COMPUTER-ASSISTED INSTRUCTION

IN

ELEMENTARY PHYSICAL EDUCATION

by

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Computer Assisted Instruction in Elementary Physical Education

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The purpose of this study was to determine the effectiveness of computer-assisted instruction (CAI) when presenting instruction related to anatomy of the human body. The experimental design was three-dimensional with dimensions of gender (male and female), grade (third, fourth, and fifth), method of instruction (computer-assisted and traditional), and length of knowledge recall (immediate, one-day, and six-week). Participants were elementary students in grades three, four, and five attending regular physical education classes. A class at each grade level was designated the traditional group (TRAD) and instructed with conventional methods. The other class was termed the computer-assisted group (CAI) and provided instruction via CD-ROM software, The Ultimate Human Body 2.0. Instructional material was presented on the anatomy of the human body related to the skeletal, heart, muscular, and circulatory systems. Testing was conducted at the conclusion of each unit (immediate recall), one day after instruction (one-day recall) and a composite test completed after six weeks.

A general linear model with repeated measures was used to determine if significant difference existed among the independent variables of instruction, grade, or gender and the dependent variables of immediate and one-day recall of knowledge for the four systems. The between-subjects effects for each group were compared with the factors of type of instruction, grade, and gender. The .05 level of probability was considered significant. The results of analysis of variance with the dependent variable of instruction were for skeletal ($F = 12.54$, $p = .001$), for muscular ($F=2.61$, $p = 0.11$),

for circulatory (F = 30.70, p = 0.00) and for the heart (F = 24.14, p = 0.00). Significant differences were obtained between computer-assisted instruction and traditional instruction for immediate recall of information for all grades. The retention of knowledge after one day and after six weeks was not significantly different for the two methods of instruction. No significant difference was obtained between genders for the recall of knowledge.

In conclusion, participants who received computer-assisted instruction displayed a greater immediate recall of knowledge than participants who received traditional instruction. The recall of knowledge after one day and after six weeks was comparable for both methods of instruction.

DEDICATION

To my mother and in memory of my father who are the real champions in my life.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Many studies have been conducted to ascertain the effectiveness of computer-assisted instruction in domains other than that of physical education. Lease (1981) cited Sanders' (1977) studies indicating the effectiveness of computers in enhancing learning. An overview of the computer-based educational materials quickly reveals that physical education specialists do not have a variety of products from which to choose especially for the elementary physical education. Physical education specialists, particularly at the elementary level, are generally expected to utilize traditional methods of instruction, i.e., demonstrations, practice, and actual game play. Technology, according to Mohensen (1998) "is defined as anything that achieves a practical purpose. In physical education, then, technology is anything that helps students improve their physical performance or cognitive understanding of physical education concepts" (p. 4). Technology has been limited to the use of video cameras to record skill movements, techniques, and devices such as heart monitors. Most physical education departments are not provided access to computers in order to provide multi-media materials to students in conjunction with themes or instructional units.

Statement of the Problem

Elementary school students are currently spending many hours playing interactive video games. If the enthusiasm for learning how to play video games could be transferred to learning in the elementary school physical education classroom, more actual learning might occur. Although research of interactive computer-assisted instruction has been conducted in other academic areas no studies were found related to elementary physical education.

Therefore, this study was conducted to determine the effectiveness of computer-assisted instruction and multi-media materials when presenting units of study on the anatomy of the human body. This study is unique in that (1) no previous research has investigated the use of interactive computer-assisted instruction at the elementary level and (2) it investigates the retention of information at immediate, after one day, and six weeks after instruction.

Definition of Terms

For the purpose of this study, the following definitions were established.

1. CD-ROM – a disk containing graphics, text information, etc. It cannot be written on by a personal computer unless the computer is equipped with a CDRW (this feature will not be available on the computers utilized in this study).
2. Computer-assisted instruction – an instructional method that utilizes computers to supplement classroom instruction as the student is guided by a computer through a course of study in order to achieve certain instructional goals (Sanders, 1997, p. 340). This type of instruction involves the use of an interactive 3D model accessed through a CD.
3. Courseware – instructional software (Mohnsen, 1998, p. 98).
4. Grade – academic level students had achieved in elementary school.

5. Immediate recall – results of tests given the same day as instruction.
6. Interactive – a method engaging multiple senses and enabling students to interact with information as it is provided. (http://www.centrax99/glossary/I.htm).
7. One-day recall – results of tests given the day after instruction.
8. Six-week recall – results of tests given six weeks after instruction composed of material covered on all systems.
9. Traditional instruction – a method of instruction in which the class is taught through lectures and activities.

Limitations of the Study

The utilization of the computer-assisted instruction and traditional methods of instruction was limited by the following:

1. Both computer-assisted instruction group and traditional instruction group were taught by the researcher.
2. The number of computers available in the computer lab was limited to fourteen.
3. Computer requirements were Windows '95, 12 Mb RAM, 26 Mb available on hard drive, CD-ROM, audio 8-bit, headphones, sound card, and mouse.
4. The computer-assisted software was challenging for third grade students.

Delimitations

This project was subject to the following delimitations:

1. Students from Homer Pittard Campus School – an elementary school in grades three, four, and five were selected as participants for this study.

2. One section of each grade was randomly assigned to receive traditional methods of instruction and the other section computer-assisted instruction.
3. Access to students for this study was limited to 25 minutes per session.
4. The duration of the study was six weeks.

Research Questions

To investigate the issues raised by this study, the following questions were asked for each of the units presented to the participants:

Q1. Is there a significant difference among the independent variables of method of instruction, grade or gender and the dependent variables of immediate or one-day recall of information related to the skeletal system?

Q2. Is there a significant difference among the independent variables of instruction, grade or gender and dependent variables of immediate or one-day recall of information related to the muscular system?

Q3. Is there a significant difference among the independent variables of instruction, grade or gender and dependent variables of immediate or one-day recall of information related to the heart?

Q4. Is there a significant difference among the independent variables of instruction, grade or gender and dependent variables of immediate or one-day recall of information related to the circulatory system?

Q5. Is there a significant difference on a six-week recall of information on a composite knowledge instrument related to the skeletal system, heart, muscular system and circulatory system with the variables of grade, gender and type of instruction?

CHAPTER 2

REVIEW OF LITERATURE

The research was designed to determine the effectiveness of computer-assisted instruction in elementary physical education. The review of literature was divided into sections. The first four concerned computer-assisted instruction in general: background of educational use of technology, development of computer-assisted instruction, benefits of computer-assisted instruction, and the Internet and education. The fifth was composed of research conducted on computer-assisted instruction. Sections six and seven provided examples of the implementation of computer-assisted instruction in the classroom and resources for technology applicable to K-12 physical education.

The Oregon Department of Education presented a "Physical Education Concept Paper" in 1989. One of the issues addressed in the paper was technology and stated:

> Technology is here to stay and will continue to influence education more in the future. The issue is not whether technology is useful, needed, or justified, but how much it will be applied in physical education. . . . The necessity for physical education teachers to obtain the training and skill necessary to keep technologically current is critical. (p. 7)

Deere (1992) noted: "Computer-assisted instruction has been widely tested and accepted as an effective method learning (Garrett & Ashford, 1986; Niemiec, Samson, Weinstein, & Walberg, 1987; Pazdernik & Walaszek, 1983)" (p. 49). Deere (1992) observed that the physical education domain lacked the number of computer-assisted instructional programs available in other areas of the curriculum.

The implications for the utilization of computer-assisted instruction in the physical education curriculum was the focus of much discussion. Three noteworthy opinions are presented in the following three quotations.

McLean (1996) stated:

> While the overall effect of the impact of technology on health, physical education, recreation, and dance education (HPERD) in the areas of research, classroom, teaching, and distance education is not yet fully assessable, the presence of technology in so many different aspects of the profession makes it important to more clearly recognize and appreciate its current and potential role. (Abstract)

Silverman (1997) noted:

> Whereas the use of computer-assisted instructed instruction will grow, there has been little research (e.g. Cregger & Metzler, 1992) on the topic in physical education. This is an area that demands research as more emphasis is put on computer-assisted instruction in all aspects of physical education. (p.308)

Mohnsen (1998) stated:

> Technology is changing the way we teach physical education – from its early use for creating fitness reports to the future use of holograms as personal trainers. Technology, however, is not a means unto itself. It is a process and a tool for increasing student learning and teacher productivity. It can provide visual, auditory, and kinesthetic input. As physical educators, we must access it, learn it, and use it. (p. 10)

Background of Educational Use of Technology

Modern technology has altered many aspects of American life, including but not limited to, recreational, commercial, and educational. *The Delta Kappa Gamma Bulletin*, 61 (3), Spring, 1995 devoted the entire issue to the impact of technology on education. In "Issues in Instructional Design Related to Computer Technology Implementation in the Classroom," Wilson (1995) cited the 1983 National Commission on Excellence in Education Report, *A Nation at Risk*, as the primary impetus for the utilization of computer technology by school systems. Scott, Cole, and Engel (1992) noted that *A Nation at Risk* was the motivating factor for the implementation of the computer and advanced technology into the classroom. While *A Nation at Risk* criticized the American educational system, one of the positive recommendations was that schools needed to include the use of technology in the curriculum. In response to these new technological devices, both the general public and educators have revised the skills that students must be taught in order to allow them to successfully compete in the business world. Kelly (1987) cited Budoff & Hutten, 1982; Cicciarella, 1983; Hanaford & Sloane, 1981; Hoffmeister, 1982: Vinsonhaler & Bass, 1972 as the sources for the statement: "From its development . . . Computer Assisted Instruction (CAI) has been heralded as one of the greatest innovations in education" (p. 74). Eisenberg (1996) noted the advent of integrating computer-assisted instruction into the content area as an important trend. Educators determined that separate computer sessions did not help students develop the skills to apply technology meaningfully.

On October 10, 1996, the state of Tennessee became one of the first states to take advantage of the advances in modern technology when all of the state's 1,560 public schools were connected to the Internet. An ambitious project, "ConnecTEN," was the result of cooperation between businesses and the state and provided even remote communities access to the libraries, museums, and databases of the world, as noted by Derks (1996).

Zaheeruddin (1995) noted that the idea of wisdom-spouting delivery systems can be dated back to ancient times and contended that the Greek oracles were the first example of an "expert system." The oracles were supposed to be able to supply supplicants with recommendations for action based on knowledge and wisdom provided by the gods. Zaheeruddin stated: "Our contemporary counterpart, the computerized expert system, is a near-fulfillment of this age-old dream. Though we often think of the expert system as a new technology, its design concepts are as old as human species" (p. 23).

The Tennessee Education Association in a 2001 IPD Tech Tips stated that "Technology, in and of itself, is nothing but equipment and cable" (p. 1). This association further stated that "The phrase 'integrating technology in the curriculum' means teaching with technology, not about technology" (p. 8).

Development of Computer-Assisted Instruction

Dence (1980) maintained that computer-assisted instruction came into existence when "educators learned to combine the features of Skinner's programmed instruction with Skinner and Pressey's teaching machines" (p. 50). Ely (1995) dated the roots of educational technology as a twentieth century development during and following World War II. Ely described the beginnings of educational technology:

> What began with an emphasis on audio-visual communications media gradually became focused on the systemic development of teaching and learning procedures which were based in behavioral psychology. Currently, major contributing fields are cognitive psychology, social psychology, psychometrics, perception psychology, and management. (On-line p. 2)

Hamilton (1995) noted that computer-assisted instruction was originally limited to drill and practice, most often in the format of a concept initially presented in the classroom followed by a trip to the computer lab where the students were provided with a series of similar problems to solve. Utilizing this format the computer assignments merely reinforced concepts with the student progressing to more difficult problem situations only when a predetermined degree of mastery had been achieved. Simonson and Thompson (1994) were cited as noting that seventy-five percent of all educational programs as late as 1984 were limited to the drill and practice formula.

According to Hamilton (1995) the second stage of computer-assisted instruction was developed in response to educators' dissatisfaction with the use of expensive equipment in a limited method. This led to the development of tutorials designed to expose the student to new concepts or skills. The student's response determined the presentation of material and the speed at which the new information was presented. Both drill and practice, and tutorials provided the instructor with records of the student's progress.

Both the previous methods of computer-assisted instruction have been replaced with simulations and hypermedia. These methods allow the student to alter variables in a presentation that produce a variety of results. Hamilton (1995) termed this type of instruction "discovery learning" in which students analyze, evaluate the data and alter responses. Blood (1984) noted that researchers became aware of the relationships between exercise and human physiology, and biomechanical specialists began to utilize technology including sophisticated cameras and computer simulations to record and analyze the movements of the human body.

Deere (1992) developed a computer-assisted instruction program to address issues identified by the National Athletic Trainers Association and the Committee on Health Education Accreditation of the American Medical Association related to the following competencies from the psychomotor domain area as stated:

> (1) "location and palpation of key anatomical structures commonly involved in injury pathology including bony landmarks, ligamentous/capsular tissue, musculotendinous structures, abdominal region, etc." and (2) "use of manual muscle testing techniques, including application of the principles of the muscles/muscle group isolation, segmental stabilization, resistance/pressure, grading, etc." (NATA, 1992, p. 6). It was the authors' intent for this CAI program to reflect these competencies by articulating the various anatomical, physiological, and kinesiological aspects of the human knee. (p. 50)

Deere's program consisted of written text, tests, static graphics, as well as a workbook. It required the student to utilize the workbook with the computer in order to obtain feedback. Deere researched the learning theories of Thorndike, Skinner, Piaget, Bruner, Gagne, Bransford, and Steinberg in preparation for the development of the computer-assisted instructional program. The meticulous process of the production of the software was detailed step-by-step from the duplication of pictures to the creation of the text, tests, and graphics. Following the development of the software in 1992, Deere planned to provide the CAI program to selected universities during the summer of 1993.

