A use of computer-assisted instruction in rural science education
Renaud, Chantelle Antoinette
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A Use of Computer-Assisted Instruction

in

Rural Science Education

Approved by
Dissertation Committee:

Lowell J. Bethel

James P. Barufaldi

Sharon E. Nichols

John P. Huntsberger

George H. Culp

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A Use of Computer-Assisted Instruction

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Rural Science Education

by

Chantelle Antoinette Renaud, B.S., M.S.

Dissertation

Presented to the Faculty of the Graduate School of

the University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

May, 1997

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To Reggie,

with love.

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A Use of Computer-Assisted Instruction

in

Rural Science Education

Publication No.__________

Chantelle Antoinette Renaud, Ph.D.
The University of Texas at Austin, 1997

Supervisor: Lowell J. Bethel

The purpose of this study was to investigate the effects of a computer-assisted tutorial program on rural, middle school students' science achievement, attitudes toward science, and attitudes toward learning via computers and computer-assisted instruction (CAI). The sample consisted of 144 seventh-grade students enrolled in a life science course. These students comprised a total of six, intact life science classes. Three of the classes made up the experimental group while the remaining three classes made up the control group. The experimental group resulted in a group of lower achieving students while the control group resulted in a group of higher achieving students.

Students that comprised the experimental group were given the opportunity to utilize a tutorial software program as an instructional supplement to their life science course. Students of the control group also interacted with computers throughout the course of the study, but they did not utilize the tutorial software

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program.

Data revealed that both the experimental and control groups exemplified significant growth in science achievement with the control group outperforming the experimental group in achievement. The results therefore indicated that the computer-assisted tutorial program improved rural students' science achievement; however, the program did not improve rural students' science achievement as well as classroom instruction without CAI.

There was no significant difference in student attitudes toward science or computers and CAI between both groups. The experimental group maintained a neutral attitude towards science throughout the study while the control group maintained a positive attitude towards science. Both the experimental and control groups had positive attitudes toward computers and CAI. As a result, the computer-assisted tutorial program did not significantly influence rural students' attitudes toward science or computers and CAI.

While the use of the tutorial software program may not result in a difference in attitudes, it does not negate rural students' attitudes toward science, computers, or CAI. More importantly, the program does improve science achievement for low achieving students.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Many of the problems related to rural education have resulted from the idea of trying to make small schools more like large schools (Beckner, 1994). It has been reasoned that the larger the school, the better the knowledge and attitudes of the students (Hill, 1984; Marshall, 1986; & Melnick, 1987). Some research today suggests that such is not the case, especially for rural schools (Enochs, 1988). It is a fact that rural science education has and continues to suffer due to several factors: small range of courses offered, few numbers of science and mathematics teachers, and a narrow range of ideas learned. More importantly, research has addressed specific problems and possibilities of science teaching/learning in rural settings and has pointed out two major problems facing rural science education (Enochs, 1988). First, the increasing decline of scientific literacy has become a national concern. Second, the growth of scientific information has created a necessity for rural science teachers to become generalists with in-depth knowledge in all the fields of science (Irion, 1982).

As this perception of a general lack of scientific literacy continues to escalate, increased efforts in science education for improvement are constantly being promoted (Jinks, 1983). Such efforts are predicted for near-future shortages of engineers and other technologists. More importantly, it is expected that schools will face more criticism and will be required to increase enrollments. This

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definitely becomes a problem for rural schools that are already limited in their abilities to provide highly specialized science curricula (Jinks, 1983; Moore, 1989). Such problems result from the limitations and disadvantages that are a part of the rural school environment, such as a lack of financial resources. Despite these negative factors, rural students do not provide consistent evidence of performing poorly on science achievement tests in comparison to urban students (Sunal, 1991). According to the National Assessment of Educational Progress Test (NAEP), scores show a decline in science achievement; yet rural students do not contribute to this decline (Sunal, 1991). However, significant changes must take place to improve science education in rural/small schools, especially for rural students who are able to overcome the obstacles that rural education faces. Such changes could provide only more enhancement and improvement of science learning. In creating change, efforts for promoting scientific literacy must include developing ways of attracting and maintaining a consistent interest and desire to learn science among rural students.

1.2 Background

As rural schools work towards increasing students' scientific literacy, they are constantly presented with equity factors such as, limited financial support and funding; limited curricular materials; limited laboratory supplies; and limited professional development programs (Baird, 1994 & Moore, 1989). Financial limitations also pose a problem on the hiring of more science as well as mathematics teachers, which unfortunately results in rural schools having fewer certified science teachers. These limiting factors assist in developing classroom

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environments that determine students' attitudes toward science and therefore their achievement in science. Research indicates that between 46-73% of students' attitudes toward science are determined by their immediate school environment (Talton, 1986). Thus, there is a strong possibility that rural students are not fairly reaching their scientifically literate potential and rural science education is in definite need of change. However, to implement change in rural education, change must be tailored to the needs and strengths of rural schools (Shroyer, 1987).

The effective use of modern technology can assist in the implementation of change while maximizing the natural advantages of rural schools (Beckner, 1994). The Educational Technology Center of Harvard University (1988) has found that computers can serve as a stimulus to learning when computers serve as vehicles for presentation and response. More importantly, data indicate that technology has had a significant impact upon students' attitudes and achievement in their science courses (Hounshell, 1989 & Yalcinalp, 1995). In spite of these positive factors, research indicates that in the majority of science classrooms computers are not being used (Brandhorst & Rakow, 1989). The reason for the limited use of computers in the science classrooms is thought to be due to the fact that few science teachers are trained to use instructional technology in addition to the lack of quality software (Becker, 1991 & Morrell, 1992).

Attempts at developing quality software have included the design of several supplemental computer-assisted instructional programs. Drill and practice programs focus on material with specific right or wrong answers as they adapt to the students' abilities. As students answer questions correctly, the program

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presents increasingly more difficult questions. Tutorial programs come closer to employing the computer as a teaching machine than do drill and practice programs. These programs introduce students to new information, quiz them on the information until they achieve mastery, and reteach the information if necessary. Finally, simulation programs allow students to develop hands-on experience with actual experiments while the computer collects and analyzes the data. These programs do not emphasize the concepts of diagnosis and remediation nor do they emphasize repetition and review. Simulations, instead, pursue answers to sequential problems.

Through the various forms of computer-assisted instruction, technology can become one avenue at assisting rural schools in improving students' achievement and science interest as well as enhancing their self-esteem (Beckner, 1994). By improving rural schools in the area of science, there can be continued improvement at the achievement level of the students, improvement in the scientific literacy of society and, at the same time, assistance in meeting the scientific/technological needs of the nation by preparing individuals to make their career endeavors in the area of science.

1.3 Statement of the Problem

How does the use of a supplemental tutorial program in a seventh-grade life science course influence rural, middle school students' attitudes toward science, attitudes toward the use of computers, and level of academic achievement when compared to those who do not use a computer-assisted tutorial program?

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1.4 Purpose

This research study is designed to investigate how rural students, who are known to be limited in their learning and understanding of science content (Kahle, 1989), may improve their attitudes towards science and their performance in science, as well as, their attitudes towards the use of computers when undergoing a supplemental tutorial program. Such a program will be implemented to serve as an additional instructional resource in the science classroom.

America today is a different country demographically from Nineteenth Century America that produced many individuals who were extraordinary in their science and technological accomplishments. As the world grows and changes, there will be fewer qualified people to enter the work force, and those that do enter the work force will have to be highly skilled and productive if they are to enhance the growth of the economy while maintaining its standard of living. This, of course, means that young students will have to be motivated and well educated. More importantly, if the nation is to continue as an advanced industrial society and world leader, many will have to join the science and engineering professions.

New and innovative ways, therefore, must be found to attract more students into science and engineering, in particular, those from rural settings who are limited in their exposure to science, mathematics, and technology. In doing so, schools must provide rural students with sound mathematics, science, and technology instruction throughout their elementary and secondary school

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experiences so that they will aspire to attend college, qualify for their majors, and be able to complete their degrees. Unfortunately, attending and completing college are factors that many rural students do not usually consider in the planning of their futures (Herzog, 1995).

Research has constantly proven how students' attitudes determine how they approach education or how they choose to learn subject matter (Charron, 1991; Khale, 1989). These attitudes are usually shaped by the students' academic self-perception, school environment, home environment, peer support, role models, and educational exposure (Talton, 1986). Technology through the use of computer-assisted instruction has now become a means for shaping the more positive attitudes of students toward subject matter. Microcomputers and instructional software i.e., tutorials, drill and practice, and simulations, now offer the opportunity to motivate and encourage students' learning, especially in those who are not able to succeed in the traditional classroom (Johnston,1987).

Thus, it is intended for this study to introduce a non-traditional form of learning and instruction into the rural school classroom that can help shape more positive attitudes toward science and lessen feelings of intimidation that students display for science, mathematics, and technology, as well as increase students' scientific literacy. If this program is able to initiate a positive change in students' attitudes and achievement, it would be intended for similar programs to serve as instructional approaches for implementation in other rural schools, as well as in schools where students tend to be limited in their learning of science and limited in their exposure to computer-assisted instruction (CAI). It is also intended for this study to remove some of the doubts and stereotypes imposed upon rural

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schools by society and to bring society and rural students to the realization that rural students are equally competent compared to their suburban and urban counterparts.

1.5 Research Questions

Specifically, this study will investigate the following research questions:

1. Is there a difference in achievement between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program?

2. Is there a difference in attitudes toward science between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program?

3. Is there a difference in attitudes toward computers between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program?

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1.6 Assumptions

It is believed by the researcher that limited exposure to science and technology will produce less interest, enthusiasm, and confidence for learning science and using computers. It is an assumption of this study that when exposed to a form of instruction, computer-assisted instruction in a tutorial format, that is different from what rural students recognize as more traditional forms of instruction, students' attitudes toward science and achievement in science will be altered. It is a belief that this study will provide students with a unique learning environment that will establish more interest and encouragement to learn science. It is further assumed that rural students, who are limited in their exposure to technology, will develop altered feelings toward the use of computer-assisted instruction in the science classroom.

1.7 Rationale

It has been discussed in previous literature (Enochs, 1988; Sunal, 1991) that traditional rural educational research has strictly focused on comparing its schools and program characteristics to those of urban schools. Unfortunately, the data have revealed that such comparisons will not provide useful answers if we are looking to improve student achievement in science and positive attitudes toward science and technology. World bank policy papers have concluded that improving the efficiency of learning in rural education implies improving the quality of school inputs such as curriculum, style of teaching, teacher qualifications, instructional materials, facilities, and use of mass media

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(Heynemann & Loxley, 1981). More importantly, if individuals are to meet the demands of tomorrow's society and compete in this modern world, ways must be found to help students master basic ideas of science processes, science, and technology.

The sample involved in this study not only represents students from a rural setting, but also represents students enrolled in a middle school science course. It is widely acknowledged that science instruction in American elementary schools receives minimal attention (Cannon, 1985). In addition to this, American rural schools receive even less attention. Now factor into the equation seventh-grade, as a student's first year of departmentalized schooling, where students are having to leave their protective, self-contained classroom environments and having to be thrust into a new school with new students and more than one teacher with which to interact. It is for these reasons that the experiences students have during their first formal and comprehensive exposure to science in middle or junior high school be viewed as a critical time period in students' science education (Cannon, 1985). More importantly, it will be these introductory experiences with science and technology that will influence students' attitudes toward science-technology and future commitment to science-related activities.

In looking at science achievement based on the quality of school inputs, it is also imperative to focus on the actual students involved in the learning process. It is known that the negative attitudes outsiders communicate about rural education has established, in rural students, feelings of inadequacy for their schools (Herzog, 1995). Rural students have been constantly bothered by their

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schools' poor facilities and their student achievement abilities (Herzog, 1995). Now imagine how these same students feel about learning science. People who believe that they are failures at an achievement task because of a lack of ability on their part or their schools' part are less likely to persist at that task (DeBoer, 1986). The assumption that students will acquire positive attitudes toward science as they learn more science facts is no longer valid (Koballa & Crawley, 1985). Science attitudes become more negative with increasing grade levels (Cannon, 1985). Planning is a definite necessity if we are to ensure the development of positive attitudes towards science. Failure to plan and teach for the development of positive attitudes toward science may result in a science curriculum that fails to prepare students to make judicious decisions about science as their future needs may dictate.

According to Irion (1982), it has also been suggested that students' success in the classroom is influenced by students' perception of the general classroom environment. Students perceive certain teacher behaviors as indicative of quality science teaching and other teaching behaviors/methods as indicative of less than quality science teaching, Behaviors identified by students as quality science teaching have included making use of the laboratory, taking field trips, and being involved in activity oriented forms of instruction. Some elementary school teachers are just not interested in teaching science and therefore curriculum practices are not producing students with positive feelings toward science (Simpson, 1990). Now imagine rural students' impressions of their science teacher who may not feel comfortable with the idea of teaching a course that they may not be academically prepared to teach. If the feelings toward the classroom environment are of negativity, then it is possible that students will not reveal their

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learning deficiencies to the teacher. As a matter of fact, they may only seek assistance from other students, from the help of tutors, or through specific tutorial programs, e.g., computer-assisted instruction.

When using computer-assisted tutorial programs, students no longer have to feel uncomfortable about the classroom environment or their own knowledge insecurities (Leonard, 1990). By fewer feelings of discomfort or intimidation offered by computer tutorial programs, students may, in fact, change their complete attitudes toward science by taking the time to become more enthusiastic about the subject matter as well as feeling more secure in learning and class participation. As students develop more of a comfort for learning their science subject matter, they may look positively upon computer-assisted instruction, especially if they are able to gain greater understanding in their science material through this, now, different approach to science classroom instruction. Not only could computer-assisted instruction encourage students to learn science, but it may give teachers a assistance in presenting some of science's more difficult concepts in a manner that is more clear to the students. This approach to instruction may also free up time for teachers to develop a better understanding and comfort for the material as well as more time for science teachers to provide focused attention to students' individual misconceptions.

These are definite problems that exist in both the urban and rural school settings; however, equity is more of a problem in rural schools since it heavily impacts faculty hiring, instructional supplies, resources, and professional development. A comparative study of rural and urban schools has shown that rural science programs do not offer other advantages for learning science as do

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science programs of urban schools (Baird, 1994). Some of these disadvantages for rural school science programs, in addition to the financial problems, include lacking of science role models, lacking of science teaching colleagues, having too many daily preparations, and overlooking the importance of multicultural science education. In spite of the disadvantages, rural students do not consistently provide evidence of performing less well academically compared to their larger city counterparts (Enochs, 1988; Sunal, 1991). If rural students were provided with opportunities to learn science that were equal to those available to nonrural students, one can only imagine the possibilities of their science performance equaling or even exceeding that of children attending schools in larger communities. This then lends to the consideration of education not having to be as centralized as society seems to intend for it.

It is anticipated that this research study will improve achievement and students' attitudes toward science and technology through efforts supporting the use of tutorial software and computers. It is also anticipated that this research study will provide preliminary answers as to why students do not excel in science as well as to the necessary mechanisms for stimulating more interest in science and technology and higher achievement in science. By providing some of these answers, this study may then serve as a model for alleviating similar problems in other rural schools.

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1.8 Statement of Hypotheses

Null Hypotheses:

H_{01}: There will be no difference in achievement between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

H_{02}: There will be no difference in attitudes toward science between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

H_{03}: There will be no difference in attitudes toward computers between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

The present research study intends to alter any feelings of insecurity and intimidation felt by rural students in the science classroom after they have been exposed to a supplemental tutorial program with computers designed to foster positive attitudes toward science-technology and to enhance science achievement. The planned study attempts to resolve these factors by 1) providing rural students with opportunities to learn science in a different type of classroom

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setting. By providing a comfortable environment for learning, an environment where there is less intimidation by authority figures, where students are not penalized for incorrect answers, and where students are able to learn science at their own pace; it is intended for such a classroom setting to provide rural students with the necessary attitude and scientific skills needed in order to progress in science. This planned study also intends to 2) provide students with the feeling and attitude that they can do science and actually enjoy science. By creating such positive feelings, rural students may become more interested in learning science at an in-depth level, which would increase the chances of them becoming encouraged to later seek career opportunities in the sciences or technology. Upon seeking science careers in the later future, seventh-graders will have begun to acquire a stronger knowledge base for not only understanding the different realms of science, but for also applying knowledge and science process skills to the field of science they may choose as a career.

The human body unit of a life science course, a seventh-grade science requirement, offered at a rural school in south Louisiana has been chosen as part of this six week study. An average of 260 seventh-grade students are enrolled in this course each year.

A computer-assisted tutorial program was used in the life science course as a course supplement to increase rural students' knowledge of science concepts through an additional form of instruction - CAI. The independent variable or treatment is the use of the science tutorial software in the computer laboratory. The software is unique in that it was written by life science teachers specifically for students enrolled in Life science courses. The software is also unique in that

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it maintains students' interest through its relevance to the content taught.

At the end of the seven week study, final scores on the unit test and scores on the attitude measures will be collected and analyzed. These scores will represent the dependent variable or the response to the treatment.

The experimental group includes subjects who use the science tutorial software while the control group represents subjects who have not used the science tutorial software.

1.9 Importance of the Study

This research study is important because it may show how rural school populations may significantly improve their performance in science and attitudes toward the sciences and technology when tutored with software that has been specifically prepared for the life science course in which they are involved. This study will also provide a wealth of information to rural education research as it will voice some of its specific needs as well as the many attributes of rural science education together with some potential ideas for improvement.

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1.10 Definition of Terms

Achievement is the accomplishment of a task, such as grades, through skill or work. In this study, achievement will be determined through the scores students receive on their examination after completing a seven-week, computer-assisted tutorial program.

Attitude is certain regularities of an individual's feelings, thoughts, and predispositions to act toward some aspect of the environment. In this study, students' attitudes toward science and computers or computer-assisted instruction will be determined.

Computer-assisted instruction (CAI) is an instructional method that directly uses a computer to teach. Instructional computer programs are classified as tutorial, drill and practice, simulation, test and game programs. CAI is very valuable in its ability to provide motivational enhancement, increased learning efficiency, and appropriate feedback with assessment of learner responses.

Computer tutorial is a computer program that is used to enhance student learning through the presentation of new information, the inclusion of more conceptual ideas instead of pure practice of examples, and the use of complex logic to examine students' pattern of responses in order to provide appropriate informational feedback and sequence of problem presentation.

Innovative instruction is instruction, information or knowledge, provided through the use of a new method that is different from a more traditional way of

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providing information. In this study, computer-assisted instruction (CAI) is considered to be an innovative form of instruction for the science classes since it will be the first time this form of instruction will be implemented in the course. It will encourage learning science-related concepts through the use of computer-assisted instruction (CAI).

Rural is considered to be a remote, geographical area where the population of people is below 20,000 and the economy is solely based on agriculture for this research study.

1.11 Limitations

This study focuses on improving students' attitudes toward science, computers, and computer-assisted instruction and achievement in science. The subjects who will be involved in the study include students who will be enrolled in a life science course at a rural middle school in south Louisiana. One middle school will be chosen to participate in the study. As a matter of fact, it is the only middle school in the district with a computer laboratory. The study will be limited to one six week period due to course scheduling and teacher scheduling of topic presentations. It will also be important that the science classes do not monopolize laboratory scheduling since other classes will be scheduled to use the computer laboratory. Therefore, all subjects comprising the study will be limited to about one hour each week in the laboratory. Classes chosen to participate in the study will be determined based on school administration and scheduling requirements rather than design considerations. Therefore, the classes

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participating in the study will include different ability groups of students. Finally, the study will be limited to the use of a specific software. Software chosen includes software accessible from floppy disks that are compatible with MS-DOS systems. This limitation was based on the existing hardware in the computer laboratory and on the school district's budget.

1.12 Outline of the Dissertation

The purpose of this research is to examine how the use of a computer-assisted tutorial program influences student achievement and attitudes toward science and computer-assisted instruction (CAI) when compared to students who are not involved in the use of the tutorial program.

The dissertation is organized as follows:

In Chapter I, an introduction to the study will be presented. The introduction will address the background, rationale, purpose, research questions, and hypotheses of the study.

In Chapter II, a discussion of the review of the current literature relating to the research will be presented. The literature review will contain the following topics: rural education; attitude and achievement in science; history of CAI, learning through CAI; attitude and achievement due to CAI; and attitude and achievement in science due to CAI.

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In Chapter III, a discussion of the research methodology will be presented. The sample, experimental design, procedures, instrumentation, and data analysis will be described in this chapter.

In Chapter IV, the results of the research will be presented. Data collected from all experiments will be analyzed using statistical procedures. The results of the study together with the hypotheses will be reported in this chapter.

In Chapter V, a discussion of the results of the research will be presented. A summary and conclusions together with future research recommendations will be reported in this chapter.

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CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 Introduction

Chapter II has been organized into an introduction with four sections. In section two, rural education will be discussed in order to provide an understanding of the trends which affect the rural school setting as well as rural science education. Section three will provide background information on computer-assisted instruction as well as discuss issues of inequity. The effects of computer-assisted instruction in section four will describe what is known about learning with computers and computerized instruction. Finally, section five will conclude Chapter 2 with a description of learning in the science classroom and the effects of computer-assisted instruction on science learning.

2.2 Rural Education

2.2.1 Trends Affecting Rural Education

Rural education is worthy of significantly more attention and assistance than researchers, policy makers, and educators have accorded it (Sher, 1978). There are over eight million children enrolled in rural schools today, which is almost 20 percent of all students in the public schools of the United States. The problem here is that it has been shown that rural school children consistently score lower than their urban counterparts on assessment or standardized tests. More

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importantly, there are over two million rural adults classified as functionally illiterate (Reed, 1984). One of the focuses of rural education is to reverse these alarming statistics; unfortunately, rural education is faced with many challenges. Among these, major challenges to the future and image of rural education involve economic, demographic, and current educational trends.

