A COMPARISON OF THE ACADEMIC INTRINSIC MOTIVATION
OF GIFTED AND NON-GIFTED FIFTH GRADERS
TAUGHT USING COMPUTER SIMULATIONS
AND TRADITIONAL TEACHING METHODS

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF EDUCATION

By
Christine Edwards Dittrich, B.A.Ed., M.Ed.
Denton, Texas
December 1998

This study investigated the use of interdisciplinary computer-based simulations compared to traditional teaching methods. The academic intrinsic motivation of gifted and non-gifted students was analyzed using a quasi-experimental design, similar to a pretest/posttest design.

Students selected for this study were from a large suburban school district in north Texas. The students were from two in-tact groups of fifth grades at two different elementary schools. There were a total of 183 subjects in the study.

The experimental group was taught using two multi-disciplinary computer simulations as part of a twelve week unit of study. These simulations include reading, math, science, and social studies content, and require approximately twenty-five hours to complete. The control group was taught the same content using traditional teaching methods.

Pretest and posttest scores on the Children's Academic Intrinsic Motivation Inventory were used for analysis. This measurement tool
includes subscales for general orientation toward schooling, reading, math, science, and social studies.

Analysis of the data revealed no statistical differences and negligible effect sizes in general orientation toward schooling, reading, math, science, and social studies for both gifted and non-gifted students.

It is recommended that further studies be conducted to investigate the use of computer simulations over a longer period of time, and at other grade levels. It is also recommended that other dependent variables be investigated.
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CHAPTER 1

INTRODUCTION

Persons, children or adults, are interested in what they can do successfully, in what they approach with confidence and engage in with a sense of accomplishment. Such happiness or interest is not self-conscious or selfish; it is a sign of developing power and of absorption in what is being done.

Dewey, 1913, p. 35

The desire to seek and to conquer challenges is at the core of intrinsic motivation in the classroom. It is fueled by students’ psychoacademic needs to control their own decisions...; to do things that help them feel successful...; to feel good about who they are; and to find pleasure in what they do.

Raffini, 1996, p. 3

Even though over 80 years separate these two statements, Dewey and Raffini address essentially the same principle, one many educators feel is the key to successful learning. Dewey refers to it as “interest,” while researchers of late, including Raffini, refer to it as “intrinsic motivation.” More specifically,
academic intrinsic motivation is the internal drive for learning through challenging, novel, and difficult tasks in school. This internal drive can be observed in many situations and at different stages of life, from a preschooler engrossed in a puzzle, to an adult absorbed in a novel. Dewey (1913) writes, "If we can secure interest in a given set of facts or ideas, we may be perfectly sure that the pupil will direct his energies toward mastering them" (p. 1). In line with Dewey's expectations, academic intrinsic motivation has been linked to higher student achievement by promoting active engagement in learning (Gottfried, 1985; Terrell & Rendulic, 1996; Nastasi & Clements, 1994). Since this intrinsic motivation is such a powerful force in learning, a key challenge for educators is to foster this quality by providing rigorous, yet enjoyable learning experiences allowing for student success.

One popular method teachers have used to provide this type of experience is educational simulations. They have been used from elementary schools to graduate schools in vast contexts and disciplines. They allow students to role play people engaged in real-life pursuits. The aspects of real life are simplified and presented in a way controlled in the classroom (Joyce, Weil & Showers, 1992). There is some degree of research-based consensus on the effectiveness of simulations to increase student motivation. Many different theories attempt to explain why this is true. Among the explanations, some researchers have found simulations to be motivational
because they generate enthusiasm, excitement, and enjoyment, and because students are actively involved in their learning (Rakes & Kutzman, 1982).

Given the effectiveness of simulations and the recent proliferation of computers in the classroom, there has been increased interest in using computers to present these simulations. Substantial amounts of research have been conducted to determine the effects of this pairing. For example, Teague and Teague (1995) have found computer simulations effective due to their immediate and relevant feedback. Since simulations and computer use have each been shown to increase intrinsic motivation, it seems only natural together they could be more beneficial.

As more computer simulations become available, researchers will be able to determine which children they motivate, and under what conditions. When comparing different groups of children on their intrinsic motivation levels, gifted children scored significantly higher than non-gifted children in all areas (Colangelo, Kelly & Schrepfer, 1987; Karnes & Whorton, 1988). Simulations may further increase gifted children’s motivation by giving them experiences to control, manipulate, and explore. What effect computer simulations have on the motivation of gifted and non-gifted students alike is not yet known.

Given what still needs to be studied pertaining to the value of motivation, the ability of some computer simulations to increase motivation, and the motivational characteristics of gifted and non-gifted children, there
appears to be a vast array of research topics to explore. Many studies have been conducted on motivation and simulations, but few on academic intrinsic motivation and instructional simulation software. This study is one attempt to clarify the relationship between academic intrinsic motivation and computer simulations. In short, it looks at the effects of using multi-disciplinary computer simulations as an integral part of instruction for both gifted and non-gifted learners.

Statement of Problem

The problem for this study is to compare the academic intrinsic of gifted and non-gifted fifth graders using computer simulations and traditional instructional methods. The measurement instrument used is the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986). One subscale is general academic intrinsic motivation. The four discipline subscales include academic intrinsic motivation in reading, math, science, and social studies.

Purposes of Study

With the prevalence of computer simulations in schools today, it is important for educators to explore the impact of these simulations on students in different subject areas. The purposes of this study are to discover
whether significant differences exist between the academic intrinsic motivation of students who use computer simulations and those students taught using traditional teaching methods. More specifically, this study will attempt to discover whether a significant difference exists in academic intrinsic motivation of gifted and non-gifted students who use computer simulations and those taught using traditional teaching methods. It is important for educators to understand the impact of the curriculum and instructional methods have on students at all ability levels.

Hypotheses

1. The difference score on various scales of academic intrinsic motivation for a group of fifth grade students identified as gifted taught using multidisciplinary computer simulations will be significantly higher than the difference scores of a control group of fifth grade students identified as gifted taught using traditional teaching methods.

1a. Gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the General Orientation Toward School Learning scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods.
1b. Gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Reading scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods.

1c. Gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Math scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods.

1d. Gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Science scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods.

1e. Gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Social Studies scale of the
Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than
gifted fifth grade students taught using traditional teaching methods.

2. The difference score on various scales of academic intrinsic
motivation for a group of non-gifted fifth grade students taught using multi-
disciplinary computer simulations will be significantly higher than the
difference scores of a control group of non-gifted fifth grade students taught
using traditional teaching methods.

2a. Non-gifted fifth grade students taught using multidisciplinary
computer simulations will have difference scores from pretest to posttest
significantly higher on the General Orientation Toward School Learning scale
of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986)
than non-gifted fifth grade students taught using traditional teaching
methods.

2b. Non-gifted fifth grade students taught using multidisciplinary
computer simulations will have difference scores from pretest to posttest
significantly higher on the Academic Intrinsic Motivation in Reading scale of
the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986)
than non-gifted fifth grade students taught using traditional teaching
methods.
2c. Non-gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Math scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods.

2d. Non-gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Science scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods.

2e. Non-gifted fifth grade students taught using multidisciplinary computer simulations will have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Social Studies scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods.
Limitations

1. *Go West!* (Edunetics Interactive, 1996) and *Frontier Ahead* (Edunetics Interactive, 1998), the two computer simulations used in this study, are both multi-disciplinary simulations and include reading, math, science, and social studies objectives. Like *Go West!* and *Frontier Ahead*, many simulations address two or more disciplines; however, broad generalizations cannot be made to other simulations addressing a single discipline.

2. This study provides information about the effects of computer simulations on academic intrinsic motivation in a population of fifth grade students. Broad generalizations cannot be made about simulations' effects on intrinsic motivation in primary or secondary grades.

3. This study provides information about the effects of curriculum related computer simulations used in a school setting. Broad generalizations cannot be made to computer simulations used in other contexts, including home use.

Basic Assumptions

This current research assumed the measurement instrument, Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986), was given under
similar conditions using the instructions provided by the author, and students answered to the best of their ability. It is also assumed the teachers involved in the study followed the scope and sequence of the curriculum specified for fifth grade at the time of the study.

Definition of Terms

Academic intrinsic motivation – “enjoyment of school learning characterized by an orientation toward mastery, curiosity, persistence, and the learning of challenging, difficult, and novel tasks” (Gottfried, 1985, p. 631). For this study, academic intrinsic motivation was measured by the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986).

*Frontier Ahead* (Edunetics Interactive, 1998)– a multidisciplinary computer simulation created for fifth grade students. It was designed as an integral part of the curriculum being used by teachers in this study. It was used throughout a six week period of instruction, requiring approximately ten to fifteen hours to complete.

Gifted learners –students identified and placed in the school district’s gifted program. Students’ placement in the program was determined by performance on a battery of tests and rating scales. These included the Otis
Lennon School Abilities Test (OLSAT), Screening Assessment for Gifted Elementary Students (SAGES), Stanford Achievement Test given one year above grade level, teacher survey, creative writing task, problem solving task, and other non-verbal activities. For the purpose of placement, point values were assigned to ranges of scores on each of the three tests, four tasks, and teacher rating scale. Using this data, an individual program identification profile was completed which is used for determining placement. A minimum total number of points were needed to qualify for the program. The gifted program elementary identification profile and placement standards are presented in the appendix. The students in the gifted program comprise the upper 5% of the total student population of the district.

Go West! (Edunetics Interactive, 1996) – a multidisciplinary computer simulation created for fifth grade students. It was designed as an integral part of the curriculum being used by teachers in this study. It was used throughout a six week period of instruction, requiring approximately ten to fifteen hours to complete.