Benefits of Technology in the Classroom

Sanders and Birkin (1980) and Guthrie (1991) noted that computer-assisted instruction's ability to provide individualized learning is the main advantage over traditional instructional methods. By means of software that employs animation and hyper-text in simulations that respond to the student, the educational climate is closer to the ideal situation of one teacher per student. Sanders and Birkin maintained that students received more positive reinforcement from computer-assisted instruction than from an overworked instructor.

Schroeder (1991) presented the following reference from Allred and Locatis (1988):

> Hypermedia provides many advantages to the learner, especially through its abilities to adapt to individual differences and to allow the learner to control the path of his/her study. The learner can either be directed or wander through information. The system can provide customized interfaces for each user with varying levels of guidance. (online p. 2)

Peck and Dorricott (1994) stated: "Technological tools can foster students' abilities to revolutionize the way they work and think, and give them access to the world" (p. 40). The authors further listed the following advantages for the educator: the ability to individualize instruction, the ability to create simulations to permit students to master new concepts, and the ability to stimulate the creativity of students.

Kanning (1994) noted: "In prototype classrooms, students can communicate with other classes, access CD-ROM databases in the school library, and log onto Dialog and Internet" (p. 41), and "Multimedia is most successful when it helps students reach curriculum goals" (p. 43). The successful integration of technology in an inner-city elementary magnet school in Los Angeles was cited by Kanning (1994) as evidence of the benefits of multimedia instruction to students. The introduction of educational technology began in 1986 at the first and second grade level. By the fifth or sixth grade, a writing instructor at the school noted that students were producing researched, five-page term papers with more professional results than would have been possible with older research methods. Students were better prepared for the middle and junior high grades and possessed skills to utilize technology.

Means, and Olson (1994) maintained that technology has the ability to play an important role in reforming education. The tools of computers, software, and network resources can be integrated into the curriculum and employed to provide students with the means to develop such skills as analysis, interpretation, and design. However, Haugland and Wright (1997) maintained that both the experience with which the student is provided as well as the appropriateness of the software determines the successful incorporation of computer-assisted instruction into the curriculum.

Campbell, Campbell, and Dickinson (1996) when discussing the values and implications of computer-assisted instruction stated, "Computers allow visually-oriented students to learn through their strengths as they interact with the technology. They can take advantage of opportunities to see and manipulate the material they are accessing or creating in many different forms before they make final copies of a written project" (p. 126).

Wells and Kick (1996) contended that in order to fully benefit from multimedia technology all capabilities of technology must be utilized including components such as high quality graphics and images, sophisticated navigational techniques and transitional effects, music and sound, animation, 3-D modeling and virtual reality. An ancient Chinese proverb, "If you tell me I'll forget, if you show me I'll remember, if you involve me I'll learn" (p. 1), was cited with the following explanation:

> Classroom interaction between instructor and students can be linked to this proverb as follows: lecture me and I'll forget, use multimedia technology in the "glorified transparency mode" and I'll remember, employ the full features of multimedia technology in the classroom and I'll learn. Since the de facto goal of the classroom process is for the instructor to teach, and for the student to learn, it stands to reason multimedia capabilities which enhance the teaching and learning process should be used. (p. 1)

The Tennessee Instructional Model (TIM) adheres to this line of reasoning and was developed to provide a format for the educator to implement daily lesson plans. Butefish (1999) listed and described the components of the following three teaching activities that compose TIM: set, instruction, and closure.

The four components of set as enumerated by Butefish are: labeling the learning or informing the students regarding what will be learned, not the activities involved; involving the students by ensuring that all actively participate; relating to the previous learning by reminding the students of material previously studied or activities completed; and establishing a need for the learning by relating the new content matter to the students' lives in and out of school. All situations do not require all four of the components of set, however Butefish strongly recommended each lesson contain set as an introduction to the material.

Instruction, Butefish (1999) noted may be divided into three components: teaching, monitoring and adjusting, and supervised practice. The first of the components, teaching or instruction, was referred to and described by Butefish as "interactive teaching" (p. 2). "Interactive teaching is the process whereby teachers and students communicate about successful completion of a learning task. The emphasis in this description should be on communication" (p. 2). Butefish noted and described three problems in the implementation of interactive teaching: "no teaching, all teaching, modeling the learning without labeling" (p. 2). No teaching at the elementary level may result from the use of printed exercises presented to the students with poor or incomplete instructions and at the secondary level class assignments with limited monitoring. All teaching may be defined as a lecture-type situation with no provisions made for the students to clarify content and no method for determining student comprehension during the class session. Modeling the learning without labeling was the term used by Butefish to describe an instructor presentation of material without informing students what to look for or what to expect during the instruction period. Butefish (1999) revealed, "Modeling without labeling is characterized by the teacher who demonstrates a skill (a physical skill, a problem-solving skill, etc.) in its entirety without breaking the skill into steps, labeling (identifying) the steps, and explaining what to look for or how to check for accuracy at that point in the exercise" (p. 3).

Closure, noted Butefish, is the means by which the lesson is brought to a logical conclusion. Butefish (1999) explained that, "The Tennessee Instructional Model calls for closure to be a 'summarization by the students, NOT the teacher.' It is an opportunity for students to complete one more example or to restate what has been learned. The emphasis here is on content, not activity. WHAT has been learned, not HOW it was learned" (p. 3).

Stokes (1997) noted that an educator's role has been redesigned by technology as the utilization of technology permits the educator to be a facilitator of learning. The following are values of technology to students and athletes as listed by Stokes at a 1997 Technology Conference: motivate student learning, provide individualized instruction, allow the learner to work at his or her own pace, provide immediate feedback, and allow self-evaluation.

The skill of evaluating information is one that must be learned by students in the rapidly evolving world of technology stated an online education technology agenda (1997). Educators at the John Witherspoon Middle School, Princeton, New Jersey explained: "It is preceded by "gathering" and followed by "analyzing" and "presenting." Collectively, acquiring these skills adds up to learning how to think, the teachers say" (On-line p. 4).

High hopes, high hurdles (1997), one of the sections featured in a web site designed for all educators listed many advantages of incorporating technology into the curriculum. By the use of technology, students assume a greater level of responsibility for mastering content. Teachers who once presented a body of material to be comprehended now serve as guides while students learn various ways to obtain information, sort and analyze the data, then present conclusions to the class and often to a wider audience via the Internet. The classroom assumed a far different role than from that of the past in which a student studied in isolation to learn a block of information that would be repeated to ascertain mastery and comprehension.

Mohnsen (1998) reported that "Studies show that when computer programs are used, learning time can be shortened by 50 percent, retention can be increased by 80 percent, and costs can be cut in half (Levin & Meister 1986; Niemiec, Blackwall, & Wallberg 1986; Gu 1996)" (p.3).

An on-line technology site (2001) provided by the Tennessee Education Association listed the following benefits of technology after a review of related literature:

- In many cases, students' self-esteem was increased when they used computers. This change has been most dramatic in cases of at-risk and handicapped youngsters.
- Students find computer-based instruction to be more motivational, less intimidating, and easier to persist with than traditional instruction.
- Students improve problem-solving skills, outscore class-mates, and learn more rapidly in a variety of subject areas when using technology as compared to conventional methods of study.
- Using technology encourages cooperative learning, turn-taking among young children, peer tutoring, and other valuable social skills. (p. 7)

The benefits of the implementation of technology are numerous and may be applied to any aspect of the curriculum. Fewer references have been made to applications of technology in the physical education curriculum, especially at the elementary level. An attempt to ascertain the effectiveness at this level of the curriculum was the motivation for this research project.

The Internet and Education

Computer technology became an important resource for educators when many school systems connected to the Internet. Gallagher (1997) noted that while many individuals managed to avoid the daily use of technological instruments, educators were required to utilize them. The Internet may be incorporated in many ways in the classroom, from supplemental research to lesson plans for the K-12 classroom teacher. The web site “Education World” referred to itself as “The educator’s best friend” and was designed to provide information that has been submitted by many other educators. Sturm (1996) presented *Classroom Connect*, a newsletter designed to keep K-12 educators informed about effective ways to use the Internet. The 1996 trial issue of the commercial product featured an Internet challenge, lesson plans, a site that linked classrooms to teachers and students from the United States to those around the world, new educational Web sites, technology tips, as well as a glossary of terms.

An online education technology agenda (1997) noted that use of the Internet in the classroom as an educational resource is a work in progress. Kathleen Schrock, Dennis-Yarmouth Regional School District, South Yarmouth, Massachusetts department head for technology stated when interviewed about Internet use in education: “It is not a giant encyclopedia, but I think that by teaching the students how to evaluate information we are teaching them a skill that they will use throughout their lives” (On-line p. 4).

Research on Computer-Assisted Instruction

Research on implementation of technology in pre-service physical educators

Physical education departments at various universities have implemented technology into their curricula. Several research projects are cited as examples of the utilization of technology while students prepared for careers as physical education specialists. The discussion and results of three such research investigations are presented in this section of review of literature.

Nelson (1977) reported that teacher education research in physical education began in 1972 at The Ohio State University in an effort to better prepare those planning to enter the field of education as physical education specialists. These early studies were significant contributions to the profession and Nelson's research on observing, changing, and evaluating teacher behavior in a physical education environment served as an extension with the emphasis on technology. Nelson's study focused on determining the effectiveness of prompting during observations as a method of changing the instructor's behavior. Nelson noted that prompting could be "considered as a shaping procedure for developing control" (p. 23). An FM communication system provided instant feedback. The system consisted of a miniature FM transmitter and receiver operated on a standard commercial FM Band. The microphone (transmitter) was small and was worn on the lapel yet sensitive enough so that both instructor and student could be heard. The receiver was a commercial unit adapted for the study by the addition of an earphone, removal of the speaker, and by using a two-conductor shielded cable as the external antenna. The observer was provided with an electronic clipboard developed to record the data by means of a coded system, which "consisted of behavioral definitions which were assigned numbers . . .then entered sequentially as the behaviors occurred. These entries were made on an electronic clipboard which indicated the interval in which the behavior number should be coded. The result was a frequency versus time readout of the behaviors" (p. 138).

A transmitter was built into the clipboard so communication between the subject and the observer was guaranteed. The subject could either receive as the experimenter transmitted or the subject could transmit while the experimenter monitored. Two male physical education instructors, each with less than two years of teaching experience, and one female dance instructor, with five years of teaching experience, were the subjects for the study. Observers (or experimenters) were university students trained at the university to view and code video-taped teacher behaviors. Subjects were observed at the beginning of the school term for 10 weeks. Data were recorded on the clipboard by the experimenter and by an observer provided with a digital readout and a slave device connected by wire to the main clipboard. Twenty-three behaviors or dependent variables were observed and coded. A prompt was issued determined by the following criteria:

1) was student behavior occurring to which the teacher should respond but was not,
2) prompts were given only when the teacher was not talking or engaged in assisting a student,
3) if one negative comment was made by the teacher the experimenter was to prompt the polar behavior. For example, if the teacher said, "lousy try Susie," the experimenter would prompt the teacher to say something positive like "tell Susie that her hand position was excellent,"
4) if two negative comments in a row were stated by the teacher, the experimenter told the teacher to desist from making those remarks and would then offer a polar response,
5) no reinforcement of behavior was to be made after the teacher made a response,

6) the experimenter was to use judgment about when or what to prompt in the absence of the previous cues. (p. 78)

Eight formulas were used for data analysis. Nelson noted that the traditional method of computing reliability, A/A + D method, was used as well as a point-by-point comparison. Nelson concluded after data analysis that with one exception prompting, both verbal and nonverbal, resulted in an increase in behavior rate over baseline in positive skill feedback.

The use of technology in preparing pre-service physical educators for behavior management was the focus of Montelione's study (1984) that cited a 1982 Gallup poll indicating that twenty-seven percent of those surveyed cited a lack of discipline as one of the primary issues in the public school system. Montelione's research focused on determining the effectiveness of computer- assisted instruction in enhancing knowledge and techniques for behavior management in the physical education environment. Research subjects were 57 undergraduate Southwest Texas State University students in required upper division physical education courses. The subjects were divided into three groups of 19 each and were provided with one of the following: CAI, lecture, or control over a two-week period. Each of the experimental groups received approximately 200 minutes or four class hours of instruction. Data on behavior management techniques were collected for both pretest and posttest by utilization of a multiple-choice test developed by Montelione for the research, the Montelione Behavior Management Test. Montelione wrote four computer-assisted instructional lessons on behavior management in Applesoft BASIC language to be used on the Apple II+ and Apple IIe computers. As sources for discipline problems encountered in a physical education setting, regular physical education instructors and adapted physical education instructors were surveyed. Both CAI and traditional lecture method of instruction required a 50-minute class session. The CAI group was provided with the developed programs, the lecture group was provided with traditional methods, and the control group was provided no instruction in techniques of behavior management.