Presently, three populations continue to affect rural America (Herzog, 1995). First, the rural proportion of the U.S. population is steadily decreasing. Second, the working-age population has been increasing more in the metropolitan areas than in the rural areas. Finally, the older segment of the population is increasing in rural areas. With both the metropolitan and rural areas increasing in its working-age segment, the metropolitan areas, comprising the U.S. population, have become larger than ever. This rural-to-metropolitan migration has been due to the working-segments moving for better job-related opportunities. At the same time, the metropolitan-to-rural migration has been due to rural areas attracting the retirement age segment (Hobbs, 1994). It is changes such as these population shifts that now challenge the importance of rural education. The major question of concern becomes how can rural education put forth innovative ideas and enhance educational growth when there are no young minds left to replenish the cycle of education. More importantly, different age groups will have differing opinions on the importance of education.

A major misconception about rural communities is its supposed retreat from poverty. Unfortunately, 5% of rural school-aged children are poor and 40% of all poverty in the United States has been associated with rural areas (Parks, 1980). According to 1990, economic trends, the rural family income was about

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three-fourths the income of metropolitan families. The reason for these variations in incomes has been largely due to the fact that metropolitan areas have a greater share of professional and upper-level managerial positions. Rural areas, on the other hand, have a greater share of the working poor who largely consume low-wage, low-benefit jobs (Herzog, 1995). These economic conditions imply that rural education will be more associated with communities that have high unemployment, low family income, and higher rates of poverty. This, of course, means that the majority of rural students will come from impoverished backgrounds instead of from families of more professional backgrounds.

Another factor challenging rural education is educational trends such as the completion of high school and college. From 1980 to 1990, high school completion of students was about 7.8% lower for the rural population compared to the more urban/metropolitan areas. However, the gap in college completion rates between the two populations has increased each decade (Herzog, 1995). As a matter of fact, students from poor counties now have problems producing sufficient scores on college entrance examinations. More so, if rural students enter college, many of them require remediation (North Carolina, 1991). School consolidation, another educational trend, has also become the most frequently implemented trend of the 20th century. These changes have resulted in a large decrease in the number of rural schools and school districts, thus creating larger schools with larger school districts. However, rural schools are still smaller and poorer than nonrural schools (Stern, 1994). Each of these educational problems arises due to a dwindling tax base, which means less money to improve school facilities, acquire instructional resources, and hire more teachers.

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In order for rural education to survive the modern-day trends, rural communities will have to develop new economies, attract working-age people, and redesign schools (Herzog, 1995). Otherwise, rural students will continue to be at an educational disadvantage and their goals for professional careers will remain out of reach.

2.2.2 Attitudes Toward Ruralness

As economic, demographic, and educational trends challenge rural education, so do the opinions and attitudes of outsiders. One problem facing rural education is the lack of a definitive understanding of the meaning of rural (Haas, 1991). The United States government defines rural areas as being nonmetropolitan whereas, the Census Bureau defines it as a community with less than 2,500 inhabitants or fewer than 1,000 inhabitants per square mile. This word has usually been defined from the outsider's perspective or from the urban perspective. Unfortunately, it has been the urban perspective that has created a weak identity among rural students. Being stereotyped as "down home country folks", rural students have often been apologetic for being from the country (Herzog, 1995). Moreover, the deeply rooted prejudices of modern society against rural communities and education have created inferiority complexes for students in regards to not only their origins, but also to their education.

In describing the rural experience, many students think of close-knit people, nature, and community. Their most common words used in describing rural include: peaceful, safe, and warmth; yet, they are very critical of their schools.

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Rural students are bothered by their poor school facilities, achievement abilities, and their low socioeconomic status (Herzog, 1995). As a matter of fact, they would prefer that their rural schools be able to provide better opportunities for disadvantaged students, students preparing for college, and students preparing for the workplace.

As negative attitudes and opinions of students and outsiders have challenged and created a negative image of rural education, it becomes more and more difficult for rural students to find positive attributes in their rural schools and communities. Such feelings of inadequacy and negative attitudes are what rob rural students of a meaningful education.

2.2.3 Rural Science Education

As studies have examined the need for rural systems to strengthen their science curricula, it has been pointed out that rural systems encounter several problems uniquely associated with its setting (Beckner, 1994; Enochs, 1988). For instance, Moore (1989) discussed how rural schools have not been fortunate in their exposure to modern science. It was pointed out that rural students do not always have the luxury of participating in out-of-school science activities such as visiting a research laboratory. Opportunities such as these are thought to expose students to modern, sophisticated technology and mentors so that students can begin to acknowledge the application of technology to a wide variety of fields. These types of experiences can assist students in thinking divergently about careers, as they would begin to develop networks and contacts. Another study

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indicates (North Central, 1989) that there is a positive relationship between opportunity to learn and actual learning. Because rural students have fewer opportunities to learn science in class and through informal activities, there are expected to be discrepancies in their science performance.

Opportunities for developing curricular materials that use resources of the local rural setting are scarce (Enochs, 1988). Reasons for scarcity of appropriate curricular offerings have been due to no economic reason for publishers to produce books specifically for rural schools; no agency willing to fund the development of curricular materials; and rural areas lack of expertise, time, and funding to develop their own materials. Curriculum, textbooks, pedagogy and standards of excellence created for urban school models are used in rural schools (Shroyer, 1987). School models such as urban school models do not assist in improving rural science education because it overlooks the rural school's unique needs. One study reported the cooperative effort between New Mexico rural elementary teachers, the New Mexico Museum of Natural History, and New Mexico Center for Rural education to improve rural science education when utilizing available resources (Dacus, 1989). The study reported successfully planned and executed natural history field schools for rural elementary schools that demonstrated hands-on science activities and modeled effective teaching methods. Efforts such as these must continue so that rural science educators can become developers and adaptors of alternative models of curriculum that more appropriately fit their rural communities.

The need for providing adequately and appropriately trained teachers, however, poses another threat to rural science education (Moore, 1989).

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Unfortunately, few college programs are designed to prepare teachers for rural settings (Finson, 1990). For instance, rural school teachers are usually placed in multi grade, multi subject classroom situations; yet, most secondary education programs prepare teachers for single-subject, single-grade-level classrooms (Finson & Beaver, 1990). Therefore, upon entering rural school settings for which they have not been prepared, teacher retention becomes a problem. It has also been found that rural science teachers lack use of the latest interventions and instructional techniques (Enochs, 1987). Rural science teachers report less use of the following classroom activities: cooperative learning groups, hands-on laboratory activities, individualized strategies, and inquiry teaching. At the same time, rural education has expressed a strong need for in-service programs in science content, instructional materials, and new teaching strategies (Baird, 1994).

Insufficient funding for materials and supplies continues to challenge education in isolated areas (Baird, 1994; Davis, 1987; Moore, 1989). Financial resources are limited in terms of offering a diversity of quality programs to rural schools. It is suggested that financial support will have to come from outside the school systems, from governmental private sector funding agencies, if there is to be improvement (Enochs, 1988).

In spite of problems associated with rural science education, the rural setting assumes six vital relationships for maintaining successful science education (Enochs, 1988). Most important among these relationships is the one between teachers and students. The second relationship is with students and teachers outside of the classroom. This offers an opportunity for students to see teachers

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in a different light, preferably as the community science expert. A third relationship is one between the science teachers and parents. Parents are viewed as an invaluable resource that can provide opportunities to help cultivate student interest in science and gain a broader perspective of student needs and background. Fourth, is the relationship between the science teachers and the community. Hopefully by maintaining an active involvement with the community, teachers can find a valuable source of ideas and experiences with which to increase the relevance of their science courses and at the same time, enrich their lives as well as their students' lives. Fifth is the relationship beyond the community. Industries, businesses, and state and country agencies are sources that definitely need cultivating by science teachers. Finally, a relationship between the teachers and the science education profession is essential. The more complacent we allow ourselves to become through lack of discovering new ideas, the more susceptible we are to ineffectiveness and burn-out (Enochs, 1988).

2.2.4 Rural Science Education - Achievement

As research has focused on rural science education, some studies have examined the relationship between school size and student achievement in regards to science learning. For the most part, achievement results for students from small rural schools vary from school to school and from state to state (Hill, 1984; Sunal, 1991). In fact, it is also noted that rural students do not give consistent evidence of performing less well on achievement tests than students from more populous areas (Melnick, 1987).

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One study examined the relationship between school size and student achievement (Edington, 1986). With other studies producing mixed results such that some rural schools had higher achievement than larger schools and other rural schools did not, this study sought to make corrections for other predictors of student achievement. Predictors included: percentage of students in special education, average district teacher's salary, average years teaching experience in districts, percentage of teachers with advanced degrees, percentage of minority students, mobility rate of students in the district, and expenditures per pupil. Results of this study indicated that enrollment size was not related to achievement, the percentage of students eligible for Title I programs was significantly related to achievement, and ethnicity variables were significantly related to achievement.

A study conducted by Walberg and Fowler (1986) also found results similar to Edington (1986). However, results indicated that socioeconomic status was significantly related to achievement while per-student expenditures were not related to achievement; school size was negatively correlated with achievement, however, small school districts had higher student achievement.

Research also reported that ratings of rural schools as having more laboratories, laboratory equipment, science instructional materials, and general resources correlated higher with science achievement than schools with a greater need for these materials (Sunal, 1991). Also curriculum rated as more compatible to student needs was correlated with high student achievement. Finally, Sunal (1991) reported that high science achievement was related to higher teacher ratings of effective science education in-service programs,

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significant numbers of certified teachers, fewer class cancellations, and lower teacher/student absenteeism. It was concluded from this study that school and teacher variables have a significant impact on rural student science achievement.

Some evidence also points out that the relative success of rural students is related to the interaction between the rural student and the rural teacher (Irion, 1982). This study reports that because of the small size of rural schools there is more opportunity for interpersonal communication in student-student and student-teacher relationships. It seems as though students are able to develop a sense of trust and comfort with their teachers when an interest or concern for the student is shown. More importantly, the school becomes the focal point of the rural community, thus allowing teachers, students, and parents to develop close, supportive relationships.

Baird (1994) also reports that the most obvious factors affecting rural student achievement in science are the student's perception of the classroom environment, the level of interest, instructional strategies, perception of academic competence, family encouragement/support, exposure to modern science programs, and exposure to role models in the science fields. Unfortunately, only a small number of studies have attempted to identify the effects of school variables on achievement and fewer have written about those variables affecting the teaching and learning of specific content areas in rural schools. Therefore there is little research examining variables in rural science education (Sunal, 1991).

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2.2.5 Rural Science Education - Attitude

A number of studies have shown that students, who have a high level of interest in the sciences, are more likely to pursue majors and continue with careers in those fields than those students who have lower interest levels (Thomas, 1986). Pursuit of such majors and careers are usually influenced by how much the student actually likes science based upon experiences with the subject matter.

Research indicates that, in a particular rural school, younger pupils perceived science as doing and making things (Charron, 1991). They saw science as being fun, whereas older pupils seldom mentioned these features. The students' views were definitely supported by the kinds of instruction offered in the respective classrooms (Charron, 1991). Not only do such feelings exemplify the need for a more consistent approach to science across all grade levels, but such inconsistencies can contribute to the lack of or loss of student interest, thus leading to fewer students pursuing careers in science. Therefore, the goal for creating overall positive views of science may be to first remove the intimidating feelings that come with learning science by giving students the feeling that they can do science. This is possible through the implementation of different teaching approaches. In developing such positive attitudes, confidence levels are able to build. However, as seen at the primary levels, students are more interested and confident in learning science. The problem then, at the secondary level, is to keep that interest by continuing to implement similar teaching strategies at a more advanced level.

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In the same study, when parents from a rural setting were asked about the value of science, many frequently drew a blank (Charron,1991). Many believed that science was only valuable for those students who planned to attend college. Despite the efforts of the instructors to connect science instruction to the daily lives of these parents' children, many pupils felt that science had little relevance to them (Charron, 1991). Based on these surprising results, a three-year follow-up study was conducted on this particular high schools' 1983 graduates. The results indicated that of the 70% not attending college or vocational school, many held positions in assembly work or sales for which little knowledge of science was necessary (Charron, 1991). In addition to this, the school librarian stated that, "You do not need to know much about a microwave oven, or even science for that matter, to benefit from it." These illustrations indicate that what students gather from science instruction depends, in part, on the experiences and influences which the students bring to the classroom from elsewhere (Charron, 1991). More importantly, if one does not see "real-live" science in the making or scientists doing science, then of course, what are our beliefs and attitudes going to be toward science if there are no role models to emulate or words of encouragement to hear?

In another study conducting a survey on the comparison of perceptions among rural and nonrural secondary science teachers' needs, rural science teachers indicated that one of their schools' greatest needs was trying to get students to become more motivated to learn science (Baird, 1994). Another study indicated that rural students in rural high schools have fewer role models, participate less frequently in extracurricular science activities, and have less science career information than do their urban peers (Kahle, 1989). It was also indicated that

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girls in rural schools were at a disadvantage. They continue to score below the national mean on all cognitive science items and express negative attitudes toward science. The results of this study were developed from the implementation of Project Scores program. The goal of the program was to develop an intervention model utilizing the strategies of teachers who were successful in getting students to continue in science and to remediate rural students in science who had shown a lack of participation. Rural students in the Scores program consistently received lower scores on the survey instruments than students of other school settings. Therefore, it was indicated from these results that there is a special need for programs stressing positive attitudes toward science and information about science careers in rural settings (Kahle, 1989).

In spite of rural students' attitudes toward science, one study reports that the relative success of rural science students is due to the relationship between rural students and rural teachers (Irion, 1982). Because of the small size of rural schools, there is more interpersonal communication between students and teachers. These relationships are highly valuable to the student and lend opportunity for a supportive learning process.

2.2.6 Rural Schools - Educational Technology

A new approach to educating rural students in the area of science is definitely of concern. There are numerous variables that play a role here somehow. Obviously, classroom discussions of science applications are no longer enough. In such settings, teachers will need to develop ways to involve pupils in doing

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science projects that provide tangible benefits. In order to do this, it is important to know more about what science presently means to students in given settings, and to build upon those meanings as instruction is designed. One attempt at this problem could be through educational technology.

The National Rural Education Association at the National Congress on Rural Education on 11 October 1992, implemented an extensive effort to identify the needs of rural education. The congress reached consensus on major questions dealing with obstacles to improve rural education in addition to strategies and solutions for addressing the obstacles (Gregory, 1992). Several of the barriers related to the use of technology included: 1) adequate funding; 2) provision for special circumstances of rural education; 3) staff development; 4) adequate and qualified teaching personnel and; 5) administrator work overload. A few examples of how the National Congress on Rural Education views technology in meeting these needs are discussed.

Adequate funding for the purchase of hardware and software could provide cost savings primarily through teaching and staff personnel reductions. Competencies of teaching personnel, access to instructional equipment, information and materials, and adequate funding are all "special circumstances" that could be alleviated through technology use. Teaching skills and resources for teaching and learning are important for staff development. Technology can provide for more effective teaching as it would provide educators with access to information for instruction that could improve teaching methods. Providing for and effectively teaching the various educational experiences that students need is a major obstacle in rural schools. Meeting the specialized needs of students at

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different grade levels entails extensive preparation and skills that are limited to rural schools. Distance learning and computer-assisted instruction can assist in meeting these needs. The overwhelming and extensive tasks of rural administrators are another concern as their tasks are equivalent to urban administrative tasks, but with less help. Technology again provides assistance through a multitude of programs geared specifically for administrative tasks.

In addition to meeting these problems in the rural school setting, remoteness, limited curricula, small multigraded classes, and high cost are other factors that could find use in technological applications. As a matter of fact, one of the most pervasive features of rural schools is their geographical isolation. For example, some Alaskan schools are only accessible by air or water and some of their communities may have only one phone (Barnhardt, 1983). This makes it very difficult for educators to enhance education that would rely on transportation or communication. Educational technology helps alleviate some of these problems by providing students with electronic mail and bulletin board systems which can be used for communication between students. Audioconferencing also allows students and teachers to interact with their peers across the entire world. Such opportunities provide students with a realistic view of the world beyond their rural communities.

Limited resources yields limited curricula; therefore, rural students are limited in their learning opportunities comparable to larger schools in urban settings (Thruston, 1992). Therefore, technology has become an alternative for expanding curricular offerings. The microcomputer has become a popular tool for enhancing curricular opportunities. It is able to provide alternative methods

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of instruction through drill and practice, tutorials, and simulations (Bull, 1988). Microcomputers also assist in enhancing the language arts curriculum through their word processing capabilities. It provides opportunities for teachers to use software that aids in diagnosing students' learning capabilities. Finally, microcomputers provide students and teachers with accessibility to data storage and retrieval systems.

With small enrollments in rural schools, classes sometimes consist of students functioning at different ability levels. In this situation, educational technology provides teachers with computer-assisted courses to supplement specific curriculum areas. In some cases, technology can be used to offset existing expenses in high cost areas such as travel and communications. Time and money can be saved through audioconferencing or electronic mail systems. This then allows schools to implement funds into more productive uses and, at the same time, reduce overall school expenses (Barnhardt, 1983).

In assessing the effects of technology on the quality of rural education, the question of who controls the use of technology in rural schools will be a critical one. If the use of technology is determined by external investors, technology will become an unimportant tool for the education and empowerment of rural people and communities. However, if its use is controlled by the users and educators, technology can become a powerful tool for rural education (Dubbs, 1982).

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2.2.7 Rural Schools - Available Technology

Research does not provide accurate data on the educational technologies made available to the nation's rural schools. However, it is thought that the larger school districts are further along in their adoption of technologies than the average small rural districts. Technology adoption ranges from computers to CD-ROM to video.

Technology trends for large and medium-size school districts for the 1992-93 school year according to Quality Education Data (QED) included: 48% Apple IIe machines, 17% Macintosh machines, 30% MS-DOS machines, and 5% other types of computers (Beckner, 1994). According to these findings, about half of all schools are still using computers from the mid-1980s. More recently, the purchase plans for new computers in the 1993-94 school year reported 5% Apple IIe, 43% Macintosh, 51% MS-DOS computers, and 1% other computers (Beckner, 1994). Obviously the trend now is to discontinue Apple IIe machines and upgrade to Macintosh and MS-DOS systems.

In addition to purchasing hardware, schools are also purchasing software for all areas of curriculum. In software purchases, mathematics programs have been more popular over language arts, science, reading, social studies, and business applications. The QED survey also indicates the ratio of instructional software to hardware spending in schools to be at 30%; meaning, for every dollar spent on hardware, $0.30 was spent on software. Imagine, if this is the case for large school districts, how long it will take smaller school districts to reach this level of technological exposure.

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2.3 Computer-Assisted Instruction (CAI)

2.3.1 CAI - Historical Background

As Americans became more urbanized and the United States became a major industrial power in the world, the search for efficient and cost-effective teaching methods began with technology offering the option of increased instructional productivity. The history of CAI began in the mid 1920s with Sidney Pressey's development of a mechanical device for scoring student examinations. However, Pressey's interest not only included saving time for teachers, but also included delivering individualized instruction. Ideas for individualized instruction led to the subsequent development of Pressey's "teaching machines" which had been based on the idea of programmed instruction (Pagliaro, 1983).

B. F. Skinner's work (1954) in the area of stimulus-response and reinforcement further contributed to the understanding and use of "teaching machines". It was Skinner's belief that mechanized instruction be implemented into all schools to act as a supplement for the teacher. His ideas created the programmed instruction movement which remained unchallenged for most of the 1950's. Norman Crowder later challenged Skinner's work with his idea of "branched" programming which is now implemented in the majority of CAI programs (Niemiec, 1989).

During the 1960's CAI grew very popular in education as it was used in a variety of subject areas. Two major systems, the IBM-1500 and PLATO, were utilized specifically for CAI. IBM-1500 Instructional System, under the direction of Richard Atkinson and Patrick Suppes, was developed to teach reading and

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mathematics to primary school students (Atkinson & Hansen, 1966; Suppes, 1966). PLATO (Programmed Logic for Automatic Teaching Operations) was soon developed to deliver CAI through large mainframe computers as opposed to delivery through mini-computers such as the IBM-1500. PLATO I was further developed into PLATO II, under Donald Bitzer's direction, to include more speed and storage that could maintain instruction for a number of students concurrently as opposed to PLATO I (Bitzer, Braunfel, & Lichtenberger, 1962). Another major CAI system, TICCIT (Time-Shared Interactive Computer Controlled Information Television), was designed to teach higher-order concepts using an instructional design system that utilized three modes: rule, example, and practice (Merrill, 1980). TICCIT thus became the first CAI system to be based in instructional theory.

As CAI seemed to provide a positive mechanism for educational instruction, CAI was limiting in user accessibility. Unfortunately, set-up and maintenance costs for mainframe CAI projects were overwhelming and therefore out-of-reach for most school districts. However, due to the microcomputer revolution, during the mid-70's, CAI became more accessible (Niemiec, 1989).

Microcomputers provided a scaled down version of large computers and by 1975 were released in the form of a kit ready for assembly by the consumer. Its attractive features assisted in promoting CAI as there became a wider interest among educators for its use. Microcomputers had produced more interest in CAI than previous CAI delivery systems and many schools were finally having their first experience with CAI because of this innovation (Pagliaro, 1983). As a result of this, there became a stimulated interest to learn more about

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microcomputers and their applications.