Multidisciplinary computer simulation – software designed to engage students in role playing situations depicting real world scenarios. Students must utilize problem solving and decision making skills in a variety of subject areas to maneuver through the simulation.
CHAPTER 2

REVIEW OF LITERATURE

Because this study involves using multi-disciplinary computer simulations with gifted and non-gifted students, and the effects of these simulations on academic intrinsic motivation, the review of literature is divided into several sections. The first section, "Teaching with Simulations," defines simulations and describes their known benefits. The next section, "Simulations and Intrinsic Motivation," explains what researchers have found about simulations and intrinsic motivation. In "Theories of Intrinsic Motivation," there is a discussion of intrinsic motivation, including its definition, how it may develop, and its importance. Gifted learners differ from non-gifted learners in their motivation levels, as discussed in the fourth section, "Intrinsic Motivation and Gifted Learners." Finally, a discussion of simulations and motivation levels of gifted and non-gifted learners in the summary concludes the literature review.

Teaching with Simulations

The term simulation is difficult to define because of the wide variety of instructional techniques often categorized as such. In general, a simulation
involves students playing roles of persons engaged in real-life pursuits. The aspects of real life are simplified and presented in a way that can be controlled in the classroom (Joyce, Weil & Showers, 1992). Only the most critical variables of the environment may be included in the simulation, so students can focus on key elements. A simulation can serve as a vehicle for exploring the inner workings of real-life experiences on a level appropriate for the development of the learner (Heitzmann, 1983). A simulation abstracts important aspects of reality without having to reproduce all of it (Diulus & Baum, 1991). A simulation affords children the chance to learn about things too dangerous, too abstract, too complex, too lengthy, or too distant to be easily studied in the classroom. The learning takes place as the student explores the simulated environment; thus, there is often a strong emphasis on the progress through the simulation, not just the end result (Randel, Morris, Wetzel & Whitehill, 1992; Marks, 1992).

The terms “simulation” and “game” are often used interchangeably; however, this is inaccurate. Game implies direct competition, with the focus more on enjoyment than learning (Jones, 1980; Jones, 1985). Simulations usually involve students experiencing a situation with no winners or losers. Just as in the reality being simulated, there are successes and failures; thus, there are aspects of the simulation children will not enjoy. Teague and Teague (1995) write, “Two characteristics, realism and relevance, seem to separate simulations from outright games and make their use an excellent
teaching and learning activity” (p. 22). While simulations and games do share many characteristics, simulations have more potential for instructional use in the content areas.

There are distinct differences between simulations and role playing also, although these terms are often used interchangeably. Even though both might involve portraying identities, role playing involves students taking on another personality and making decisions based on how a character would react (Jones, 1980, 1985). Simulations have students only changing function, job, or duty (Jones, 1985). In simulations, students make decisions and take action based on their understanding of the situation, not as a character they are portraying would react (Jones, 1980). Role playing is often less structured, with less direction, and may not be based on realistic situations. The authentic problem solving elements of simulations differentiate them from role-playing scenarios.

Successful simulations have four distinct phases. The first is the orientation, where students learn the concepts to be studied and background information they will need to help them make decisions. Phase two is participant training which includes declaring rules and procedures and assigning roles. Next is the action, where the students carry out the simulation. The fourth phase of the simulation is debriefing. During the debriefing session the students may summarize the events, analyze the
process, compare the simulation to the real world, or discuss insights (Joyce, Weil & Showers, 1992).

Research has shown numerous advantages in the use of simulations, both computer and non-computer based, as instructional tools. They are unique in their ability to allow students active involvement with problem solving in a realistic context. Thatcher (1990) writes, “Fundamental to all learning is some kind of active experience. The learner has to be engaged and to be involved with the material or skill to be able to learn” (p. 264). In using simulations, students’ learning is perceived, and not received (Diulus & Baum, 1991). Research shows one reason teachers use simulations is to address their students’ needs for autonomy (Hootstein, 1995; Jones, 1980). Another important strength of simulations is the chance they offer students to analyze situations, determine possible solutions, and implement them (Diulus & Baum, 1991). Researchers have found the use of simulations improved children’s understanding of rules (Degelman, Free, Scarlato, Balckburn & Golden, 1986), higher-order thinking (Nastasi & Clements, 1994), and metacognition (Clements, 1986; Lehrer, 1986; Lehrer & Randle, 1987; Miller & Emihovich, 1986). Simulations allow students to solve problems that, “illustrate interactive, whole systems, organize and integrate complex skills, and show how individual actions affect complex systems. Games simulate whole systems, not parts, forcing players to organize and integrate many skills” (Betz, 1995, p. 195). In a study of college students using computer
simulations, significant improvements were found in the science process skills of identifying and stating hypotheses, designing investigations, and interpreting data and graphs (Farynjarz, Lockwood, 1992). However, Bredemeier and Greenblat (1981) warn against inaccurate simulations. “If the content of a game doesn’t truly represent the reality it is supposed to represent, participants may enjoy the game experience but cannot be expected to learn the ‘right things’ from it” (p. 311). When used correctly, the potential for a simulation to be an effective educational method is heightened by the fact it requires active participation to solve problems in a realistic activity.

The results of studies on attitudinal changes resulting from the use of simulations are inconclusive. Livingston and Kidder (1973) found students’ political attitudes were affected more by simulations than traditional teaching methods, and others have reported significant attitudinal changes in regard to racism from using simulations (Bredemeier & Greenblat, 1981). However, DeVries and Slavin (1978) reported using a simulation does not influence student satisfaction or attitude toward school. Specific variables may determine a simulation’s effect on attitudinal changes. Williams (1980) conducted research with high school students and determined the amount to which attitudes were changed was based on how much the student identified with his or her role in the simulation. He also noted students’ personalities affect their attitudinal propensity for being affected by simulations. “The available evidence thus suggests under certain circumstances and for some
students simulation-gaming can be more effective than traditional methods of instruction in facilitating positive attitude change toward the subject and its purposes” (Bredemeier & Greenblat, 1981, p. 324).

Students’ interest in simulations verses traditional methods of instruction is generally high. Simulations often lead to increased interest because they are student-centered and students have power over their learning (Heitzmann, 1983; DeVries & Edwards, 1973; Sleet, 1985; Straus, 1986). In 1995, Betz conducted a study in which students used a computer simulation and read information about city planning to gain information. Of the subjects, 82% said they would, given a choice, select a simulation over reading material. In a study of students learning basic electronics, 68% preferred the practice circuit problems simulated on the computer to other methods of instruction (Whitehill & McDonald, 1990). The greater interest in games is evident, even when controls for initial novelty have been used (Randel, Morris, Wetzel & Whitehill, 1992). Given the diverse populations included in these studies, the implication is simulations are interesting to most students, regardless of grade level or discipline.

Simulations are effective for teaching specific skills and facts. A study of students using economy simulations in a college course showed students had comparable learning gains in seven hours of simulation instruction to other students’ twelve hours of traditional instruction (Raghaven & Katz, 1989). Since the learning takes place over a shorter amount of time, some might
question whether the retention of this information is comparable with traditional instruction. Several studies have found retention over time is higher for students using simulations than those who were taught with traditional instructional methods (Cohen & Brandley, 1978; Pierfy, 1977; Watson, 1988; Heitzmann, 1983). In one summary article, Randel, Morris, Wetzel, Whitehill (1992) found ten of fourteen studies showed significantly more information retained after a period of time, even though seven of those ten showed no difference on posttests given immediately after instruction.

Simulations have proven effective in many disciplines, but are often associated with science and social studies. For science instruction they have been used in a variety of contexts. In a study of high school chemistry classes, students reported the advantages to completing experiments using computer simulations included immediate feedback, and the ability to easily alter an experiment and compare results. Improved achievement in chemistry and proper use of science process skills were reported (Geban, Askar, and Ozkan, 1992). Significant differences in dynamics conceptions were found with eight grade students learning with computer simulations on free fall and horizontal motion (Weller, 1995). White (1993) found sixth graders using computer simulations for learning force and motion concepts were better able to apply their understanding in real world contexts than eight graders taught the same concepts through conventional methods. The strengths of
computer simulations in science instruction seem to be their ability to represent conditions students otherwise would not be able to experience.

Similar benefits have been found in social studies instruction with the use of computer simulations. Teachers can allow students to visualize mental images of places and times absent from their present experiences. The students may explore in detail and be able to identify with a situation more vividly than if they were to study it through text and pictures (Hootstein, 1995). Klenow (1992) writes, "students role-play, debate, solve realistic dilemmas, and explore the complexities involved in decision-making as they learn about a specific place or time" (p. 66). Simulations help students to make a connection between historical figures and events and their own lives (Hootstein, 1995). With social science teachers often searching for ways to engage students in historical study, it seems simulations may be an effective method of addressing this need.

Simulations and Intrinsic Motivation

Perhaps the most advantageous reason to use simulations is their apparent effect on intrinsic motivation, this effect being shown from elementary to college students. In one study using end-of-course evaluations for classes using simulations, it was found college students frequently mentioned the simulation experiences as an excellent aspect of a course.
Overall, they enjoyed the class and found the simulations motivating (Bredemeier & Greenblat, 1981). Similar results were found in a 1995 study of secondary social studies teachers determining which instructional methods were most used to increase student motivation and why the teachers felt these methods were effective. The teachers overwhelmingly responded simulations were their best tools, and students concurred they were motivated by simulations. Simulations were said to, “encapsulate in simplified form the essential elements of real-life historical situations, and present these elements to be dealt with by the students” (Hootstein, 1995, p. 24). In a study of third graders who programmed in Logo, a computer simulation environment, the students’ ideas of themselves as learners improved (Burns & Hagerman, 1989). Despite these findings, in a study of fifth graders, no significant difference was found in locus of control and achievement motivation in students using Logo and those having traditional teaching methods (Tyler & Vasu, 1995).

