard as I can in math?" How hard do you work in math or on math tasks? Studying - Homework - Tests How much time do you spend studying for tests and on homework?

3. Do you ever slack off in math?

4. How important is it for you to make good grades in math? Why is that important or unimportant?

5. What do you hope to accomplish in mathematics this year and in your future?
   What does this statement mean to you, "I will take a good deal of math in high school." or "I want to complete the whole book by the end of the year so I can take more math in high school."

6. What tasks do you find most interesting in math?

7. How would you rate yourself in mathematics?

8. Does math challenge you? Explain. In what areas?

9. What are some strategies you use in solving hard math problems?

10. Are you good at math?

11. What do your parents say to you about what they expect of you in math?

12. If you do poorly on a test, what do you tell your parents? Well on a test?

13. How do you feel when you do well on a test? Poorly on a test?

14. Do you receive rewards for doing well in math?

15. How important is math to you?

16. When you are working on a difficult math problem, what do you focus on the most in order to solve the problem?

17. When you hear this statement, what do you think of first? "Math is one of the easier subjects for me?"

18. How do you study for a math test?

19. Do your parents help you study or do homework in math? How?

Table G-II

Post-Sort Interview Guidelines
Ideal Math Student
Student________________

1. Describe the ideal math student.

2. Name the five most important characteristics of the ideal math student.

3. What tasks in math would the ideal math student like most?

4. What goals do you think the ideal math student would have for his or her eighth grade year and the future?

5. What strategies would the ideal math student use in order to solve hard math problems?

6. Which statement do you think would be more important to the ideal math student? Why?
   1. I like math because it makes me think.
   2. I will take a good deal of math in high school.
   3. I really concentrate on making good grades in math.
   4. I like math.
   5. I try to work as hard as I can in math.

7. How hard does the ideal math student work in math class? Explain.

8. What do you think parents expect of their ideal math student?

9. What role do parents play in helping the ideal student?

10. How would the ideal math student feel about his or her abilities in math?

11. How do you differ from the ideal math student?

APPENDIX H

DATA TABLES, Z-SCORES, FACTOR ARRAYS WITH

DEMOGRAPHICS, AND ARRAY POSITIONS

FOR FACTORS

Table H-I
Normalized Factor Z-Scores
Factor One: Math Oriented Mathematics Student

Statement	Number	Z-Scores
I like math.	4	1.736
I try to work as hard as I can in math.	33	1.281
I really concentrate on making good grades in math. That is . . .	20	1.243
I like math because it makes me think.	11	1.205
I will take a good deal of math in high school.	23	1.134
Math is one of the easier subjects for me.	39	1.038
I spend a lot of time studying for tests and quizzes in math.	25	0.987
I want to complete the whole book by the end of the year so . . .	22	0.982
I try to understand the purpose and procedure so I can go . . .	13	0.961
I want to get better at math this year.	19	0.931
The formulas in math help me build a foundation of what . . .	12	0.926
Math is pretty important.	2	0.923
When I am working on a difficult math problem, I try to do . . .	31	0.766
I try hard, work hard, and get everything done in math. That. . .	10	0.729
Math is one subject I can use in almost all my classes and . . .	15	0.721
When I look at the answer to a math problem, I make sure it . . .	32	0.712
In engineering, the math things we do are interesting . . .	1	0.690
I feel good when I do well in math, but I expect it.	36	0.650
I like to work math problems that sound complicated to . . .	14	0.539
When I am working on a hard math problem, I try to . . .	27	0.504
I like the good feeling I get from being able to figure out . . .	38	0.350
When I do well on a math test, I feel proud.	37	0.344
My dad and mom know that I am capable because they . . .	43	0.293
If I am paying attention, I can get most of my math . . .	28	0.233
My dad and/or mom expects a lot out of me in math.	42	-0.066
I like story problems. They make math more meaningful.	3	-0.095
I compare grades in math, but I don't try to boast about . . .	17	-0.279
My dad or mom usually helps me at home on math when . . .	44	-0.482
When I am working on a hard math problem, I guess and check.	29	-0.511
I only compare grades in math so I can get the right answer.	18	-0.543
My parents say very little to me about what they expect of . . .	41	-0.682
I don't want to look stupid at a store if I am buying . . .	21	-0.702
When I do poorly on a test, I tell my parents that I couldn't . . .	45	-0.743
When I do well on a test, I get excited and surprised.	34	-0.872
I want more privileges from my parents as a reward for . . .	8	-0.905
The only math tasks I find interesting are the ones where I . . .	5	-0.933
I rely on my calculator as much as possible when I get to a . . .	30	-1.105
I would like to receive money for good grades in math.	6	-1.111
As a reward for making good grades in math, I don't get . . .	7	-1.151
I receive money for good grades in math.	9	-1.272
Math has too many rules about numbers and I can't always . . .	40	-1.530
I put forth only as much effort that I need to get my math . . .	24	-1.539
I struggle at taking tests in math.	35	-1.597
Math is the same problems over and over and over. I . . .	26	-1.775
I will take the least amount of math possible in the future.	16	-1.984