Despite these advances, CAI remains to be fully exploited by relatively few. A survey conducted in 1989, revealed that over 60% of teachers did not use computers (Becker, 1991). It has been rationalized that teacher resistance to classroom technology may include threatening feelings of change, feelings of being dispensable, or feelings that the traditional role of the teacher is being assailed (Hannafin, 1993). More importantly, as teachers embark upon the use of classroom technology or consider its use, the idea of both the teacher and the student assuming different roles in the classroom provides another source of resistance. There becomes opportunity for students to assume more of the responsibility for learning while the teacher becomes the imparter of knowledge as well as the learner-explorer along with the students. In addition to the apprehensive feelings teachers have toward CAI, other variables such as time and training also factor into the equation of teacher resistance to classroom technology. One of the most important barriers of microcomputer implementation is the lack of time available to teachers for previewing software, planning appropriate uses of software, and managing the use of software (Ellis, 1992). Studies indicate that teacher training is also a necessity if educators are to keep pace with the development of technology for teaching (Baird, 1989; Ellis, 1992; Okey, 1985). However, despite high-quality software, better inservice training, more accessible microcomputers, and curricular integration, if computers are to encourage classroom change and learning, there must first be teacher acceptance of classroom technology (Baird, 1989).

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2.3.2 CAI - Inequity

As the goal of school reform has been to improve the quality of teaching and learning in the classroom, educators have now become excited about the use of microcomputers for enhancing classroom instruction and student learning experiences. Unfortunately, the benefits to be gained from classroom technology are not equally accessible to all schools. This inequity now threatens to separate groups and communities by providing some individuals with more effective tools for living in the computer information age.

The Center for Social Organization of Schools at Johns Hopkins University conducted a National Survey of School Uses of Microcomputers between December 1982 and March 1983. Data based on 1,082 microcomputer-using schools revealed that the schools least likely to use microcomputers were small, private schools and public schools in the poorer school districts. These results thus indicated that nearly 67% of the schools in more affluent school districts have microcomputers while only 41% of the poorer school districts are equally equipped. The study also analyzed the racial status of schools to report that predominantly minority schools have about the same access to computers as low-income schools while 57% of high-income schools have at least one computer.

The Hopkins study also addressed the differential uses of computers as it indicated that predominantly minority schools use drill-and-practice activities more than they use programming activities with their students and provide below-average students with more access to microcomputers than other categories of schools. At the same time, it was found that predominantly white schools of a

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low socioeconomic status (SES) are more involved in programming activities than drill-and-practice activities and are more involved in these activities than schools of the highest socioeconomic status. Cole and Griffin (1987) also found that computers are used more for drill-and-practice among poor students than among middle and upper class students. Thus, Watt (1982) indicated that affluent students are learning to tell the computer what to do while less affluent students are learning to do what the computer tells them. The Christian Science Monitor reports that this situation will result in an intellectual gap between students in affluent and less affluent areas.

Another national study, the Minnesota Study, also addresses evidence of computer inequity based on its testing of a random sample of 18,900 9-, 13-, and 17-year-old students (Hueftle, Rakow, & Welch, 1983). As with the Hopkins study, the results of this study indicate that the number of students enrolling in computer programming is found to be lower in schools that rely on Chapter I assistance. The results of these two studies also agree in that the number of students using computers is much lower in schools of rural, low-income, and minority communities. However, the Minnesota study disagrees with the Hopkins study in that it did not find significant numbers to indicate racial differences in computer use. Geographical location has also proven to be another limiting factor of computer equity as the study reported that students living in the South are much less likely to have use of computers in school than students living in other parts of the country. Lautenberg (1984) agrees with this point as he indicated that the West leads the country in the ratio of computers to students.

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As computer inequity creates an economic and intellectual gap between schools and students, it also creates a gender gap (Alvarado, 1984). Ironically as both girls and boys display a similar appreciation for the significance of educational technology, boys are experiencing a broader working knowledge of computers through hands-on computer-related activities. A California statewide survey revealed that nearly 75% of twelfth grade girls and 67% of sixth grade girls from a population study of 17,861 students agreed that a knowledge of computers helps in getting a better job (Fetler, 1983). The 1983 Youth Survey reported that girls between the ages of 13-19 planned to take computer courses in school. Over 50% of these same students also planned to acquire a computer-related major in college. As positive as these results may seem, these same surveys indicated that boys are experiencing greater access to computers. Therefore, the edge that boys are gaining in computer technology is not due to sex differences in understanding the relevance of computers. These results are indicative of sex differences in access to and use of computers. It is believed that the lower rate of female participation in computer-related activities has a correlation to direct/indirect costs of computing, relevance and interest in computer curriculum, and the social context of computing (Lockheed, 1984).

According to the Minnesota study, racial differences concerning computer use were not large; however, more recent studies are disagreeing with these results. The Educational Testing Service surveyed the nation's third, seventh, and eleventh-grade students for their knowledge and skill using computers. Results indicate that White students had an advantage over African-American and Hispanic students at all three grade levels with the greatest performance differences in the higher grades (Martinez, 1988). These results confirmed that at

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the high school level, White students have a definite advantage over African-American and Hispanic students in regards to computer knowledge and skill. As studies suggest that inequalities are related to limited access to computers and differential use of computers (Becker, 1986; Cole & Griffin, 1987; Edwards, 1988) studies also indicate that a lack of computer-using role models serves as another barrier to computer equity for minorities (Martinez, 1988). This study revealed that over 90% of computer coordinators in both seventh and eleventh grades were White. Obviously, there is an under representation of minority computer coordinators relative to the Hispanic and African-American population.

2.4 Effects of Computers and Computer-Assisted Instruction (CAI)

2.4.1 A Learning Tool

Educational computing is regarded as a technology that makes a difference in how students learn. In regards to this notion, computer-assisted instruction (CAI) has been shown to support the theory that the computer is a powerful education tool when it is used appropriately (Martini, 1986). CAI provides for active student involvement, student evaluation of learning, adaptation of instructional strategies to meet individual needs, and adjustment to different levels of achievement and interest. These activities thus permit computers with the flexibility and capacity to provide for individualized instruction (Geisert, 1990).

Research indicates that when students must master new and timely information or tasks, students utilize different styles of learning (Center for the

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Study of Learning and Teaching Styles, 1990). These learning styles are defined by students' reactions to their instructional environments such as: immediate environment, emotionality, grouping preferences, and physiological characteristics (Dunn, Dunn, & Price, 1985). According to Geisert (1990), computers are able to present challenging information to students in a way that is conducive to students' learning preferences (auditory, tactual, or visual). Then, as it is able to accommodate for multisensory learning, computers also allow for reinforced learning through sequencing and branching of a program. This approach to learning provides motivation as well as flexibility to work with or without extensive introduction from the teacher and also flexibility to break or not break from learning.

CAI also provides assistance in learning of textbook information. Textbooks represent a primary means for which information is extracted by students. Unfortunately, many students do not have the reading proficiency necessary to extract information from textbooks and to incorporate that knowledge into previous experiences. Many textbooks are also difficult to understand due to heavy information loads, vocabulary, and dense concentrations of concepts. Present research attempts to combat this problem by developing computer-assisted strategies for teaching textbook information to secondary students (Horton & Lovitt, 1994). It is believed that the primary factor leading to the failure that many students experience when attempting to learn information from their assigned textbooks stems from insufficient sustained exposure and repetition with the material. Computer-assisted instruction (CAI), in this respect, provides the advantages of self-pacing, frequent responding, correction feedback, and cumulative review (Budoff, 1984). Such an approach places

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much more emphasis on mastery of the material than the typical "test and move on" approach that is often applied in traditional instruction (Horton & Lovitt, 1994). Also, if a student has missed a lesson, the dynamics of teacher-student interaction can rarely be reconstructed. However, with computer-assisted instruction, those dynamics are always accessible to the student and are not bound by traditional constraints.

Tutorial programs, one form of computer-assisted instruction, provides an opportunity for students to make sense of new knowledge. Tutorial instruction utilizes the constructivist theory of knowledge as students negotiate meaning from what is learned (Lorsbach, 1992). As the program provides information, students compare the given information to prior knowledge and personal experiences, thus alleviating any discrepancies between what is known and the implications of prior knowledge and personal experiences. This form of learning gives students time to clarify, elaborate, describe, compare, negotiate and reach a consensus as to what the entire learning experience, implied from the program and the students' experiences, means to them.

Tutorial programs may be a strong possibility for helping rural educators meet their content objectives along with meeting the aforementioned criteria. More importantly, this supplemental form of instruction could actually offer differentiated instruction adjusted to a student's knowledge, aptitude, learning rate, and learning style - a program that could surpass customary lab exercises and textbook-and-chalkboard instruction (Klopfer,1986).

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Depending upon the level of the tutorial program, it is possible to meet some or even all of these criteria when used as a supplement to instruction. For instance, one level of tutoring known as “minimal tutoring dialogue” uses a limited number of programming statements to assist in instruction. The computer merely presents the data/information for which the student responds, and based upon the response, the computer continues to the next screen of information or it presents remedial information to assist the student in understanding the concepts presented. Another level of tutoring instruction, which seems to be more popular, is known as “intelligent tutoring systems”. This form of computerized tutoring attempts to model the student’s understanding of the subject matter and then tailor instruction to meet the individual needs of the student in the form of examples, hints, advice, maps, and problems (Becker, 1982). Such an approach is based upon the idea that the student is best able to determine when assistance is needed and how much practice should be given to any specific concept before receiving additional instruction.

The overall use of computer-assisted instruction, according to research, can be used to influence positive results in the form of students’ attitudes and achievement across all curricular areas (Hasselbring, 1986). In comparison to traditional instruction, CAI demonstrates equal or better achievement in less time especially since it fosters increased academic learning time, a mediating variable for achievement. More importantly, its greatest gains are accomplished when CAI is integrated into on-going curriculum instead of as a course replacement (Hasselbring, 1986). Ferguson and colleagues (1993) argue that computer-assisted instruction enhances both student motivation and learning and is valuable in teaching science subjects, for example , genetics, which require development

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of problem-solving skills. Experience shows that development of problem-solving skills based on the application of basic concepts requires repetitious drill. The most limited resource in the classroom- the teacher's attention and response to individual student needs is often taken up directing and monitoring this practice activity, instead of pursuing other instructional efforts that people, not computers, can best provide (Becker,1982). Not only does this reduce the need for continuing teacher tutorial time, but CAI provides more opportunity for meaningful contact between educators and students as it permits time for diagnosing weaknesses and misconceptions needed for enhancing efficient learning (Anderson, 1995).

More specifically, computer-assisted tutorial programs have been found to be more effective for low-ability than for middle or high-ability students (Hasselbring, 1986). This is of major significance as researchers attempt to find ways of influencing low-achievers to become more interested and enthusiastic about science. However, tutorials not only positively influence low-achievers and the apprehensive science student, but it also has a positive influence on students with desired interests in science whose experiences in science courses may have been limited or negative experiences (Buttles, 1992). By providing a comfortable atmosphere for learning, tutorial programs permit students, at all ability levels, to work at a self-determined pace that provides opportunity for creative thinking and problem solving (Buttles, 1992). More importantly, tutorial programs increase student achievement and establish positive feelings toward computers and toward school work (Beckner, 1994).

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2.4.2 Utilization of CAI

Computer-assisted instruction (CAI) defined as the use of computers to serve in direct instruction of students, includes four modes of instruction, drill-and-practice tutorials, simulations, and testing programs. Through the use of these programs, students are able to become involved in simple question/answer tasks, more detailed content learning, "real life" studies, and innovative forms of testing. These four modes of computer-assisted instruction are defined below.

1) Drill-and-Practice programs: These programs are designed to put students in contact with course content and procedures. Drill programs divide the instructional program into discrete tasks where progress from one task to another depends on a student's prior performance (Becker, 1982). As drill programs have the potential to increase student learning and classroom involvement, they focus on material with specific right or wrong answers (Stringfield, 1994) and therefore concentrate on the rehearsal of factual knowledge (Baird, 1989).

2) Tutorial programs: Tutorials involve the presentation of content-related subject matter with the inclusion of more conceptual ideas instead of pure practice examples. These programs apply a more sophisticated method of analyzing student performance and determine more appropriate informational feedback and sequence of problem presentation (Becker, 1982; Smyth, 1987). A computerized tutorial program designed to help students understand physics concepts was successful in remedying misconceptions (Murray, 1990).

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3) Simulation programs: These programs are ideally suited for inquiry and for the development of higher order thinking skills. Simulations can be thought of as models for "real time" situations. They allow students to perform activities that would be too time consuming, dangerous, expensive, or impractical (Okey, 1985; Stringfield, 1994). When used to supplement interactions with objects and situations, simulations can be motivational and enriching.

4) Testing programs: These programs utilize the ability of computers to construct and score tests. Such programs provide assistance not only to educators in generating tests, answers, and maintaining records but also to assist in testing of large student populations at pre-college and college levels (Park, 1993).

2.4.3 Achievement

Based upon years of research on computer-based instruction (CBI) or computer-assisted instruction (CAI), several conclusions can be drawn in regards to the effectiveness of this type of instruction on student achievement (Hasselbring, 1986).

1. When CBI/CAI and traditional instruction are compared, students receiving CBI/CAI demonstrate equal or better achievement.
2. When CBI/CAI and traditional instruction are compared, equal or better achievement using CBI/CAI is obtained in less time.
3. The use of CBI/CAI improves student attitudes toward the use of

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computers in the learning situation.

4. The positive effect on learning achievement occurs regardless of the type of CBI/CAI used, the type of computer system used, or the age range of students.
5. "Primary CBI/CAI", where no teacher interaction occurs during the learning process, is much less effective than "adjunct CBI/CAI" where teacher interaction is a critical part of the instruction.
6. While advocates of teaching computer programming claim that programming will result in higher-level cognitive skills and capabilities to learn, there is little evidence to support or disprove these claims.
7. Tutorial and drill modes seem to be more effective for low-ability students than for middle or high-ability students.
8. The effect on learning achievement seems to be greatest for learners of pre-college age.

2.4.4 Attitude Towards Computers in Learning

As the use of computers in United States schools increases, it is logical to predict that computers will continue to be an important necessity in the educative process. With the increase in computer use, there has become an increase in research to evaluate its effects on students and the classroom setting. In particular, studies concerning attitudes toward computers have become a major topic in the literature today.

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Students' experiences with computers was a factor worth considering in a recent study (Gardner, 1993). Based upon an attitude-behavior theory, it was hypothesized that as students gain experience with computers they develop certain beliefs about computers which leads to the development of favorable or unfavorable attitudes toward computers. The results of the study supported this hypothesis as students felt that they were more skilled in using computers due to their increased experience with computers. Unfortunately, the students did not enjoy their experiences and thus developed negative attitudes toward computers. However, it believed that these attitudes developed as a result of early, negative experiences with computers. Other studies also support these results as it is again suggested that the most significant factor affecting students' attitudes toward computers is computer experience (Bear, 1987; Chen, 1986; Levin, 1989). Sufficient use of computers leads to less anxiety and therefore positive attitudes.

The use of computers in school courses is also an important factor in the development of attitudes toward computers. A study conducted by Moore (1985) revealed that courses involving the use of computers produced more favorable attitudes toward computers compared to non-computer courses. A more recent study also produced these findings as it discussed the importance of the relationship between working with computers and courses studied in school (Martin, 1991). In particular, it has been reported that attitudes toward mathematics courses are significantly related to attitudes toward computers (Miller, 1994). It is believed that these factors correlate as a result of past computer instruction being mostly associated with mathematics courses. Studies suggest that as students develop less math anxiety their attitudes toward

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computers becomes more positive (Gressard & Loyd, 1987; Munger & Loyd, 1989). Spain and Allen (1990) reported that offering supplementary computerized instruction in a freshman chemistry course received strong support from students. Skinner's work (1988) also supports these results as college student responses indicated a positive rating of the instructional effectiveness and appropriateness of CAI.

Computer anxiety has also been a preventive measure in efforts to completely computerize schools. An obvious high degree of computer anxiety thus tends to have a negative effect on attitudes toward computers (Levin, 1989). A recent study conducted, on sixth and seventh grade students, in India measured the influence of psychosocial factors on students' attitudes toward computers and discovered anxiety to be a significant factor in predicting computer attitudes (Miller, 1994).

The availability of computers in the home, in addition to their availability at school, has been proven to have an effect on students' attitudes towards computers. A study conducted by Miller (1994) has shown that students who are exposed to computers tend to have positive attitudes toward computers. Another study revealed that no significant relationship exists between computer attitudes and home use (Martin, 1991). Instead, it revealed that students who have had prior computer experience display more favorable attitudes. The results from both of these studies agree that the findings are indicative of the need for exposing students to computers at a younger age and thus support the results from Gardner's (1993) study on computer experience. More importantly, these studies indicate that males are more likely to have home computers than females.

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Studies have also investigated gender differences in relation to computer attitudes and have shown, for the most part, that males have more positive attitudes toward computers than females (Chen, 1986; Gardner, 1986). A study conducted on Canadian students also revealed similar results as eighth grade boys were more positive about computers than eighth grade girls (Collis, 1987). Martin (1991) mentions in a recent study that males tend to have more favorable attitudes in relation to having a home computer and therefore are using computers more than girls (Swadener, 1986). It is suggested that male-female computer attitude differences stem from socialization factors that have resulted from the assigning of stereotypical sex-specific roles. This socialization process thus has an effect on motivating males and females to either work with or not work with computers. Collis (1986) suggests providing computer activities that are more attractive to females as a mechanism for enhancing female attitudes toward computers. A more recent study that measured computer-related attitudes of eighth and eleventh grade students in the form of a pretest/posttest indicated that gains in computer attitudes are independent of gender (Woodrow, 1994).

Socioeconomic status (SES) is also considered in studying the effects of student computer interest. According to a study conducted by Miura (1987), students of a low SES gave themselves higher ratings than students of a high SES for an interest in learning about computers. Also, although students of a low SES are less likely to have home computers, these students are more curious in learning about computers as well as are more interested in considering a computer-related career. These were also positive results in spite of the fact that the low-SES students received less parental support for their needs and curiosity.

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2.5 Science Learning and the Effects of CAI on Science Learning

2.5.1 Attitude Toward Science

A recent study reported that the science curriculum and practices which have currently been used in schools do not produce students with positive feelings toward science (Simpson, 1990). It is also suggested that the average American student enters middle or junior high school with an inadequate science background, experiences formal exposure to science courses for the first time, develops a less than positive attitude towards science, and then registers for the minimum science requirements in high school. Studies indicate that students' attitudes toward science are influenced by their school environment, family, peers, and self-concept (Cannon, 1985; Talton, 1985; Talton, 1986).

In efforts to improve attitudes toward science, research discusses the importance of improving teaching methods, strategies, and conditions of learning (Cannon, 1985; Menis, 1987; Perez & Menis, 1986). Extensive and consecutive seat work assignments such as reading textbook chapters, listening to lectures, questioning-and-answering sessions, and completing worksheets have been found to have an unfavorable impact on students' attitudes (Hill, 1985). Different strategies such as the use of hands-on inquiry at the elementary level contribute to more positive science attitudes while laboratory work at the secondary level contributes to more positive science attitudes. Findings also suggest that instructional practices, ability-focused instructional practices, that emphasize the importance of good grades, competition, and being "the best" at science may be related to lower levels of motivation in science classes (Anderman, 1994).

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It is also known that the teacher's attitude toward science influences students' attitudes toward science (Koballa, 1985; Schibeci & Riley, 1986)). For instance, the time in which a teacher spends teaching science and the manner in which science is taught is reflected in a teacher's negative or positive attitude towards science. Yager (1985) reported students have better perceptions of science, science classes, science teachers, the value of science, and what it is like to be a scientist in grade three than when they are in grade eleven. This study speculated that the reason for these differences in perception was due to elementary school teachers being prepared to handle student questions, enthusiasm, and curiosity as they showed eagerness to seek advice and information concerning student questions. However, secondary teachers displayed more of a discomfort when they did not have the knowledge to answer student questions. A more recent study, however, points out that that elementary school teachers, as a group, are not as interested in teaching science as they are other subjects (Simpson, 1990). Therefore, students begin to experience science courses that influence a downward shift in their attitudes toward science. It is thought that if teachers increase their awareness of impactful teaching strategies and the classroom environment on students' attitudes, it will become possible to increase student interest and achievement in science (Talton, 1986).

As the number of opportunities for student-student and student-teacher interaction declines, academically and socially, negative attitudes toward science increase (Piburn, 1993). This qualitative study reported how students feel the need to be empowered through voicing their opinions and contributing suggestions on curriculum matters and teaching strategies. A past study also discussed how thirteen-year-old students perceived that they had more

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opportunity than seventeen-year-old students to decide the way they wanted to learn science, select the order of topics to be learned, work at their own pace, and decide when tests or assignments were to be done (Yager, 1984). These junior high students had highly favorable attitudes toward their science teachers. Now imagine what their attitudes were possibly toward science. This study points out how obviously important it is that students be placed at the forefront of educators' thinking if there is to be improvement in science education and attitudes toward science.

It is known that the norms or goals of certain groups and organizations to which students belong or hold with the highest regards are very influential on attitudes. Therefore, it is only likely that social interactions also have a significant influence student attitudes toward science (Koballa, 1985).

Family has a strong influence on the adolescent student (Talton, 1986). For example, parental beliefs and attitudes toward the importance of science may be translated by students as being supportive or lacking in concern for the study of science. One investigation reported that parental interest in science exemplified a modest to strong relationship with student attitudes (Simpson, 1990). However, family variables only accounted for 39% of the total variance of attitude towards science. Simpson (1990) also concluded how early childhood experiences correlated with family variables serve to influence early experience with school science. It is also mentioned that the personality characteristics of children in combination with parental attitudes have been found to be motivating and reinforcing in younger children's formal experience with science. Such feelings of success and family decisions regarding school science then serve as a base on

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which young students build during middle or junior high school. Parental education also has been shown to play a significant role in shaping Nigerian students' attitudes toward science (Mordi, 1991). However, students' home background did not contribute substantially to students' attitudes toward science because homes could not afford televisions, radios, and science fiction novels that would enhance attitudes toward science. It is implied that such a situation would lend for students to experience science only in the school environment and therefore would view science as a difficult subject.