Perhaps the conflicting findings are not due to the different simulations, but to the different types of students using them or the different psychological constructs assessed. Heitzmann (1983) found one of the most consistent and strong claims for using simulations is increased motivation, especially for underachievers, disadvantaged students, and inner-city students. Orbach (1977) found increases in motivation are related to many variables within the student, including learning style, identification with the role in the
simulation, learning atmosphere, and rank in outcome. Covington (1992) suggests games and role playing are good for increasing intrinsic motivation. "It is the combination of the joyous and creative coexisting with the serious side of play - the analytic, the empirical, and the deliberate - that most recommends gaming and role playing as ideal vehicles for encouraging both the will to learn and the capacity to think" (p. 217).

Simulations can be presented using many different methods. The use of computers for this purpose continues to increase as they become more and more powerful. With this, come new questions about the impact of computer simulations on students' motivation. Computer simulations have been found to be motivational because they generate enthusiasm, excitement, and enjoyment and because students are actively involved in their learning (Rakes & Kutzman, 1982; Wesson, Wilson & Mandlebaum, 1988). In a study of motivation and computer simulations, Laurillard (1990) writes, "In simulation software, in which the focus is on problem solving, one of the intended advantages of using computers is learners may test hypotheses against the program’s model" (p. 23). In essence, the student is motivated to "beat" the computer and thus be in control of the learning (Cope and Simmons, 1994). Another advantage of the computer simulation is its effectiveness in increasing student motivation through near-instant, real time feedback, directly resulting from each choice or decision the student makes (Ediger, 1988; Vockell, 1990). This allows them to try different decisions
and analyze the wisdom of each choice (Joyce, Weil & Showers, 1992). This feedback also encourages systematic thinking in problem solving situations (Klein & Freitag, 1991) and fosters cognitive growth (Nastasi and Clements, 1994). Many researchers have found the motivational benefits of computer use and simulations, so it seems only logical together they would be effective.

It has been found computer simulations are especially effective teaching tools for gifted children. Orbach (1979) found them effective in promoting motivation because of gifted children’s high need for achievement, and because of the challenge involved with many simulations. The students have a chance to choose, explore, and manipulate factors within the learning environment. Especially helpful for gifted students, “simulation allows gifted children the opportunity to be wrong and to find out it is okay to be wrong” (Marks, 1992, p. 25).

Theories of Intrinsic Motivation

Those persons who are intrinsically motivated show enjoyment in learning, take pride in their accomplishments, and recognize personal benefit gained from doing a task (Brophy, 1983). They are curious, spontaneous, and like to explore because they are interested in their surroundings. Those who are intrinsically motivated engage in activities simply because they want to
(Brophy, 1998), and their primary motivators are immediate, internal gains (Deci & Ryan, 1985).

There are many conflicting theories as to how intrinsic motivation is developed and maintained (Berlyne, 1965; Bruner, 1966; Deci, 1975). Some theorists believe motivation is fueled by a drive for achievement in a particular area. Covington (1992) describes it as “an internal state, need, or condition that impels individuals toward action” (p. 13). The action may be done for a variety of reasons, including attempts to attain excellence, obtain promotion, improve on past experiences, increase speed, increase quality, or become more efficient (Alschuler, Tabor & McIntyre, 1975). Some people may be motivated by a drive to find innovative, unique solutions to difficult problems. This self-determination encourages people to extend their capabilities to find satisfaction (Condry & Stokker, 1992; Deci & Ryan, 1991; Deci & Ryan, 1985). It is this inner drive for achievement some theorists believe is the basis of intrinsic motivation.

Still other theorists believe motivation is fueled by goals attainable only through personal effort (Covington, 1992). The incentive for motivation here is the person’s perceived internal locus of control. If a student feels his or her actions will affect change, motivation is increased. If it is perceived outside forces will affect change despite the actions of the student, motivation will decrease. Weiner (1972) suggests “perception of one’s effort is the most important cause of future achievement behavior” (p. 392). Having attributed
previous successes to personal responsibility, one is more likely to work
toward a goal and persevere until the goal is reached. Perceived external
control over behavior leads to a reduction in motivation (Covington, 1992;
de Charms, 1976; Lepper 1983). When someone sees an opportunity and is
motivated, they set goals and define personal actions needed to accomplish
the goal (Brophy, 1998). The purpose of a goal can be toward attaining success,
or avoiding failure (Heckhausen, Schmalt & Schneider, 1985; Covington,
1992). “Motivation consists of the anticipation of possible actions expected to
lead to an outcome that will have certain consequences, which will possibly
bring the person closer to a superordinate goal” (Heckhausen, Schmalt and
Schneider, 1985, p. 26). Based on this theory only through successes based on
personal action can one’s motivation be developed and maintained.

Alternately, Csikszentmihalyi (1993) believes motivation is driven by a
person’s emotions. He emphasizes the importance of any experience where
someone becomes absorbed in a task. “Intrinsically motivated activities are
ones characterized by enjoyment, those for which the reward is the ongoing
experience of enjoying the activity” (p. 192). For this to happen, the person
must be in what Csikszentmihalyi refers to as flow. Here the perceived level
of challenge and perceived level of ability are both at high levels (Deci &
Ryan, 1985). For flow to occur, the environment must be optimally
challenging and provide effective, relevant feedback concerning performance
(Clifford, 1991; Csikszentmihalyi, 1975). When someone is in "flow" the motivation is high for the activity to continue for a substantial amount of time. This situation may happen in novel or familiar situations. If the person is not motivated in the task, he or she will instead be frustrated, bored, or apathetic, depending on the level of threat of the activity, and his or her own perceived level of competence.

Cognitive theorists believe intrinsic motivation increases when children have novel experiences from which they attempt to understand and assimilate new knowledge into their current understanding. The motivation can be seen in their curiosity, exploration, and investigation (Gottfried, 1983). Based on the work of Piaget, cognitive theorists believe when a child encounters a discrepant experience beyond his or her schemata, the child experiences cognitive conflict. This conflict is resolved when the child accommodates the new information. Children are motivated to explore when the event is "optimally different," being neither too familiar or too novel (Gottfried, 1983; Mischel, 1971). Based on this theory, intrinsic motivation occurs only in novel situations.

Some theorist argue all children are intrinsically motivated to learn and the activities of learning and discovery are rewarding in their own right because they allow a child to feel competent and successful in his or her environment (Deci, 1975). Competence theorists suggest motivation derives from perceptions of competence in novel situations, which can be seen in
persistence and exploration (Gottfried, 1983). This motivation leads people to take on challenges within their capabilities yet challenging enough to warrant feelings of accomplishment upon successful completion (Deci, 1975; Deci & Ryan, 1985). With each success, a person’s perception of his or her competency is enhanced, and she is thus more likely to undertake challenges in the future (Bandura, 1986; Schunk, 1989). Motivation is thus fostered with successes and diminished with failure.

Nicholls (1983) suggests there are two different types of intrinsic motivation, both driven by the desire to develop or demonstrate high rather than low ability. Students develop these based on their experiences in learning. The first, ego-involvement, is evident when the focus is on self, specifically maintaining dignity and not appearing foolish. Merely being right or wrong is important, not the continuation of learning. Seeking help is seen as an admission of low ability. Students in situations where they are ego-involved will likely be anxious if they perceive themselves as less capable than others. Alternately, task-involved students focus on the task, and not on themselves. Learning and understanding are the goal, and feelings of competence and enjoyment come from gaining new insight and improving performance. It is assumed more effort will be rewarded with more learning. Asking for help is merely another tool for reaching success. Students who feel less able often are more successful in task-involved conditions, and those who feel more able are successful in both ego-involved and task-involved
situations (Brockner, 1979; Brockner & Hulton 1978). Nichols (1983) suggests teachers who encourage student autonomy rather than teacher control produce higher levels of task-involvement. Task-involvement motivation is beneficial to learning, and ego-involvement hinders learning.

Just as the type of intrinsic motivation may vary from child to child, so too can the motivation level in one child vary, depending on the situation in which he or she is involved. Harter suggests some students are consistently intrinsic or extrinsic in all subjects, suggesting motivational attributes are an inherent trait. Harter also suggests also some students are intrinsically motivated in some subjects, yet not in others; thus, their motivational level is not a trait. This theory developed from findings showing many students whose general internal motivation was in the average range yet correlations of motivation in different subject areas were present. Further study shows for both types of students, perceived scholastic competence is a major predictor of motivational level. Those students who felt competent often endorsed an intrinsic orientation, whereas students who felt incompetent often felt motivated by external forces (Harter, 1992).

Despite the many opposing theories explaining motivation, there is consistent research showing the value of intrinsic motivation. Researchers have found a correlation with motivation and achievement. Children in grades four through eight with higher academic intrinsic motivation also had higher school achievement. They perceived themselves as more competent
and had lower academic anxiety (Gottfried 1982, 1983; Terrell and Rendulic, 1996).

Increasing academic intrinsic motivation in elementary school is especially important, as Harter found a gradual decline in motivation from third to sixth grade, especially for girls in math and science. Ecceles & Midgley (1988, 1990) suggest the lack of fit between junior high school students and the school environment is the cause. As students seek autonomy, the school becomes more controlling. As students need more adult support outside their families, teachers become more impersonal. Their decreased motivation may negatively impact their academic performance, and erode their perception of confidence. Nicholls (1983) writes, “There is evidence to support the view that, if teachers create and sustain the right motivation, many other educational problems will solve themselves” (p. 211).