Table H-II
Form Board
Factor One: Math Oriented Mathematics Student

Array Positions

-5	-4	-3	-2	-1	0	1	2	3	4	5
MOST UNLIKE					**NEUTRAL**				**MOST LIKE**	
11	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
26. Math is the same problems over and over and over. I sometimes slack off.	24. I put forth only as much effort that I need to get my math homework done.	6. I would like to receive money for good grades in math.	45. When I do poorly on a test, I tell my parents that I couldn't remember and I couldn't apply what we learned in class to the test.	17. I compare grades in math but I don't try to boast about doing well.	27. When I am working on a hard math problem, I try to remember what the teacher told us in math class.	10. I try hard, work hard, and get everything done in math. That, in itself, is an accomplishment for me.	13. I try to understand the purpose and procedure so I can go further in math.	23. I will take a good deal of math in high school.	20. I really concentrate on making good grades in math. That is one of my top priorities.	4. I like math.
16. I will take the least amount of math possible in the future.	35. I struggle at taking tests in math.	7. As a reward for making good grades in math, I don't get grounded.	34. When I do well on a math test, I get excited and surprised.	44. My dad or mom usually helps me at home on math when I need it.	38. I like the good feeling I get from being able to figure out math problems that seem kind of hard.	15. Math is one subject I can use in almost all my classes and it can be used in so many fields.	19. I want to get better at math this year.	39. Math is one of the easier subjects for me.	11. I like math because it makes me think.	33. I try to work as hard as I can in math.
		9. I receive money for good grades in math.	8. I want more privileges from my parents as a reward for good grades in math. I want to do more things and have more space.	29. When I am working on a hard math problem, I guess and check.	37. When I do well on a math test, I feel proud.	32. When I look at the answer to a math problem, I make sure it makes sense and it sounds reasonable.	12. The formulas in math help me build a foundation of what most of life is based on.	25. I spend a lot of time studying for tests and quizzes in math.		
		40. Math has too many rules about numbers and I can't always remember them.	5. The only math tasks I find interesting are the ones where I am trying to figure something out.	18. I only compare grades in math so I can get the right answer to the problems I missed.	43. My dad and mom know that I am capable because they have seen how well I have done on past tests and in past grades.	1. In engineering, the math things we do are interesting.	2. Math is pretty important.	22. I want to complete the whole book by the end of the year so I can take more math in high school.		
			30. I rely on my calculator as much as possible when I get to a hard math problem.	41. My parents say very little to me about what they expect of me in math.	28. If I am paying attention, I can get most of my math homework done in class.	36. I feel good when I do well in math, but I expect it.	31. When I am working on a difficult math problem, I try to do it two or three different ways and make sure that I get the same answer no matter how I set it up.			
				21. I don't want to look stupid at a store if I am buying something and I don't have enough money. That is why I need to know math.	42. My dad and/or mom expect(s) a lot out of me in math.	14. I like to work math problems that sound complicated to most people. Really they aren't complicated. They are pretty simple to figure out if I understand what the problem is talking about and asking.				
					3. I like story problems. They make math more meaningful.					