Montelione's method was provided as follows: "Descriptive statistics (range, mean, standard deviation, and standard error of the mean) were computed for the Montelione Behavior Management Test data by the use of the SPSS Frequencies Program" (p. 63). The use of the pretest scores as the covariate provided the one-way analysis of covariance as described by Dixon et al, 1983. The resulting significant difference exhibited on the adjusted posttest means required a Scheffé post hoc test. Data analysis revealed: "Both the CAI and lecture groups' adjusted posttest means were significantly higher than those of the control group. Additionally, the CAI group's adjusted posttest mean was significantly higher than the lecture group's adjusted posttest mean" (p. 71).

Engstrom (1993) researched the effective use of technology in the instruction of pre-service physical education teachers. Since the very dynamic nature of the physical education class environment can easily lead to behavior not conducive to the acquisition and development of skills, it was evident that pre-service physical education specialists must learn the most effective means of class management. Teacher preparation for classroom management at the high school level was difficult to provide, therefore, technology was employed. An interactive laserdisc video system was designed to provide pre-service teachers with the opportunities to react to possible discipline problems that might be experienced in a physical education class. Staged and rehearsed discipline scenarios were videotaped using college students. Engstrom's study was divided into three areas of research and a follow-up question.

1. Are preservice physical education students able to improve their discipline content knowledge using an interactive laserdisc video tutorial?
2. Are preservice physical education students able to improve their discipline content knowledge using a group decision support system environment?
3. Are preservice physical education students able to improve their discipline content knowledge using a combination of interactive laserdisc video instruction and a group decision support system environment?
4. Is there a difference in the acquisition of discipline content knowledge when comparing the three treatment groups? (pp. 7-8)

Subjects were 55 college students divided into three groups by gender and by information revealed on pretests of discipline content knowledge. Eighteen subjects were assigned to the first group and viewed interactive laserdisc videos (IV). A second group of eighteen students was assigned to assess the group decision support system (GDSS) as posed in the second research question and a third group of nineteen students was assigned to assess question number 3, both interactive video and group decision support system (IV & GDSS). Group 1 (IV) was provided with six scenarios for an average of 44.9 minutes. Group 2 (GDSS) and group 3 (IV & GDSS) watched two videotapes per day for three days with each session approximately 45 minutes in length. Content for the videotaped scenarios was selected based on the researcher's experience in public school physical education at the high school level. Discussions with physical education instructors at the university level and individuals from five universities across the nation involved with student teacher observation also provided the basis for inclusion in the material. The discipline scenarios included the following situations:

1. Fighting: The teacher had to break up a fight between two students because he failed to respond to clues earlier in the lesson.
2. Cheating: Two students were involved in an argument about the correct number of reported sit-ups during a fitness test. One of the students incorrectly reported the number of sit-ups performed.
3. Poor Classroom Management: The physical education teacher proceeded through the early part of a lesson without monitoring student behaviors and failed to have a procedure for handing out equipment.
4. Off-Task Behavior: One student in the class repeatedly defies the teacher's request to stay involved in the class activity.
5. Apathy: A student refused to participate in the lesson activity despite the teacher's encouragement.
6. Low Ability: The teacher established a rule to induce participation by students of all ability levels. A higher skilled student becomes frustrated with a lower skilled teammate, telling him to leave the game. (pp. 42-43)

Group decision support system (GDSS) data were collected from the system at the University of Northern Colorado in the Decision Support Center. A local network was composed of twenty 386 DOS computers equipped with VGA color monitors linked by a file server. Collection of data was accomplished by the use of the topic commenter and vote tools from the GroupSystems V™ software package.

The posttests consisted of 35 single response multiple choice questions on discipline content knowledge. All three groups were tested at the completion of the varying treatments. Engstrom employed the following statistical design for the research question investigated: Research questions one, two and three in this study were analyzed using a t-test for related samples. The alpha level for the t-tests was predetermined at the .0165 level to ensure that the probability of a type I error was not greater than a .05 level for each comparison.

> Research question number four was analyzed using one-way analysis of covariance to determine if there was a difference between the three treatments' posttest scores. The pretest scores functioned as the covariate in the analysis of covariance. Significance for analysis was predetermined and set at the .05 level. (p. 54)

Analysis of the data indicated that the subjects in treatment group one (IV) were able to improve their knowledge of discipline content significantly. No significant improvement of discipline content knowledge was demonstrated by the subjects in group two (GDSS) or in group three (IV & GDSS).

Research on computer-assisted instruction at the university level

More research on the effectiveness has been conducted at the university level including the domain of physical education. The first two of the following investigations presented were in the physical education curriculum; the other three were in other domains. The results of the researchers are presented to validate the implementation of technology in physical education as well as other domains.

Lease (1981) noted that there was a lack of computer-assisted educational software in the physical education domain. Therefore, Lease developed and implemented computer-assisted instructional supplemental programs for use by undergraduate students enrolled in kinesiology courses at Texas Woman's University. The programs were designed to include material on the mechanical analysis of motion, a topic covered in undergraduate kinesiology. Sixteen students enrolled in undergraduate kinesiology courses during the first summer session of 1981 were selected as subjects. The supplementary material was accessed on large mainframe timesharing computers usually during peak "user-time." Lease wrote the programs, which included both a pretest and a posttest, in BASIC Plus 2 language. Comprehension was determined by pretests and posttest data analysis by utilization of a t – test for related samples as the statistical tool on the scores for each subject Of the nine subjects who completed one computer-assisted program the calculated $\underline{t}$ – value was significantly higher and favored the posttest. Scores for the nine subjects who completed two computer-assisted programs also revealed a significant increase and favored the posttest. Eight subjects completed all four of the computer programs with the posttest means revealed to be significantly higher. Lease concluded that based on the research results, student knowledge of kinesiology increased. The subjects reported that it had taken a significant amount of time to complete each program – at least 1 to 1 ½ hours which may be explained by the type of computer system utilized for the study.

Guthrie (1991) noted that despite the volume of computer-assisted instructional research, the effectiveness of such methods of instruction has not been well documented and stated: "... much that is reported in educational and professional journals on the effectiveness of CAI particularly in the physical education domain is based on speculation" (p. 2). Therefore, Guthrie designed a study to determine the value of computer-assisted instruction compared to that of traditional instructional methods at the university level in the physical education curriculum. Subjects were students at Lakehead University, Thunder Bay, Ontario, Canada, enrolled in PE 2015 "Introduction to Biomechanics." The 37 volunteer subjects were divided into two groups depending on the type of instruction: CAI plus lectures or lectures only. Research was conducted over the span of a semester with the course content divided into six units. Each unit required a two-week period to complete with testing conducted at the conclusion of each unit. A customized computer-assisted learning program was designed to supplement the traditional lectures and was accessed at the campus computer lab on IBM compatible AT microcomputers. The information provided via computer was presented in the same order as the material was presented in class lectures. The CAI plus lecture subjects were randomly assigned to one of two groups, A or B. The few computers available required that volunteer subjects randomly assigned to group A were provided access to the computer lab during units 2 and 4 and the subjects in group B were provided computer access during units 3 and 5. Guthrie (1991) reported the following analysis of data and conclusions:

> The results of the theoretical competency test scores were analyzed using a paired t-test and an analysis of variance. . . . Null hypotheses of equal population means between treatments, between groups, and within groups were tested. Analysis of all test scores showed subjects who received CAI (N = 37) as a complement to lectures scored higher (mean = 77.223) compared to when they did not receive CAI (mean = 72.86), however, no significant difference was detected between the two instructional treatments. (p.60) Based on the findings of this investigation, the implementation of a customized CAI program as a complement to tradition lectures in undergraduate biomechanics was a feasible and practical course of action. (pp. 74-75)

Computer-assisted instruction in a freshman mechanical engineering course at the University of Illinois at Urbana-Champaign has been utilized since the late 1970s. Jones and Kane (1994) noted that the computer-based material ran first on the PLATO and subsequently ran on the NovaNET system. Student enrollment varied from 108 to 526 depending upon the semester with students placed in one of two situations, those taking a traditional course and those taking a course that featured computer based instruction. Students in the traditional class (106A) as well as students in the computer-assisted course (106P) were required to attend two one-hour lectures per week as well as one two-hour lab per week. The lectures were conducted in a large lecture hall by a university faculty member. The most notable difference between the two sections was that the traditional method students (106A) were required in addition to the lectures and lab to attend a discussion-quiz two-hour session each week under a teaching assistant. The CAI students (106P) were scheduled for two hours per week in a computer-equipped classroom under an undergraduate tutor for tutorials and homework exercises. Quizzes that took approximately 25 minutes required the 106P students to attend the computer lab but for the remainder of the scheduled lab sessions, students were permitted to work from any computer station on campus. A comparison of performance at the end of each semester following the same final exam indicated that both means of instruction were equally effective. Students were asked to evaluate the various course components such as lecture, textbook, PLATO (NovaNET), discussion/lab section for effectiveness in learning course material for 27 consecutive semesters. The very long time span over which the evaluations were conducted gave weight to the conclusions. Student evaluations rated the computer-assisted instruction as more helpful than the lecturer, text, and lab sessions for each of the 27 semesters.

Ester (1994) noted the research and consensus of the effectiveness of computer-assisted instruction. Ester cited Keefe (1987) and Messick (1976) as having conducted research and prepared summaries of the identification of learning traits and styles. However, Ester noted that more research was needed to determine the relationships and benefits of computer-assisted instruction and learning styles. Ester's study compared the effectiveness of computer-assisted instruction with that of traditional lectures in a study of undergraduate students in the music department at Ball State University. The subject matter was vocal anatomy and function. Sixty undergraduate students were the subjects of the research. The subjects, 33 males and 27 females, were in the men's and women's choral ensembles with the majority – 80% nonmusic majors. Students were categorized by means of a pretest developed by Ester, the Vocal Anatomy Test (VAT), and the Gregorc Style Delineator into one of two learning styles, abstract or concrete. The Vocal Anatomy Test consisted of 35 questions comprised of 18 identification by name the illustrated cartilage or muscle and 17 multiple choice questions related to laryngeal function. The Gregorc Style Delineator, requiring only approximately five minutes, was developed by Gregorc in 1982 and required the rank-ordering of four words in 10 sets. The VAT results, the results of the Gregorc Style Delineator, and the subject's grade point average determined the subject's classification. Placement in the sequential or random learners was based on the Gregorc Style Delineator scores. The student's grade point average dictated a rank-order in each of the two learning style categories. Students who were ranked number 1 were assigned to lecture while students who were ranked number 2 were assigned to computer-assisted instruction for each of the learning style categories.

Ester utilized the style theory of Gregorc (1982). According to Gregorc, there are two basic learning categories, concrete and abstract. Within these two categories the subject may prefer sequential or random methods of instruction. Thus, the concrete sequential learner would especially emphasize the use of the physical senses. This person would prefer to learn by using computers, demonstrations, or guided practice. The concrete random learner would depend more heavily on intuition and trial-and-error. This learner would prefer independent study to structured lessons. The abstract sequential learner would rely more on his intellectual processes. This type of learner would prefer reading or lectures to hands-on projects. The abstract random learner lets his/her emotions dictate learning preferences. This type of learner would prefer the arts to structured drills or assignments.

Lectures for the students in the traditional groups were presented during a 45-minute session in conjunction with the use of large illustrations of the specific cartilages and muscles discussed. Additional material prepared for the traditional instructional method featured written material on the anatomy of the larynx as well as a study guide. The subjects in the computer-assisted instructional treatment groups were provided access to a computer lab equipped with 13 Macintosh computer stations. Each computer was equipped with Hyper Vocal Anatomy (HVA), a HyperCard- based computer-assisted instructional resource developed by Ester. Students were permitted access to the lab throughout the study to promote independent use of the HVA. Three 50-minute sessions over a five-day period comprised the research procedure. Ester designed the study to test three hypotheses as listed:

> H1: No difference will exist between the means of the lecture and CAI treatment groups with respect to vocal anatomy knowledge achievement as measured by the VAT.
> H2: No differences will exist among the means of the four learning style categories with respect to vocal anatomy knowledge achievement as measured by the VAT.
> H3: No interaction will exist between treatment and learning style with respect to vocal anatomy knowledge achievement as measured by the VAT. (P. 133)

ANCOVA, a two-way analysis of covariance, was utilized for analysis of the statistics with pretest scores utilized as the covariate and posttest scores as the dependent variable. Data analysis indicated that subjects classified as concrete learners posted approximately the same results with both methods of instruction. Subjects classified as abstract learners posted greater achievement when exposed to the traditional lecture treatment compared to abstract learners exposed to the computer-assisted instructional treatment. Implications drawn from the study indicated that computer-assisted instruction may be used to enhance those classified as concrete learners. The recommendation was that more research be conducted to determine the relationship that exists between methods of instruction and the learning styles of students.