Even more influential than the attitudes of parents toward science are the attitudes held by peers (Koballa, 1985). Studies (Simpson, 1990; Talton, 1985) have found that the relationship between peer and individual attitude towards science increased significantly over grades 6, 7, and 8 and peaked in grade 9. These studies concluded that attitude toward science is contagious and if students' attitudes toward science improved in the classroom, then it would be possible to see a synergistic effect throughout the entire classroom. However, it is also concluded that when attitudes become increasingly negative during adolescence, such would lead to increasingly negative group attitudes. Talton (1986) also concludes that how friends view and perform in science may have a significant influence on students during adolescence.

Findings also report that there is evidence of a strong relationship between science attitudes and self-concept (Haladyna, Olsen, & Shaughnessy, 1982; Handley & Morse, 1984; Mullis & Jenkins, 1988). Talton (1986) indicated that subject-area related feelings of self-confidence have a strong relationship with attitudes toward the subject. It is thought that increased positive feelings toward

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a specific discipline improves self-concept. Piburn (1993) cites NAEP results which indicated that nine-year-olds deny that science classes make them feel dumb; yet, at age thirteen only 20% of the students said that science classes made them feel confident. Also, students' fear of failure has been shown to prevent students from enrolling in physics courses (Crawley, 1992). When relationships across ability groups were investigated, attitude toward science of the middle ability group declined more rapidly than advanced or basic ability groups. It was concluded here that additional attention paid to superior students or students in need of special assistance may mediate against the decline associated with average students (Cannon, 1985). This point is also discussed in another study that revealed how students who are less learning focused, students with a diminishing self-concept of their ability in science, and value science less are identified as students who have academic difficulties as well as fewer patterns of motivation compared to normally achieving and special education students (Anderman, 1994).

2.5.2 Achievement in Science

Bloom suggested that 25% of the variance in school achievement could be attributed to how students felt toward what they were studying, their school environment, and their concept of self. Another 25% of the variance in school achievement has been attributed to the quality of instruction that a student receives. Similarly, these variables are also predictors of positive attitudes toward science (Simpson, 1990).

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In a study conducted by Cannon and Simpson (1985) to determine the different achievement levels in science by seventh-grade, life science students, it was reported that significant increases in science achievement occurred from the beginning to the middle of the year. As the school year progressed, science attitude and achievement motivation declined regardless of student ability group. These results suggested that science attitude is a good predictor of science achievement. Therefore, students with positive attitudes toward science will develop a deeper appreciation and understanding of science and consequently achieve higher in science. Simpson and Oliver (1990) also address the findings of an even stronger relationship between science achievement and attitude at the tenth-grade level. Another previous study on motivation in science education has also provided consistent evidence that attitudes toward science influence achievement (Haladyna, 1982).

Students who were more cognitively engaged in trying to learn by memorizing, organizing, and transforming classroom material through the use of rehearsal, elaboration, and organizational cognitive strategies were shown to achieve higher than students who tended not to use such strategies (Weinstein & Mayer, 1986).

Self-related variables, such as family and school related influences, are also strong predictors of achievement in science (Simpson, 1990). As Oliver and Simpson (1988) conducted a study to track achievement in science of high school students, it was reported that while the structuring of the science classroom environment was a significant factor in improving students' science self-concept, it would also be possible to encourage students to achieve at a higher level in

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science. Walker (1985) suggests that the extent to which an individual feels control over achievement experiences, perceptions of success and failure, determines a motivational disposition to achievement.

Studies also indicate that motivation is critical to student achievement (Fyans & Maehr, 1987; Maehr & Archer, 1987). In 1984, Walberg suggests that motivation accounts for 16%-20% of the variation in student achievement.

2.5.3 Effects of CAI on Science Learning

A scheme that has become in vogue in education is the use of microcomputers to facilitate learning. As computer-assisted instruction (CAI) offers itself as a valuable, supplemental teaching aid, research data on the use of microcomputers in science has become heavily populated with information on student attitude and achievement related.

A recent study examined the effect of computer-assisted instruction (CAI), used as a problem-solving approach to classroom instruction, on secondary students' attitudes toward chemistry and understanding of chemistry concepts (Yalcinalp, 1995). Results indicated that the CAI approach enhanced students' attitudes toward chemistry as well as increased student performance. It was concluded that the computer instructional approach offered an interactive experience in a nonthreatening manner which was thought to enhance student achievement and attitude. These results also support Clariana, Ross, and Morrison's (1991) work in that the quality of courseware and its ability to

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provide immediate feedback are influential on students' attitudes and achievement.

An introductory genetics course also utilized a computer-assisted genetics instructor (CAGI) to assist in developing students' problem solving skills and identifying students' weaknesses and misconceptions (Ferguson, 1993). According to the results, over 96% of CAGI users received a grade of a B or better whereas 67% of the CAGI nonusers earned a B or better in the course. More importantly, when given the option of taking an additional exam to increase grades, only 20% of CAGI users chose this option whereas 52% of the nonusers chose the optional exam. Obviously, CAGI users were more satisfied with their performance than were the nonusers.

Computer-assisted instruction has also brought an interest to developing Third World countries as Nigerian students were included in a study to determine the effect of CAI on learning biological concepts (Jegede, 1991). Data concluded that students did exemplify a favorable attitude change toward the use of computers in learning biological concepts, however; data did not support increased levels of achievement due to computer instruction. Hounshell and Hill (1989) also found similar results related to achievement when students were exposed to a computer-loaded biology course. However, attitudes related to the computer-loaded biology course proved to be significantly higher in regards to the comparison group of nonusers of the software. This enhancing effect of computer-assisted instruction on students' learning of scientific concepts has also been addressed in Britain (Barnes, 1989).

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These studies suggest that the computer provides much promise as a tool in the science classroom, however; it is safe to assume that the subject matter included in the investigation does affect the outcome of CAI research (Yalcinalp, 1995).

Different approaches to the use of CAI are also known to have a positive influence on science learning. Vockell and Rivers (1984) studied the effects of computer-based simulations on high school biology students' problem-solving abilities. Results indicated that students using computer simulations were able to meet the unit objectives just as well as students not using computer simulations. Thus computer-based simulations are thought to be effective in increasing students problem-solving skills. Another study conducted on the effectiveness of computers used as tutorials in a rural, high school biology course reported that CAI tutorials were no more or less effective in promoting student achievement than the traditional lecture/discussion approach (Morrell, 1992). However, there were differences in student attitudes toward CAI depending upon the unit students were tutored on. One group found CAI to be more motivating than traditional classroom instruction while a second group disagreed with these feelings. This study thus indicates that more research is needed to determine the effectiveness of computer-based tutorials. Waugh's (1985) study on the microcomputer-administered diagnostic testing of ninth- and tenth-grade students revealed that such testing has only an immediate effect on student achievement. Additionally, students expressed an interest in wanting more computer use. Therefore, computerized testing may have some effect on arousing students' interest in the use of microcomputers. Finally, research conducted to monitor student performance in chemistry through microcomputer drill and practice

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programs revealed a linear improvement in student performance over time (Zitzewitz, 1985).

Studies also reveal that the inclusion of CAI with other instructional approaches enhances science learning. Geban (1992) conducted a study on the effects of a computer-simulated experiment (CSE) and the problem-solving approach on students' chemistry achievement and attitudes toward chemistry. Data suggested no significant difference between the problem-solving approach and CSE. As a matter of fact, CSE improved the problem-solving skills of learners. These two instructional approaches together produced significantly greater achievement in chemistry and science process skills than the conventional approach. The CSE approach also produced significantly more positive attitudes toward chemistry than the other instructional approaches, with the conventional approach being the least effective. Another study was undertaken to assess third-grade students' attitudes and weather knowledge when a combination of CAI and hands-on instruction was administered. According to Gardner (1992), hands-on activities increase both student knowledge and science attitudes. However, a combination of both hands-on activities and CAI produced significantly higher achievement gains from pretest to posttest compared to hands-on activities on both assessments. Thus hands-on activities and CAI, or both produced increased understanding of weather concepts and positive attitudes toward science and computers. Investigations conducted by Shaw and Okey (1985) revealed data on the effects of laboratory work, computer simulation, a combination of both instructional strategies, and conventional instruction on sixth- and seventh-grade students' attitudes and achievement. Results suggested no significant differences in attitude among the four treatments, however; the combination of computer

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simulation and laboratory work and these two individual approaches produced higher achievement scores as compared to the conventional approach.

Regarding sex differences, Choi and Gennaro (1987) have found no significant differences in performance when comparing males with females using CAI in the learning of chemistry. Findings of this nature suggest that teachers do not have to worry about the differential effects of learning based on gender.

2.6 Summary

This chapter has examined the literature related to the investigation described in Chapter III. According to the review of literature, computer-assisted instruction (CAI) has become a major instructional resource for the classroom over the last few years.

Efforts at using computer-assisted instruction (CAI) in the classroom have shown positive results in terms of students' attitudes and achievement. Studies indicate that CAI is able to provide instruction conducive to students' different learning preferences which makes learning less intimidating. As a result, students' achievement improves and attitudes become more positive toward their subject matter. More importantly, many studies have shown that the inclusion of CAI, specifically in the science classroom, enhances learning as well as attitudes.

Unfortunately, due to financial circumstances and limiting professional development programs, rural schools have found it very difficult to remain

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current in the latest technological developments. Studies report that technology can provide rural schools and students with more and better access to instructional information for the science classroom. This innovative exposure can assist in eliminating some of rural schools' problems such as: limited curricula, remoteness, multi-graded classrooms, and high costs. It is therefore suggested that computers and CAI offer much promise, as an instructional tool, not only to the science classroom, but also to the rural science classroom if accessible.

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CHAPTER III

RESEARCH METHODOLOGY

3.1 Demographics

The school selected for the study is a junior high school northwest of New Orleans in the state of Louisiana. The student population consists of a total of 529 seventh and eighth grade students. There are 84 employees with one principal and two assistant principals. The students that attend the school live in Ward I and come from five feeder schools in the area. Seventy-two percent of these students live in government housing and are bussed to school daily. Seventy-five percent of the school's students qualify for the parish's free lunch program. The school only receives 5% parental support.

Non-Title I students reading levels were of a twelfth-grade reading level while Title I students reading levels were below a first-grade reading level. The Title I program at this junior high school consists of 121 students receiving assistance in reading and mathematics. These students were selected based on the results of the California Achievement Test (CAT) and the Louisiana Educational Assessment Program (LEAP). The school is now considered Targeted Assistance with only eligible students qualifying (121 students). In the following year, Targeted Assistance will be school wide, all programs and all students.

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Within the school parish, financial resources are limited to projected budgets and therefore it is very difficult for the schools to receive monies for additional or innovative instructional resources. The school involved in the present study was fortunate enough to receive additional monies to fund the development of their computer laboratory as a result of a grant written by one of the school's teachers. Presently, the school faculty is submitting other grants to support the purchase of software for their science computer courses as well as other academic courses.

The school faculty is also seeking funds to begin the upgrading of its computer facilities. At present, the school houses 68 networked computers. The computer laboratory houses 33 of these MS-DOS systems, two of which include CD-roms, five dot matrix printers and one laser printer. All of the school's language arts classes have at least one MS-DOS system with the library having three full computer systems. The principal and faculty are now working to acquire at least one multi-media computer for each of its science classes.

3.2 Description of Research Methodology

This research study is designed to investigate how rural students, who are known to be limited in their learning and understanding of science content (Kahle, 1989), may improve their attitudes towards science and their performance in science, as well as, their attitudes towards the use of computers when undergoing a supplemental tutorial program. Such a program will be implemented to serve as an additional instructional resource in the science classroom.

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To investigate the research problem, the study was designed as a quasi-experimental study that utilized a posttest control group design. This design permitted an investigation of the effectiveness of computer-assisted instruction (CAI) on student attitude and learning of science content. Such a study did not permit a random assignment of individual subjects to the groups. Intact classes were selected for each of the groups.

This chapter provides a detailed description of the research methodology. The focus of the chapter will include a description of the selection of subjects, treatment, instrumentation, data collection, and data analyses.

3.3 Research Questions and Hypotheses

1. Is there a difference in achievement between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program?

   H_{01}: There will be no difference in achievement between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

2. Is there a difference in students' science attitudes between the posttest mean score of students who participate in the computer-assisted tutorial

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program and the posttest mean score of students who do not participate in the computer-assisted tutorial program?

H_{02}: There will be no difference in students' science between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

3. Is there a difference in students' computer attitudes between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program?

H_{03}: There will be no difference in students' computer attitudes between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

3.4 Selection of Subjects

All subjects for the purposes of the study included seventh-grade students enrolled in a life science course at a junior high school. The sample was comprised of six, intact classroom sections for an N = 144 students, averaging about 24 students per class section. These six classes were ranked, by the

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school, according to the students' ability levels with class-one consisting of students with the highest achievement levels and class-six consisting of students with the lowest achievement levels. Three classes each comprised the experimental group and the control group. The control group consisted of students from classes 1, 2, and 3 while the experimental group consisted of classes 4, 5, and 6. The sample thus consisted of a control group of high achievers and an experimental group of low achievers.

Subjects in this study ranged in ages from 11 to 16 with age 12 being the average age of the seventh-grade population. The student population at this grade level was 57.6% African American and 37.5% Anglo. The student population pool consisted of 53.5% girls and 46.5% boys. Thirty-three percent of the students discussed having home computers while 92.4% of the students discussed having some prior computer experience across the various subject areas in elementary school. All students were given a student identification number in lieu of using names. This provided anonymity for students involved in the study. A profile on all the students selected to participate in the study is summarized in Table 3.1.

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Table 3.1 Summary of all participants. (N=144)

Variable	Value	Frequency	Percent
Average Age	12.35		
Avg. attended Days	5.50		
Ethnic Group	African American	83	57.6
	Anglo (White)	54	37.5
	Unknown	7	4.9
Gender	Male	67	46.5
	Female	77	53.5
Group	Control	76	52.8
	Experimental	68	47.2
Home Computer	yes	48	33.3
	no	96	66.7
Prior Computer Experience	yes	133	92.4
	no	6	4.2
	unknown	5	

3.5 Experimental Design

This quasi-experimental research study used a single factorial design, which was a posttest control group design. Intact classes were assigned to either a control group or an experimental group. The treatment evaluated in the study involved a six-week analysis of the effectiveness of a computer-assisted tutorial program, together with special software, on its presentation of science content knowledge in the life sciences.

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3.5.1 Dependent Variables

The dependent variables in the study were student achievement and attitudes toward computer-assisted instruction and learning of science concepts. Achievement was used to assist in the measurement of students' content knowledge related to the different systems of the human body: digestive, skeletal, muscular, circulatory, respiratory, excretory, and nervous system. Attitude was used to assist in the measurement and analysis of students' feelings toward learning science content and the use of computer-assisted instruction as a teaching strategy.

3.5.2 Independent Variable

The independent variable for this study included a form of computer-assisted instruction, a tutorial software program, designed to supplement the various units comprising a life science course. This software program was designed to provide students with an additional instructional resource for the human body unit of the course.

3.6 Treatment

Students enrolled in a seventh-grade life science course were tutored on the human body unit of their life science course during the second six-week period of the school semester. Tutoring was provided through the use of tutoring software

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made available in the school's first computer laboratory. The software was accessible from two 3.5 inch disks, designated Human Body Part I and Human Body Part II, that was designed to run on either MS-DOS or Macintosh systems.

The software program entitled Life Science Topics, developed by Intentional Educations, Incorporated, includes a series of interactive tutorials designed as a stand-alone supplement to courses in middle school life science. Throughout its instruction, the program was geared specifically towards tutoring seventh-grade students on the human body unit of the course as it covered the various systems of the human body: skeletal, muscular, digestive, circulatory, respiratory, excretory, and nervous systems.

These tutorials provided students with opportunities to be tutored on the course materials correlated to their life science class. Through use of the science topics software, students were introduced to middle school life science topics and concepts for discussion in class. Students also used the software program for the purpose of helping them to master difficult vocabulary and to explore topics beyond those taught in class. For the purposes of preparing for examinations, the software program was used as a mechanism for reviewing material studied and for self-testing and drill on central concepts. Finally, students used the software program for remediation in areas not well learned.

Students were able to perform the aforementioned tasks as the software program offered instruction through the use of text and figures in addition to simple, engaging animations. Throughout the course of instruction, students were also able to use inductive and deductive skills where appropriate, for

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example, in going through the process of a simulated experiment. As students prepared for examinations, reviews, or remediation, the software program then provided students with diagnostic self-tests together with a series of question types (fill-in, multiple choice, matching, labeling, pairing, and vocabulary). Feedback was provided in a timely manner as students completed and responded to each of the questions. Overall, the software program was intended to assist students in mastering middle school life science concepts and in developing and fine-tuning computer literacy skills through a series of interactive tutorials designed as a science course supplement.

It was intended for these tutorials to provide students with several potential benefits: stimulate a higher level of thinking related to life science concepts; motivate students to learn life science and apply it to "real life;" stimulate more positive attitudes toward science subject matter; remove feelings of intimidation towards learning science; create more self-confidence in learning science; and enhance computer literacy.

These potential benefits were intended to provide the researcher with insight into some of the types of learning environments conducive to learning, some of the forms of instruction that motivate learning and enhance concept comprehension, and the skills necessary for developing computer literacy.

In choosing the most useful and beneficial instructional software package, the researcher evaluated the software based on the following criteria:

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Policy Issues

1. Program exploits the computer's special capabilities (animations,simulations) to provide a learning experience that students cannot easily obtain through other instructional media.

2. The software package clearly defines the purpose and intended student learning outcomes.
   a. For review of material studied.
   b. For introduction to topics not yet covered in class.
   c. For self-testing and drill on central concepts.
   d. For mastery of key vocabulary.
   e. For remediation in areas not well understood.
   f. For exploration of topics beyond those taught in class.
   Purpose: To reinforce and enhance understanding of classroom and text presentation.

3. Two or more students may interact while using the software package.

Science subject-matter standards

1. Science content is free from errors.
2. Science content represents up-to-date scientific knowledge/information.
3. Science inquiry processes are well-integrated into the software package.

Instructional Quality

1. The instruction used in the software package incorporates good learning sequences, motivating features, and learning assessment procedures (text with animation and diagrams followed by various question types).
2. The computer program's instructional strategies are based on relevant educational or psychological research findings (motivating, self-paced, conducive learning environment, innovative).

Technical Quality

1. Students can easily and independently operate the computer program after a modest period of orientation.
2. The computer program's feedback to students' responses is appropriate, informative, and timely.

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3.7 Instrumentation

The instruments selected for this research study included: (1) the Survey of Attitudes Toward Computer-Assisted Instruction and Science and (2) the Life Science Concepts Test. Both instruments were administered prior to the beginning of the study and following the conclusion of the study.

3.7.1 Attitude Survey

Two surveys were combined and used: Attitude Survey for Junior High Science and Attitude Survey Towards Computer-Assisted Instruction (see Appendix F - combined survey). The 40-item combined-instrument consisted of 20 items that measured the attitudes of students toward computer-assisted instruction (CAI) and 20 additional items that measured the attitudes of students toward junior high science (Fisher, 1973). The 20-item sub scale that measured attitudes toward computer-assisted instruction (CAI) included two factors: (1) general attitude toward computers, and (2) attitudes toward computer-assisted instruction. Ten items were selected from an attitude survey (Vermette, Our, & Hall, 1986) that related to student general attitudes toward computers, and ten items were related to attitudes of students toward using computer-assisted instruction (Park, 1993). Although the two surveys were combined for the purposes of administering one complete survey, scoring of the survey was separated to indicate two separate scores: science score and the combined computers and computer-assisted instruction score.

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The 40-item survey was based on a five-point, Likert scale: strongly agree, agree, uncertain, disagree and strongly disagree. Strongly agree was assigned 5 points and 1 was assigned to strongly disagree. For the negatively worded questions, the scores were reversed. Since the survey consisted of two combined surveys, each subscale was capable of yielding a maximum score of 5 x 20 or 100 points and a minimum score of 1 x 20 or 20 points. A neutral score would yield 3 x 20 or 60 points.

The most recent reliability for the survey measuring attitudes toward computer-assisted instruction was determined in Park's study (1993) by employing a split-half technique based on students' responses on the pretest. The split-half technique represented the measure of internal consistency because of the two equivalent forms contained within a single test. The test was split into two equal parts. A reliability of r = 0.65 was obtained for the pretest. The reliability of the whole test was estimated using the Pearson correlation coefficient and the Spearman-Brown formula.

Content validity for the sub scale measuring attitudes toward junior high school science was established by six science curriculum specialists. The reliability of the instrument was established by both test-retest and spilt-halves methods (Fisher, 1973). The test-retest procedure was one that utilized 43 students while the split-halves procedure utilized 39 students. Its test-retest and split-half coefficients yielded values of r = 0.79 and r = 0.83 respectively. With 151 students, its alpha and split-half internal consistency coefficients yielded values of 0.78 and 0.86 respectively.

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3.7.2 Achievement Test

A 24-item Life Science Concepts achievement test (see Appendix E) was developed by the researcher through the use of test items designed for life science and biology courses. The test items were developed and obtained from professional test development programs such as: Jefferson County Life Science Program distributed by Kendall/Hunt Publishing Company; Knowledge Master Library of Test Items designed by Academic Hallmarks; Science Library of Test Items developed by the Assessment and Evaluation Unit of the Directorate of Studies - New South Wales Department of Education; and Life Science Test Bank distributed by Harcourt Brace Jovanovich Publishers.

The test questions were selected based upon the content taught in the classroom and presented through the computer-tutorial program. Course content covered the various systems of the human body which included: skeletal, muscular, digestive, respiratory, circulatory, excretory, and nervous systems. Each system contributed four test items with the exception of the skeletal-muscular systems and the respiratory-excretory systems which were both taught as a combined, single lesson. These two lessons each contributed six test items. The final test consisted of 24 items which included 50% knowledge and 50% comprehensive type questions.