Demographics

Conditions of Instruction		Gender		Ability Level			Age		Independent Student	
		Male	*Female*	*High*	*Average*	*Low*	*13*	*14*	*Yes*	*No*
Actual	7	5	2	2	3	2	4	3	3	4
Ideal	30	11	19	14	9	7	10	20	16	14

Table H-III
Normalized Factor Z-Scores
Factor Two: Achievement Oriented Mathematics Student

Statement	Number	Z-Score
I will take a good deal of math in high school.	23	1.845
My dad and/or mom expects a lot out of me in math.	42	1.717
Math is one of the easier subjects for me.	39	1.713
I want to complete the whole book by the end of the . . .	22	1.499
My dad and mom know that I am capable because they . . .	43	1.477
If I am paying attention, I can get most of my math . . .	28	1.084
I like the good feeling I get from being able to figure . . .	38	1.026
Math is one subject I can use in almost all my classes . . .	15	0.974
I want to get better at math this year.	19	0.894
I feel good when I do well on a math test, but I expect it.	36	0.846
Math is pretty important.	2	0.844
When I do well on a math test, I feel proud.	37	0.705
I like math.	4	0.679
I like to work math problems that sound complicated . . .	14	0.576
I try to understand the purpose and procedure so I can . . .	13	0.473
I really concentrate on making good grades in math.	20	0.424
I would like to receive money for good grades in math.	6	0.415
When I am working on a hard math problem, I try . . .	27	0.375
When I do well on a math test, I get excited and surprised.	34	0.294
I want more privileges from my parents as a reward for . . .	8	0.149
I rely on my calculator as much as possible when I get . . .	30	0.094
Math is the same problem over and over and over. I . . .	26	0.036
I put forth only as much effort as I need to get my . . .	24	0.035
I compare grades in math, but I don't try to boast about . . .	17	0.031
When I look at the answer to a math problem, I make . . .	32	-0.004
When I am working on a hard math problem, I make . . .	29	-0.125
The only math tasks I find interesting are the ones where . . .	5	-0.192
I like math because it makes me think.	11	-0.231
I try hard, work hard, and get everything done in math . . .	10	-0.262
I only compare grades in math so I can get the right . . .	18	-0.430
As a reward for making good grades in math, I don't get . . .	7	-0.479
The formulas in math help me build a foundation of . . .	12	-0.595
I don't want to look stupid at a store if I am buying . . .	21	-0.625
Math has too many rules about numbers, and I can't . . .	40	-0.688
I try to work as hard as I can in math.	33	-0.766
My parents say very little to me about what they expect . . .	41	-0.820
When I am working on a difficult math problem, I try . . .	31	-1.039
When I do poorly on a test, I tell my parents that I . . .	45	-1.106
I like story problems. They make math more meaningful.	3	-1.178
I struggle at taking tests in math.	35	-1.241
My dad or mom usually helps me at home on math . . .	44	-1.278
In engineering, the math things we do are interesting.	1	-1.624
I spend a lot of time studying for tests and quizzes in math.	25	-1.746
I will take the least amount of math possible in the future.	16	-1.772
I receive money for good grades in math.	9	-2.000

Table H-IV
Form Board
Factor Two: Achievement Oriented Mathematics Student

Array Positions

-5	-4	-3	-2	-1	0	1	2	3	4	5
MOST UNLIKE					**NEUTRAL**				**MOST LIKE**	
11	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
16. I will take the least amount of math possible in the future.	1. In engineering, the math things we do are interesting.	45. When I do poorly on a test, I tell my parents that I couldn't remember and I couldn't apply what we learned in class to the test.	21. I don't want to look stupid at a store if I am buying something and I don't have enough money. That is why I need to know math.	5. The only math tasks I find interesting are the ones where I am trying to figure something out.	8. I want more privileges from my parents as a reward for good grades in math. I want to do more things and have more space.	14. I like to work math problems that sound complicated to most people. Really they aren't complicated. They are pretty simple to figure out if I understand what the problem is talking about and asking.	19. I want to get better at math this year.	43. My dad and mom know that I am capable because they have seen how well I have done on past tests and in past grades.	39. Math is one of the easier subjects for me.	23. I will take a good deal of math in high school.
9. I receive money for good grades in math.	25. I spend a lot of time studying for tests and quizzes in math.	3. I like the story problems. They make math more meaningful.	40. Math has too many rules about numbers and I can't always remember them.	11. I like math because it makes me think.	30. I rely on my calculator as much as possible when I get to a hard math problem.	13. I try to understand the purpose and procedure so I can go further in math.	36. I feel good when I do well in math, but I expect it.	28. If I am paying attention, I can get most of my math homework done in class.	22. I want to complete the whole book by the end of the year so I can take more math in high school.	42. My dad and/or mom expect(s) a lot out of me in math.
		35. I struggle at taking tests in math.	33. I try to work as hard as I can in math.	10. I try hard, work hard, and get everything done in math. That, in itself, is an accomplishment for me.	26. Math is the same problem over and over and over. I sometimes slack off.	20. I really concentrate on making good grades in math. That is one of my top priorities.	2. Math is pretty important to me.	38. I like the good feeling I get from being able to figure out math problems that seem kind of hard.		
		44. My dad or mom usually help me at home on math when I need it.	41. My parents say very little to me about what they expect of me in math.	18. I only compare grades in math so I can get the right answer to the problems I missed.	24. I put forth only as much effort that I need to get my math homework done.	6. I would like to receive money for good grades in math.	37. When I do well on a math test, I feel proud.	15. Math is one subject I can use in almost all my classes and it can be used in so many fields.		
			31. When I am working on a difficult math problem, I try to do it two or three different ways and make sure that I get the same answer no matter how I set it up.	7. As a reward for making good grades in math, I don't get grounded.	17. I compare grades in math but I don't try to boast about doing well.	27. When I am working on a hard math problem, I try to remember what the teacher told us in math class.	4. I like math.			
				12. The formulas in math help me build a foundation of what most of life is based on.	32. When I look at the answer to a math problem, I make sure it makes sense and it sounds reasonable.	34. When I do well on a math test, I get excited and surprised.				
					29. When I am working on a hard math problem, I guess and check.					