Intrinsic Motivation and Gifted Learners

In studying motivation theories, it is important to consider gifted learners separately. Motivation, or task commitment, is often included in definitions of giftedness. It is one of the three components Renzulli (1978) suggests must be present to identify a gifted learner. Motivation is the catalyst gifted children must have to transform their abilities into talents (Gagne, 1985).
Emphasis on motivation and gifted students is supported by research showing the differences in motivational levels of gifted and non-gifted students. Elementary gifted students scored significantly higher than did non-gifted students on the School Attitude Measure which includes a subscale of motivation for schooling, concerned with the effects of previous school experiences on students' motivation for school (Colangelo, Kelly & Schrepfer, 1987). A comparable study conducted with just fifth graders using the same measurement instrument supported the previous findings; gifted students scored significantly higher on the subscale for motivation (Karnes & Whorton, 1988). In a longitudinal study involving primary and intermediate aged gifted and non-gifted children, it was found at every age level, the academic intrinsic motivation scores of the gifted children were significantly higher in math, reading, social studies, and science, as well as the general motivation for schooling, as seen in the Children's Academic Intrinsic Motivation Inventory (Gottfried & Gottfried, 1996).

This motivation is often associated with gifted students' confidence and their belief in control of learning outcomes. Gifted students find successes and failures are based on personal effort (Eriksson, 1990; Mulcahy, Wilgosh & Peat, 1991; Vallerand, 1994; Chan, 1996). For gifted students especially, effort is expended primarily in environments providing challenge and allowing them to test their skills and develop perceptions of competence (Vallerand, 1994). The curriculum must be rewarding and challenging to meet their creative
and intellectual needs (Davis & Rimm, 1989). If these types of experiences are not available at school, gifted students' motivation may suffer.

Low motivation of gifted students is often associated with underachievement. Characteristics of underachievers include poor academic performance, difficulty in peer relationships, low self esteem, indifferent or negative attitudes of school, and avoidance behavior. Underachievement can have serious consequences. Ten to twenty percent of high school students not graduating are believed to be gifted (Davis & Rimm, 1989). To combat this problem, the challenge for teachers of gifted students is to identify ways of maintaining high levels of intrinsic motivation, by providing rigorous experiences promoting competence.

Summary

"Most work in the U. S. is becoming computer-based, and the nature of schoolwork will make a parallel shift" (Collins, 1991, p. 28). Computers have become an integral component in many classrooms. They are employed at all levels, and some theorists have likened them to the printing press in their impact on education. Collins (1991) writes, "...the computer and the electronic network are likely to have significant effects on education, and it behooves us to consider what those effects might be as we think about the issue of restructuring schools" (p. 29).
Research has shown one of the benefits of computers in schools is increased student motivation. To increase motivation Gottfried (1983) suggests children have experiences where they control a situation and have novel, varied, and challenging activities in environments responsive to the their actions. These are features of computer simulations affecting a child’s academic intrinsic motivation. According to Klein and Freitag (1991), “although many educators theorize that simulations are effective for providing students with motivating practice, research is inconclusive” (p. 304). Much of the research has been focused on cognitive learning, and less research has been conducted on the affective area of learning (Butler, Markulis & Strang, 1988). Many studies have been conducted on motivation and simulations but few on academic intrinsic motivation and instructional simulation software.

This study is one attempt to explain the relationship between academic intrinsic motivation and computer simulations. It looks at the effects of using multidisciplinary computer simulations as an integral part of instruction for gifted and non-gifted.
CHAPTER 3

METHODOLOGY

Population

The population for this study consisted of all fifth graders in two elementary schools in a large suburban school district. The school district is located in north central Texas and has approximately 43,500 students for the 1997-1998 school year. The district is composed of two senior high schools, five high schools, nine middle schools, thirty-three elementary schools, and one special programs center. The district serves the residents of approximately 100 square miles, and includes children from one large suburban city and portions of five other cities. The total population of the primary city in the district was 189,486 in 1997. There has been a 48.2% increase in population since 1990; thus, the district has seen rapid growth in the last ten years. The ethnic composition of the school district includes 5.7% African Americans, 7.3% Hispanic, 77.2% White, 9.6% Asian/Pacific Islander, and 0.2% Native American. The district is has a majority of middle to upper-middle class, with a mean household income of $53,905 in 1990. The economically disadvantaged comprise 10.1% of the student population.
For the 1997-1998 school year, there were approximately 2,700 teachers in the district. Of this staff, approximately 60% have a master's degree, and two percent have doctoral degrees. The average teaching experience is eleven years.

The total budget for the 1996-1997 school year was approximately $260,000,000, the major source being personal property taxes. The district budgeted $4,835 per student enrolled, which is below the national average expenditure. Eighty-three percent of the expenditure per student was spent for direct instruction and instructional and pupil services.

The population for the study included all fifth grade students from two elementary schools in this district. One elementary school with seventy-five students was used for the study control group. It was selected because it is the home school of the researcher. The simulations to be used in this study were not available at this school, so these students were taught using traditional teaching methods.

Of the thirty-two other elementary schools in the district, only two had the computer simulations to be studied in this research; thus, only these two were available for the experimental group. The school selected for the experimental group was chosen because of its similarity to the school being used in the control group. There is a 14.1% mobility rate in the experimental group, and 1.1% of the students are economically disadvantaged. In the control group, there is 11.1% mobility rate, with 3.6% of the students being
economically disadvantaged. Ten percent of all students in the district are economically disadvantaged.

The following table shows the student enrollment by program for each school, including special education, bilingual, and gifted and talented.

Table 1: Program Enrollment of Experimental Group and Control Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Special Education</th>
<th>Bilingual</th>
<th>Gifted And Talented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>10.9</td>
<td>3.1</td>
<td>4.7</td>
</tr>
<tr>
<td>Control</td>
<td>14.4</td>
<td>2.4</td>
<td>6.0</td>
</tr>
</tbody>
</table>

No statistically significant differences were found between the experimental and control groups for the proportion of students enrolled in special education, bilingual, and gifted and talented programs (p = .4789, .7782, and .6977, 2 sided z-test for independent proportions).

The experimental and control groups have similar proportions of minority students, both below the district average of 22.8%. The experimental group is 16.8% minority and the control group is 15.2% minority. There is no statistically significant difference in these proportions for the experimental and control groups (p = .7723, 2 sided z test for independent proportions). The following table shows the minority percentages for the school district, the experimental, and control groups. Because the number of students in the control and experimental groups are both less than one hundred, the
differences in minority percentages reflect few differences in actual numbers of students.

Table 2: Ethnic Distribution Percentages of School District, Experimental Group and Control Group

<table>
<thead>
<tr>
<th>Group</th>
<th>African American</th>
<th>Hispanic</th>
<th>Asian/Pacific Islander</th>
<th>Native American</th>
<th>Total Minority</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>5.7</td>
<td>7.3</td>
<td>9.6</td>
<td>.2</td>
<td>22.8</td>
</tr>
<tr>
<td>Experimental</td>
<td>3.2</td>
<td>2.4</td>
<td>10.6</td>
<td>.5</td>
<td>16.8</td>
</tr>
<tr>
<td>Control</td>
<td>6</td>
<td>4.1</td>
<td>4.9</td>
<td>.02</td>
<td>15.2</td>
</tr>
</tbody>
</table>

The control group and the experimental groups both completed the Iowa Test of Basic Skills and Cognitive Abilities tests in the fall of their fifth grade year. The following tables show percentile ranks of standard scores based on national student norms for the control and experimental groups for the Iowa Test of Basic Skills and standard scores of cognitive abilities of experimental and control groups.
Table 3: Percentile Rank of Standard Scores Based on National Student Norms for the Control and Experimental Groups for the Iowa Test of Basic Skills for Gifted and Non-Gifted

<table>
<thead>
<tr>
<th>Group</th>
<th>Reading</th>
<th>Language</th>
<th>Math</th>
<th>Social Studies</th>
<th>Science</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gifted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>91.4</td>
<td>94.8</td>
<td>93.1</td>
<td>88.5</td>
<td>90.6</td>
<td>95.5</td>
</tr>
<tr>
<td>Control</td>
<td>90</td>
<td>96</td>
<td>96.9</td>
<td>86.7</td>
<td>94.5</td>
<td>96.8</td>
</tr>
<tr>
<td>Non-gifted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>73.4</td>
<td>78.5</td>
<td>82</td>
<td>69.2</td>
<td>78.9</td>
<td>77.3</td>
</tr>
<tr>
<td>Control</td>
<td>72.3</td>
<td>74.8</td>
<td>79.4</td>
<td>65.9</td>
<td>76.3</td>
<td>75.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>75</td>
<td>80</td>
<td>83</td>
<td>71</td>
<td>80</td>
<td>79</td>
</tr>
<tr>
<td>Control</td>
<td>75</td>
<td>78</td>
<td>82</td>
<td>69</td>
<td>79</td>
<td>79</td>
</tr>
</tbody>
</table>

Table 4: Standard Scores of Cognitive Abilities of Experimental and Control Groups for Gifted and Non-Gifted

<table>
<thead>
<tr>
<th>Group</th>
<th>Verbal</th>
<th>Quantitative</th>
<th>Nonverbal</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gifted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>131.3</td>
<td>120.9</td>
<td>121.7</td>
<td>127.8</td>
</tr>
<tr>
<td>Control</td>
<td>129.1</td>
<td>127.3</td>
<td>124.1</td>
<td>131.3</td>
</tr>
<tr>
<td>Non-gifted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>109.4</td>
<td>108.7</td>
<td>110.9</td>
<td>110.4</td>
</tr>
<tr>
<td>Control</td>
<td>106.6</td>
<td>106.3</td>
<td>109.9</td>
<td>108.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>111.4</td>
<td>109.8</td>
<td>111.9</td>
<td>112.0</td>
</tr>
<tr>
<td>Control</td>
<td>110.0</td>
<td>109.5</td>
<td>112.0</td>
<td>111.5</td>
</tr>
</tbody>
</table>
The standard scores for verbal, quantitative, nonverbal and composite for the experimental and control groups were not statistically significantly different (t=.14, .03, -.01, .05, t-tests for the difference between two means for independent samples, p > .05).