Content validity was determined by using the two-way table of specifications method (Kubiszyn, 1996; Gronlund, 1985). Five content experts were given a pool of prospective test items and were asked to identify the conceptual objective that best fit each question. They were then asked to indicate how strongly they

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felt about their placement of each question into a specific conceptual category (see Appendix C). Responses were reviewed and statistically analyzed to produce a kappa value of 0.69. The kappa statistic, used to calculate interscorer reliability (Brown, 1973), was used to compare the ratings of each observer for the same objects.

An index of the test's reliability, Cronbach alpha, was used to measure the degree of consistency within the test. A reliability of r = 0.65 was obtained for the posttest.

3.8 Experimental Procedures

Prior to beginning the research study, permission was obtained from The University of Texas Institutional Review Board for the use of human subjects who volunteered for the study. At the time of approval from The University, the researcher also received permission from the junior high school's principal and science faculty to begin the study during the Fall semester 1996. Before the Fall semester was to begin, the researcher was given the opportunity to visit with the school's science faculty and to observe the structure and facilities of the school's computer laboratory. It was then decided that a schedule would be worked out, after classes began, between the laboratory facilitator and the science teachers as to the time and days the science classes would attend the laboratory.

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3.8.1 Consent Form, Student Profile, and Pretests

One month prior to the beginning of the study, students were informed about the research study and were asked to participate in the study. Consent forms (see Appendix A) were then distributed to the students and later returned that month to their science teachers validating their informed consent to participate in the study. Students also received permission from their parents to use the computer laboratory's facilities. Each participant was then assigned a laboratory password by the laboratory facilitator, for logon purposes. On the first day of the study, which was at the beginning of the second six weeks of school, students were assigned a personal identification number by the researcher and were asked to complete a student profile sheet and the pre-achievement/pre-attitudinal tests (see Appendices B, E and F). Student participants were then to attend the computer laboratory with their life science class on the assigned laboratory days. Participants in the study first attended the classroom lectures and then attended the computer lab for practice and reinforcement of the life science concepts learned in the classroom lectures.

3.8.2 Computer-Assisted Instructional Group Sessions

Students who volunteered to participate in the study comprised six, intact life science classes with two science teachers assigned to three classes each. Three of the classes were assigned to the control group while the remaining three classes were assigned to the experimental group. One science teacher was responsible for two classes assigned to the control group and one class assigned to the

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experimental group and the other teacher had one class assigned to the control group while the other two classes were assigned to the experimental group. Both of these groups were instructed using the exact same science lessons each week for a period of six weeks.

The experimental group included students who received supplemental instruction through the use of a computer-assisted tutorial software program. As part of the experimental group, students were expected to attend the computer laboratory with their life science class once a week for one hour. Each week students would receive tutorial instruction on a different topic related to a particular system of the human body. As students completed each tutorial exercise, they were always encouraged to go back and review previously taught programs. Before beginning tutorial instruction, all students assigned to the experimental group were given an orientation lesson on how to properly manipulate the software program. As a personal reference, each student was also given a handout that reviewed the various commands and directions for running the Life Science software package (see Appendix D).

The control group included students who did not receive the supplemental tutorial instruction course. As part of the control group's activities, students were also expected to attend the computer laboratory with their life science class for one hour a week. During their one hour visit to the computer lab, students were given a series of typed questions or mock experimental questions (see Appendix G) to read over and then answer using the word processing program on the laboratory computers. When answering questions, students were given the option of using their life science textbooks. At the end of the laboratory

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period, students were then required to turn in their printouts. The questions always related to the human body system that the students were studying that week. However, the questions given were purposefully chosen so as not to represent answers or questions that were covered in the pre-post achievement tests. Before beginning their laboratory assignments, students in the control group were also oriented to the use of the computer's word processing program.

3.8.3 Posttests

Immediately after the end of the six-weeks period, all student participants were administered a post-achievement test and post-attitudinal measure to determine any improvement in science content knowledge and any change in attitudes toward science and computer-assisted instruction.

Also during the study, both the experimental and control groups were informally asked to answer some brief interview questions (see Appendix H), written by the researcher, concerning their feelings and views of science and science learning. The experimental procedures above are summarized in Table 3.2.

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Experimental Procedures. Table 3.2

Step I - Prior to beginning the Study

a. Students signed and returned consents forms providing consent to participate in the research study.
b. Students returned lab forms providing permission to use the laboratory's facilities.
c. Students assigned logon passwords.
d. Classes assigned laboratory schedule.

Step II - First Class Day

a. Students assigned personal identification numbers.
b. Students completed student profile sheets.
c. Pre-attitude measure completed by students.
d. Pre-achievement test completed by students.

Step III - Laboratory Days (Weeks 1 - 6)

Experimental Group

a. Students oriented to the logon process and use of the software.
b. Students reviewed handouts on the commands/directions for using the software.
c. Students began tutorial instruction (human body systems).
d. Students reviewed previous instructional programs (human body systems).

Control Group

a. Students oriented to the logon process and use of the word processor program.
b. Students received question handouts.
c. Students answered questions and turned in printouts.

Step IV - End of Study

a. Post-attitude measure completed by students.
b. Post-achievement test completed by students.

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3.9 Data Analyses

The pretest scores and the posttest scores for both the achievement test and the attitude survey were collected for each student participating in the study. The pretest scores were collected prior to beginning the treatment and the posttest scores were collected immediately following the six-week treatment.

A one-way Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) were used in order to test each hypothesis. The Analysis of Variance (ANOVA) was used to analyze the pretest scores (achievement test, attitude survey) between the control and experimental groups. The F-value was set at a significance level of alpha = 0.05.

An Analysis of Covariance (ANCOVA) was used to further analyze the data. This statistical analysis was used to compare the posttest scores (achievement test, attitude survey), while the pretest was used as the covariate. This analysis was responsible for removing any variables that would have established additional differences between the control and experimental groups. These differences would have included variables that the researcher may not have been able to account for during the study.

3.10 Summary

The purpose of this research was to measure the impact of computer-assisted instruction (CAI), via science tutorial software, on the attitudes and achievement

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of seventh-grade students. A rural school setting was selected for the study as it is rural students who are not fairly reaching their science potential due to the disadvantages of rural schools.

This chapter has described the research design and methodological approaches used in investigating the problem. The research methodology includes subject selection, experimental treatment, procedures, and instrument development. The experimental results of this research study will be presented and summarized in the next chapter.

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CHAPTER IV

RESEARCH FINDINGS

4.1 Overview of Analysis Procedures

This study investigated the effects of learning science concepts through computer-assisted instruction in a seventh-grade life science course. This chapter contains an overview of the statistical procedures used in analyzing the data and the results of the data analysis.

A total of 144 students participated in this study during the fall semester of the 1996 school year. All student participants were given pretests at the beginning of the study. Following the pretesting, students attended their regular science classes and some attended a computer laboratory where their classroom lessons had been supplemented with computer-assisted tutorials. At the end of the six-weeks study, all student participants were given posttests.

4.2 Profile of Subjects

In a comparison between the control and experimental groups (Tables 4.1 and 4.2), it was found that the average age of the students in the experimental group was 12.66 while the average age of students in the control group was 12.06. It was also shown that students in the experimental group attended the computer

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laboratory for an average of 5.26 days out of a maximum of six days. The control group's average for laboratory attendance was 5.75 days out of a maximum of six days. The experimental group was shown to have more African-American students than Anglo students, whereas the control group was almost equal among the two ethnic groups. Gender variables indicated an equal distribution of males and females in the experimental group and 13% more females than males in the control group. The majority of the students in the experimental group also did not have home computers as compared to students in the control group. However, the majority of students in both the control and experimental group had some prior experience with computers in the classroom.

Table 4.1 Experimental Group. Subject Background Information. (N=68)

Variable	Value	Frequency	Percent
Average Age	12.66		
Avg. days attended	5.26		
Ethnic Group	African American	42	61.8
	Anglo (White)	21	30.9
	Unknown	5	7.4
Gender	Male	34	50.0
	Female	34	50.0
Home Computer	yes	14	20.6
	no	54	79.4
Prior Computer Experience	yes	59	86.8
	no	5	7.4
	unknown	4	5.9

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Table 4.2 Control Group. Subject Background Information. (N=76)

Variable	Value	Frequency	Percent
Average Age	12.06		
Avg. days attended	5.75		
Ethnic Group	African American	41	53.9
	Anglo (White)	33	43.4
	Unknown	2	2.6
Gender	Male	33	43.4
	Female	43	56.6
Home Computer	yes	34	44.7
	no	42	55.3
Prior Computer Experience	yes	74	97.4
	no	1	1.3
	unknown	1	1.3

4.3 Analysis of Variance (ANOVA)

This section discusses the pretest results on achievement and attitude for students comprising the experimental and control groups, gender groups, and ethnic groups. The results of achievement and attitude were analyzed to determine differences in achievement mean scores and attitude mean scores among the experimental and control groups. Additional analyses were reported on males and females and Anglo Americans and African Americans. Attitudinal mean scores were further analyzed to determine attitudes toward science and computer-assisted instruction. An ANOVA design was used to analyze the

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pretest mean scores on achievement and the pretest mean scores on attitude for the aforementioned groups (see Appendices J and K).

4.3.1 Analysis of Pretest Achievement and Attitude Results

Results indicated a significant difference in achievement pretest scores between the experimental and control groups, F = 8.487, p = .004. A significant difference in achievement pretest scores was also reported for Anglos and African Americans, F = 6.920, p = .009. However, no significant difference in achievement pretest scores was reported for males and females, F = 2.991, p = .085. The F-value was set at a significance level of alpha = 0.05.

Results regarding attitude pretest scores between the experimental and control groups indicated a significant difference between the two groups in regards to their attitudes specifically toward science, F = 13.317, p = .000. No significant difference was found between the experimental and control groups in regards to their attitudes specifically toward computer-assisted instruction, F = 2.936, p = .088.

ANOVA analysis revealed no significant difference between males and females in regards to their attitude scores specifically related to science, F = .159, p = .690. Finally, no significant difference was found between males and females in regards to their attitude scores specifically related to computer-assisted instruction, F = 2.590, p = .109.

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Data analysis for Anglos and African Americans also revealed no significant difference in their overall attitude pretest scores, $F = 1.305$, $p = .255$. A significant difference, however, was found between these two groups in regards to their science attitude scores, $F = 4.643$, $p = .032$. No significant difference was found between Anglo Americans and African Americans in regards to their computer-assisted instructional attitude scores, $F = .890$, $p = .347$. The F-value was set at a significance level of alpha = 0.05.

4.4 Analysis of Covariance (ANCOVA)

Due to differences observed from the ANOVA analysis on pretest achievement and attitude scores, the experimental and control group posttest data were then analyzed using the ANCOVA design. This analysis allowed for analyzing posttest mean score differences after correcting for any differences that would have existed between the experimental and control groups when the ANOVA analysis was conducted.

4.4.1 ANCOVA Results on Achievement

The posttest results include a data comparison of achievement mean scores for students who received the computer-assisted tutorial instructional approach (experimental group) and for students who did not receive the computer-assisted tutorial instructional approach. Results were reported in order to test the following hypothesis.

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The null hypothesis H_{01} was:

There will be no difference in achievement between the posttest mean score of students who participated in the computer-assisted tutorial program and the posttest mean score of students who did not participate in the computer-assisted tutorial program.

Table 4.3 summarizes the results from an ANCOVA analysis. The results include data on the posttest achievement scores for the experimental and control groups after using the achievement pretest as a covariate. Data indicated a significant difference in posttest mean scores between the two groups, F = 13.006. p = .000. The F-value was set at a significance level of alpha = 0.05.

Table 4.3 Achievement results from ANCOVA--Control and Experimental

Source of Variation	SS	df	MS	F	p	Mean G1	Mean G2
Achievement							
Between	107.748	1	107.748	13.006	.000	10.97	9.19
Within	768.346	141	8.285				

G1-Control group; G2-Experimental group

The results regarding Hypothesis 01 denied acceptance of the null hypothesis after controlling for achievement pretest scores.

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4.4.2 ANCOVA Results on Science Attitude

Attitude results provide comparative data on the posttest mean scores for the experimental and control groups' attitudes specifically toward science. Students' overall attitude was also included in the data. Results were reported in order to test the following hypothesis.

The null hypothesis H_{02} was:

There will be no difference in students' science attitudes between the posttest mean score of students who participated in the computer-assisted tutorial program and the posttest mean score of students who did not participate in the computer-assisted tutorial program.

Table 4.4 summarizes the ANCOVA results. The data provides a summary of information on both the experimental and control groups' posttest attitudes toward science. These results were analyzed after using the science attitude pretest as a covariate. No significant differences were concluded from the mean scores on science attitudes, $F = 2.435$, $p = .121$. The F-value was set at a significance level of alpha = 0.05.

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Table 4.4 Science Attitude results from ANCOVA--Control and Experimental

Source of Variation	SS	df	MS	F	p	Mean G1	Mean G2
Attitude - Science							
Between	194.538	1	194.538	2.435	.121	70.30	67.86
Within	11264.317	141	79.889				

G1-Control group; G2-Experimental group

The results regarding Hypothesis 02 required acceptance of the null hypothesis after controlling for attitude pretest scores.

4.4.3 ANCOVA Results on CAI Attitude

In this section, ANCOVA results provide a comparative analysis of the experimental and control groups' posttest mean scores related to attitudes toward computer-assisted instruction. The data also includes comparative results of the two groups overall attitudes as discussed in the previous section. Results were reported in order to test the following hypothesis.

The null hypothesis H_{03} was:

There will be no difference in students' computer-assisted instructional attitudes between the posttest mean score of students who participated in the computer-assisted tutorial program and the posttest mean score of students who did not participate in the computer-assisted tutorial program.

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Table 4.5 includes a summary of ANCOVA results. The results report on the differences in the experimental and control groups' posttest attitudes toward computer-assisted instruction after controlling for the pretest computer-assisted instructional attitude scores. Similar to the science attitude posttest scores, no significant differences were reported for the experimental and control groups' posttest computer-assisted instructional attitude scores, F = 3.252, p = .073. The F-value was set at a significance level of alpha = 0.05.

Table 4.5 Computer-Assisted Instruction Attitude results from ANCOVA--Control and Experimental

Source of Variation	SS	df	MS	F	p	Mean G1	Mean G2
Attitude - Computer							
Between	96.506	1	96.506	3.252	.073	76.23	74.58
Within	4183.747	141	29.672				

G1-Control group; G2-Experimental group

The results regarding Hypothesis 03 required acceptance of the null hypothesis after controlling for attitude pretest scores.

4.5 t-Test Analysis

In order to determine significant differences between pretest and posttest results of achievement and attitude, a t-test was used to analyze pretest and posttest mean scores for the experimental group and the control group. Although

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the ANCOVA design had permitted analysis of posttest mean scores while correcting for differences that had occurred between the two groups at the time of the pretest, the differences were very slight. Therefore a t-test was also conducted. This test thus permitted another method of analyzing gain scores or differences in scores within the experimental group and within the control group (see Appendices L and M).

4.5.1 t-Test Analysis of Experimental Group Achievement and Attitude

The table in Appendix L contains the results of the t-test summary for the mean differences between the pretest and posttest achievement mean scores; pretest and posttest attitude mean scores for the experimental group. Results indicated a significant difference between the pretest and posttest achievement mean scores, $t = 4.16$, $p = .000$. The difference between the pretest and posttest mean scores was 1.5882. There was a significant gain in attitudes and achievement for the experimental group.

There was no significant difference between the pretest and posttest mean scores in overall attitude, $t = .57$, $p = .571$. As a result, there was no difference between the pre- and posttest mean scores on the science attitude sub scale, $t = .77$, $p = .444$. The results were similar for the pre-computer attitude sub scale and post-computer attitude sub scale, $t = .09$, $p = .932$. The alpha level of significance was set at 0.05.

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4.5.2 t-Test Analysis of Control Group Achievement and Attitude

The results of the mean differences between the pre- and posttest achievement mean scores; pretest and posttest attitude mean scores for the control group are summarized by t-test analysis in Appendix M. There was a significant difference between the pretest and posttest achievement mean scores, t = 8.10, p = .000. The difference between the pre- and posttest mean scores was 2.815. Therefore there was a significant gain in attitude and achievement in the control group.

There was no difference between pre- and posttest mean scores on attitude, t = .17, p = .868. As a result, there was no difference in pre- and posttest mean scores on the science attitude sub scale, t = .18, p = .855. The results were the same for the pre- and posttest mean scores on the computer attitude sub scale, indicating no significant difference, t = .68, p = .501. The alpha significance level was set at 0.05.

4.6 Summary of Findings

The results of the data analyses has been presented in this chapter. In addition to the data analysis, a summary of the sample demographics was included together with the hypotheses tested.

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Computer-assisted tutorial instruction (CAI) improved students' achievement, but not as significantly as classroom instruction without computer-assisted instruction. Students comprising the control group outperformed students comprising the experimental group regardless of the treatment as the results reveal. Students comprising both the control and experimental groups exemplified significant growth in achievement from the pretest to the posttest. Although no significant difference was observed, Anglos outperformed African Americans in achievement. However, both groups exemplified growth, throughout the study, in achievement.

Computer-assisted tutorial instruction did not significantly influence students' attitudes toward science and computer-assisted instruction. Therefore, students' attitudes did not change from the beginning to the end of the study.

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CHAPTER V

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

A summary of the investigation together with the results will be presented in this chapter. Included will be a summary of the findings, discussion of the findings, and conclusions based on the results. Finally, implications and recommendations for future research will be discussed.

The decline of scientific literacy in rural school settings has become a national concern. As researchers have looked into the reasons behind the drop in rural school scientific literacy, many factors have been found to affect rural science education. Limitations in finances, innovative instructional materials, laboratory supplies, and certified science teachers have been concluded to be major barriers to good rural science education. These limiting factors make it difficult to maintain effective science instruction (Mann,1993) which in turn discourages students' interest and achievement in science as well as choosing it as a possible major at the college levels. Computer-assisted instruction (CAI), a valuable tool in classroom instruction, is becoming an avenue for implementing change in rural science education.

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The use of computers in rural, school science classes may offer the opportunity for learning in a different classroom setting that provides for a less intimidating classroom environment, allows for self-paced instruction, encourages independent thinking, and provides motivation and encouragement in the learning of science skills and concepts. More importantly, the use of computers as a learning tool in rural science education will provide an opportunity for rural schools to become more exposed to the different forms of computer-assisted instruction such as tutorials, simulations, and drill/practice activities. It is also intended and hoped that, with the successful use of CAI in rural school settings, there can be a spread of encouragement and optimism across all rural school settings to begin successfully acquiring and administering innovative forms of science instruction that include among other things, computer-assisted instruction.

The problem that was investigated in this study was: *How does the use of a supplemental tutorial program in a seventh-grade life science course influence rural, middle school students' attitudes toward science, attitudes toward the use of computers, and level of academic achievement when compared to those who do not use a supplemental tutorial program?*

An experimental research design was planned and implemented to investigate the research problem. The research study employed a single factorial design. One-hundred forty-four students enrolled in a seventh-grade life science course at a rural, middle school participated in the study. Six intact classes were assigned to one of two groups: a control group consisting of students not involved in the use a computer-assisted tutorial program and an experimental group consisting of

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students involved in the use of a computer-assisted tutorial program.

Prior to beginning the study, all subjects were administered two pretests to determine students' prior knowledge and attitudes. The tests included a science achievement instrument, an attitude toward computer-assisted instruction survey, and an attitude toward junior high science survey. The attitude surveys were combined into one survey. Following completion of the treatment, all subjects comprising both the control and experimental groups were administered the test instruments in order to determine the effects of the treatment on students' academic science performance and attitudes. The statistical procedures employed to evaluate the collected data included both one-way ANOVA and ANCOVA analyses.

5.2 Findings and Discussion

As this investigation focused on studying the effects of a computer-assisted tutorial program (CAI) on students' achievement in science and attitudes towards science and computer-assisted instruction, several research questions were formulated. The results of the research questions proposed for the purposes of this study are discussed throughout the remainder of this section. The null hypotheses included the following:

H_{01}: There will be no difference in achievement between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not

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participate in the computer-assisted tutorial program.

H_{02}: There will be no difference in science attitudes between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

H_{03}: There will be no difference in computer attitudes between the posttest mean score of students who participate in the computer-assisted tutorial program and the posttest mean score of students who do not participate in the computer-assisted tutorial program.

5.2.1 Science Achievement

The investigation was designed to determine the effect of an innovative form of instruction, computer-assisted instruction (CAI), on rural students' ability to learn their science course concepts. Therefore, it was important to the research to determine if any achievement differences between two groups of students existed before beginning the treatment.

The results of the ANOVA analysis revealed a significant difference in the achievement pretest mean scores between the control and the experimental group. The mean score results indicated higher achievement to be in favor of the control group. A significant difference in achievement pretest scores was also reported for Anglos and African Americans with Anglos outperforming African Americans

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in science achievement.

Due to the significant differences observed on the achievement pretest between the experimental and the control groups, the two group's achievement posttest results were analyzed using ANCOVA analysis. ANCOVA analysis allowed for analyzing achievement posttest mean scores after controlling for the pretest achievement mean scores. This method of analysis controlled any unknown variances that may have existed between the two groups prior to the achievement posttest.

Posttest results, according to ANCOVA analysis, revealed a significant difference in achievement between the experimental and the control group. Thus, these results answer research question 1 with rejection of the null hypothesis H_{01}. The mean score difference indicated that the control group did outperform the experimental group on the science achievement posttest. However, ANCOVA analysis also indicated that no significant difference in achievement posttest mean scores existed between Anglos and African Americans.

5.2.2 Attitudes Toward Science and Computers

The research questions 2 and 3 were concerned with students' attitudes toward science and toward computers. Therefore, a survey was administered that evaluated students' attitudes specifically toward science and computers. The data compared students' attitudes in both the the experimental and control groups.

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ANOVA analysis of students' attitudes specifically towards science displayed some difference in pretest mean scores between the control and experimental groups. Prior to the study, students in the control group displayed a weakly positive attitude toward science while students in the experimental group displayed neutral feelings toward science.