Demographics

Conditions of Instruction		**Gender**		**Ability Level**			**Age**		**Independent Student**	
		Male	*Female*	*High*	*Average*	*Low*	*13*	*14*	*Yes*	*No*
Actual	11	5	6	8	3	0	4	7	9	2
Ideal	0	-	-	-	-	-	-	-	-	-

Table H-V
Normalized Factor Z-Scores
Factor Three: Effort Oriented Mathematics Student

Statement	Number	Z-Score
When I do well on a math test, I feel proud.	37	2.183
I want to get better at math this year.	19	1.926
When I am working on a hard math problem, I try to remember . . .	27	1.684
When I do well on a math test, I get excited and surprised.	34	1.549
I try to work as hard as I can in math.	33	1.500
If I am paying attention, I can get most of my math homework . . .	28	1.350
I like the good feeling I get from being able to figure out . . .	38	0.980
I compare grades in math, but I don't try to boast about doing . . .	17	0.922
I struggle at taking tests in math.	35	0.827
My dad and mom know that I am capable because they have seen . . .	43	0.817
When I look at the answer to a math problem, I make sure it . . .	32	0.790
My dad or mom usually help me at home on math when I need it.	44	0.789
I try to understand the purpose and procedure so I can go further . . .	13	0.720
Math has too many rules about numbers, and I can't always . . .	40	0.719
In engineering, the math things we do are interesting.	1	0.405
I rely on my calculator as much as possible when I get to a . . .	30	0.336
Math is the same problems over and over and over. I sometimes . . .	26	0.324
My parents say very little to me about what they expect of me in . . .	41	0.324
Math is pretty important.	2	0.265
I only compare grades in math so I can get the right answer.	18	0.255
I try hard, work hard, and get everything done in math. That . . .	10	0.085
I put forth only as much effort as I need to get my math . . .	24	-0.135
Math is one subject I can use in almost all my classes and . . .	15	-0.179
I would like to receive money for good grades in math.	6	-0.220
When I am working on a hard math problem, I guess and check.	29	-0.248
I spend a lot of time studying for tests and quizzes in math.	25	-0.304
I will take the least amount of math possible in the future.	16	-0.405
As a reward for making good grades in math, I don't get grounded.	7	-0.445
I like math because it makes me think.	11	-0.528
I like story problems. They make math more meaningful.	3	-0.534
When I do poorly on a test, I tell my parents that I couldn't . . .	45	-0.591
I want more privileges from my parents as a reward for good grades . . .	8	-0.619
I like math.	4	-0.632
I really concentrate on making good grades in math. That is one of . . .	20	-0.702
I like to work math problems that sound complicated to most . . .	14	-0.758
My dad and/or mom expects a lot out of me in math.	42	-0.840
I will take a good deal of math in high school.	23	-0.885
The only math tasks I find interesting are the ones where I am . . .	5	-0.887
The formulas in math help me build a foundation of what most of . . .	12	-1.017
I don't want to look stupid at a store if I am buying something and . . .	21	-1.067
I want to complete the whole book by the end of the year so I can . . .	22	-1.163
When I am working on a difficult math problem, I try to do it . . .	31	-1.417
I feel good when I do well in math, but I expect it.	36	-1.603
Math is one of the easier subjects for me.	39	-1.741
I receive money for good grades in math.	9	-1.833