All elementary schools in the district administer the state mandated Texas Assessment of Academic Skills (TAAS) to all fourth grade students in April. The Texas Education Agency (1998) states the goal of the assessment is to measure student progress toward achieving academic excellence. This criterion-referenced test measures academic skills in the areas of reading and math being taught at the fourth grade level. The Texas Education Agency (1998) also states, "the TAAS tests assess higher-order thinking skills and problem-solving ability" (Texas Education Agency, 1998). The following table shows the average percent of mastery in reading and math for the state, district, and those in the experimental and control groups from fourth grade.
Table 5: Percent of Mastery of TAAS Scores for the School District, Experimental Group and Control Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Reading</th>
<th>Math</th>
<th>Reading and Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>82.5</td>
<td>82.6</td>
<td>72.0</td>
</tr>
<tr>
<td>District</td>
<td>94.5</td>
<td>91.0</td>
<td>85.3</td>
</tr>
<tr>
<td>Gifted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Control</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Non-gifted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>87</td>
<td>90</td>
<td>87</td>
</tr>
<tr>
<td>Control</td>
<td>94</td>
<td>95</td>
<td>91</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>97.1</td>
<td>95.1</td>
<td>90.7</td>
</tr>
<tr>
<td>Control</td>
<td>97.0</td>
<td>98.0</td>
<td>90.6</td>
</tr>
</tbody>
</table>

No statistically significant difference was found between the experimental and the control groups for the proportion of students mastering the TAAS reading, math, and reading and math (p = .9686, .3074, 9818, 2 sided z test for independent proportions).

The teachers at both schools were comparable. The subjects in the experimental group had seven teachers, three of which had master’s degrees. The average teaching experience for the team was nine years. The school used for the control group had five fifth grade teachers, with an average teaching experience of 11 years. Four of the five teachers had master’s degrees. All students at both schools have two to four different teachers daily for various subject areas.
Throughout the study, the researcher and the lead teacher for the experimental group had conferences four times a week about content taught, sequence of lessons, and time frames. The schools' scope and sequence were similar throughout the study. Each teacher taught the curriculum associated with the computer simulations between 90 and 120 minutes a day. Both schools started and ended the curriculum units within a week of each other.

Due to the limited availability of the computer simulations, intact groups of fifth grade students at two elementary schools in the same district were used for the study. To ensure compatibility, the design of the study included a pretest to be given to all subjects. The pretest was used to determine if differences existed among the groups before administration of the treatment. The pretest and posttest scores were analyzed in the statistical process.

All students in fifth grade at both schools were invited to participate in the study. Only one student in the control group population did not participate in the study. Of the 108 in the experimental group population, eleven were gifted, and ninety-seven were non-gifted. There were seventy-five students in the control group population, with eleven gifted students, and sixty-four non-gifted.

Academically gifted and talented students are tested and must qualify for participation in the district's gifted program. Identification can occur at any grade level and is based on objective and subjective measures. The curriculum for the pull-out program is language arts based. Teachers of the
gifted at each grade level have received twelve hours of graduate level work on teaching the gifted.

Instrument Employed

Data collected for this study was from the administration of the Children's Academic Intrinsic Motivation Inventory (CAIMI) which was designed by Adele Eskeles Gottfried, Ph.D. in 1986 to measure academic intrinsic motivation in upper elementary and middle school students, grades four through eight. The students completed the inventory at the beginning of the study and approximately twelve weeks later at the end of the study.

The instrument has four separate scales for the subject areas of math, science, social studies, and reading, as well as an overall general scale of students' academic intrinsic motivation toward schooling. The instrument includes twenty-six questions on each of four content areas: reading, math, science, and social studies. There are eighteen items for the general score, for a total of 122 questions. Two questions are to be answered using a forced choice of intrinsic or non-intrinsic motivation. The remaining 120 questions are to be answered using a five point Likert scale. The questions are stated such that high intrinsic motivation may be shown through "strongly agree" and "strongly disagree" in equal amounts. All of the items are contained in a twelve page booklet, where students' responses are written directly. Gottfried
(1986) writes, "Items were selected to measure enjoyment of learning, an orientation toward mastery, curiosity, persistence, and the learning of challenging, difficult and novel tasks" (p. 4). Group administration is appropriate, and studies have found no significant difference between scores from group and individual administration. Specific instructions for standard administration are provided in the administration manual and student response booklet.

Development of the CAIMI extended over six years and included three major studies. Based on the findings from the first study, the CAIMI was rewritten; then all of the questions were reviewed by a panel of teachers to ensure the sentence structure and vocabulary were appropriate for grades four through eight. The final version, to be used in this study, was used in two other studies conducted by Gottfried. The 426 subjects for these studies included 216 girls and 210 boys, from fourth through eight grades. Of the subjects, 287 were white and 139 were African American. All were from middle class schools. From these studies, normative scores were found. Based on other studies, there appears to be no significant correlation between social desirability and the CAIMI scores (Gottfried, 1986).

Studies of gifted students' motivation using the CAIMI suggest there is no ceiling. The following chart shows the maximum score attainable and mean scores and standard deviations for each subject area and for the general
score of motivation from a study of gifted students using the CAIMI. There were 20 subjects in the study.

Table 6: Maximum Scores, Means, and Standard Deviations for Gifted Children's CAIMI Scores for Reading, Math, Science, Social Studies, and General Motivation

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>136</td>
<td>100.4</td>
<td>17</td>
</tr>
<tr>
<td>Math</td>
<td>136</td>
<td>105.8</td>
<td>12.4</td>
</tr>
<tr>
<td>Science</td>
<td>136</td>
<td>105.2</td>
<td>14.9</td>
</tr>
<tr>
<td>Social Studies</td>
<td>136</td>
<td>100.1</td>
<td>17.6</td>
</tr>
<tr>
<td>General</td>
<td>90</td>
<td>73.7</td>
<td>7.6</td>
</tr>
</tbody>
</table>

(Gottfried & Gottfried, 1996)

The reliability of the CAIMI has been established through test-retest reliability studies and internal consistency studies, both of which find the reliability satisfactory. The following table (Table 1) indicates the results of internal consistency reliability studies.

Table 7: Internal Consistency of CAIMI

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Reading</th>
<th>Math</th>
<th>Social Studies</th>
<th>Science</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>260</td>
<td>.90</td>
<td>.89</td>
<td>.91</td>
<td>.90</td>
<td>.80</td>
</tr>
<tr>
<td>B</td>
<td>166</td>
<td>.92</td>
<td>.93</td>
<td>.93</td>
<td>.91</td>
<td>.83</td>
</tr>
</tbody>
</table>

(Gottfried, 1986)
Test-retest reliability over a two month period showed coefficients of .66 to .76. Both internal constancy and test-retest reliability were consistent for all grades, genders, and races (Gottfried, 1986). The scales for reading, math, science, social studies, and the general scale were all intercorrelated, and it was found the average proportion of variance shared between the scales was .15.

Validity of the instrument has been addressed in a variety of ways. Concurrent validity was found by both positive and negative correlations, both hypothesized and obtained. Gottfried found the results of CAIMI were positively related to school achievement test scores in all of the specific subject areas except social studies. The scores were most strongly correlated in mathematics. Similar studies comparing the CAIMI results to grades received in the subject areas support this finding. Gottfried found similar results with research using the CAIMI and achievement tests in California (Gottfried, 1986). Students' perceptions of themselves, as well as teachers' perceptions of them, seem to be correlated to the CAIMI results. Academic intrinsic motivation in each specific subject area is negatively related to academic anxiety in each of those subject areas. Academic intrinsic motivation, as determined by the General score on the CAIMI, is positively related to children's perceptions of their academic competence (Gottfried, 1985). Finally, higher academic intrinsic motivation is associated with lower extrinsic orientation. Gottfried found a correlation between the scores of the CAIMI
and the scores of the Scale of Intrinsic Verses Extrinsic Orientation in the Classroom developed by Harter in 1991. The author conducted much of this research during development of the instrument.

In the review of CAIMI found in *The Tenth Mental Measurements Yearbook*, Posey (1989) concludes the instrument is reliable and unique in its measurement of academic intrinsic motivation. He writes, "Studies of convergent and discriminant validity indicate these scales provide a fairly good measure of a child’s academic ability, thoughts regarding self efficacy as it relates to school work, and teacher perceptions of a child’s motivation.” He notes the apparent lack of bias in the instrument but warns the size and ethnic representations of the subjects upon which the norms were drawn are not adequate (CD ROM). For this study, the norms were not needed since this study compared the experimental and control groups’ raw scores. Overall, Posey believed the CAIMI to be an effective measurement tool.

Research Design

Random selection of subjects within the population was not possible due to the availability of only intact student groups. The study involved a quasi-experimental design, similar to a pretest-posttest control group design. The control group consisted of fifth graders at one elementary school, and the experimental group consisted of fifth graders at another elementary school in
the same school district. The groups are similar in many areas, including standardized test scores, ethnicity, mobility rates, and percentages of economically disadvantaged students.

The study began with a pretest of all subjects in a group administration. Both groups then were taught the curriculum designed in conjunction with the simulations, for approximately two hours a day, with an average of about ten hours a week. Many of the instructional materials used with both groups were identical, since the materials were distributed centrally by the district.

The experimental group used the computer simulations *Frontier Ahead* and *Go West!* during the twelve week study for between two and three hours per week. The control group learned the same content covered in the simulations, only with traditional instruction and lessons not including computer simulations. These lessons were available through the district because when the curriculum was written, the software was not yet available. As a result, lessons covering the same content were written. At the end of the twelve week study, each student in both groups completed a post-test through group administration.