Raidl, Wood, Lehman, and Evers (1995) reported their utilization of three computer-assisted programs to improve the clinical reasoning skills of dietetics students. Standards had been established by The American Dietetic Association based on studies of knowledge required to function as an entry-level dietitian. Research had indicated that each step of the three-step process of the development of clinical reasoning skills presented problems for students. Raidl et al, noted that unlike basic reasoning skills that may be taught in the classroom clinical reasoning skills dependent upon knowledge, experience, and intuition were not developed by listening to class lectures or from a textbook. Nardone et al (1987) and Harless et al (1990) were cited as having documented the effectiveness of computer-assisted instruction in medical schools to enhance medical students' skills in the collection of a medical history from a patient during an examination. Previous studies on computer-assisted instruction utilized in nursing schools indicated student preference warranted an examination of the implementation of such instruction in dietetics programs. At the time of Raidl et al's study (1995) the instructional materials utilized in nutrition were limited to programs reinforcing nutrient analysis and menu planning and did not provide enhanced information on nutrition science or diet counseling. The lack of appropriate software and research prompted the development of programs utilized in Raidl et al's study. The research implemented three aspects of computer-assisted instruction: a drill and practice program, a tutorial, and a simulation. The objectives for the study were presented as follows:

Lower-level thinking skills (collecting information)
Objective 1: The student will collect appropriate information from the kardex/medical chart.
Objective 2: The student will collect appropriate informat from a diet history.
Objective 3: The student will collect appropriate information from a diet instruction.
Higher –level thinking skills (evaluating information and making decisions)
Objective 4: The student will make appropriate decisions for nutrition care treatment of a patient.
Objective 5: The student will correctly evaluate information from the kardex/medical chart.

Objective 6: The student will correctly evaluate information collected from the diet history and instruction. (p. 870)

The programs were designed for IBM-compatible computers and were sent to 32 undergraduate coordinated programs in dietetics (CPD) or didactic programs in dietetics (DPD). Four hundred thirteen students enrolled in 30 programs were subjects for the research over a two-semester period. The subjects were randomly placed in one of three groups and received the appropriate methods of instruction after completion of lectures on the material: Group 1 (Drill) utilized the drill-and-practice program; Group 2 (Tutorial) utilized the tutorial program; Group 3 (No CAI) was provided with no computer-assisted instruction. Groups 1 and 2 implemented the simulation program after completion of the required program and group 3 was provided only with the simulation program. Each subject recorded responses on a disk throughout the program. The disk included background information related to the subject such as school year, computer experience, and medical chart experience. Statistical analysis was reported by Raidl et al (1995), "One-way analysis of variance and Student-Newman Keuls tests were conducted to determine any differences among the three groups. Reliability was determined using the Kuder-Richardson Formula 20" (p. 868).

Analysis of the data revealed that the subjects in group 2 (Tutorial) posted higher scores on the simulation test than either of the other two groups. Subjects in group 2 (Tutorial) spent more time in active learning than those in the drill-and- practice group. Results indicated that such instruction as provided by implementation of tutorials enhanced clinical reasoning skills.

Szabo and Poohkay (1996) noted the lack of research on the effectiveness of animation on student comprehension and retention of subject matter. The following citation from Siliauskas, 1996, p. 83 was presented as rationale for the research:

> It is a fact that we will have increasing access to presentation and response capabilities that have never before been possible. Guidelines for the use of these capabilities are not yet available, and on the basis of the current state of research in the field, we can predict that such assistance will take time in arriving. The CAI designer, however, needs to be aware of this impending shift from text-dominated lessons to graphics-oriented presentations where it will be necessary to design new and different interactions. (p. 390)

Szabo and Poohkay noted that research conducted by Alesandrini in 1984 indicated that graphics combined with visual presentations increased the amount of material retained by adults while Pressley reported similar research results with children in 1977.

Undergraduate elementary education majors at the University of Alberta were chosen for an experiment devised to determine the effects of animation on mathematics topics at a tenth grade level and subject's attitude toward computer-assisted instruction. Three levels of instruction were presented to each of three test groups: text only instruction, text plus static graphics instruction, and text plus animated graphics. The experiment featured a one-hour lesson on the topic of construction of triangles using a compass. Demonstration on triangle construction with a compass was provided in the animated version while only static versions of the compass were presented in the graphics version. Instruction was presented on computer with mathematics achievement defined as responding to questions about triangles as declarative and constructions of triangles with a compass as procedural. The 173 test subjects were divided into three groups on the basis of a pretest, stratified according to previous math achievement and gender and randomly assigned to one of the three groups. The pretest consisted of 19 items and involved math computation and the solving of trigonometric problems. Szabo and Pookay noted that the Cronbach Alpha reliability of the pretest was 0.63 while the posttest had a Cronbach Alpha reliability coefficient of 0.83. Material on the posttest required construction and multiple-choice questions on the construction of triangles. The subject's attitude toward computer-assisted instruction was measured by completion of a 25-item Likert type instrument. Reliability of the Likert type instrument was determined to be 0.86. Computer collection routines and traditional paper-and-pencil scores were utilized for data collection. Research findings were presented as follows:

> Analysis of variance results indicated a difference in achievement scores among treatment means: F(2.170) = 32.3....The Scheffé analysis indicated the animation group outscored both the graphics group and the text group on the achievement instrument. On the dependent variable of attitude, both the animation and graphics group scored higher than the text group but equivalently to one another. (p. 396-397)

Szabo and Poohkay concluded that research results supported the hypothesis that animation provided through computer-assisted instruction would increase learning when compared to static graphics and text-based instruction. Results of the survey of subjects' reaction to computer-assisted instruction indicated that both animation and graphics were preferred over the text only method of instruction.

Computer-Assisted Instruction in the Classroom

There are many implementations of computer-based programs, especially at the university level. Three examples illustrate the use of computers in the physical education curriculum with two examples in other domains. Each of the examples illustrates the successful utilization of technology.

Hill (1975) advocated the development of computer-based resource units in the health and physical education department. This method, modeled on a resource bank developed at the State University of New York at Buffalo, provided Hill with a convenient means to store resources on information concerning obesity and weight control. Hill noted that such a resource system was for instructors and students and contained objectives as well as activities to be utilized in the development of a unit of instruction.

Coulson and Wood (1975) noted that technology was utilized in the Department of Physical Education at the University of Maryland for the purpose of the construction of knowledge tests in a system termed Test Assembly System (TAS). Noted as advantages of the system were:

> First, items of known measurement quality and curriculum content are stored, therefore contributing to better test construction. Second, the computer allows for better test item security than the traditional card file or filing cabinet, in that changeable codes and passwords must be known to the system user. Third, the test is printed out and duplicated without leaving the sight of the instructor or TAS operator. (p.28)

An Imagine video (1992) demonstrated the many ways in which technology changed the avenues by which students learn and teachers teach. One example was that of Paul Privateer at Arizona State University. Privateer combined technology, collaborative learning, and short lectures to retain the interest of sampled students in a humanities class. As a result of this innovative mixture of technology, the students were successful in developing higher order cognitive skills, synthesis, critical thing skills, and a higher degree of analysis.

McLean (1996) reported the development and implementation of a shareware package, "HPERIntern" by McLean and Hill in 1993. The program featured the utilization of HyperCard, a commercial product. "HPERIntern, a menu-based application, was designed to lead university and college students through internship development and the placement process. The menu-base permitted the student to enter the program at any level, which provided the user the ability to control the learning process rather than having to follow a predetermined series of progression through the material. McLean (1996) noted that the implementation of HPERIntern reduced the amount of classroom time required for internship preparation as well as a reduction in the amount of counseling needed for an intern.

Silverman (1997) noted that physical educators were utilizing technology for continuing education. The California Physical Education Home Page was developed in 1996 as a 15-hour Internet course (URL: http//www.stan-co.k12.ca.us/calpe/). Participants were able to access the course from any computer equipped with an Internet Service Provider. The course content featured the National Standards for Physical Education, the California Physical Education Framework, and FITNESSGRAM testing. Students utilized e-mail, listservs, chat sessions, the World Wide Web, and a virtual auditorium. Also mentioned was the development of a computer-based master's degree program for physical education developed by Virginia Tech University (URL: http://infoserver.etl.vt.edu/coe/COE_admin/programs/hpe/hpe_p.html).

Educators at the K-12 level have become aware of the benefits of technology when incorporated into the curriculum. Many examples of the successful implementation of computer in the classroom have been presented in various articles, journals, and on-line sources. The following are illustrations of the utilization of technology, both in regular classrooms and in the physical education curriculum.

Kanning (1994) presented an example of the incorporation of technology at the middle school level. To meet the demand for easy to use multimedia applications that would fit into the classroom, Kanning developed twelve episodes of a math unit, *Interactions: Real Math – Real Careers*. The material designed to be accessed on a Macintosh required just a television set and a laserdisc player with a bar-code scanner and was implemented in the curriculum by middle school mathematics instructors in three city school systems. The episodes integrated middle school math topics with specific careers by the presentation of projects such as planning a trip to Mars or the use of statistics to predict the water needs of New York.

High hopes, high hurdles (1997), an online source, reported the following examples of integrating technology into the curriculum in grades K-12:

> In Mendocino, California, math students at Mendocino Middle School study linear and exponential patterns of growth by experimenting with population simulation programs they download from Virginia Polytechnic Institute. Based on these programs, they prepare reports for state and foreign governments on the likely impact of population changes on demand for public services.

> In Cranford, New Jersey, students at Cranford High School have designed a website that details a fictitious murder case. As they describe each step of the legal process, they present detailed fact sheets explaining the underlying legal principles. By the end readers not only have been treated to an interesting story, they have also absorbed a comprehensive primer on the entire U.S. judicial system.
>
> In Pullman, Washington, students at Sunnyside Elementary School learn about linguistic and cultural differences by exchanging artwork with their peers overseas and discussing the results by email.
>
> In Boulder, Colorado, students at Centennial Middle School work with their peers at schools in three other states and Canada to produce an electronic newspaper expressing their views on contemporary issues (On-line p.1-2).

The benefits of the utilization of technology are still being researched. The actual implementation by physical education specialists in Florida was investigated by Cole (1994). A professional journal recently polled physicals educators for their views regarding technology in physical education.

Cole (1994) researched the application of computers in physical education in the state of Florida's public school system with a study designed to identify the factors that supported or impeded the utilization of computers and computer applications. Cole noted from a 1993 Florida Department of Education report that the state of Florida had 162,622 computers for instructional purposes in the public school system with .01% of those computers specified for use by instructors in Health and Physical Education. The fact that there had been few studies focusing on the use of computers in the domain of physical education was noted by Cole. A questionnaire was developed to be mailed to physical educators with the state of Florida records and data bases accessed as the sources for the names of instructors at each level in the public school system, elementary, junior high or middle, and high school. Cole concluded that the selection of 25% of instructors from each of the three school system divisions furnished a stratified sampling. The design of the questionnaire was divided into eight sections which included: demographic and professional data, paperwork demands, attitudes, changing motivation, computer basis knowledge, training and experience, computer accessibility, and amount of computer use. The questionnaires were mailed to the randomly selected physical education instructors on May 10, 1993, with a follow-up post card in one week. From the total of 1,098 randomly selected instructors, 414 responded, with 395 deemed usable which provided a return rate of 36%. Analysis of data revealed that the highest usage of computers was at the high school level and that acceptance of computer applications was directly related to computer literacy. Cole concluded that computer technology is available and that only by learning how to implement the technology might the way be paved for the more efficient utilization of technology in the physical education curriculum in the future.

"Should K-12 physical educators make more use of technology in their classes?" was the subject of the Issues feature of the February 2001 Journal of Physical Education, Recreation and Dance. Eight out of the ten individuals whose responses were included in the article felt that technology could make a positive impact on physical education programs at all educational levels. Ogden, an Instructional Services Coordinator in Naples, FL, cited technology as the means to motivate students, enhance their learning, and empower the students to improve their own health and fitness levels. Holligan, a student at Columbia University, noted that the use of computer-based programs may enhance the students' realization of the connection between learning, thinking, and physical activity.

The following are examples of the implementation of computer-assisted instruction in K-12 physical education settings. Sinclair (1983) reported the successful implementation of the integration of technology in the physical education curriculum under the direction of Henrik Lyth in the Canadian Vancouver (B.C.) School District. In a coeducational, multi-graded four-year program whose goal was to expose students to activities that would provide the basis for lifetime activity, Lyth initiated a health unit utilizing a computer for students to use to record test data. This program was followed by a tennis unit that featured a computer-managed multiple-choice assessment that provided information regarding the degree of content mastery. A third program was implemented in order to measure student attitudes before and after each semester. The students responded with increased interest in several aspects of the physical education curriculum.

The utilization of videotapes in the physical education curriculum was reported by McKenzie and Croom (1994). Several examples of the use of videotapes were discussed such as the demonstration of a skill performed either by the physical education instructor or by a skilled athlete to illustrate the performance of a skill. The inclusion of still pictures in a video may be used for demonstration or correction of performance techniques was another possibility listed. Other recommendations were the videotaping of special presentations by guest lecturers as well as archiving material needed every year and the use of tapes to exchange ideas with other instructors. McKenzie and Croom concluded video production provided a valuable teaching tool for the physical education specialist.

The successful use of heart rate monitors in the implementation of a fitness program in a middle school in Fargo, North Dakota was reported by Strand, Mauch, and Terbian (1997). In response to the reports of the Surgeon General and the recommendations of the President's Council on Physical Fitness and Sports, the project was devised to enhance student understanding of the basic principles of activity and how heart rate was affected. By means of this program, students were able to comprehend the connection between exercise and fitness and were furnished with the incentive to pursue fitness activities in order to stay physically fit.