Table H-VI
Form Board
Factor Three: Effort Oriented Mathematics Student

Array Positions

-5	-4	-3	-2	-1	0	1	2	3	4	5
MOST UNLIKE					**NEUTRAL**					**MOST LIKE**
11	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
39. Math is one of the easier subjects for me.	31. When I am working on a difficult math problem, I try to do it two or three different ways and make sure that I get the same answer no matter how I set it up.	5. The only math tasks I find interesting are the ones where I am trying to figure something out.	4. I like math.	16. I will take the least amount of math possible in the future.	18. I only compare grades in math so I can get the right answer to the problems I missed.	40. Math has too many rules about numbers and I can't always remember them	35. I struggle at taking tests in math.	33. I try to work as hard as I can in math.	27. When I am working on a hard math problem, I try to remember what the teacher told us in math class.	37. When I do well on a math test, I feel proud.
9. I receive money for good grades in math.	36. I feel good when I do well in math, but I expect it.	12. The formulas in math help me build a foundation of what most of life is based on.	20. I really concentrate on making good grades in math. That is one of my top priorities.	7. As a reward for making good grades in math, I don't get grounded.	10. I try hard, work hard, and get everything done in math. That, in itself, is an accomplishment for me.	1. In engineering the math things we do are interesting.	43. My dad and mom know that I am capable because they have seen how well I have done on past tests and in past grades.	28. If I am paying attention, I can get most of my math homework done in class.	34. When I do well on a math test, I get excited and surprised.	19. I want to get better at math this year.
		21. I don't want to look stupid at a store if I am buying something and I don't have enough money. That is why I need to know math.	14. I like to work math problems that sound complicated to most people. Really they aren't complicated. They are pretty simple to figure out if I understand what the problem is talking about and asking.	11. I like math because it makes me think.	24. I put forth only as much effort that I need to get my math homework done.	30. I rely on my calculator as much as possible when I get to a hard math problem.	32. When I look at the answer to a math problem, I make sure it makes sense and it sounds reasonable.	38. I like the good feeling I get from being abile to figure out math problems that seem kind of hard.		
		22. I want to complete the whole book by the end of the year so I can take more math in high school.	42. My dad and/or mom expect(s) a lot out of me in math.	3. I like story problems. They make math more meaningful.	15. Math is one subject I can use in almost all my classes and it can be used in so many fields.	26. Math is the same problems over and over and over. I sometimes slack off.	44. My dad or mom usually helps me at home on math when I need it.	17. I compare grades in math but I don't try to boast about doing well.		
			23. I will take a good deal of math in high school.	45. When I do poorly on a test, I tell my parents that I couldn't apply what we learned in class to the test.	6. I would like to receive money for good grades in math.	41. My parents say very little to me about what they expect of me in math.	13. I try to understand the purpose and procedure so I can go further in math.			
				8. I want more privileges from my parents as a reward for good grades in math. I want to do more things and have more space.	29. When I am working on a hard math problem, I guess and check.	2. Math is pretty important.				
					25. I spend a lot of time studying for tests and quizzes in math.					

Demographics

Conditions of Instruction		Gender		Ability Level			Age			Independent Student	
		Male	*Female*	*High*	*Average*	*Low*	*13*	*14*	*15*	*Yes*	*No*
Actual	8	1	7	1	2	5	1	6	1	1	7
Ideal	0	-	-	-	-	-	-	-	-	-	-