**Instructional Method Being Studied**

The first simulation, *Frontier Ahead* (Edunetics Interactive, 1998), involves the students in role playing an explorer, one similar to those on the
Lewis and Clark expedition. The challenge for students is to survey a fictitious continent, determine their location using a sextant, and identify various plants, animals, rocks, and soil types. They must then create a map of their findings.

The students utilize and develop various reading, math, science, and social studies skills throughout the simulation. Reading skills are practiced as students examine an extensive handbook of information and record their findings in a journal. Math skills are utilized as students use numeric readings to determine feasibility of river crossings, and use sextant readings to determine longitude. As students identify and characterize plants, animals, rocks, and soil types, they gain scientific knowledge. They apply this knowledge to help them overcome obstacles, such as sickness and starvation throughout the simulation. Social studies skills are acquired as students interact with other characters in the simulation and develop an extensive map. Frontier Ahead thus addresses curriculum from the four major disciplines.

The scenario of Go West! (Edunetics Interactive, 1996) the second of the simulations, involves the students role playing the head of an immigrant family moving to Kansas from the east coast in the 1880s. The family receives 160 acres of land as part of the Homestead Act and must farm the land to remain in Kansas. To be successful in the simulation, students must establish a farm, market crops, manage finances, and interact with neighbors. The
students must select from three different goals: being mayor, being prosperous in business, or being prosperous as a farmer. Each of these offers students different opportunities and experiences. The scenario continues until the year 1918.

Reading, math, science, and social studies are all be addressed in Go West! Reading skills are utilized as students examine forms, letters, announcements, and newspapers of the time included in the simulation. Throughout, students must manage their finances, including calculating costs of purchases at the general store, budgeting finances, borrowing money from the bank, identifying the most cost effective crop, and determining worth of their holdings. These actions, as well as the evaluation of the cost effectiveness of hiring various workers, allows students to utilize their skills developed in math. To use their science knowledge, they must determine the appropriate growing season and conditions of various seed types and utilize new inventions. As students interact with many neighbors in the simulation and learn more about society in the late 1800s and early 1900s, they expand their social studies knowledge. Writing skills are addressed through a journal students must keep throughout the simulation. Frontier Ahead and Go West! are both an integral aspect of the curriculum for the fifth graders participating in this study.
Treatment of Data

To evaluate the use of multidisciplinary computer simulations as learning tools in fifth grade, five variables were investigated including mathematics, social studies, science, and reading academic intrinsic motivation, as well as a general scale of academic intrinsic motivation. The Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) was given to students prior to the twelve week study and immediately following the twelve week study. The scores were hand calculated by the researcher. The highest score for each question was matched with the response indicating the highest intrinsic motivation level. The lowest possible score of one on each question was matched with the response indicating the lowest level of intrinsic motivation. Five separate groups of scores, for general motivation, reading, math, science, and social studies, were obtained for each student for pretest and posttest. When completing the analysis, the difference scores from pretest to posttest were used as the dependent variable.

This study has conducted a general linear regression model with a continuous covariate, pretest score, with the main effects of pretest and group, and interaction effect between group and the pretest score.

To increase stability of results with respect to new data, standard outlier analysis was conducted to remove highly influential data. This was done using Cook’s Distance Index.
Hypothesis One

Hypothesis one stated that the difference score on various scales of academic intrinsic motivation for a group of fifth grade students identified as gifted taught using multidisciplinary computer simulations would be significantly higher than the difference scores of a control group of fifth grade students identified as gifted taught using traditional teaching methods.

For the first scale, the hypothesis stated that gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the General Orientation Toward School Learning scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the gifted students in general orientation toward schooling are presented in Table 8.
Table 8: Means and Standard Deviations for Difference scores from Pretest to Posttest of Gifted Students on the General Orientation Toward Schooling Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-.2634</td>
<td>.3510</td>
</tr>
<tr>
<td>Control</td>
<td>-.0397</td>
<td>.2846</td>
</tr>
<tr>
<td>Total</td>
<td>-.1713</td>
<td>.3355</td>
</tr>
</tbody>
</table>

The means presented are the difference from pretest to posttest scores for each question in the subscale. Negative means indicate posttest scores lower than pretest scores.

The results of the linear regression model are presented in Table 9.

Table 9: Results of Linear Regression Model for Gifted Students Scores on the General Orientation Toward Schooling Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>.402</td>
<td>1</td>
<td>4.908</td>
<td>.045</td>
<td>.274</td>
<td>.536</td>
</tr>
<tr>
<td>Group</td>
<td>.0969</td>
<td>1</td>
<td>1.183</td>
<td>.297</td>
<td>.083</td>
<td>.172</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.103</td>
<td>1</td>
<td>1.255</td>
<td>.283</td>
<td>.088</td>
<td>.180</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>1.066</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.299</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Within the sample size of twenty-two for this model, Cook’s Distance Index analysis found three outliers. The difference in results when including the outliers was minimal. Results are not statistically significant and negligible in effect.

For the second scale, the hypothesis stated that gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Reading scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the gifted students in reading are presented in Table 10.

Table 10: Means and Standard Deviations for Difference scores from Pretest to Posttest of Gifted Students on the Academic Intrinsic Motivation in Reading Scale on the Children’s Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-.1453</td>
<td>.2691</td>
</tr>
<tr>
<td>Control</td>
<td>-.1538</td>
<td>.4209</td>
</tr>
<tr>
<td>Total</td>
<td>-.1496</td>
<td>.3427</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 11.
Table 11: Results of Linear Regression Model for Gifted Students Scores on the Academic Intrinsic Motivation in Reading Scale on the Children’s Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>.0114</td>
<td>1</td>
<td>.085</td>
<td>.775</td>
<td>.006</td>
<td>.059</td>
</tr>
<tr>
<td>Group</td>
<td>.102</td>
<td>1</td>
<td>.755</td>
<td>.399</td>
<td>.051</td>
<td>.128</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.104</td>
<td>1</td>
<td>.768</td>
<td>.396</td>
<td>.052</td>
<td>.129</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>1.888</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.399</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Within the sample size of twenty-two for this model, Cook’s Distance Index analysis found three outliers. The difference in results when including the outliers was minimal. Results are not statistically significant and negligible in effect.

For the third scale, the hypothesis stated that gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Math scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using
traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the gifted students in math are presented in Table 12.

Table 12: Means and Standard Deviations for Difference scores from Pretest to Posttest of Gifted Students on the Academic Intrinsic Motivation in Math Scale on the Children’s Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-.05</td>
<td>.4672</td>
</tr>
<tr>
<td>Control</td>
<td>-.1294</td>
<td>.5836</td>
</tr>
<tr>
<td>Total</td>
<td>-.0916</td>
<td>.5198</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 13.
Table 13: Results of Linear Regression Model for Gifted Students Scores on the Academic Intrinsic Motivation in Math Scale on the Children’s Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>1.790</td>
<td>1</td>
<td>8.757</td>
<td>.009</td>
<td>.340</td>
<td>.796</td>
</tr>
<tr>
<td>Group</td>
<td>.281</td>
<td>1</td>
<td>1.375</td>
<td>.257</td>
<td>.075</td>
<td>.198</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.198</td>
<td>1</td>
<td>.969</td>
<td>.339</td>
<td>.054</td>
<td>.153</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>3.474</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.580</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No outliers were found using the Cook’s Distance Index. Results are not statistically significant and negligible in effect.

For the fourth scale, the hypothesis stated that gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Science scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard
deviations of the dependent variable of difference scores for the gifted students in science are presented in Table 14.

**Table 14: Means and Standard Deviations for Difference scores from Pretest to Posttest of Gifted Students on the Academic Intrinsic Motivation in Science Scale on the Children's Academic Intrinsic Motivation Inventory**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-0.2479</td>
<td>0.5564</td>
</tr>
<tr>
<td>Control</td>
<td>-0.4087</td>
<td>0.4750</td>
</tr>
<tr>
<td>Total</td>
<td>-0.3235</td>
<td>0.5103</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 15.

**Table 15: Results of Linear Regression Model for Gifted Students Scores on the Academic Intrinsic Motivation in Science Scale on the Children’s Academic Intrinsic Motivation Inventory**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>2.556</td>
<td>1</td>
<td>23.924</td>
<td>.000</td>
<td>.648</td>
<td>.995</td>
</tr>
<tr>
<td>Group</td>
<td>.0479</td>
<td>1</td>
<td>.448</td>
<td>.515</td>
<td>.033</td>
<td>.095</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.0248</td>
<td>1</td>
<td>.232</td>
<td>.638</td>
<td>.018</td>
<td>.073</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>1.389</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.945</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
No outliers were found using the Cooks Distance Index. Results are not statistically significant and negligible in effect.

For the fifth scale, the hypothesis stated that gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Social Studies scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the gifted students in social studies are presented in Table 16.

Table 16: Means and Standard Deviations for Difference scores from Pretest to Posttest of Gifted Students on the Academic Intrinsic Motivation in Social Studies Scale on the Children’s Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>-.0538</td>
<td>.5723</td>
</tr>
<tr>
<td>Control</td>
<td>-.4231</td>
<td>.5645</td>
</tr>
<tr>
<td>Total</td>
<td>-.2179</td>
<td>.5833</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 17.
Table 17: Results of Linear Regression Model for Gifted Students Scores on the Academic Intrinsic Motivation in Reading Scale on the Children’s Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Sum of Squares</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescore</td>
<td>3.753</td>
<td>1</td>
<td>39.381</td>
<td>.000</td>
<td>.738</td>
<td>1.000</td>
</tr>
<tr>
<td>Group</td>
<td>.198</td>
<td>1</td>
<td>2.083</td>
<td>.171</td>
<td>.129</td>
<td>.270</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.103</td>
<td>1</td>
<td>1.076</td>
<td>.317</td>
<td>.071</td>
<td>.162</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>1.334</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.639</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Within the sample size of twenty-two for this model, Cook’s Distance Index analysis found three outliers. The difference in results when including the outliers was minimal. Results are not statistically significant and negligible in effect.