Hopkins (2000) reported the successful implementation of technology at the elementary level in Hood River, Oregon. An independent technology consultant worked with the local schools to utilize spreadsheets for the students to record and track physical fitness progress. Parents were provided with the spreadsheet reports three times during the year when report cards were sent home. Students utilized the graphs created by the spreadsheet information to determine improvement or areas that required more emphasis. Third graders at the May Street School recorded the results of fitness testing three times during the school year into an Excel spreadsheet. The data were converted to charts and graphs for each student to provide a visual of overall progress. The spreadsheet information was also utilized to produce a ranking sheet. The instructor highlighted the individual student's scores as no names were recorded on the ranking sheet. Yoshimura, a fourth and fifth grade teacher at Westside School, reported students' use of a ranking sheet to monitor fitness progress and to set goals. Classroom instructors not only integrated the spreadsheet information to interpreting graphs for math classes, but utilized the data as the basis for writing projects.

In the News (2001), an online article posted by HealthFirst Corporation reported that the Parkway Board of Education in Missouri purchased "HealthFirst Software" for implementation in some of the district's physical education programs at all levels. The wellness software program was designed to report students' health to each student, parents, the Parkway School District, and the state of Missouri. At the individual student's level, the software will enable the student to set and monitor progress. Utilization of the software will also enable the students to identify areas such as dietary risks through behavior surveys and risk of heart attack and cancer by analysis of family medical history. The capabilities of the software can be used to track fitness trends at all levels, locally and statewide. The school system plans to implement the software throughout the district.

Resources for Technology Applicable to K-12 Physical Education

Mohnsen (1998) noted that at the lower educational levels, K-12, in the 1980s the use of technology was limited to recording results of fitness testing and for lesson plans, recording locker assignments, newsletters, grading, budgets, and inventories. However, Mohnsen contended that physical education specialists have just begun to realize the potential of technology in the curriculum and stated: "Physical educators need only desire and vision to bring them (computers and technology) into their gymnasiums" (p. 3).

Lambdin (1996) developed Project COPE (Computer Organized Physical Education) and presented Putting Assessment Information to Use: Is that a computer in the gym? at the AAHPERD National Convention April 16, 1996. The sheer volume of data was overwhelming to Lambdin and prompted the origination of Project COPE. A sample screen from Project COPE featured the following:

This program will enable you to do the following:

- Identify students who need help
- Identify students who met their goals
- Identify students who performed above criteria
- Identify students who improved
- Print certificates for any of the above groups
- Summarize group performance on any measure
- Create personalized letters to parents or students
- Resort student data into new groups each year

♦Click here for choices (AAHPERD Handout)

Sample report forms from Project COPE included an individual fitness report for a student for three years: third, fourth, and fifth grades. Each measurement of fitness (cardiovascular, flexibility, abdominal strength, and arm strength) was divided into grade level as well as three times for testing, during fall, winter, and spring. The student was consulted and set a personal goal, which was entered into the report. This type of program allowed the instructor and the student to determine if the student matched or exceeded the goal. Lambdin noted that various report forms can be made from the information entered into the record.

Manross and Pennington (1996) reported the development of an exceptional resource for physical education specialists. Dr. George Graham and Health and Physical Education Program doctoral students at Virginia Tech were responsible for the web site PE Central, which premiered in August 1996. The site featured lesson plans for all grade levels with provisions of adaptations to accommodate different skill levels as well as a checklist for the instructor's use in determining the appropriateness of an activity.

McLean (1996) noted the value of the Internet and the World Wide Web for the enhancement of biology or health units by accessing the web site of a medical school. Sites produced by the University of Iowa Medical School or Johns Hopkins University not only provide information but feature videos of some of the systems of the body in operation. McLean described the following scenario:

> Students can be exposed to a video of a working heart and even create specific heart problems. Students may see a working heart with a dynamic chart that illustrates heart efficiency (amount of blood pumped per minute). By clicking on a fat-blocked heart, students watch heart efficiency drop dramatically. The students, engaged in the process now, click on the aorta to see an enlarged view a healthy and a fat-clogged aorta. Next the student clicks on the clogged aorta and receives a written or verbal description of how the heart got this way and its potential impact on the owner. Students can take notes and copy the pictures to a notebook that is built into the program, and when done, can download and print the notes. (p. 3)

Dorman (1998) compiled information detailing the technologic advances in physical education. He noted athletes in training both for Olympic events as well as professional events have utilized technology to enhance their performance. Some of those devices have become available for integration into the physical education curriculum. Dorman listed handheld devices such as the Sharp Wizard as valuable tools that allow the physical educator to collect information in various settings then download that information to a personal computer. For student use, electronic portfolios enable students to develop their own fitness and wellness programs as well as chart their own progress.

CHAPTER 3

METHODS AND PROCEDURES

Participants

Participants were elementary students in grades three, four, and five attending Homer Pittard Campus School. Students in grade six participated in a pilot study prior to the research. Permission to conduct the research project was obtained from the superintendent of the Rutherford County School System, Hulon Watson, from the principal of Homer Pittard Campus School, Dr. Stan Baskin, and from Middle Tennessee State University Institutional Review Board. Parental consent was obtained by sending a letter of explanation to the parent or guardian of each affected participant. (See Appendix A) Each letter provided a consent form to be returned to allow inclusion of the student's test scores to be utilized in data analysis with only one parent refusing permission. The research project was conducted during regular physical education class sessions; therefore, each student received instruction and was tested. The one parental refusal was honored and that student's test scores were not recorded or included in data analysis. Participants were assigned a number with a master list secured in a locked file in the researcher's office at Murphy Center, on the campus of Middle Tennessee State University, Murfreesboro, Tennessee. No names were used in the recording or reporting of scores in order to protect confidentiality.

Selection of Groups

At each grade level, one class was selected as the computer-assisted instruction group (CAI). The CAI group was provided with access to the computer lab to view the professionally prepared selected material by means of CD-ROM. The second class at each grade level was termed the traditional instruction group (TRAD). These participants were provided with the same information as the CAI group by means of traditional methods of instruction.

Computer Software

The software selected for the research project was The Ultimate Human Body 2.0, prepared by Irwin Publishing, a division of Dorling Kindersley, Toronto, Canada. The product featured interactive 3-D models to enhance exploration of the human anatomy and systems of the body. Research was limited to the following sections included in the software package: skeletal system, heart, muscular system, and circulatory system. A composite test to measure comprehension and retention was constructed by the researcher and consisted of questions previously asked on immediate and one-day recall of knowledge instruments. The comprehensive knowledge instrument was administered to the participants at the conclusion of the project.

Instructional and Testing Procedures

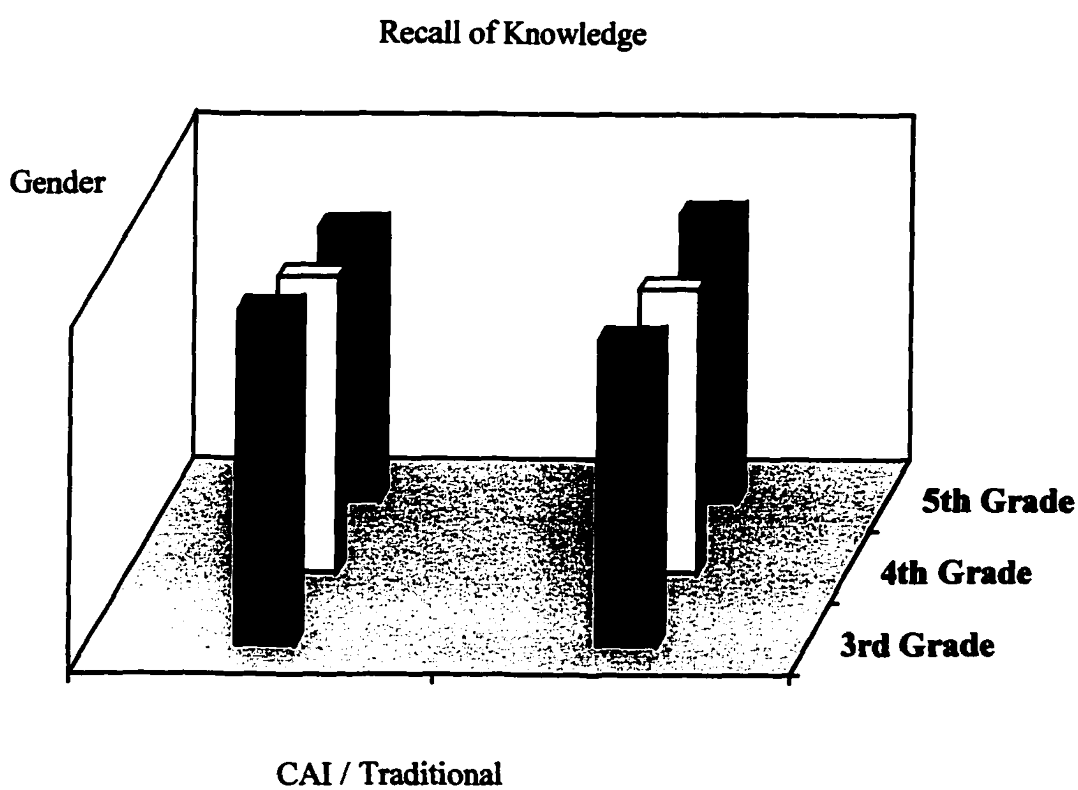
The CAI group was directed to the computer lab in order to access the material on CD-ROM. Each participant was provided with a computer equipped with headphone to listen to the recorded material while viewing the selected sections of the software. Since there was a limited number of computers and it was essential that each participant work individually, the CAI group was divided into sections. Participants completed the computer lesson and worksheet then returned to physical education class and a participant who had remained in physical education class at the beginning of the session took his or her turn in the computer lab. Assistance in the computer lab was limited to help in navigating through the material and accessing the proper screen. Worksheets utilized as instruments of testing were prepared using material provided by the software manufacturer. (See Appendix B)

Participants in the TRAD group were provided with instruction on the same material presented to the CAI group. Methods utilized for the instruction of the TRAD group were lectures, discussions, charts, and models. Participants in the TRAD group were tested at the conclusion of the lesson, tests collected, scored, and results recorded in the same manner as that implemented for the CAI group. Both groups (CAI and TRAD) were tested the day of instruction (immediate), one day after instruction (one-day) and six weeks after instruction (six-week) to measure retention of subject matter. The same tests were administered to both groups. A participant was required to complete both the immediate recall test and the one-day recall test or the participant's scores were excluded from data analysis.

Analysis of Data

The experimental design was a three-dimensional model. The dimensions were gender (male and female), grade (third, fourth, and fifth), and method of instruction (computer-assisted and traditional), and length of recall of knowledge (immediate, one-day, and six-week). A model of the model is presented in Figure 1. The most important dimension of the model was method of instruction. The next important dimension was the grade level and the third dimension was gender. The measures for instruction and gender were repeated measures on the same subjects. The same design was used for comparing gender. The grade levels were independent measures with different subjects at each grade.

Figure 1. Three-dimensional model



A reduced general linear model with repeated measures was used to analyze data using SPSS 11.0 software. The .05 level of probability was considered to be significant. The Tukey HSD multiple comparison test was used to identify the location when significant differences were obtained.

Research Questions

For the purpose of this study the following questions were posed:

Q1: Is there a difference among the independent variables of method of instruction, grade or gender and the dependent variables of immediate or one-day recall of information related to the skeletal system?

Q2: Is there a difference among the independent variables of method of instruction, grade or gender and the dependent variables of immediate or one-day recall of information related to the muscular system?

Q3: Is there a difference among the independent variables of method of instruction, grade or gender and the dependent variables of immediate or one-day recall of information related to the heart?

Q4: Is there a difference among the independent variables of method of instruction, grade or gender and the dependent variables of immediate or one-day recall of information related to the circulatory system?

Q5: Is there a difference on a six-week recall of information on a composite instrument related to the skeletal system, muscular system, heart, and circulatory system with the variables of grade, gender, and type of instruction?

CHAPTER 4

RESULTS

Data presented in the results chapter were limited to the most relevant associated with the five research questions. Retention of knowledge after instruction, immediate and at one-day recall, related to the anatomy of skeletal, muscular, heart, or circulatory system was determined by completion of a knowledge instrument. A fifth study investigated six-week retention of knowledge for all areas studied and was measured by administration of a composite knowledge instrument. The appendices include the knowledge instruments and all supporting data. Tables are included in the text and figures are used to illustrate the differences noted among the variables measured.

Tennessee Comprehensive Assessment Program (TCAP) Scores

In order to assure that the CAI instruction groups and the traditional instruction groups had comparable scientific knowledge at the beginning of the study, TCAP scores (Figure 2) were compared for all participants. The TCAP test is given each year in Tennessee elementary schools and measures the achievement of students in each grade. The science sections from tests administered in the spring of 2001 were obtained with 34 scores for third grade participants, 31 for fourth grade participants and 44 for fifth grade participants. The higher number of scores available for the fifth grade was because the majority of students were also enrolled at the campus school for the fourth grade. The scaled scores for the science portion of TCAP were analyzed to determine if significant differences existed among the groups prior to any instruction.

The results of univariate analysis of variance for TCAP scaled scores obtained are included in Table 1. Instruction, grade, gender, grade*instruction interaction, and error were the sources of variance.