According to the ANOVA analysis, there was no difference in the experimental group's and the control group's computer attitude mean scores. However, both groups displayed slightly positive attitudes toward computers on the pretest.

Attitude posttest mean scores specifically related to science were further analyzed by ANCOVA analysis after controlling for the science attitude pretest scores. Data revealed no difference in science attitudes upon comparing posttest mean scores between the experimental and the control group. However, the control group did exhibit positive attitudes while the experimental group exhibited neutral attitudes.

Posttest mean scores related to computer attitudes were also analyzed using an ANCOVA design. Similar to the science posttest mean scores, the computer posttest mean scores revealed no difference in computer attitudes between the experimental and the control group. At the conclusion of the study, both groups continued to display weakly positive attitudes toward computers.

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5.2.3 Summary of Achievement and Attitude Scores

Differences regarding pretest and posttest mean score results for the experimental group and the control group revealed that the experimental group improved significantly on the achievement posttest. The control group also improved significantly on the achievement posttest. However, the control group was found to have outperformed the experimental group on the achievement posttest when looking at gain scores.

Attitudinal mean score results were almost identical from the pretest to the posttest. The control group remained more positive than the experimental group as this group's attitudinal score increased slightly and the experimental group's score decreased slightly. According to the analysis, there were no differences in attitude scores. However, the control group maintained positive attitudes towards science and computers while the experimental group maintained a neutral attitude toward science and a positive attitude towards computers.

5.3 Conclusions

The results regarding academic achievement, in the case of both groups, is encouraging and not surprising. The analysis reveal that the control group outperformed the experimental group at both levels of testing, pretesting and posttesting. These results would normally be surprising results as the control group did not receive any supplemental instruction in the computer laboratory with the CAI program. However, it is acknowledged by the researcher that the

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control group consisted of higher achieving students compared to the experimental group at the beginning of the study. This was unexpected. Since this was the case, it was expected that the control group would continue to achieve regardless of the type of treatment. Furthermore, the teachers involved in the study could have been aware of the research design, therefore it is possible that the teachers instructing the majority of the control group students could have felt encouraged to increase their own instructional methods.

In cases such as these where students are academically separated from the rest of their classmates and told that they are the "the better students" and given more attention, one can expect such students to consistently achieve or work harder at being the best. Cannon (1985) suggests this observation in a past study where he analyzed the relationship of attitude, motivation, and achievement of ability grouped, seventh-grade life science students. It was suggested that the advanced and basic ability groups may command most of the attention and energies of educators with less resulting attention being paid to the general ability group. As a result, the general ability group demonstrated the largest declines in science attitude and achievement motivation. According to Babad (1990), it is "average" students or "lower achieving" students that do not usually receive appraisal or attention and therefore are not as easily motivated to work towards higher achievement. More importantly, past research has reported that low ability is defined and looked upon by students as a competitive failure that is demoralizing and threatening of self-worth (Ames, 1981; Harris, 1993). This failure thus accentuates perceptions of ability differences (Ames,1981).

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Another value that factors into this equation is the fact that these students are from a rural school district. Rural school students now exhibit inferiority complexes about their origins as they have internalized the prejudices of outsiders. Outsiders have taught them that they are not as better academically as their urban school counterparts. Rural school students are told this because their schools are smaller and more isolated from the "real world" and the latest academic interventions (Herzog, 1995; Theobald, 1995). Therefore if one were to now compare the "average" or "low achieving" rural school student to the "higher-achieving" rural school student, one would recognize and realize that there may be a lack of motivation in such a student. If the student is from a rural school setting and he/she is ranked as an average to low achieving student, these are two obstacles the student may have to contend with and hopefully overcome.

In spite of the academic differences between the control and experimental groups and the fact that the control group consistently outperformed the experimental group, the experimental group did display improved achievement in comparison of its achievement pretest and achievement posttest results. More importantly, after experiencing six-weeks of computer-assisted tutorial instruction, the experimental group achieved to the academic level of the control group at the beginning of the study. Results thus indicate that computer-assisted tutorial instruction does in fact enhance academic achievement of rural school students and they do not regress. More specifically, computer-assisted tutorial instruction enhances the academic achievement of lower achieving rural school students as revealed by their gain scores.

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Previous data also support these findings with reference to other subject areas. Bass (1986) has found CAI, as an additional instructional strategy, contributes to improving reading and mathematics performance of low achieving students. Computerized spelling programs have also improved spelling achievement for low achieving students (McAuley, 1992). Other studies also reveal the beneficial effects of computer-based practice on the achievement of students of low aptitude (Bangert-Drowns, 1985; Kulik, 1985). Thus it is anticipated that more positive results may be attained when such tutorial instruction is utilized by all rural students of varying academic levels.

The results regarding both groups of students' attitudes toward science and computer-assisted instruction remained very much consistent throughout the study. Both the control and experimental groups approached and concluded the study with overall positive attitudes. Also, both groups continued to display positive attitudes toward computers and computer-assisted instruction. Preliminary data revealed that 92% of the students had had prior computer experience during their elementary school career. Unfortunately, only 33% of the students had home computers with the majority of these students comprising the control group. It is possible that prior computer experience and ownership of personal computers could have maintained these positive attitudes toward computer-assisted instruction initially and throughout the study. More importantly, these students' positive attitudes toward computers and computer-assisted instruction could be attributed to the computer and software's abilities to offer an experience where students felt a sense of more control over their learning. It is also extended to on task behavior which leads to improved self-esteem.

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According to Levin and Gordon (1989) that prior computer experience, in particular, having a computer at home, has a strong influence on attitudes toward computers. Their results also suggested that pupils owning computers were more motivated to become familiar with computers and had more positive attitudes toward computers than pupils who did not own computers. Loyd, Loyd and Gressard (1987) also found that increased computer experiences decreased anxiety and increased positive attitudes.

Studies regarding motivation and computers concluded that the use of computers in secondary schools increases, at least at the start, the motivation of the students (Kinzie, 1989; Krendl, 1988). Students obviously had a better perception of learning compared with the traditional way of teaching (Kinzie, 1989). It was also discovered that student-controlled instruction was preferred to program-controlled instruction because it gave students the perception of personal control (Kinzie, 1989). More importantly, such student-control was predicted to not only affect motivation, but to also affect long-term achievement.

Unfortunately, only the control group exhibited positive attitudes toward science. The experimental group maintained neutral feelings toward science based, at this time, on test scores. According to students from both groups, their prior classroom computer experience had been more associated with mathematics and language arts at the fifth and sixth grade levels. Very few students reported having had prior computer experience in their elementary science courses. The majority of the students in the experimental group also reported, based on their interview questions, that they disliked science and did not want a job related to science. These students also felt that their dislike for science had to do with how

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they learned science. The students suggested that doing experiments was what would make science more interesting and fun to them.

In spite of these responses from students in the experimental group, their attitudes toward science were neutral. Therefore, tutoring via computer-assisted instruction could possibly have assisted in maintaining neutral feelings toward science that were otherwise communicated as negative feelings at the end of the study. According to Moonen (1992), subject matter that students usually do not enjoy during ordinary classroom lessons was found to be enjoyed more in the computer room. The computer had now offered another method of learning science which to the students may have been a more interesting way of learning science because it allowed them to maintain a focus on the material. This new method of instruction could have confused their feelings about science.

Since the students entered the study with positive attitudes and maintained their attitudes, it is obvious that computer-assisted tutorial instruction does not have a negative effect on students' attitudes towards computer-assisted instruction or even science, as revealed in this study. As a matter of fact, this form of instruction probably provided students in the experimental group with an opportunity to rethink any confusing thoughts or ideas they may have had concerning science.

Literature today indicates a strong correlation between science achievement and academic self-concept (Kahle, 1989; Mitchell & Simpson, 1982). It seems that the major factor influencing this effect in the school is students' perceptions of their competence in learning. These feelings again go back to students'

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learning environments and their confidence in learning science. To rise to their scientific potential in the classroom, students need to extract a certain level of comfort from their learning environment. The classroom should provide an environment where students are made to feel comfortable about themselves and therefore, comfortable and confident in their work. In the rural setting, possibly the most innovative teaching styles are not always present. Efforts need to be undertaken to achieve these important methodologies.

Computer-assisted tutorial instruction (CAI) can now offer an innovative form of instruction to the rural science classroom that provides a comfortable and alternative atmosphere for learning. In addition, under the complete control of the student, students are allowed to work in a self-paced environment where they can think creatively and inquire into the meaning of various concepts and develop their own problem solving skills (Okey, 1985). CAI provides a different approach to learning that actually keeps the student's attention long enough to motivate learning (Ferguson, 1993). More importantly, CAI can now assist rural students in developing a more positive self-concept about their ability to learn science concepts and possibly point them in the direction of actually beginning to find an interest and enjoyment for learning science (Beckner, 1994).

5.4 Recommendations for Future Research

The results of this study begin to demonstrate the effects of a computer-assisted tutorial program as a form of supplemental instruction in a rural middle school life science course. Students who received supplemental tutorial

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instruction via computer are found to improve their science achievement significantly. More importantly, with tutorial CAI, lower achieving students are able to achieve to the level of their higher achieving classmates. However, this study does not support a complete advantage for computer-assisted tutorial instruction over teacher directed learning activities. Furthermore, although tutorial CAI is not shown to create more positive attitudes, it does not negate rural students' attitudes about learning science or learning by computer-assisted instruction.

As this study has investigated the effects of tutorial computer-assisted instruction, it has also observed the effects that this form of instruction has on lower achieving students. However, if computers are to be used equitably as an instructional tool, an implementation plan needs to be developed such that all students receive access to computers, rather than targeting access by ability group. Recent studies indicate that when grouping low ability students with high ability students the odds of success for low ability performers are greatly increased without being deleterious to high ability performers (Harris, 1993; Knupfer, 1993). It is therefore recommended that future research investigate the effects of computer-assisted tutorial instruction on the heterogeneous grouping (varying academic levels) of rural students.

Time is another factor that the researcher questions in relation to achievement. The study was carried out over a period of six weeks that gave students a maximum of of one hour of instruction per week. Perhaps this was not a sufficient amount of time for major trends to emerge. Therefore, it is believed that more hours need to be dedicated to supplemental instruction over longer

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periods in order to provide students additional time for more organized and concise interaction with the different concepts as well as more time for teachers to completely cover all the material taught in each of the software's programs.

Improving the reliability of the Life Science Concepts test is another possibility worth considering. Many of the test scores indicated that students had scored incorrectly on similar questions. Therefore, it is thought that the test may have been somewhat of a challenge for the ability level of its students.

In regards to the students' attitudes toward science, the researcher finds it important to investigate the effects of teacher variables on rural students' attitudes toward science. It is important to determine rural teachers' attitudes towards teaching average and below average students in science. There appears to be strong evidence that teacher attitudes toward science courses, computer-assisted instruction, and toward their students also determines how students respond to and achieve in their science courses.

It was also noticed from this study that the participating school was limited to the types of instructional software that it could acquire and use. According to the results of this study, the software used in the tutorial CAI course is highly useful for supplementing the middle school life science courses. However, it was intended for this software to give rural schools a preview of what computer-assisted instruction has to offer. It is therefore anticipated that rural schools will begin to broaden their science software libraries to include programs that offer simulated instruction as well as more advanced tutorials that include multi-media, and to also see the need for hardware upgrading. Unfortunately, the resources

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necessary to fund such software programs and hardware purchases will continue to require creative uses of existing funding as well as state, national, and private funding sources.

As we look into the past, years and years of research has been dedicated to studying the use and effects of computers on learning. The study presented in this dissertation supports much of the research done in the area of computers and computer-assisted instruction (Ferguson, 1993; Hasselbring, 1986; Moonen, 1992). However, past research on learning through the use of computers has failed to take into consideration these effects on rural student populations. This study presents such information. More importantly, it has provided an initial step for rural schools to begin to more seriously consider computer technology as an instructional supplement together with software programs designed for the science classroom. In doing so, rural schools will begin to not only enhance their positive qualities, such as the close-knit support of educators, family, and community towards education, but they will also begin to provide their science classes with more sufficient and innovative resources. These resources can provide gradual steps for breaking the barriers of isolation that rural schools have been known to endure. By introducing technology and software programs used by larger school districts throughout the country into the rural science classroom, isolation barriers will eventually be broken. As a result, the instructional programs of rural schools will be definitely enlarged and more enriched.

Therefore, this study depicts the intent of assisting rural schools in overcoming isolation, however; it has only been the first step towards this goal. Due to the promising effects of computer-assisted tutorial instruction on rural

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students' science achievement and attitudes, this particular school, as well as other rural school systems, have been given an incentive to work towards purchasing and upgrading their science software and hardware supplies. In doing so, more research can be conducted in the rural school environment in order to continue firmly addressing the need to overcome isolationism in rural school settings. One such approach would be to study the use of the internet in the rural science classroom as well as delving into the perceptions of educators and students toward such innovative practices and technologies and therefore into the values they hold towards education and science. By doing so, research can then begin to focus more on the unique aspects of rural science teaching and learning.

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APPENDICES

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APPENDIX A

Consent & Assent Forms

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CONSENT FORM
A Use of Computer-Assisted Instruction
in Rural Science Education

You are invited to participate in a study of students' learning of science concepts and attitudes toward science. My name is Chantelle Antoinette Renaud and I am a graduate student at The University of Texas at Austin, Department of Curriculum and Instruction. The proposed study involves research whereby I hope to establish how educational practioners can begin to improve students' attitudes toward learning science concepts while also determining the types of instruction that are conducive to student learning in the rural educational setting. You were selected as a possible participant in this study because your school and science teachers are interested in implementing different forms of instruction in their science classes. The Life science classes have been randomly chosen as the first science classes to experience this implementation. You will be one of one-hundred and twenty subjects invited to participate in this study.

If you decide to participate, I will ask you to participate in a series of classroom exercises (reading, writing, and discussion exercises) that will be designed to assist you in understanding science concepts related to a particular unit in your Life science class. You may be asked to attend a computer laboratory where you will perform the above exercises via computer. Classroom exercises will also include testing your knowledge of science concepts learned in class and exercises that will ask how you feel towards learning in the class. The study will involve you and your classmates participating in the above mentioned classroom exercises for one hour a week for seven weeks. Testing of your knowledge of science concepts and feelings toward learning in the class will occur once at the beginning and end of the seven week study. The purpose of the study will be to determine whether or not the exercises help you to better understand what you are learning in your Life science class as well as your feelings toward the course. The study will also help to determine whether or not the exercises help you to perform better on your Life science tests. Potential risks to you are minimal and next to none. Your participation or your withdrawal from participating in the study will not affect you academically, physically, or financially. There will be no

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inconveniences on the part of the study. Your participation will simply involve the presence of you in your Life science class for the assigned time that it meets. However, if at any time during your participation that you do feel uncomfortable, you will have the right to withdraw from the study. Potential benefits will include:

a. The research program will work to stimulate a higher level of thinking among students in science as they will gain the opportunity to learn how to think critically, problem solve, and synthesize information through a form of instruction that provides an opportunity to learn differently from the students' general classroom experiences.
b. Students will also have the opportunity to learn in an environment more conducive to their learning strategies. It is It is hoped that a different learning environment will stimulate increased enhancement of creative thinking and inquiry skills, an increase in achievement, and a more positive attitude toward the subject matter as students work at a self-determined pace.

If you do not attend the computer laboratory, you will be involved in classroom exercises similar to and just as advantageous as those that would take place on the computer. All of the procedures will be exactly as the above mentioned procedures with the exception of not using a computer to perform the exercises.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. The only personally identifiable information to be released will be the statistical data that is to be collected from student surveys and tests. This information will be released in Chantelle Renaud's final dissertation report which is to be accessible by the general public.

Your decision whether or not to participate will not affect your future relations with The University of Texas at Austin or Opelousas Junior High School. If you decide not to participate in the study, your non-participation will simply involve you not attending the computer laboratory and not participating in any additional classroom exercises associated with the study. Your non-participation will not affect your involvement in the classroom's regular activities aside from the research study. If you do decide to participate, you are free to

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discontinue participation at any time.

You are making a decision whether or not to participate. Your signature indicates that you have read the information provided above and have decided to participate. You may withdraw at any time after signing this form, should you choose to discontinue participation in this study.

If you have any questions, please ask us. If you have any additional questions later, Chantelle Renaud [11215 Research Blvd. #2017, Austin, Texas, 78759 (512-795-8388 or 318-942-4391)] or Lowell Bethel, Ed.D. [Science Education Center, University of Texas at Austin, Box D5500, Austin, Texas, 78712-1294 (512-471-7354)] will be happy to answer them.

You will receive a copy of this form. Once the consent forms are returned to the students' Life science teachers, copies of the signed forms will be returned to the students by mail. It is asked that students include a return address on the back of the consent form.

____

Signature of Participant Date

____

Signature of Parent or Legal Guardian Date

____

Signature of Investigator Date

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ASSENT FORM

A Use of Computer-Assisted Instruction in Rural Science Education

I agree to participate in a study that is interested in studying students' learning of science concepts and attitudes toward science. I understand this study has been explained to my mother/father/guardian and that she or he has given permission for me to participate. I understand that I may decide at any time that I do not wish to continue this study and that it will be stopped if I say so. Information about what I say and do will not be given to anyone else.

I understand that I will be asked to participate in a series of classroom exercises (reading, writing, and discussion exercises) that will be designed to assist me in understanding science concepts related to a particular unit in my Life science course. Some of the exercises may or may not involve my use of a computer. I will be given ideas on protecting myself, that is, keeping myself safe. I will also be tested on my knowledge of science concepts learned in class and asked questions concerning how I feel towards learning in the class. I understand that nothing bad or wrong will happen to me if I decide to stop my participation in this study at any time. I also understand that if I decide not to participate in the study, my non-participation will simply involve me not attending the computer laboratory and not participating in any additional classroom exercises associated with the study. My non-participation will not affect my involvement in the classroom's regular activities aside from the research study.

When I sign my name to this page, I am indicating that this page was read to (or by) me and that I am agreeing to participate in this study. I am indicating that I understand what will be required of me and that I may stop the study at any time.

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Child's Signature Date

Signature of Principal Investigator Date

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APPENDIX B

Student Profile

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STUDENT PROFILE

NAME

____

(last) (first) (middle)

ID # _____

TEACHER:

CLASS: Life Science

PERIOD: 1 2 3 4 5 6

AGE _____

GENDER: female male

RACE/ETHNICITY: African-American Anglo Asian-American
Other_________

OF TIMES ATTENDED COMPUTER LAB: _____

DO YOU HAVE A HOME COMPUTER? YES NO

BRAND/KIND OF HOME COMPUTER: _________________________

WHAT DO YOU USE YOUR HOME COMPUTER FOR?

____.

GOAL AFTER GRADUATING HIGH SCHOOL?

____.

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APPENDIX C

Content Validity Form

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Content Validity Form

Directions:

A. Please indicate the conceptual objective category that each question best fits by circling the appropriate numeral assigned to each concept objective. (Question not fitting any category should be be placed in category X.)

B. Please indicate how strongly you feel about your placement of the statement into the conceptual category by circling the appropriate number as follows:

1. not very sure
2. strongly
3. no question about it

Skeletal and Muscular Systems

Question #	Objectives	Rating
1	I II III IV V X	1 2 3
2	I II III IV V X	1 2 3
3	I II III IV V X	1 2 3
4	I II III IV V X	1 2 3
5	I II III IV V X	1 2 3
6	I II III IV V X	1 2 3
7	I II III IV V X	1 2 3
8	I II III IV V X	1 2 3
9	I II III IV V X	1 2 3
10	I II III IV V X	1 2 3
11	I II III IV V X	1 2 3
12	I II III IV V X	1 2 3
13	I II III IV V X	1 2 3
14	I II III IV V X	1 2 3

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Digestive System

Question #	Objectives	Rating
1	I II III IV V X	1 2 3
2	I II III IV V X	1 2 3
3	I II III IV V X	1 2 3
4	I II III IV V X	1 2 3
5	I II III IV V X	1 2 3
6	I II III IV V X	1 2 3
7	I II III IV V X	1 2 3
8	I II III IV V X	1 2 3
9	I II III IV V X	1 2 3
10	I II III IV V X	1 2 3
11	I II III IV V X	1 2 3
12	I II III IV V X	1 2 3
13	I II III IV V X	1 2 3
14	I II III IV V X	1 2 3
15	I II III IV V X	1 2 3
16	I II III IV V X	1 2 3

Circulatory System

Question #	Objectives	Rating
1	I II III IV V VI VII X	1 2 3
2	I II III IV V VI VII X	1 2 3
3	I II III IV V VI VII X	1 2 3
4	I II III IV V VI VII X	1 2 3
5	I II III IV V VI VII X	1 2 3
6	I II III IV V VI VII X	1 2 3
7	I II III IV V VI VII X	1 2 3
8	I II III IV V VI VII X	1 2 3
9	I II III IV V VI VII X	1 2 3
10	I II III IV V VI VII X	1 2 3
11	I II III IV V VI VII X	1 2 3
12	I II III IV V VI VII X	1 2 3
13	I II III IV V VI VII X	1 2 3

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Respiratory and Excretory Systems

Question #	Objectives	Rating
1	I II III IV V VI VII VIII IX X	1 2 3
2	I II III IV V VI VII VIII IX X	1 2 3
3	I II III IV V VI VII VIII IX X	1 2 3
4	I II III IV V VI VII VIII IX X	1 2 3
5	I II III IV V VI VII VIII IX X	1 2 3
6	I II III IV V VI VII VIII IX X	1 2 3
7	I II III IV V VI VII VIII IX X	1 2 3
8	I II III IV V VI VII VIII IX X	1 2 3
9	I II III IV V VI VII VIII IX X	1 2 3
10	I II III IV V VI VII VIII IX X	1 2 3
11	I II III IV V VI VII VIII IX X	1 2 3
12	I II III IV V VI VII VIII IX X	1 2 3
13	I II III IV V VI VII VIII IX X	1 2 3
14	I II III IV V VI VII VIII IX X	1 2 3
15	I II III IV V VI VII VIII IX X	1 2 3
16	I II III IV V VI VII VIII IX X	1 2 3
17	I II III IV V VI VII VIII IX X	1 2 3
18	I II III IV V VI VII VIII IX X	1 2 3

Nervous System

Question #	Objectives	Rating
1	I II III IV V X	1 2 3
2	I II III IV V X	1 2 3
3	I II III IV V X	1 2 3
4	I II III IV V X	1 2 3
5	I II III IV V X	1 2 3
6	I II III IV V X	1 2 3
7	I II III IV V X	1 2 3
8	I II III IV V X	1 2 3
9	I II III IV V X	1 2 3
10	I II III IV V X	1 2 3

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APPENDIX D

Software Commands

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Commands/Directions for Running
Life Science Software

Getting started: type - last name/first initial
- password
- select "T" for Teacher Application Menu
- select Human Body I or II

Commands:

enter - press this key after typing in a response to a questions or problem.