Hypothesis Two

Hypothesis two stated that the difference score on various scales of academic intrinsic motivation for a group of non-gifted fifth grade students taught using multidisciplinary computer simulations would be significantly
higher than the difference scores of a control group of fifth grade students identified as gifted taught using traditional teaching methods.

For the first scale, the hypothesis stated that non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the General Orientation Toward School Learning scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the gifted students in general orientation toward schooling are presented in Table 18.

**Table 18: Means and Standard Deviations for Difference scores from Pretest to Posttest of Non-gifted Students on the General Orientation Toward Schooling Scale on the Children's Academic Intrinsic Motivation Inventory**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>.1182</td>
<td>.4479</td>
</tr>
<tr>
<td>Control</td>
<td>-.0820</td>
<td>.3622</td>
</tr>
<tr>
<td>Total</td>
<td>.0398</td>
<td>.4267</td>
</tr>
</tbody>
</table>

The means presented are the difference from pretest to posttest scores for each question in the subscale. Negative means indicate posttest scores lower
than pretest scores. Positive means indicate posttest scores higher than pretest scores.

The results of the linear regression model are presented in Table 19.

**Table 19: Results of Linear Regression Model for Non-gifted Students Scores on the General Orientation Toward Schooling Scale on the Children’s Academic Intrinsic Motivation Inventory**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prescore</strong></td>
<td>3.890</td>
<td>1</td>
<td>27.154</td>
<td>.000</td>
<td>.147</td>
<td>.999</td>
</tr>
<tr>
<td><strong>Group</strong></td>
<td>1.526</td>
<td>1</td>
<td>10.653</td>
<td>.001</td>
<td>.064</td>
<td>.900</td>
</tr>
<tr>
<td><strong>Group and Prescore</strong></td>
<td>1.178</td>
<td>1</td>
<td>8.222</td>
<td>.005</td>
<td>.050</td>
<td>.813</td>
</tr>
</tbody>
</table>

Adjusted Posttest Mean Error 22.489 157

Within the sample size of 162 for this model, Cook’s Distance Index analysis found one outlier. The difference in results when including the outlier was minimal. Results are not statistically significant and negligible in effect.

For the second scale, the hypothesis stated that non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic
Intrinsic Motivation in Reading scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the non-gifted students in reading are presented in Table 20.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>.0761</td>
<td>.6202</td>
</tr>
<tr>
<td>Control</td>
<td>.03</td>
<td>.5150</td>
</tr>
<tr>
<td>Total</td>
<td>.0342</td>
<td>.5816</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 21.
Table 21: Results of Linear Regression Model for Non-gifted Students Scores on the Academic Intrinsic Motivation in Reading Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>10.302</td>
<td>1</td>
<td>37.902</td>
<td>.000</td>
<td>.193</td>
<td>1.000</td>
</tr>
<tr>
<td>Group</td>
<td>.371</td>
<td>1</td>
<td>1.365</td>
<td>.244</td>
<td>.009</td>
<td>.213</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.164</td>
<td>1</td>
<td>.603</td>
<td>.439</td>
<td>.004</td>
<td>.120</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>42.944</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>54.645</td>
<td>162</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No outliers were found using the Cooks Distance Index. Results are not statistically significant and negligible in effect.

For the third scale, the hypothesis stated that non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Math scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and
standard deviations of the dependent variable of difference scores for the non-gifted students in math are presented in Table 22.

Table 22: Means and Standard Deviations for Difference scores from Pretest to Posttest of Non-gifted Students on the Academic Intrinsic Motivation in Math Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>.1130</td>
<td>.5034</td>
</tr>
<tr>
<td>Control</td>
<td>-.0835</td>
<td>.4461</td>
</tr>
<tr>
<td>Total</td>
<td>.0353</td>
<td>.4897</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 23.

Table 23: Results of Linear Regression Model for Non-gifted Students Scores on the Academic Intrinsic Motivation in Math Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>5.681</td>
<td>1</td>
<td>30.005</td>
<td>.000</td>
<td>.160</td>
<td>1.000</td>
</tr>
<tr>
<td>Group</td>
<td>1.431</td>
<td>1</td>
<td>7.556</td>
<td>.007</td>
<td>.046</td>
<td>.780</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.904</td>
<td>1</td>
<td>4.773</td>
<td>.030</td>
<td>.029</td>
<td>.584</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>29.914</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38.818</td>
<td>162</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
No outliers were found using the Cooks Distance Index. Results are not statistically significant and negligible in effect.

For the fourth scale, the hypothesis stated that non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Science scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The means and standard deviations of the dependent variable of difference scores for the non-gifted students in science are presented in Table 24.

Table 24: Means and Standard Deviations for Difference scores from Pretest to Posttest of Non-gifted Students on the Academic Intrinsic Motivation in Science Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.2543</td>
<td>.5434</td>
</tr>
<tr>
<td></td>
<td>.0727</td>
<td>.5924</td>
</tr>
<tr>
<td></td>
<td>.1826</td>
<td>.5685</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 25.
Table 25: Results of Linear Regression Model for Non-gifted Students Scores on the Academic Intrinsic Motivation in Science Scale on the Children's Academic Intrinsic Motivation Inventory

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.340</td>
<td>1</td>
<td>1.249</td>
<td>.265</td>
<td>.008</td>
<td>.199</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.0974</td>
<td>1</td>
<td>.347</td>
<td>.557</td>
<td>.002</td>
<td>.090</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>43.014</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>57.433</td>
<td>162</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No outliers were found using the Cooks Distance Index. Results are not statistically significant and negligible in effect.

For the fifth scale, the hypothesis stated that non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Social Studies scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods. The hypothesis was tested using a general linear regression model with a continuous covariate of the pretest score and an interaction between group and pretest score. The
means and standard deviations of the dependent variable of difference scores for the non-gifted students in social studies are presented in Table 26.

**Table 26: Means and Standard Deviations for Difference scores from Pretest to Posttest of Non-gifted Students on the Academic Intrinsic Motivation in Social Studies Scale on the Children’s Academic Intrinsic Motivation Inventory**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>.0103</td>
<td>.5061</td>
</tr>
<tr>
<td>Control</td>
<td>.0153</td>
<td>.5422</td>
</tr>
<tr>
<td>Total</td>
<td>.0125</td>
<td>.5189</td>
</tr>
</tbody>
</table>

The results of the linear regression model are presented in Table 27.

**Table 27: Results of Linear Regression Model for Non-gifted Students Scores on the Academic Intrinsic Motivation in Social Studies Scale on the Children’s Academic Intrinsic Motivation Inventory**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
<th>Eta Squared</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>7.850</td>
<td>1</td>
<td>35.029</td>
<td>.000</td>
<td>.182</td>
<td>1.000</td>
</tr>
<tr>
<td>Group</td>
<td>.0839</td>
<td>1</td>
<td>.374</td>
<td>.542</td>
<td>.002</td>
<td>.093</td>
</tr>
<tr>
<td>Group and Prescore</td>
<td>.0261</td>
<td>1</td>
<td>.117</td>
<td>.733</td>
<td>.001</td>
<td>.063</td>
</tr>
<tr>
<td>Adjusted Posttest Mean</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>35.184</td>
<td>157</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>43.097</td>
<td>161</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Within the sample size of 162 for this model, Cook’s Distance Index analysis found one outlier. The difference in results when including the outlier was minimal. Results are not statistically significant and negligible in effect.
CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This study investigated the use of multi-disciplinary, computer-based educational simulations compared with teaching the same curriculum using traditional teaching methods. The study compared gifted students and non-gifted students in samples of fifth grade students. The difference scores on the Children's Academic Intrinsic Motivation Inventory from pretest to posttest were used for analysis. Subscales for reading, math, science, social studies, and a general score for orientation toward schooling were included.

Summary of Findings

Included in the study were 183 fifth graders from two elementary schools in a large suburban district in north Texas. The experimental group used curriculum-based computer simulations throughout a twelve-week study. The control group students were taught the same content using traditional teaching methods. The Children's Academic Intrinsic Motivation Inventory
was the measurement instrument. All students completed a pretest before the
twelve week study and completed a posttest upon conclusion of the study.

For data analysis, difference scores were calculated and used in a linear
regression model, with a continuous covariate of pretest scores and the
interactions of group and pretest scores.

Findings

The major findings resulting from the analysis of the statistical data
presented in the study were as follows:

1a. Statistical analysis did not support the hypothesis stating gifted fifth
grade students taught using multidisciplinary computer simulations would
have difference scores from pretest to posttest significantly higher on the
General Orientation Toward School Learning scale of the Children’s
Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth
grade students taught using traditional teaching methods. There was a small
effect size of the pretest score and group with the posttest score, with the
control group having a higher mean difference score than the experimental
group.

1b. Statistical analysis did not support the hypothesis stating gifted fifth
grade students taught using multidisciplinary computer simulations would
have difference scores from pretest to posttest significantly higher on the
Academic Intrinsic Motivation in Reading scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. There was a small effect size of the pretest score and group with the posttest score, with the experimental group having a higher mean difference score than the control group.

1c. Statistical analysis did not support the hypothesis stating gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Math scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. There was a small effect size of the pretest score and group with the posttest score, with the experimental group having a higher mean difference score than the control group.

1d. Statistical analysis did not support the hypothesis stating gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Science scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. There was a medium
effect size of the group with the posttest score, with the experimental group having a higher mean difference score than the control group.

1e. Statistical analysis did not support the hypothesis stating gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Social Studies scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than gifted fifth grade students taught using traditional teaching methods. There was a small effect size of the pretest score and group with the posttest score, with the experimental group having a higher mean difference score than the control group.