Table 1

Results of Univariate Analysis of Variance for TCAP Scaled Science Scores

Source	Sum of Squares	df	Mean Square	F	p
Corrected Model	22759.44	6	3793.24	3.80	.00
Intercept	44649661.13	1	44649661	44750.27	.00
Grade	6141.88	2	3070.94	3.07	.05
Instruction	2086.34	1	2086.34	2.09	.15
Gender	7733.54	1	7733.54	7.75	.01
Grade * Instruction	8063.79	2	4031.89	4.04	.02
Error	102768.42	103	997.75		
Total	46412219.00	110			
Corrected Total	125527.86	109			

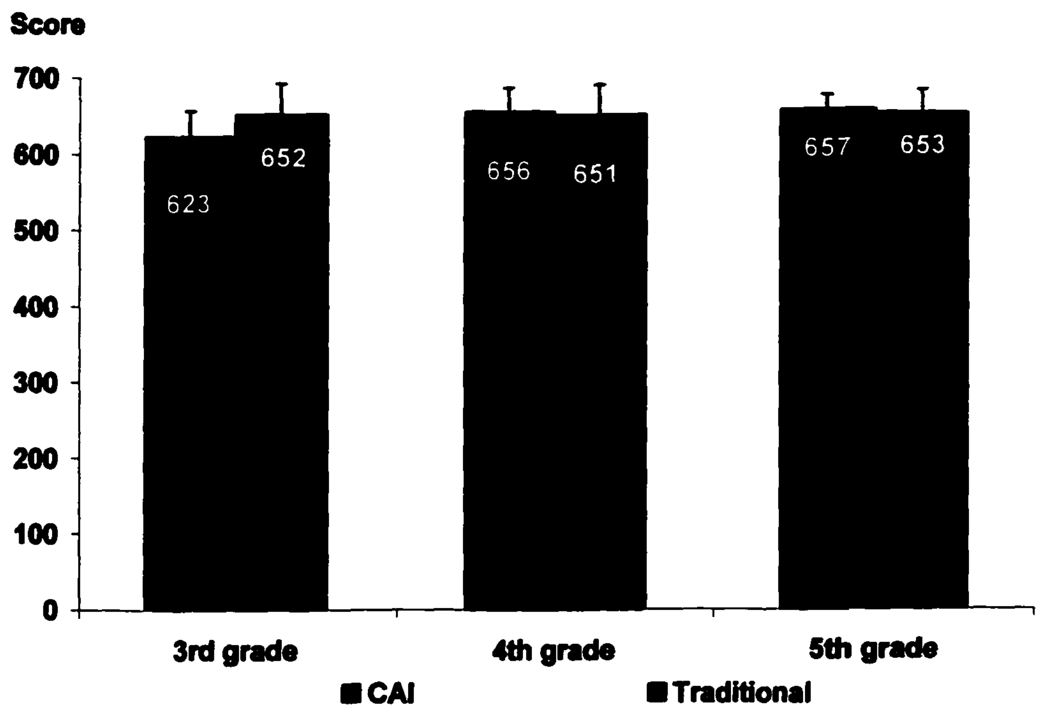
The F value for variance among different grades was 3.07, $p = .05$ which is equal to the established valued for significance of .05. The results of analysis of variance $F=7.75$, $p = .01$ indicated that males were significantly higher than females for each grade (Figure 2). No significant differences $F= 2.09$, $p = .15$ were obtained for comparison between computer-assisted instruction and traditional instruction. Figure 3 shows the significant difference indicated by the F value of 7.75, $p = .01$ between males and females. Descriptive statistics are included in Appendix C.

A post hoc analysis using the Tukey HSD test (Table 2) indicated the mean difference of 18.62 between the third and fifth grades was significant p = .03. No significant differences were noted between third and fourth grades and the fourth and fifth grades. A trend, although not significant, indicated that as students progressed from the third to fourth to fifth grade the level of scientific knowledge increased. An interesting aspect of the Tukey comparison is the differences in standard error between the different grades. These data indicated that the difference between standard error for differences among grades ranged between 7.84 and 7.18. This small range is illustrated by the standard error bars in Figure 2.

Table 2

Results for Tukey HSD Multiple Comparisons for TCAP Scaled Science Scores

Grade	Grade	Mean Difference	Standard. Error	p
3	4	-16.62	7.84	0.09
	5	-18.62	7.18	0.03
4	3	16.62	7.84	0.09
	5	-2.00	7.37	0.96
5	3	18.62	7.18	0.03
	4	2.00	7.37	0.96



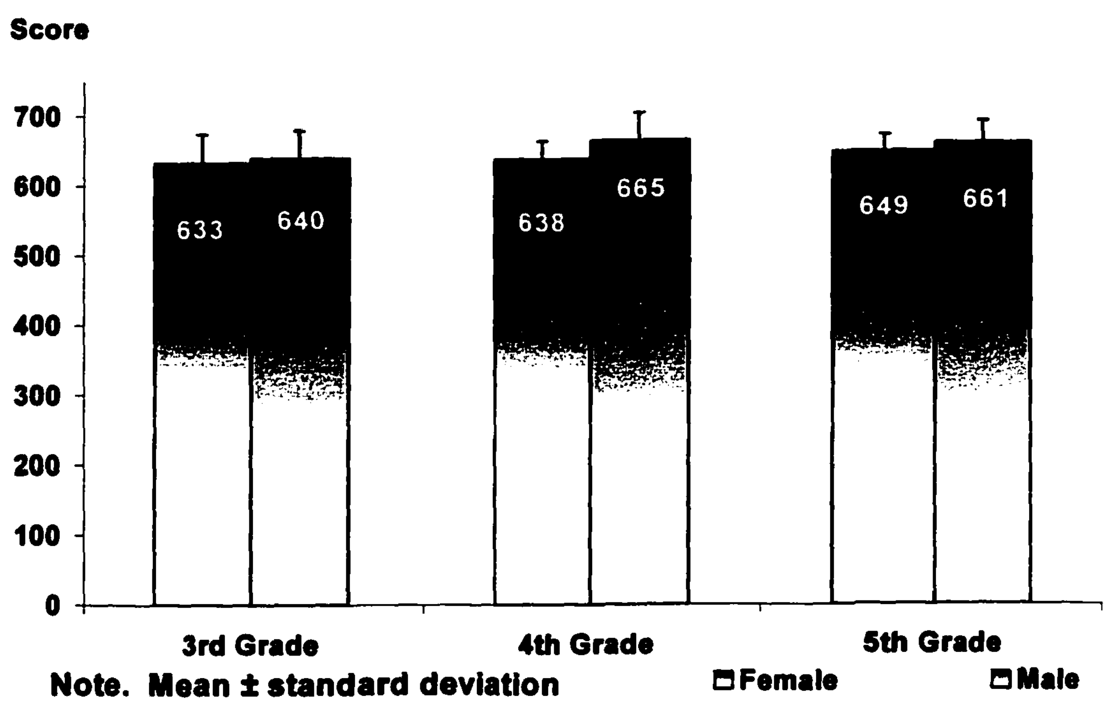


Figure 2. Comparison of CAI and traditional instruction (upper bars) and gender (lower bars) for TCAP scaled scores

Skeletal System

The research question was to determine if any differences existed among the independent variables of instruction, grade or gender and dependent variables of immediate or one-day recall on information. Sixty-three participants in the CAI instruction group and 64 in the traditional instruction group answered fourteen questions on the knowledge instrument. Three of the questions were definition with the remaining eleven questions identification by labeling parts of the skeletal system. The knowledge instrument is located in Appendix B.

Data obtained from coded record spreadsheets revealed that participants who received computer-assisted instruction most frequently missed question 3 on the immediate recall knowledge instrument. The questions most frequently answered correctly at one-day recall was question 10 and the question most often answered incorrectly was question 13. The specific questions were:

3. What is the function of the skeleton?
10. (Identify by labeling) Skull
13. (Identify by labeling) Pelvis

Participants who received traditional methods of instruction responded correctly most frequently to question 7 and most frequently incorrectly to questions 3 and 13 on the immediate recall knowledge instrument. Below are the specific questions:

7. (Identify by labeling) Bones of the Hand
3. What is the function of the skeleton?
13. (Identify by labeling) Pelvis

The questions most frequently answered correctly at one-day recall were questions 4 and 5. Question 13 was the most frequently answered incorrectly. The specific questions are presented below.

4. (Identify by labeling) Bones of the shoulder

5. (Identify by labeling) Upper arm bones

13. (Identify by labeling) Pelvis

Descriptive statistics for knowledge of the skeletal system are displayed in Appendix C. Analysis of the difference among means indicated that the participants at each grade level who received computer-assisted instruction demonstrated higher scores on immediate recall knowledge than participants who received traditional instruction (Figure 4). Participants in grade three and four who received computer-assisted instruction scored higher on the one-day recall testing than those participants who received traditional methods of instruction. Participants in the fifth grade who received traditional methods of instruction scored higher than those who received computer-assisted instruction (Figure 5). A comparison of the mean scores for immediate recall and one-day recall for participants who received computer-assisted instruction revealed a decrease of 1.35 for third grade, 0.85 for fourth grade and 1.44 for fifth grade. A similar comparison for participants in the traditional group indicated a 0.53 increase for third grade, a 0.39 decrease for fourth grade, and a 0.59 increase for fifth grade. These data were obtained by comparing results resented in Figure 4 and Figure 5.

Results of analysis of data between subjects with the following factors: type of instruction (computer-assisted and traditional), grade level (third, fourth, and fifth) and gender (male and female) are presented in Table 3.

An F value of 3.56, p = .03, a significant difference, was obtained for differences among grades. Type of instruction produced an F value of 12.54, p = .00 which was significant The F value .09, p = .77 was not significant in regard to gender. The interaction between grade and instruction with F = 1.34, p = .27 was not significant.

Table 3

Results of General Linear Model Repeated Measures for Skeletal System

Source	Sum of Squares	df	Mean Square	F	p
Intercept	38767.30	1	38767.30	8784.57	0.00
Grade	31.44	2	15.72	3.56	0.03
Instruction	55.32	1	55.32	12.54	0.00
Gender	0.38	1	0.38	0.09	0.77
Grade * Instruction	11.79	2	5.90	1.34	0.27
Error	529.57	120	4.41		

The Tukey HSD multiple comparisons test revealed the significant mean difference of -0.782, p = .047, between the third and fourth grade. No significant differences were noted between the third and fifth grade and fourth and fifth grades.

Table 4

Results for Tukey HSD Multiple Comparisons for Skeletal System

Grade	Grade	Mean Difference	Standard. Error	p
3	4	-0.782	0.327	0.047
	5	-0.169	0.327	0.863
4	3	0.782	0.327	0.047
	5	0.614	0.317	0.133
5	3	0.169	0.327	0.863
	4	-0.614	0.317	0.133

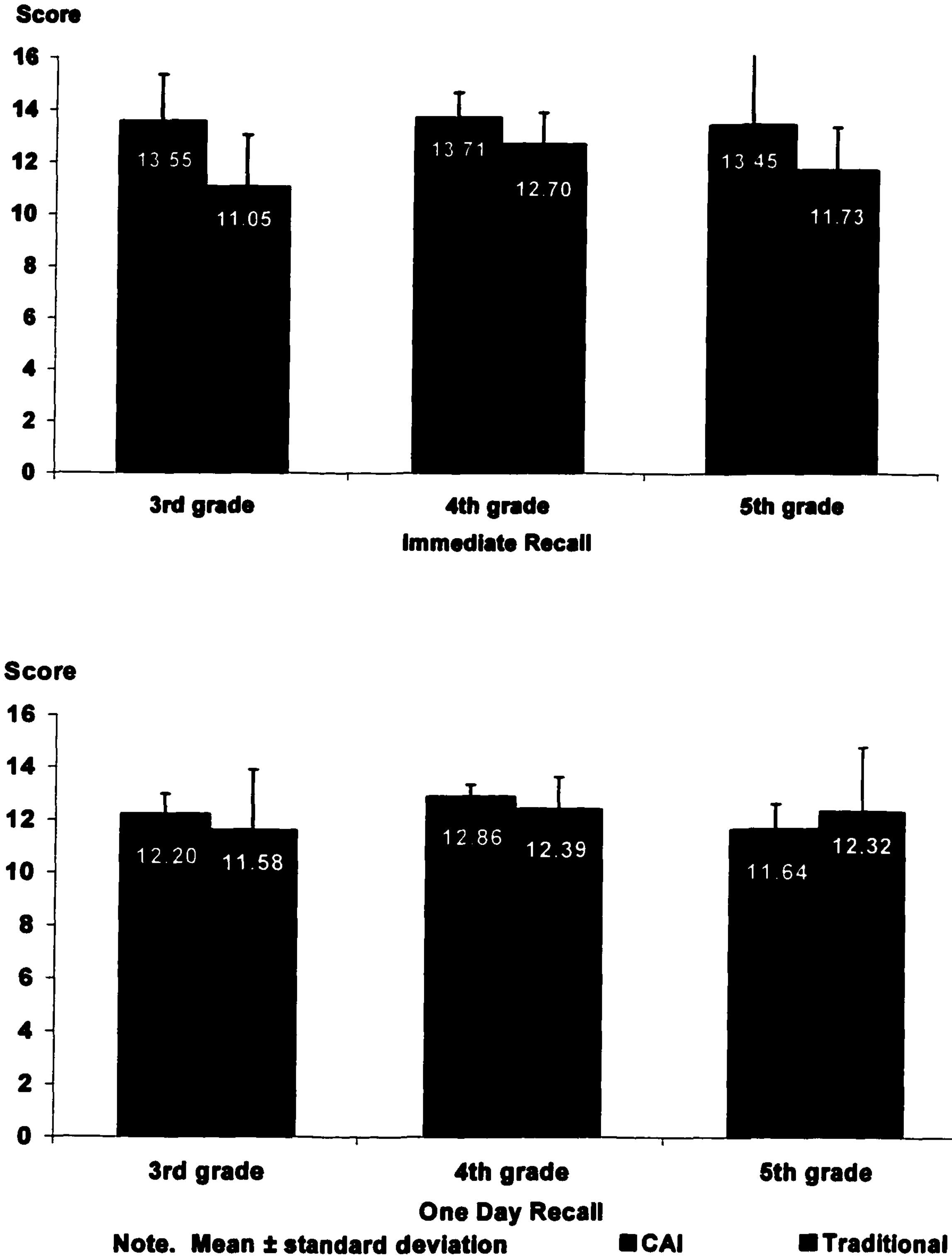


Figure 3. Comparison of CAI and tradition instruction upon immediate recall (top bars) and one-day recall (lower bars) of skeletal system knowledge.