ESC (escape) - press this key to go back to the menu of the program you are working in.
- press this key also if you want to leave the program you are working with in order to select a new program to work with from the menu.
- press this key to return to the **Main Menu**.

? - press this key if you need help answering the questions or completing the problems that the computer program asks you. A **correct answer** will be then be given.

backspace or <-- - press this key if you need to **delete** or **change** your answers. This key will erase anything on the left side of the cursor.

F1 - help book (pg. 3 - for list of commands)

Alt-D - press this key to bring up the **"Dictionary"**. The dictionary will provide definitions of vocabulary words.

PgUp - press this key to **back up** to the previous screen.
- press **any key to go forward** to the next screen.

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Vocabulary Review

1. **arrow keys** - press one of these keys to select the vocabulary word that fits the definition given.

2. **space bar** - press this key to change to another definition.

3. **Enter** - press this key to make a match between the vocabulary word and definition.

Pairing Problems

1. **arrow keys** - press one of these keys to highlight a word or phrase to be matched with the word or phrase the computer has given.

2. **Enter** - press this key to match the highlighted word or phrase you have chosen with a word or phrase that the computer has already highlighted.

3. **space bar** - press this key for the computer to give you a new highlighted choice.

Grouping Problems

1. **arrow keys** - press one of these keys to highlight a word or phrase in the list.

2. **space bar** - press this key to put a check next to the correct word or words that you highlight.

3. **Enter** - press this key for the computer to check your answer or answers.

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Sorting Problems

1. **arrow keys** - press one of these keys to highlight a word or phrase that must be matched to a word or phrase that you will highlight using the space bar key.

2. **space bar** - press this key to move through the list of words or phrases.

3. **Enter** - press this key after you have matched a pair of highlighted words or phrases together.

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APPENDIX E

Achievement Test

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Life Science Concepts Test

Student ID # _____ Date __________

Circle the correct answer. Only one choice for each question. Place your student ID # on each page of the test.

1. Receives impulses from the front of the spinal cord...
   a. muscle cells b. nerve roots
   c. spinal nerves d. all of the above

2. In the human body, the diaphragm.....
   a. filters blood
   b. encloses the brain
   c. holds the body upright
   d. causes the lungs to expand
   e. regulates body temperature

3. When muscles of the muscular system work they
   a. contract
   b. shorten
   c. use oxygen
   d. all of the above

4. Which organ is not part of the human excretory system?
   a. lungs b. kidneys
   c. bladders d. sweat glands
   e. salivary glands

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Student ID # _____

5. The body does not have a pair of ...
    a. ulnas
    b. femurs
    c. fibulas
    d. scapulas
    e. carpals

6. The hollow or central cavities of bones are filled with ...
    a. bile
    b. lymph
    c. mucus
    d. marrow

7. There are two types of digestion, chemical and mechanical digestion. In the stomach...
    a. only mechanical digestion occurs
    b. only chemical digestion occurs
    c. both chemical and mechanical digestion occur
    d. no digestion occurs as it begins in the mouth

8. Pancreatic juices contain three different enzymes which digest....
    a. cellulose fiber and starch
    b. carbohydrates, salts, and milk
    c. minerals, vitamins, and proteins
    d. carbohydrates, proteins, and fats

9. Another name for a nerve cell is....
    a. neuron
    b. platelet
    c. leucocyte
    d. chromosome
    e. erythrocyte

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Student ID # _____

10. The muscular system is made of 3 different kinds of muscles...
    a. cardiac, smooth, skeletal
    b. smooth, voluntary, involuntary
    c. circulatory, respiratory, nervous
    d. supportive, circulatory, involuntary

11. As food leaves the esophagus, it enters __________.
    a. small intestine   b. esophagus
    c. large intestine   d. pancreas

12. Which blood vessel most likely contains one-way valves?
    a. vein   b. capillary
    c. artery   d. aorta

13. The muscles that allow voluntary movements such as walking and throwing a ball are
    a. smooth muscles
    b. skeletal muscles
    c. cardiac muscles
    d. involuntary muscles

14. Which organ is part of the nervous system?
    a. liver
    b. femur
    c. brain
    d. esophagus
    e. thyroid gland

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Student ID # _____

15. A substance that is a normal part of urine is
    a. carbon dioxide
    b. water
    c. bacteria
    d. glucose

16. Which association is incorrect?
    a. humerus - arm
    b. fibula - leg
    c. tarsals - ankle
    d. scapula - chest
    e. patella - knee

17. Four large chambers are found in which organ?
    a. lungs b. brain c. heart d. kidney

18. The lungs are in the...
    a. oral cavity
    b. nasal cavity
    c. cranial cavity
    d. chest cavity

19. One of the following is not associated with digestion. That one is
    a. liver
    b. adrenal glands
    c. pancreas
    d. salivary glands

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Student ID # _____

20. Functions of a neuron include:
    a. receive information
    b. analyze and send information
    c. send instruction to cells
    d. all of the above

21. The three types of blood cells are:
    a. red, white, platelets
    b. capillaries, veins, arteries
    c. plasma, capillaries, veins
    d. none of the above

22. The waste product formed by the breakdown of protein is
    a. amino acids   b. fatty acids
    c. urea   d. urine

23. Carries blood from the heart to the body
    a. pulmonary artery   b. aorta
    c. vena cava   d. pulmonary vein

24. Which is not part of the respiratory tract?
    a. appendix   b. lungs
    c. larynx   d. nose
    e. trachea

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APPENDIX F

Attitude Survey

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SURVEY OF ATTITUDES TOWARD COMPUTER-ASSISTED AND JUNIOR HIGH SCIENCE

Student ID # ____

There is no one "right" or "wrong" answer to any question. We are interested in your opinion on each of the statements below. Do not hesitate to put down exactly how you feel about each item. Please draw a circle around the letter that matches closest to your feeling about each statement.

1. Anyone can learn to use computers.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

2. Reading science is difficult.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

3. Learning to use computers is a waste of time.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

4. We spend too much time doing science experiments.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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5. I can control the computers.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

6. I am learning a lot in science this year.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

7. I don't like working on computers when other people are around.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

8. What we do in class is what a real scientist would do.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

9. Computers can solve problems better than people.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

10. In science class we study "Today's Problems."

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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11. It's a good idea to have computers in schools.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

12. I dislike coming to science class.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

13. Computers are too picky.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

14. I read more science materials than I did in sixth grade.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

15. I don't like to use computers.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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16. I enjoy doing the science experiments.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

17. I know a lot about computers.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

18. I can solve problems better than before.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

19. Everyone should know how to use computers.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

20. My friends enjoy doing science experiments.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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21. I like learning science concepts with the computer.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

22. What I am learning in science will be useful to me outside school.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

23. I am **not** overly concerned about how to handle a terminal keyboard for mastering a science concept.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

24. I think about things we learn in science class when I'm not in school.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

25. Learning on a computer terminal makes me feel that no one cares whether I learn or not.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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26. I do not want to take any more science classes than I have to take.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

27. Computers make me "scatter-brained" when I work with them.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

28. Reading science is more fun than it used to be.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

29. I like to know immediately whether or not my answer to practice questions is correct.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

30. Experiments are hard to understand.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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31. The computerized practice is helpful in increasing my understanding about science concepts.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

32. Science is dull for most people.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

33. I am concerned that Computer-Assisted Instruction will make learning too machinelike and unchanging.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

34. The things we do in science class are useless.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

35. I get bored using computers in the science classroom.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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36. The kinds of experiments I do in class are important.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

37. Computer-Assisted Instruction uses a student's time effectively.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

38. I learn a lot from doing my science experiments.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

39. Computers make me nervous while I use them.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

40. Most people like science classes.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
(A)	(B)	(C)	(D)	(E)

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APPENDIX G

Control Group Activities

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The Digestive System

1. Write a paragraph (no less than 6 sentences) describing how food is digested.

2. Read the following:

The digestive glands of the stomach are called gastric glands. These glands give off (secrete) a liquid called gastric juice.

Gastric juice contains the enzymes pepsin and rennin. It also contains hydrochloric [hy-druh-KLAWR-ik] acid and mucus.

*Pepsin starts protein digestion.

*Rennin "curdles" milk. It changes liquid milk protein to a "cheeselike" substance. This keeps the protein from passing through the digestive tract too quickly. It gives protein-digesting enzymes time to digest the protein.

*Hydrochloric acid Pepsin can only digest protein properly in an amino acid environment. Hydrochloric acid, in the stomach, provides this environment. The mucus in gastric juice helps protect the stomach lining from the acid.

EXPERIMENT:

A scientist labels 3 test tubes. One **A**, the next **B**, and the last tube **C**.

1. She then places one piece of meat in each test tube.
2. To test tube **A**, she now adds a pepsin liquid and some water until the tube is half full.
3. To test tube **B**, she adds the same amount of pepsin and then some hydrochloric acid until the test tube is half full.
4. To test tube **C**, she only adds water until the tube is half full.
5. She then places all 3 test tubes in a rack to stand overnight.

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Predict what you think happened to the meat in each test tube by the next day when the scientist analyzed (looked at) her 3 test tubes. Discuss your predictions in a paragraph (no less than 6 sentences), use the following questions to discuss your predictions.

1. Does the meat change only slightly, great, or does it not change in each test tube?
2. Do you think the meat will completely dissolve? In which test tube? What does most of the meat in this test tube change to (solid or liquid)?
3. In which test tube has no digestion taken place?
4. In which test tube has only slight digestion taken place?
5. In which test tube has the most digestion taken place?

Something to think about (conclusion). Write the answers only.

1. Water (does, does not) digest protein.
2. Pepsin alone (does, does not) digest protein, buy very (slowly, fast).
3. Pepsin digests protein quickly when it is mixed with an __________________.
4. Name the acid in gastric juice.
5. Chemical digestion changes (large, small) molecules into (large, small) molecules.

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Skeletal and Muscular System

1. What two bones make up the lower leg?

2. How do muscles work together to produce body movement?

3. How do bones develop as the body grows?

4. What causes muscle cramps?

5. What bone is the heaviest bone in the body?

6. What is the strongest muscle in the body?

7. What is the function of bone marrow?

8. Why is the heart an involuntary muscle?

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The Respiratory System

1. Describe how the rate of breathing is controlled?

2. What is exchanged during the process of gas exchange?

3. Breathing and respiration are related. What is the difference between breathing and respiration?

4. What happens in the lungs? Answer the following.

   a. Air that enters the air sacs is rich in (oxygen, carbon dioxide).
   b. Air that leaves the air sacs is rich in the gas (oxygen, carbon dioxide).
   c. Air sacs are surrounded by ____________.
   d. The capillaries around the air sacs take in (oxygen, carbon dioxide).

5. Unscramble the words and write your answer.

   a. ALEHEX
   b. MCLUES
   c. HINALE
   d. SBRI
   e. GMRHPAAID
   f. DEWINPPI
   g. SOEN

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Excretory System

1. Define excretion and discuss its importance to the body.

2. Waste materials leave the body through many paths. Write the correct waste product next to the body part. Remember, some waste materials leave the body through more than one part.

Waste Products

carbon dioxide	harmful chemicals
solid waste	water
salt	heat

A. Skin - ____________

B. Large intestine - ____________

C. Lungs - _______________

D. Kidneys - _______________

3. How do nephrons produce urine?

4. What is the liquid mixture produced by sweat glands? What are the materials that make up this mixture?

5. Describe how urine reaches the urinary bladder. Why is urine transported to the urinary bladder?

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Nervous System

1. Name the main parts of a neuron and describe the function of each of its parts.

2. What are the 3 main parts of the brain? What does each part control?

3. What is the largest part of the brain? What is the smallest part of the brain?

4. What is the central nervous system?

5. Describe how a reflex works.

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APPENDIX H

Interview Questions

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Interview Questions

1. What does science mean to you?

2. Why do you like or dislike science?

3. Does your like or dislike for science have anything to do with how you learn science?

4. How would you learn science so that you could begin to like science or to like science even more than you already do?

5. How do you think you would feel if you could learn science in a way that would make you start to like science?

6. Do you think you would like a job related to science? Why or why not? What kind of science job would you want and what would your task or job description be?

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APPENDIX I

Sample Responses
to
Interview Questions

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Sample Responses

#107

1. It means alot to me.
2. I like science because it is fun and I like to play science games on computers.
3. No, it does not.
4. I don't know.
5. I would like that .
6. Yes, it would be alright. I don't know.

#55

1. This studying things and it's not fun.
2. Dislike some things that are not interesting!!!
3. No.
4. T.V.
5. Great.
6. No.

#39

1. It means learning about making my life better.
2. Like, because I like doing the experiments.
3. No.
4. More experiments.
5. Happy
6. No, because I don't like science.

#161

1. Science means I have to sit down and listen to some boring stuff.
2. I dislike science because I really have no reason . I just hate it.
3. No, I just don't like science.
4. I wouldn't if I didn't have to.
5. I probably wouldn't care because I don't like science.
6. I don't like science so I don't want a job in science.

#138

1. Science means the answers of some question about this world and other worlds.
2. I like science because you can learn about many things.
3. Yes.
4. By doing science experiments, and working more on the computer.
5. I already like science.
6. Yes, because science is a interesting and fun thing and discoveries are always made. Mostly all kinds of science, because like just about every kind of science.

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APPENDIX J

ANOVA Results
of
Gender Groups

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TABLE J.1

ANOVA results on achievement--Male and Female groups.

Source of Variation	SS	df	MS	F	p
Achievement Score					
Between	28.545	1	28.545	2.991	.085
Within	1354.892	142	9.541		

TABLE J.2

ANOVA results on attitude--Male and Female groups.

Source of Variation	SS	df	MS	F	p
Attitude Score					
Between	63.882	1	63.882	.216	.642
Within	41884.610	142	294.962		
Attitude Score-science					
Between	23.160	1	23.160	.159	.690
Within	20686.061	142	145.676		
Attitude Score-computer					
Between	163.973	1	163.973	2.590	.109
Within	8989.463	142	63.306		

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APPENDIX K

ANOVA Results
of
Ethnic Groups

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TABLE K.1

ANOVA results on achievement and attitude--Anglo and African-Americans.

Source of Variation	SS	df	MS	F	p
Achievement Score					
Between	64.433	1	64.433	6.920	.009
Within	1256.924	135	9.310		

TABLE K.2

ANOVA results on attitude--Anglo and African-Americans.

Source of Variation	SS	df	MS	F	p
Attitude Score					
Between	358.943	1	358.943	1.305	.255
Within	37132.793	135	275.057		
Attitude Score-science					
Between	666.696	1	666.696	4.643	.032
Within	19382.778	135	143.576		
Attitude Score-computer					
Between	47.260	1	47.260	.890	.347
Within	7163.658	135	53.064		

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APPENDIX L

t-Test Results
of
Experimental Group

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TABLE L.1
t-Test results of achievement mean differences--Experimental group. (N=68)

Variable	Mean	SD	Mean Difference	t-value	df	Sig
Achievement			-1.588	-4.16	67	.000
pretest	7.117	3.005				
posttest	8.705	3.750				

TABLE L.2
t-Test results of attitude mean differences--Experimental group. (N=68)

Variable	Mean	SD	Mean Difference	t-value	df	Sig
Attitude			.882	.57	67	.571
pretest	139.955	17.770				
posttest	139.073	16.509				
Attitude-science			.808	.77	67	.444
pretest	65.926	12.814				
posttest	65.117	12.877				
Attitude-computer			.073	.09	67	.932
pretest	74.029	8.625				
posttest	73.955	6.840				

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APPENDIX M

t-Test Results
of
Control Group

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TABLE M.1

t-Test results of achievement mean differences--Control group. (N=76)

Variable	Mean	SD	Mean Difference	t-value	df	Sig
Achievement			-2.815	-8.10	75	.000
pretest	8.592	3.056				
posttest	11.407	3.125				

TABLE M.2

t-Test results of attitude mean differences--Control group. (N=76)

Variable	Mean	SD	Mean Difference	t-value	df	Sig
Attitude			-.276	-.17	75	.868
pretest	149.263	15.355				
posttest	149.539	16.180				
Attitude-science			.210	.18	75	.855
pretest	72.960	10.285				
posttest	72.750	11.828				
Attitude-computer			-.486	-.68	75	.501
pretest	76.302	7.288				
posttest	76.789	6.785				

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APPENDIX N

ANCOVA Results
of
Ethnic Groups

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TABLE N.1

Summary of ANCOVA Achievement results - Ethnic Groups

Source of Variation	SS	df	MS	F	p	Mean G1	Mean G2
Achievement							
Between	9.926	1	9.926	1.088	.299	9.95	10.51
Within	1222.772	134	9.126				

G1-African American; G2-Anglo

TABLE N.2

Summary of ANCOVA Attitude results - Ethnic Groups

Source of Variation	SS	df	MS	F	p	Mean G1	Mean G2
Attitude							
Between	143.744	1	143.744	.918	.340	145.3	143.1
Within	21776.09	141	154.440				
Attitude-science							
Between	107.945	1	107.945	1.32	.253	69.80	67.95
Within	10968.776	141	81.857				
Attitude-computer							
Between	.224	1	.224	.008	.929	75.31	75.39
Within	3820.269	141	28.509				

G1-African American; G2-Anglo

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BIBLIOGRAPHY

Ames, C. (1981). Competitive versus cooperative reward structures: The influence of individual and group performance factors on achievement attributions and affect. *American Educational Research Journal, 18*, 273-287.

Anderman, E. M. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching, 31* (8), 811-831.

Anderson, J. R. (1995). Cognitive tutors: Lessons learned. The Journal of the Learning Sciences, 4 (2), 167-207.

Anon. (1988). *Making sense of the future: A position paper on the role of technology in science, mathematics, and computing education*. Cambridge, MA: Educational Technology Center of Harvard Graduate School of Education.

Atkinson, R. C., & Hansen, D. N. (1966). Computer-assisted instruction in initial reading: The stanford project. *Reading Research Quarterly, 2*, 5-25.

Babad, E. (1990). Measuring and changing teachers' differential behavior as perceived by students and teachers. *Journal of Educational Psychology, 82* (4), 683-690.

Baird, W. E. (1989). Status of use: Microcomputers and science teaching. *Journal of Computers in Mathematics and Science Teaching, 8* (4), 14-25.

Bangert-Drowns, R. L., Kulik, J. A., & Kulik, C.-L. C. (1985). *Effectiveness of computer-based education in secondary schools.* Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Baird, W.E., Prather, J. P., Finson, K. D. and, Oliver, J. S. (1994). Comparison of Perceptions among Rural versus Nonrural Secondary Science Teachers: A Multistate Survey. *Science Education.* 78:555-576.

Barnes, R. E. (1989). Which bleach?: Let the computer do the work sir. *School Science Review, 70,* 76-77.

Barnhardt, R. and, Barnhardt, C. (1983). Chipping Away at Rural School Problems: The Alaskan Experience with Educational Technology. *Phi Delta Kappan.* 64:274-278.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Bass, G., Ries, R. & Sharpe, W. (1986). Teaching basic skills through microcomputer-assisted instruction. *Journal of Educational Computing Research, 2,* 207-218.

Bear, G. G., Richards, H. C., & Lancaster, P. (1987). Attitudes toward computers: Validation of a computer attitudes scale. *Journal of Educational Computing Research, 3,* 207-218.

Becker, H. J. (1982). *Microcomputers in the Classroom - Dreams and Realities.* Baltimore, Maryland: The John Hopkins University, Center for Social Organization of Schools.

Becker, H. J. (1986). *Equity in school computer use: National data and neglected considerations.* Paper presented at the 1986 annual meeting of the American Educational Research Association, San Francisco, CA.

Becker, H. J. (1991). How computers are used in United States schools: Basic data from the 1989 I.E.A. computers-in-education survey. *Journal of Educational Computing Research, 7* (4), 385-406.

Beckner, W. and, Barker, B. O. (1994). *Technology in Rural Education. Fastback No. 366.* Paper. Bloomington, Indiana: Phi Delta Kappa Educational Foundation.

Ben-Perez, M., & Menis, J. (1986). Conditions of learning in science classrooms and what we can learn from them. *Research in Science Education, 16,* 101-110.

Bitzer, D. L., Braunfel, P. G., & Lichtenberger, W. W. (1962). PLATO II: A multiple-student, computer-controlled, automatic teaching device. In J. E. Coulson (Ed.), *Programmed learning and computer-based instruction.* New York: John Wiley & Sons.

Bull, K. S. and, Davis, C. R. (1988). Using the Microcomputer with Gifted and Talented: Rural Applications. *Rural Special Education Quarterly.* 8:31-36.

Buros, O. K. (1975). *Science Tests and Reviews: A Monograph Consisting of the Science Sections of the Seven Mental Measurements Yearbooks and Tests in Print II.* New Jersey: Gryphon Press.