Table H-VII
Factor Q Sort Values for Each Statement
Array Positions

Statement	Number	Factor Arrays 1	2	3
In engineering, the math things we do are interesting.	1	1	-4	1
Math is pretty important.	2	2	2	1
I like story problems. They make math more meaningful.	3	0	-3	-1
I like math.	4	5	2	-2
The only math tasks I find interesting are the ones where I am trying . . .	5	-2	-1	-3
I would like to receive money for good grades in math.	6	-3	1	0
As a reward for making good grades in math, I don't get grounded.	7	-3	-1	-1
I want more privileges from my parents as a reward for good grades . . .	8	-2	0	-1
I receive money for good grades in math.	9	-3	-5	-5
I try hard, work hard, and get everything done in math. That, in itself. . .	10	1	-1	0
I like math because it makes me think.	11	4	-1	-1
The formulas in math help me build a foundation of what most of . . .	12	2	-1	-3
I try to understand the purpose and procedure so I can go further in . . .	13	2	1	2
I like to work math problems that sound complicated to most people.	14	1	1	-2
Math is one subject I can use in almost all my classes, and it can be . . .	15	1	3	0
I will take the least amount of math possible in the future.	16	-5	-5	-1
I compare grades in math, but I don't try to boast about doing well.	17	-1	0	3
I only compare grades in math so I can get the right answer to the . . .	18	-1	-1	0
I want to get better at math this year.	19	2	2	5
I really concentrate on making good grades in math. That is one of . . .	20	4	1	-2
I don't want to look stupid at a store if I am buying something and . . .	21	-1	-2	-3
I want to complete the whole book by the end of the year so I can . . .	22	3	4	-3
I will take a good deal of math in high school.	23	3	5	-2
I put forth only as much effort as I need to get my math homework . . .	24	-4	0	0
I spend a lot of time studying for tests and quizzes in math.	25	3	-4	0
Math is the same problems over and over and over. I sometimes . . .	26	-5	0	1
When I am working on a hard math problem, I try to remember what. . .	27	0	1	4
If I am paying attention, I can get most of my math homework done . . .	28	0	3	3
When I am working on a hard math problem, I guess and check.	29	-1	0	0
I rely on my calculator as much as possible when I get to a hard math . . .	30	-2	0	1
When I am working on a difficult math problem, I try to do it two or . . .	31	2	-2	-4
When I look at the answer to a math problem, I make sure it makes . . .	32	1	0	2
I try to work as hard as I can in math.	33	5	-2	3
When I do well on a math test, I get excited and surprised.	34	-2	1	4
I struggle at taking tests in math.	35	-4	-3	2
I feel good when I do well on a math test, but I expect it.	36	1	2	-4
When I do well on a math test, I feel proud.	37	0	2	5
I like the good feeling I get from being able to figure out math . . .	38	0	3	3
Math is one of the easier subjects for me.	39	3	4	-5
Math has too many rules about numbers and I can't always . . .	40	-3	-2	1
My parents say very little to me about what the expect of me in math.	41	-1	-2	1
My dad and/or mom expects a lot out of me.	42	0	5	-2
My dad and mom know that I am capable because they have seen . . .	43	0	3	2
My dad or mom usually helps me at home on math when I need it.	44	-1	-3	2
When I do poorly on a test, I tell my parents that I couldn't . . .	45	-2	-3	-1

2

VITA

Gayla Imler Howell

Candidate for the Degree of

Doctor of Education

Thesis: CHARACTERISTICS THAT IDENTIFY SUCCESS IN THE MATHEMATICS CLASSROOM AS PERCEIVED BY ADOLESCENTS: A Q-METHOD STUDY

Major Field: Curriculum and Instruction

Biographical:

Personal Data: Born in Boise City, Oklahoma, May 4, 1969 to Roy and Melva Imler. Married to Steve Howell, August 3, 1991.

Education: Graduated from Boise City High School, Boise City, Oklahoma in May 1987; received Bachelor of Science degree in Elementary Education with endorsements in mathematics and science from Southwestern Oklahoma State University, Weatherford, Oklahoma, in December 1991; received Master of Arts degree from Southern Nazarene University with a major in Curriculum and Instruction - Early Childhood Education in Bethany, Oklahoma, May 1996. Completed the requirements for the Doctor of Education degree with a major in Curriculum and Instruction - Math Education at Oklahoma State University, Stillwater, Oklahoma, July 2000.

Experience: Middle school reading and social studies teacher at Hennessey, Oklahoma from 1992-1993; Junior High school science and mathematics teacher at Okarche, Oklahoma from 1993-1995; Physical education teacher K-6 at Okarche, Oklahoma from 1993-1995; Sixth grade elementary teacher at Okarche, Oklahoma from 1995-1998; Oklahoma State University Writing Project teacher consultant at Stillwater, Oklahoma from 1997 to present; Eighth grade science teacher at Westminster Middle School, Oklahoma City, Oklahoma from 1998 to present.

Professional Memberships: National Science Teachers Association, Oklahoma Education Association, National Education Association, Kappa Delta Phi, Oklahoma Council of Teachers of Mathematics, International Society for the Scientific Study of Subjectivity.