Muscular System

The research question was to determine if any differences existed among the independent variables of instruction, grade or gender and dependent variables of immediate or one- day recall of information related to the muscular system. Sixty-four participants in the CAI instruction group and 64 in the tradition instruction group answered twelve questions on the knowledge instrument administered on the day of instruction and one day after instruction. One question was termed a definition question with the remaining eleven questions as identification by labeling parts of the muscular system. The knowledge instrument is located in Appendix B.

The utilization of spreadsheets coded with the participant's number and results of each question provided the basis for analysis in determining the degree of difficulty of questions. Data recorded for tests on the muscular system revealed participants who received computer-assisted instruction on the immediate recall knowledge instrument most often answered Question 1 incorrectly. At one-day recall question 1 once again was most frequently answered incorrectly as was question 9. Questions 3 and 4 were answered correctly more frequently at one-day recall. Specific questions were:

1. What is the muscular system?
9. (Identify by labeling) Abdominal muscles
3. (Identify by labeling) Chest and shoulder muscles
4. (Identify by labeling) Lower arm muscles

Participants who received traditional methods of instruction responded correctly more frequently to question 10 and incorrectly to questions 3 and 9 on the immediate recall of knowledge. Question 4 was answered correctly by more participants at one-day recall and questions 9 was most often answered incorrectly. The related questions are listed below:

10. (Identify by labeling) Muscles of the hand

4. (Identify by labeling) Lower arm muscles

9. (Identify by labeling) Abdominal muscles

Descriptive statistics for knowledge of the muscular system are displayed in Appendix C.

Table 5

Results of General Linear Model Repeated Measures for Muscular System

Source	Sum of Squares	df	Mean Square	F	p
Intercept	29327.53	1	29327.53	8755.35	0.00
Grade	19.31	2	9.65	2.88	0.06
Instruction	8.75	1	8.75	2.61	0.11
Gender	3.00	1	3.00	0.89	0.35
Grade * Instruction	24.02	2	12.01	3.59	0.03
Error	411.3205	126	8.890124		

The between subjects factors were the type of instruction (computer-assisted and traditional), grade (third, fourth, and fifth) and gender (male and female). The within subjects factors were immediate and delayed recall of muscular information.

Comparison of retention of knowledge among the three grade levels revealed an F value of 2.88 with $p = .06$. An F value of 2.61, $p = .11$ was obtained for differences among grades related to instruction of muscular knowledge. The F value of 0.89 for differences between genders was not significant $p = .35$; however, significant interaction with $F = 4.36$, $p = .01$ was obtained between grades and methods of instruction. Participants in all three grades who received computer-assisted instruction scored higher on immediate recall than those who received traditional methods of instruction.

The means and standard deviations for immediate recall for the three grades are presented in Figure 4. The fourth grade had the highest score 11.95 and the mean difference between the fourth and fifth grade of 0.07 was within one standard deviation. The standard deviations were larger in the traditional than CAI group.

The means and standard deviations for one-day recall in the traditional instruction group for three grades are presented in Figure 4. These data indicated that the traditional instruction group scored higher than the CAI group for grades four and five. The mean differences were 0.25, 0.64 and 1.73 for the third, fourth, and fifth grades respectively.

When analyzing data related to the retention of information between immediate and one-day recall, a decrease was noted in the CAI group. The mean difference for the third grade was 0.50 for third grade, 1.80 fourth grade, and 2.57 for fifth grade. The standard deviations were higher in the one-day recall as compared to immediate recall. In the traditional group the test scores increased between the immediate recall test and one-day recall. Comparison of immediate and one-day recall of muscular knowledge following traditional instruction displayed the increases of 0.35, 0.04, and 0.17 were low and less than 0.5 standard deviation. The results of the Tukey multiple comparisons revealed no significant differences between mean differences at grade levels.

Table 6

Results for Tukey HSD Multiple Comparisons for Muscular System

Grade	Grade	Mean Difference	Standard. Error	p
3	4	-0.66	0.28	0.06
	5	-0.50	0.28	0.17
4	3	0.66	0.28	0.06
	5	0.16	0.27	0.83
5	3	0.50	0.28	0.17
	4	-0.16	0.27	0.83

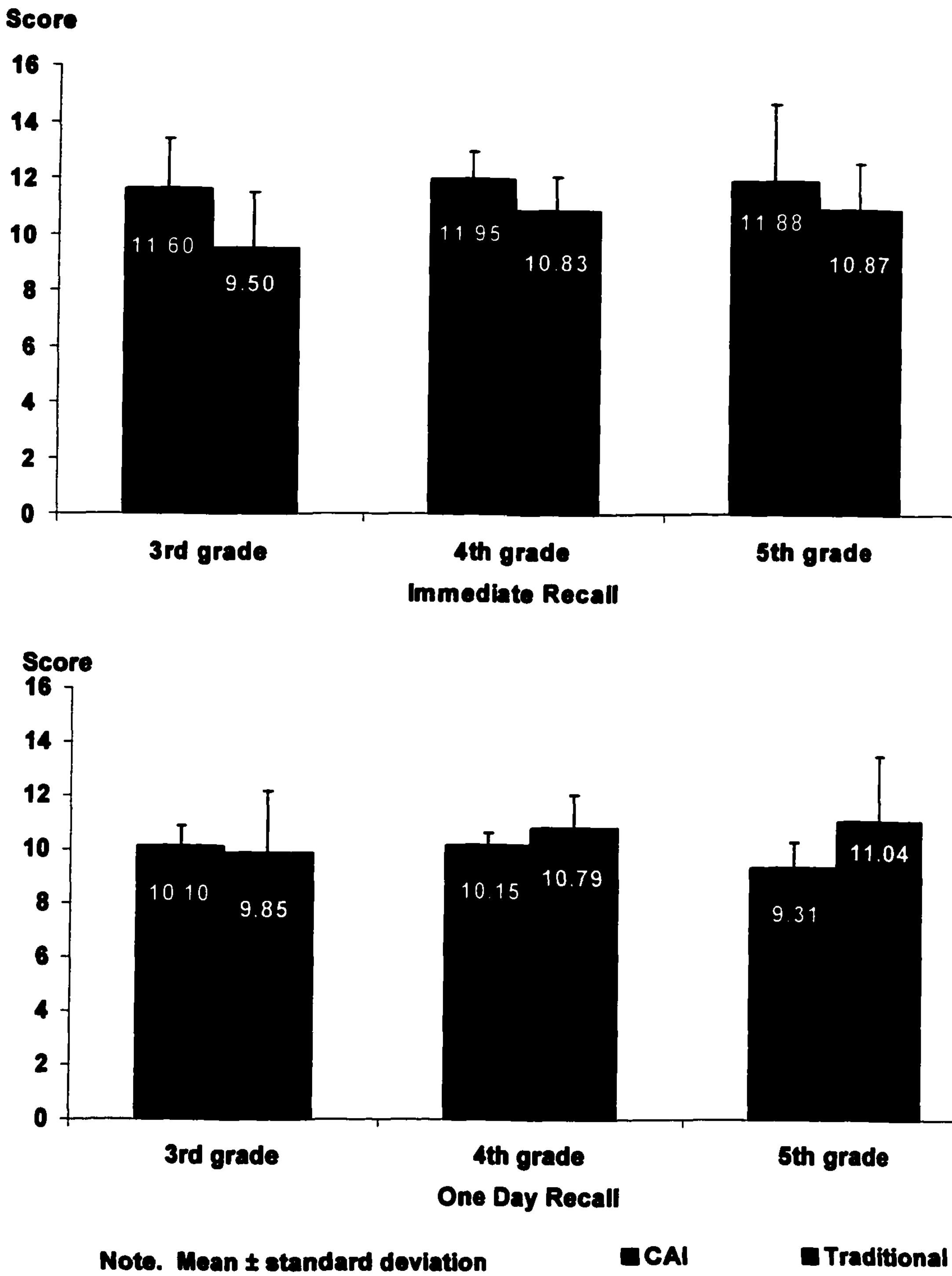


Figure 4. Comparison of CAI and traditional instruction upon immediate recall (top bars) and one-day recall (lower bars) of muscular system knowledge.

Heart

The heart was the only organ investigated. One hundred twenty-eight participants in grade levels three, four and five complete both knowledge instruments. Sixty-four participants in the CAI instruction group and sixty-four in the tradition instruction group answered twelve questions on the knowledge instrument administered on the day of instruction and one day after instruction. One question was definition with the remaining information on a coded spreadsheet was used to identify questions most frequently answered correctly or incorrectly. Immediate recall information indicated that participants who received computer-assisted instruction responded most frequently with an incorrect answer to question 9. Participants received computer-assisted instruction on one-day recall most frequently answered question 1 correctly. The questions missed most frequently on one-day recall were question 4 and question 6, and listed below:

9. What factors might change the rate at which your heart beats?
1. How would you describe the sound of your heart?
4. (Identify by labeling) Pulmonary veins
6. (Identify by labeling) Inferior vena cava

Participants who received traditional methods of instruction at immediate recall most frequently responded correctly to question 1 and most frequently missed questions 4 and 5. Participants at one-day recall most often responded correctly to question 1 (as immediate recall) and incorrectly to questions 4 and 5.

1. How would you describe the sound of your heart?
4. (Identify by labeling) Pulmonary veins
5. (Identify by labeling) Coronary arteries

Analysis of the data revealed participants at each grade level presented with computer-assisted instruction scored higher than participants presented with traditional methods of instruction on immediate recall of knowledge. See Figure 5 for display of analysis. An examination of mean scores for one-day recall of knowledge revealed that grade three participants who received traditional methods of instruction posted higher scores than participants who received computer-assisted instruction. Grade four participants who received traditional methods of instruction posted higher scores that those who received CAI at the one-day recall period. Participants who received traditional instruction in grade five achieved slightly higher mean scores than those who received CAI. Participants who received computer-assisted instruction displayed a mean decrease from immediate recall to one-day recall of 4.27, 2.86, and 3.88 for the third, fourth, and fifth grades respectively. Participants who received traditional instruction displayed an increase on one-day recall over immediate recall of .0.77, 1.04, and 0.52 for the previously mentioned grades.

Analysis of data between subjects effects with the factors of type of instruction (computer-assisted and traditional), grade level (third, fourth, and fifth) and gender (male and female) produced the results displayed in Table 7. A significant difference was indicated by the F value of 3.865, $p = .024$ for grade. Comparison of instruction indicated another significant difference with an F value of 24.14 and $p = .000$. No significant difference was indicated for gender with an F value of .001 and $p = .971$.

Table 7

Results of General Linear Model Repeated Measures for Heart

Source	Sum of Squares	df	Mean Square	F	p
Intercept	9315.630	1	9315.630	1810.10	.00
Grade	39.786	2	19.893	3.87	.02
Instruction	124.240	1	124.240	24.14	.00
Gender	6.706E-03	1	6.706E-03	.00	.97
Grade*Instruction	44.920	2	22.460	4.36	.02
Error	622.725	121	5.146		

The Tukey HSD Test was implemented to determine if significant differences exist between the grades participating in the research. A comparison of grade 3 with grade 4 produced a mean difference of -.94 with p = .03 indicating a significant difference. No significant difference was noted between grades 3 and 5 or between 4 and 5.

Table 8

Results for Tukey HSD Multiple Comparison for Heart

Grade	Grade	Mean Difference	Standard Error	p
3	4	-.94	.359	.027
	5	-.27	.355	.722
4	3	.94	.359	.027
	5	.67	.335	.119
5	3	.27	.355	.722
	4	-.67	.335	.119

Circulatory System

The results presented relate to the research question if differences existed among the independent variables of instruction, grade or gender and dependent variables of immediate or one-day recall of information on the circulatory system. One hundred eighteen participants responded to twelve questions on a knowledge instrument (Appendix B) consisting of 5 definition questions and 7 identification questions.