Buttles, S. (1992). A Model for Incorporating and Evaluating Use of a Computer Laboratory Simulation in the Nonmajors Biology Course. *American Biology Teacher, 54,* 491-494.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Brown, F. G. (1983). Consistency. In, *Principles of Educational and Psychological Testing* (pp. 74-97). Fort Worth, TX: Holt, Rinehart and Winston, Inc.

Cannon, R. K., & Simpson, R. D. (1985). Relationships among attitude, motivation, and achievement of ability grouped, seventh-grade, life science students. *Science Education, 69* (2), 121-138.

Center for the Study of Learning and Teaching Styles. (1990). *Annotated bibliography.* Jamaica, NY: St. John's University.

Charron, E. H. (1991). Classroom and Community Influences on Youths' Perceptions of Science in a Rural County School System. *Journal of Research in Science Teaching.* 28:671-687.

Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research, 2,* 265-282.

Choi, B., & Gennaro, E. (1987). The effectiveness of using computer simulated experiments on junior high students' understanding of the volume displacement concept. *Journal of Research in Science Teaching, 24,* 539-552.

Clariana, R. B., Ross, S. M., & Morrison, G. R. (1991). The effects of different feedback/strategies using computer-administrated multiple-choice questions and instruction. *Educational Technology Research and Development, 39,* 5-17.

Cole, M., & Griffin, P. (1987). *Contextual factors in education: Improving science and mathematics education for minorities and women.* Wisconsin Center of Education Research, Madison, Wisconsin.

Collis, B. A., & Loyd, O. (1986). An examination of sex differences in secondary school students' attitudes toward writing and toward computers. *The Alberta Journal of Educational Research, 32* (4), 297-306.

Collis, B. A., & Williams, R. L. (1987). Cross-cultural comparison of gender differences in adolescents' attitudes toward computers and selected school subjects. *Journal of Educational Research, 81* (1), 17-27.

Crawley, F. E., & Black, C. B. (1992). Causal modeling of secondary science students' intentions to enroll in physics. *Journal of Research in Science Teaching, 29* (6), 585-599.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Dacus, J. M., & Hutto, N. (1989). Improving science education in rural elementary schools: A collaborative approach for centers of rural education and museums of natural history. *Journal of Rural and Small Schools, 4* (1), 13-17.

Davis, J. (1987). Rurality and isolation in education. *Rural Educator, 9* (1), 11-14.

DeBoer, G. E. (1986). Perceived science ability as a factor in the course selections of men and women in college. *Journal of Research in Science Teaching, 23* (4), 343-352.

Dubbs, P., and Barnhardt, R. (1982). *The Log of School: A Case for Appropriate Design.* Cross Cultural Issues in Alaskan Education, Vol. II. Fairbanks: Center for Cross-Cultural Studies, University of Alaska.

Dunn, R., Dunn, K., & Price, G. E. (1985). *Learning Style Inventory (LSI) Manual.* Lawrence, KS: Price Systems, Inc., Box 1818, Lawrence, KS 66044-1818.

Edington, E., & Martellaro, H. (1988). School Size and Academic Achievement. *The Rural Educator, 9* (3), 6-11.

Edwards, C. (1988). *Enhancing minority student educational opportunities through instructional computing: A report on project micro.* Paper presented at the 1988 Council of Great City Schools National Technology Forum, San Diego, CA.

Ellis, J. D. (1992). Teacher development in advanced educational technology. *Journal of Science Education and Technology, 1* (1), 49-65.

Ellis, J. D. and, Kuerbis, P. J. (1992). Implementing Microcomputers in Science Teaching. *Journal of Science Teacher Education.* 3:65-75.

Enochs, L. G. (1988). *Toward Improving Rural Schools with Implications for Teaching Science.* Paper. (Eric Document Reproduction Service No. ED 297 926).

Enochs, L. Oliver, J. S., & Wright, E. (1987). Perceived needs and status of secondary science teachers in Kansas - 1987 (Tech. Rep. #1). Manhattan, KS: Center for Science Education, Kansas State University.

Erlandson, D., Harris, E., Skipper, B. and Allen, S. (1993). *Doing Naturalistic Inquiry.* Newbury Park: CA: Sage Publications Inc.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Ferguson, N. H and, Chapman, S. R. (1993). Computer-Assisted Instruction for Introductory Genetics. *Journal of Natural Resources of Life Science Education, 22,* 145-147.

Fetler, M. (1983). *Computer literacy of California sixth and twelfth grade students.* California Department of Education, Division of Planning Evaluation and Research. Sacramento, CA.

Finson, K. D. (1990). A survey of the status for NCATE/NSTA accreditation at small rural colleges. *Science Education, 74,* 609-624.

Finson, K. D., & Beaver, J. B. (1990). Rural science teacher preparation: A re-examination of an important component of the educational system. *Journal of Science Teacher Education, 1* (3), 46-48.

Fisher, T. H. (1973). The development of an attitude survey for junior high science. *School Science and Mathematics, 73,* 647-652.

Fyans, L. J., Jr., & Maehr, M. L. (1987). *Sources of student achievement: Student motivation, school context and family background.* Unpublished research report, Illinois State Board of Education and the University of Illinois, Urbana-Champaign, IL.

Gardner, C. M., Simmons, P. E., & Simpson, R. D. (1992). The effects of CAI and hands-on activities on elementary students' attitudes and weather knowledge. *School Science and Mathematics, 92* (6), 334-336.

Gardner, D. G., Dukes, R. L., & Discenza, R. (1993). Computer use, self-confidence, and attitudes: A causal analysis. *Computers in Human Behavior, 9,* 427-440.

Gardner, J. R., McEwen, A., & Curry, C. A. (1986). A sample survey of attitudes to computer studies. *Computers and Education, 10* (2), 293-298.

Geban, O., Askar, P., & Ozkan, I. (1992). Effects of computer simulations and problem-solving approaches on high school students. *Journal of Educational Research, 86* (1), 5-10.

Geisert, G., Dunn, R., & Sinatra, R. (1990). Reading, learning styles, and computers. *Reading, Writing, and Learning Disabilities, 6,* 297-305.

Gregory, L. (1992). *Proceedings: National Congress on Rural Education.* Oak Brook, Ill.: North Central Regional Educational Laboratory.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Gressard, C. P., & Loyd, B. H. (1987). An investigation of the effects of math anxiety and sex on computer attitudes. *School Science and Mathematics, 87,* 125-135.

Gronlund, N. E. (1985). *Measurement and evaluation in teaching.* New York, NY: Macmillan.

Haas, T. (1991). Why Reform Doesn't Apply. *Rural Education: Issues and Practice.* New York: Garland. 412-26.

Haladyna, T., Olsen, R., & Shaughnessy, J. (1982). Relationships of student, teacher, and learning environment variables to attitudes toward science. *Science Education, 66* (5), 671-687.

Hannafin, R. D., & Savenye, W. C. (1993). Technology in the classroom: The teacher's new role and resistance to it. *Educational Technology, 33* (6), 26-31.

Handley, H. M., & Morse, L. W. (1984). Two-year study relating adolescents' self-concept and gender role perceptions to achievement and attitudes toward science. *Journal of Research in Science Teaching, 21* (6), 599-607.

Harris, A. M., & Covington, M. V. (1993). The role of cooperative reward interdependency in success and failure. *Journal of Experimental Education, 61* (2), 151-168.

Hasselbring, T. S. (1986). Research on the Effectiveness of Computer-Based Instruction: A Review. *International Review of Education.* 32:313-324.

Herzog, M. J., and Pittman, R. B. (1995). Home, Family, and Community Ingredients in the Rural Education Equation. *Phi Delta Kappan.* 77:113-118.

Hueftle, S. J., Rakow, S. J., & Welch, W. W. (1983). *Images of science - A summary of results from the 1981-82 National Assessment in Science* (Minneapolis: Minnesota Research and Evaluation Center, University of Minnesota).

Hill, A. (1984). Review of Research on Small Schools. *The Small School Forum.* 5:12-15.

Hobbs, D. (1994). *Demographic Trends in Nonmetropolitan America.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Hord, S. M. and, Huling-Austin, L. (1986). Effective Curriculum Implementation: Some Promising New Insights. *Elementary School Journal.* 87:97-115.

Horton, S. V. and, Lovitt, T. C. (1994). A Comparison of Two Methods of Administering Group Reading Inventories to Diverse Learners. *Remedial and Special Education, 15,* 378-390.

Hounshell, P. B., & Hill, S. R. (1989). The microcomputer and achievement and attitudes in high school biology. *Journal of Research in Science Teaching, 26* (6), 543-549.

Irion, D. A. and, Jinks, J. L. (1982). *Rural Science Education: Blueprint for All.* Paper. (ERIC Document Reproduction Service No. ED 235 945).

Jegede, O. J., Okebukola, P. A., & Ajewole, G. A. (1991). Computers and the learning of biological concepts: Attitudes and achievement of nigerian students. *Science Education, 75* (6), 701-706.

Jinks, J. (1983). Computers and science education: The future. *Rural Educator, 5*(2), 22-26.

Johnston, V. (1987). Attitudes towards microcomputers in learning: 1. Pupils and software for language development. *Educational Research, 29* (1), 47-55.

Kahle, J. B. (1989). *Scores: Science Career Options for Rural Environment Students.* Paper. (ERIC Document Reproduction Service No. ED 331 694)

Kinzie, M. B., & Sullivan, H. J. (1989). Continuing motivation, learner control, and CAI. *Educational Technology Research Development, 37,* 5-14.

Klopfer, L. E. (1986). The Coming Generation of Tutoring Software. *Science Teacher, 53,* 34-37.

Koballa, T. R., and Crawley, F. E. (1985). The Influence of Attitude on Science Teaching and Learning. *School Science and Mathematics.* 85:223-232.

Kubiszyn, T., & Borich, G. (1996). Educational testing and measurement. Classroom application and practice. (5th ed.) New York: HarperCollins

Kulik, J. A., Kulik, C.-L. C., & Bangert-Drowns, R. L. (1985). *Effectiveness of computer-based education in elementary school.* Paper presented at the annual meeting of the American Educational Research Association, Chicago.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Knupfer, N. N. (1993). Logo and transfer of geometry knowledge: Evaluating the effects of student ability grouping. *School Science and Mathematics, 93* (7), 360-67.

Krendl, K. A., & Lieberman, D. A. (1988). Computers and learning: A review of recent research. *Journal of Educational Computing Research, 4*, 367-89.

Larsbach, A., & Tobin, K. (1992). Research matters - To the science teacher. Constructivism as a referent for science teaching. *National Association for Research and Science Teaching.* No. 30.

Levin, T., & Gordon, C. (1989). Effect of gender and computer experience on attitudes toward computers. *Journal of Educational Computing Research, 5* (1), 69-88.

Lockheed, M. E., & Frakt, S. B. (1984). Sex equity: Increasing girls' use of computers. *The Computing Teacher, 2* (8), 16-18.

Lotven, B. (1983). Multicultural Experiences Exist in Rural Areas. *Rural Educator.* 5:17-20.

Loyd, B. H., Loyd, D. E., & Gressard, C. (1987). Gender and computer experience as factors in the computer attitudes of middle school students. *Journal of Early Adolescence, 7* (1), 13-19.

Maehr, M. L., & Archer, J. (1987). Motivation and school achievement. In L. Katz (Ed.), *Current topics in early childhood education.* Norwood, NJ: Ablex.

Mann, G. (1993). *Rural secondary school science teachers: What they need to be successful.* Paper. (Eric Document Reproduction Service No. ED 366 472).

Martin, R. (1991). School children's attitudes towards computers as a function of gender, course subjects and availability of home computers. *Journal of Computer Assisted Learning, 7* (3), 187-194.

Marshall, J. C. and Bannon, S. H. (1986). Educational Computing in Rural Versus Urban Settings. *Research in Rural Education.* 3:131-135.

Martinez, M. E., & Mead, N. A. (1988). *Computer competence: The first national assessment.* Educational Testing Service, Princeton, NJ.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Martini, M. (1986). An analysis of the relationships between and among computer-assisted instruction, learning style perceptual preferences, attitudes, and the science achievement of seventh grade students in a suburban New York school district (Doctoral dissertation, St. John's University, 1986). *Dissertation Abstracts International, 47,* 877A.

McAuley, S. M., & McLauglin, T. F. (1992). Comparison of add-a-word and compu spell programs with low-achieving students. *Journal of Educational Research, 85* (6), 362-369.

Melnick, S. A., Shibles, M. R. and, Gable, R. K. (1987). School District Size, Student Achievement and High School Course Offerings in Connecticut. *Research in Rural Education.* 4:119-123.

Menis, J. (1987). Chemistry teaching and classroom instruction. *Chemistry Education, 3* (4), 27-33.

Merrill, M. D., Schneider, E., & Fletcher, K. (1980). *TICCIT.* Englewood Cliffs, NJ: Educational Technology Publishers.

Miller, F. (1994). The effects of psychosocial factors on indian children's attitudes toward computers. *Journal of Educational Computing Research, 10* (3), 223-238.

Mitchell, H. E. &, Simpson, R. D. (1982). Relationship between attitudes and achievement among college biology students. *Journal of Research in Science Teaching, 19* (6), 459-468.

Miura, I. T. (1987). Gender and socioeconomic status differences in middle-school computer interest and use. *Journal of Early Adolescence, 7* (2), 243-254.

Moonen, J. C. M. M., & Beishuizen, J. J. (1992). Technology-enriched schools in the Netherlands. Collis B. and Carleer G. (Eds.) *In Technology-Enriched Schools. Nine Case Studies with Reflections* (pp. 67-77). ISTE, Eugene: Oregon.

Moore, J. L., (1985). An empirical study of pupils' attitudes to computers and robots. *Journal of Computer Assisted Learning, 1,* 87-98.

Moore, N. D. (1989). Rural Students/Regional Programs. *Roeper Review.* 12:112-113.

Mordi, C. (1991). Factors associated with pupils' attitudes toward science in Nigerian primary schools. *Research in Science & Technological Education, 9* (1), 39-49.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
www.manaraa.com

Morrell, P. D. (1992). The Effects of computer assisted instruction on student achievement in high school biology. *School Science and Mathematics, 92* (4), 177-181.

Mullis, I. V. S., & Jenkins, L. B. (1988). The science report card: Trends and achievement based on the 1986 national assessment. Princeton, NJ: Educational Testing Service.

Munger, G. F., & Loyd, B. H. (1989). Gender and attitudes toward computers and calculators: Their relationship to math performance. *Journal of Education Computing Research, 5,* 167-177.

Murray, T., Schultz, K., Brown, D., & Clement, J. (1990). An analogy-based computer tutor for remediating physics misconceptions. *Interactive Learning Environments, 1* (2), 79-101.

Niemiec, R. P., & Walberg, H. J. (1989). From teaching machines to microcomputers: Some milestones in the history of computer-based instruction. *Journal of Research on Computing in Education, 21* (3), 263-276.

North Carolina Civil Liberties Union/American Civil Liberties Union. *A Right Denied: Educational Inequity in North Carolina's Schools* presented to the North Carolina General Assembly, Raleigh, 1991, p.26.

Okey, J. R. (1985). Integrating computing into science instruction. *Journal of Computers in Mathematics and Science Teaching, 4* (2), 14-18.

Pagliaro, L. A. (1983). The history and development of CAI: 1926-1981, An overview. *Alberta Journal of Educational Research, 29* (1), 75-84.

Park, I. H. (1993). *Cooperative learning and individual learning with computer-assisted instruction in an introductory university level chemistry course.* Unpublished doctoral dissertation, University of Texas, Austin.

Parks, G. (1980). *The Double Jeopardy of Rural Schools in the 1980s.* (Eric Document Reproduction Service No. ED193399).

Piburn, M. D., & Baker, D. R. (1993). If I were the teacher...qualitative study of attitude toward science. *Science Education, 77* (4), 393-406.

Rakow, S. J., & Brandhorst, T. R. (1989). Using microcomputers for science teaching. *Fastback No. 297.* Paper. Bloomington, Indiana: Phi Delta Kappa Educational Foundation.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Reed, D. F., & Seyfarth, J. T. (1984). Assessing teacher needs in rural schools. *Rural Educator, 6* (1), 12-17.

School Uses of Microcomputers, Reports from a National Survey, No. 1 (1983). (Baltimore: Center for Social Organization of Schools, The Johns Hopkins University), p.1.

Scibeci, R. A., & Riley, J. P. (1986). Influence of students' background and perceptions on science attitudes and achievements. *Journal of Research in Science Teaching, 23* (3), 177-187.

Shaw, E. L., Jr. (1984). Effects of Microcomputer Simulations on Concept Identification Achievement and Attitudes Towards Computers and Science Instruction of Middle School Students of Various Levels of Logical Reasoning Ability. (University of Georgia, 1984). *Dissertation Abstracts International, 45* (9): 2827-A.

Shaw, E. L., Jr., & Okey, J. R. (1985). *Effects of Microcomputer Simulations on Achievement and Attitudes of Middle School Students.* Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, French Lick Springs, IN. (ERIC Document Reproduction Service No. ED 255 389).

Shaw, M. and, Wright, J. M. (1967). *Scales for the Measurement of Attitudes.* New York: McGraw-Hill Inc.

Sher, J. (1978). Ending Federal Neglect of Rural Schools. *Phi Delta Kappan,* 60, 280-282.

Shroyer, G., & Enochs, L. (1987). Strategies for assessing the unique strengths, needs, and visions of rural science teachers. *Research in Rural Education, 4* (1), 39-43.

Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education, 7* (1), 1-18.

Skinner, B. F. (1954). The science of learning and the art of teaching. *Harvard Educational Review, 24,* 86-97.

Skinner, M. E. (1988). Attitudes of college students toward computer assisted instruction: An essential variable for successful implementation. *Educational Technology, 28,* 7-14.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

Smyth, T. (1987). Response evaluation in computer based tutorials. *Journal of Computer Assisted Learning, 3,* 99-104.

Spain, D. J., & Allen, J. (1990). Instructional computing as replacement for recitation in freshman chemistry. *Journal of Chemical Education, 67,* 766-769.

Stern, J. D. (1994). *The Condition of Education in Rural Schools.* Washington, D.C.: U.S. Department of Education.

Stringfield, J. K., (1994). Using commercially available, microcomputer-based labs in the biology classroom. *The American Biology Teacher, 56* (2), 106-108.

Sunal, D. W. (1991). Rural School Science Teaching: What Affects Achievement. *School Science and Mathematics.* 91:202-210.

Suppes, P. (1966). The use of computers in education. *Scientific American, 215,* 207-220.

Suppes, P., & Moringstar, M. (1966). Computer-assisted instruction. *Science, 166,* 343-350.

Swadener, M., & Jarrett, K. (1986). Gender differences in middle grade students' actual and preferred computer use. *Educational Technology, 26* (9), 41-47.

Talton, E. L., & Simpson, R. D. (1985). Relationships between peer and individual attitudes toward science among adolescent students. *Science Education, 69* (1), 19-24.

Talton, E. L., & Simpson, R. D. (1986). Relationships of attitudes toward self, family, and school with attitude toward science among adolescents. *Science Education, 70* (4), 365-374.

Theobald, P. and, Nachtigal, P. (1995). Culture, Community, and the Promise of Rural Education. *Phi Delta Kappan.* 77:132-135.

Thomas, G. (1986). Cultivating the Interest of Women and Minorities in High School Mathematics and Science. *Science Education.* 70:31-43.

Thurston, L. P., McGrath, D. and , Stone, D. (1992). Bringing High Tech to the Heartland. *Journal of Rural and Small Schools.* 5:18-23.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission. www.manaraa.com

1989. *Science Education in Rural America.* Paper. North Central Regional Educational Laboratory. (ERIC Document Reproduction Service No. ED 317 387).

Vaughan, M.,Boethel, M., Hoover, W., Lawson, G., Torres, M. (1989). *Conditions and Needs of Rural Education in the Southwest Region.* Austin,Texas: Southwest Educational Development Laboratory.

Vermette, R., Our, R., & Hall, M. H. (1986). Attitudes of Elementary School Students and Teachers Toward Computers in Education. *Educational Technology, 26* (1), 41-47.

Vockell, E. L., & Rivers, R. H. (1984). *Computerized Science Simulations Stimulus to Generalized Problem Solving Capabilities.* Paper presented at the Annual Convention of the American Educational Research Association, New Orleans, La. (ERIC Document Reproduction Service No. ED 253 397).

Walberg, H., & Fowler, W. (1986). *Expenditure and size efficiencies of public school districts.* Las Cruces, NM: ERIC Clearinghouse on Rural Education and Small Schools.

Walker, C. L. (1985). The status of hispanic american students in science: Attitudes. *Hispanic Journal of Behavioral Sciences, 7* (3), 225-245.

Watt, D. (1982). Education for citizenship in a computer-based society. In R. Siedel, R. Anderson and B. Hunter, eds., *Computer Literacy*. Academic Press, New York, 59.

Waugh, M. L. (1985). Effects of microcomputer-administered diagnostic testing on immediate and continuing science achievement and attitudes. *Journal of Research in Science Teaching, 22* (9), 793-805.

Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), *Handbook of research on teaching* (pp. 315-327). New York: Macmillan.

Woodrow, J. E. (1994). The development of computer-related attitudes of secondary students. *Journal of Educational Computing Research, 11* (4), 307-338.

Yager, R. E., & Penick, J. E. (1984). What students say about science teaching and science teachers. *Science Education, 68* (2), 143-152.

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Yager, R. E., & Yager, S. O. (1985). Changes in perceptions of science for third, seventh, and eleventh grade students. *Journal of Research in Science Teaching, 22* (4), 347-358.

Yalcinalp, S., Geban, O., & Ozkan, I. (1995). Effectiveness of using computer-assisted supplementary instruction for teaching the mole concept. Journal of Research in Science Teaching, 32 (10), 1083-1095.

Zitzewitz, B. S., & Berger, C. F. (1985). Applications of mathematical learning models to student performance of general chemistry: Microcomputer drill and practice programs. *Journal of Research in Science Teaching, 22* (9), 775-791.

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