2a. Statistical analysis did not support the hypothesis stating non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the General Orientation Toward School Learning scale of the Children’s Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods. There was a small effect size of the pretest score and group with the posttest score, with the experimental group having a higher mean difference score than the control group.

2b. Statistical analysis did not support the hypothesis stating non-gifted fifth grade students taught using multidisciplinary computer simulations
would have difference scores from pretest to posttest significantly higher on
the Academic Intrinsic Motivation in Reading scale of the Children's
Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted
fifth grade students taught using traditional teaching methods. There was a
small effect size of the group with the posttest score, with the experimental
group having a higher mean difference score than the control group.

2c. Statistical analysis did not support the hypothesis stating non-gifted
fifth grade students taught using multidisciplinary computer simulations
would have difference scores from pretest to posttest significantly higher on
the Academic Intrinsic Motivation in Math scale of the Children's Academic
Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade
students taught using traditional teaching methods. There was a small effect
size of the pretest score and group with the posttest score, with the
experimental group having a higher mean difference score than the control
group.

2d. Statistical analysis did not support the hypothesis stating non-gifted
fifth grade students taught using multidisciplinary computer simulations
would have difference scores from pretest to posttest significantly higher on
the Academic Intrinsic Motivation in Science scale of the Children's
Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted
fifth grade students taught using traditional teaching methods. There was a
small effect size of the group with the posttest score, with the experimental group having a higher mean difference score than the control group.

2e. Statistical analysis did not support the hypothesis stating non-gifted fifth grade students taught using multidisciplinary computer simulations would have difference scores from pretest to posttest significantly higher on the Academic Intrinsic Motivation in Social Studies scale of the Children's Academic Intrinsic Motivation Inventory (Gottfried, 1986) than non-gifted fifth grade students taught using traditional teaching methods.

Conclusions

This study investigated the effect of curriculum based, multi-disciplinary computer simulations on academic intrinsic motivation. Overall, the simulations did not have a significant effect on fifth grade students' intrinsic motivation and their effect size was negligible.

Intrinsic motivation levels remained relatively constant from pretest to posttest for most students. Harter (1992) suggests that some people are inherently intrinsically or extrinsically motivated. For these students, most interventions will have little effect. For other students whose motivation varies from subject to subject, interventions may be effective. Further research may help identify characteristics of students that could be used to create more effective simulations.
Informal observation by teaching staff suggested that the motivation of students was high when using simulations. But surprisingly, the mean scores decreased slightly from pretest to posttest for most gifted and some non-gifted students. Perhaps this can be explained by threats to internal validity. For example, the pretest was administered the last week in January, while the posttest was given the last month of school, a week after students completed standardized testing. Motivation levels of both groups may have been affected by these factors as well as others beyond the scope of this study.

Changes in intrinsic motivation of some students may not have been detected using the measurement tool employed for this study. It was designed to evaluate intrinsic motivation in four subject areas, and general motivational level. Because simulations incorporate the subject areas into one activity, students may not have realized they were doing math, reading, science, and social studies, but instead saw the experience as a real-life endeavor where subject areas are not delineated. Perhaps with more descriptive data collection about general motivational levels, including student open responses, and teacher and researcher observation, other changes in intrinsic motivation may be better identified.

Suggestions for Further Research

Results from this study suggest the following areas for further research:
1. Since this study was conducted during a twelve week period, other longitudinal studies should be conducted to assess the differences in intrinsic motivation with students using computer simulations over a longer period of time.

2. Because the students used the computer simulations for less than one hour per day, a study of students using computer simulations more intensively for a shorter period of time should be conducted.

3. Similar studies employing the use of descriptive data collection, including student writings, teacher observations, and researcher observations, should be conducted.

4. Similar studies should be conducted using multi-disciplinary computer simulations at other grade levels, from lower elementary to graduate level.

5. A study of the effects of computer simulations on students' general school attitude, as well as attitudinal beliefs in reading, math, science, and social studies, should be conducted.
Grade 2-5 Placement Standards Spring 1998

District Standard:
• Total points: 29 or higher

Campus Selection Committee Placement
• Total points: 26-28
• One 125 in area of aptitude: OLSAT Verbal or Nonverbal or SAGES Composite Quotient

Exceptions Committee at District Level
• Total points: 25 or less
• Strong committee support
• Additional Data Form and work samples
**PACE PROGRAM ELEMENTARY IDENTIFICATION PROFILE**

<table>
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<td>-Non-Verbal</td>
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<td>4. STUDENT ACTIVITIES/ PRODUCTS</td>
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<td>Creative Writing</td>
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<td>Problem Solving Writing</td>
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<td>Non-Verbal</td>
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<td>Differences</td>
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<td>Pattern Blocks/Tangrams</td>
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</tr>
</tbody>
</table>

**Additional Information:**

- Aptitude Test Scores (CogAT OLSAT) ____________
- Achievement Test Scores (ITBS) ____________
- DATE ____________
- DATE ____________
- Verbal ____________
- Quantitative ____________
- Non-Verbal ____________
- Reg. Comp ____________
- Math ____________
- Parent Information (See attached)
- Other Pertinent Information: ____________

The Selection Committee has reviewed this student's data and has determined that he/she:

- qualifies for program placement by meeting district standards
- does not qualify for placement
- is placed in program with exception
- is referred to the Central Selection Committee

The following persons were present and participated in this recommendation on ____________

- Principal ____________
- PACE Team Teacher ____________
- Gifted Specialist ____________
- Member ____________

The Central Selection Committee has reviewed this student's data and has determined that he/she:

- is placed in the program
- is not placed in the program

- Coordinator of Gifted Programs ____________
- Gifted Specialist ____________
- Gifted Specialist ____________
- DATE ____________
GUIDE TO ABBREVIATIONS USED ON PACE FORMS

OLSAT- Otis Lennon School Abilities Test
   T- Total Score
   V- Verbal Score
   NV- Non-verbal Score

SAGES- Screening Assessment for Gifted Elementary Students
   (aptitude score)
   RSG- Reasoning
   SAI- School-Aquired Information
   QUO- Quotient (aptitude score)

Achievement- Stanford Achievement Test (test given is one year above level)
   R- Reading Comprehension
   M- Math Applications

Teacher Survey- (Altman-Winter Teacher Referral Instrument)
   L- Learning Characteristics
   A- Affective Characteristics

Verbal Activities
   CW - Creative Writing scored holistically using rubric. Scored by 2-3 PACE teachers (teachers do not score their own school)
   PS- Problem Solving Activity scored same way the creative writing is scored. (see above)

Non-Verbal Activities
   Diff.- Differences puzzle
   PB/T- Pattern blocks or tangram activity
Dear Fifth Grade Parents,

Mathews Elementary School has been selected to participate in a research study because of its outstanding students and teachers. All fifth graders will be able to participate. The results of this study will enable teachers to determine the best time to have students use two computer simulations in our curriculum.

Over the past few years, fifth graders have learned from and enjoyed using the computer simulation Go West! This year your child's class will be among the first to use a new simulation called Frontier Ahead, in addition to Go West! Mathews is fortunate to be one of only three schools in the district using Frontier Ahead.

The research study will be conducted from late January to April by Chris Dittrich, a fifth grade teacher at Dooley Elementary in Plano, who has worked with me for the past five years on the science and social studies integrated curriculum. All fifth graders at Mathews are invited to participate, but participation is strictly voluntary. Please review the information on the following page in order to make a decision concerning consent for your child to participate in this study.

Yours Truly,

Beverly Lamkin
Fifth Grade Team Leader
Dear Fifth Grade Parents,

Dooley Elementary School has been selected to participate in a research study because of its outstanding students and teachers. All fifth graders will be able to participate. The results of this study will enable teachers to determine the best time to have students use two computer simulations in our curriculum.

Over the past few years, fifth graders have learned from and enjoyed using the computer simulation Go West! This year your child’s class will be among the first to use a new simulation called Frontier Ahead, in addition to Go West! Dooley is fortunate to be one of only three schools in the district using Frontier Ahead.

The research study will be conducted from late January to April by Chris Dittrich, a fifth grade teacher at Dooley, and a doctoral candidate at the University of North Texas. All fifth graders at Dooley are invited to participate, and participation is strictly voluntary. Please review the information on the following page in order to make a decision concerning consent for your child to participate in this study.

Yours Truly,

Barbara Salamone
Principal
Parental Consent Form

Plano Independent School District has given approval to conduct a study to determine the best time for students to use computer simulations in the curriculum.

As part of this study, your child would be completing a questionnaire used to measure his or her motivation for learning. The questions cover such topics as curiosity, perseverance, and how much your child enjoys new and challenging tasks in school. The questionnaire would be completed at two different times between January and April. Chris Dittrich will be doing all of the scoring, and no individual child's identity will be revealed in the reporting of results. The results of the study, as well as your child's questionnaire results, will be available to you. In addition, a copy of the questionnaire will be available at Mathews if you would like to examine it. Your child's participation in the study is voluntary, and he or she may withdraw at any time.

If you have any questions, or would like more information about the questionnaire, the study, or the computer simulations, please feel free to contact me at Dooley, (972) 519-8823, at home, (972) 380-4607, or via e-mail at chris@emphasys.net. This project has been reviewed and approved by the University of North Texas Institutional Review Board for the Protection of Human Subjects in Research 940/565/3940. Please sign below to give permission for your child to be a part of this study. Thank you.

Yours truly,

Chris Dittrich

Student's Name   Student Signature   Signature of Parent/Guardian   Date
REFERENCES


Williams, R. H. (1980). Attitude change and simulation games: The ability of a simulation game to change attitudes when structured in accordance with either the cognitive dissonance or incentive models of attitude change. *Simulation & Games*, 11, 177-196.