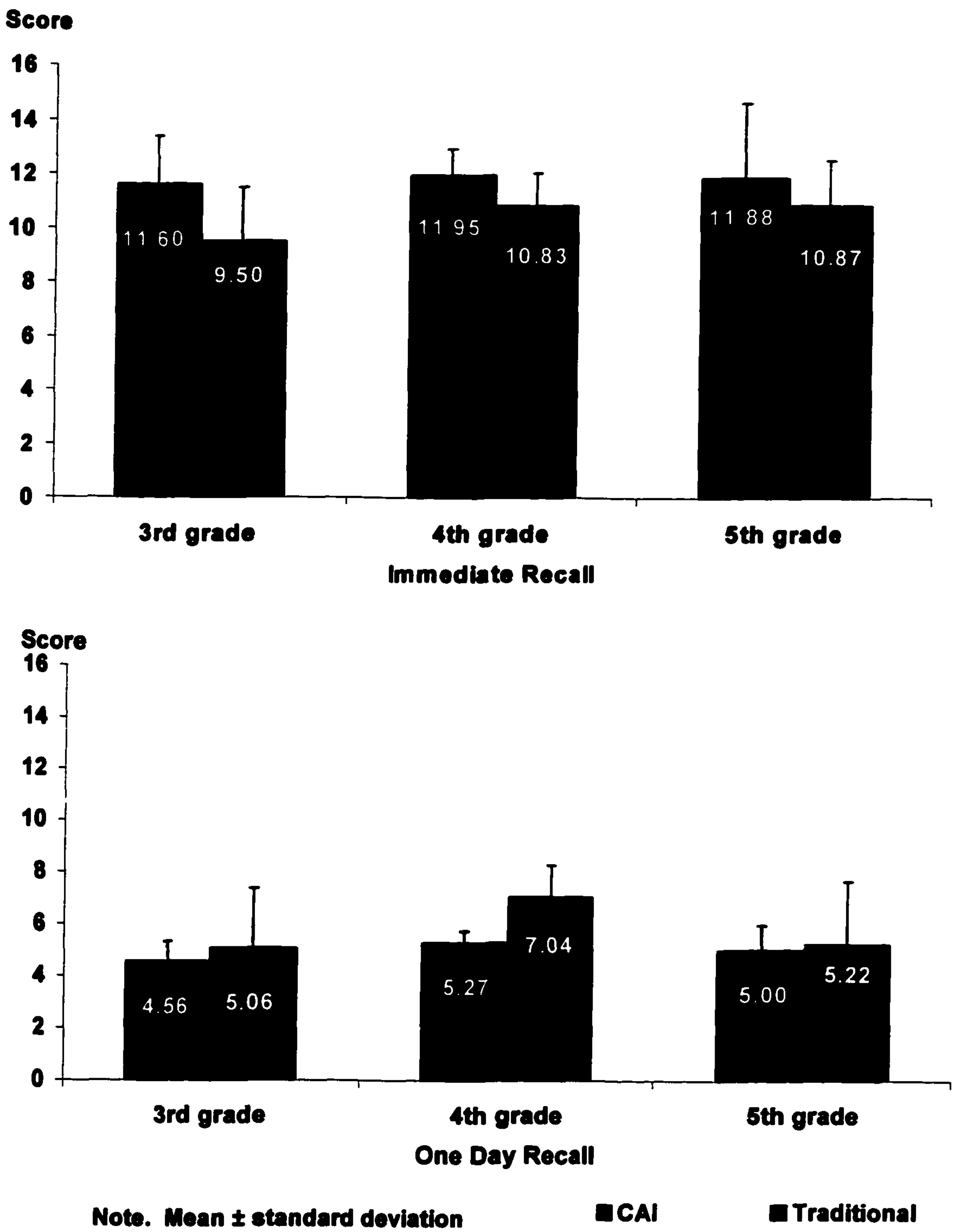


Figure 5. Comparison of CAI and traditional instruction upon immediate recall (top bars) and one-day recall (lower bars) for knowledge of heart.

Participants who received computer-assisted instruction at immediate recall of knowledge most frequently answered the questions listed below incorrectly.

1. What makes up the circulatory system?

10. (Identify by labeling) Blood vessels of the wrist and hand

Participants who received computer-assisted instruction answered questions 2 and 7 most often correctly at one-day recall and most often incorrectly to questions 5 and 9.

2. What does the circulatory system do?

7. (Identify by labeling) Blood vessels of the lower leg

5. (Identify by labeling) Blood vessels of the upper abdomen

9. (Identify by labeling) Blood vessels of the lower abdomen

Participants provided with traditional instruction responded most often correctly to question 10 at immediate recall and most often incorrectly to question 1.

10. (Identify by labeling) Blood vessels of the wrist and hand

1. What makes up the circulatory system?

At one-day recall participants who received traditional instruction answered questions 10 and 12 most often correctly and questions 2 and 5 most often incorrectly.

10. (Identify by labeling) Blood vessels of the wrist and hand

12. (Identify by labeling) Blood vessels of the foot and ankle

2. What does the circulatory system do?

5. (Identify by labeling) Blood vessels of the upper abdomen

The results for immediate recall and one-day recall of knowledge of the circulatory system were similar to those obtained for the skeletal system. Results of analysis are displayed in Appendix C.

Analysis of the mean scores recorded for immediate recall demonstrated that participants at all grade levels who received computer-assisted instruction achieved higher scores on the immediate recall knowledge instrument. These data are illustrated in Figure 6. The mean scores for one-day recall of information revealed that participants at grade levels three and four who received computer-assisted instruction posted higher scores than participants who received traditional instruction. Participants who received traditional instruction at grade level five achieved higher scores than participants who received computer-assisted instruction. The comparison of the results for each grade level and for the method of instruction was used to discover differences in recall of information. An examination of the mean scores revealed that third grade participants who received computer-assisted instruction demonstrated a mean decrease of 3.83 from immediate recall to one-day recall while third grade student who received traditional instruction posted a mean increase of 0.52 from immediate recall to one-day recall. The mean scores for participants in fourth grade who received computer-assisted instruction decreased 2.31 while fourth grade students who received traditional instruction posted 0.44 higher mean scores on one-day recall. Participants in fifth grade who received computer-assisted instruction displayed a decrease of 2.38 from immediate to one-day recall while those receiving traditional instruction increased the mean score by 1.21.

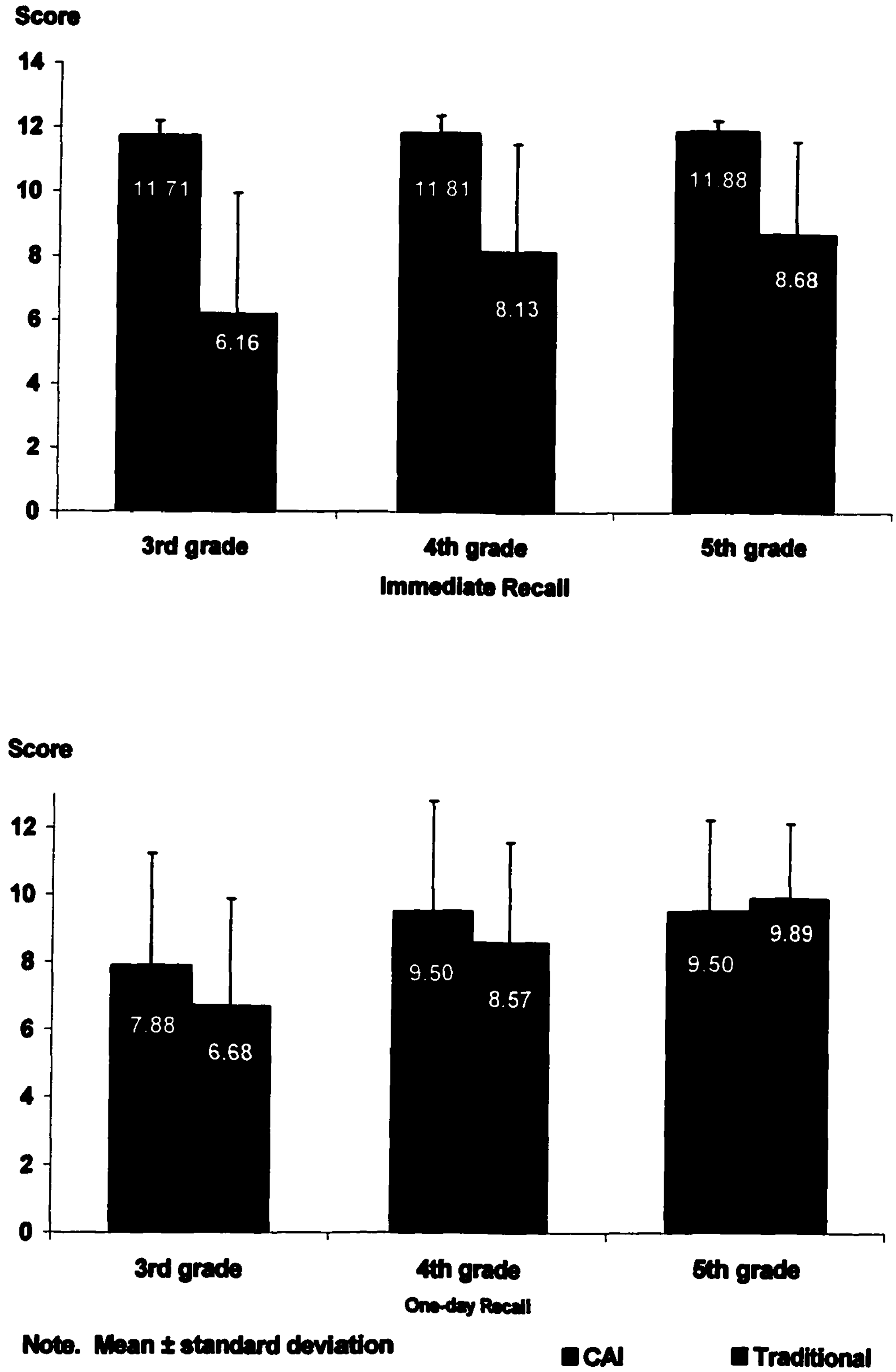


Figure 6. Comparison of CAI and traditional instruction upon immediate recall (top bars) and one-day recall (lower bars) of circulatory system knowledge.

Between subjects effects with the factors of type of instruction (computer-assisted and traditional, grade level (third, fourth, and fifth) and gender (male and female) data analysis results are presented in Table 9. The factor of grade produced an F value of 6.89, p = .00 indicating significance as did an F = 30.70, p = .00 which was obtained for method of instruction. Gender as a factor did not prove to have a significant difference with an F value of 2.42, p = .12.

Table 9

Results of General Linear Model Repeated Measures for Circulatory System

Source	Sum of Squares	df	Mean Square	F	p
Intercept	19563.32	1	19563.32	1837.35	0.00
Grade	146.73	2	73.36	6.89	0.00
Instruction	326.91	1	326.91	30.70	0.00
Gender	25.72	1	25.72	2.42	0.12
Grade*Instruction	39.07	2	19.54	1.83	0.16
Error	1181.88	111	10.65		

Table 10 presents the results of the Tukey test analysis of data with multiple comparisons. A mean difference of -1.28 with p = .048 between grades three and four was significant. Comparison of grades three with grade 5 obtained a significant result with a mean difference of -2.06, p = .000. No significance was found between grades four and five.

Table 10

Results for Tukey HSD Multiple Comparisons for Circulatory System

Grade	Grade	Mean Difference	Standard Error	p
3	4	-1.28	.533	.047
	5	-2.06	.521	.000
4	3	1.28	.533	.047
	5	-.77	.510	.286
5	3	2.06	.521	.000
	4	.77	.510	.286

Composite Test

A composite test was administered six weeks after the initial instruction. This test consisted of twelve questions selected from the circulatory, heart, muscular and skeletal test. Six of the questions were definition and six were identification by labeling parts of the heart and skeletal, muscular, circulatory, system and were questions from pervious tests. The knowledge instrument is located in Appendix B. Sixty-three participants in the CAI instruction group and 62 in the traditional instruction group answered all question of the composite examination.

The total scores for the test were analyzed using SPSS 11.00 to identify if significant differences existed among the groups six weeks after initial instruction. The results of univariate analysis of variance for are included in Table 11.

Table 11.

Results of Univariate Analysis of Variance for Six-week Recall of Composite Information

Source	Sum of Squares	df	Mean Square	F	p
Corrected Model	77.35	6	12.89	2.54	0.02
Intercept	10997.26	1	10997.26	2165.77	0.00
Grade	47.99	2	24.00	4.73	0.01
Instruction	3.98	1	3.98	0.78	0.38
Gender	21.52	1	21.52	4.24	0.04
Grade * Instruction	0.48	2	0.24	0.05	0.95
Error	599.17	118	5.08		
Total	11778.00	125			
Corrected Total	676.53	124			

The between-subjects factors were the type of instruction (computer-assisted or traditional), grade (third, fourth, and fifth) and gender (male or female). The F value for variance among different grades was 4.73, $p = 0.01$ indicating a significant difference. No significant differences $F = 0.78$, $p = .38$ were obtained for differences between computer-assisted instruction and traditional instruction or the interaction between grade and instruction of F = .05, p = .95. The composite test scores also indicated significant differences between males and females in all grades as displayed in Figure 7. These data indicated that the females had higher scores than males for the third and fifth grades; whereas, the males in fourth grade had slightly higher scores than the females.

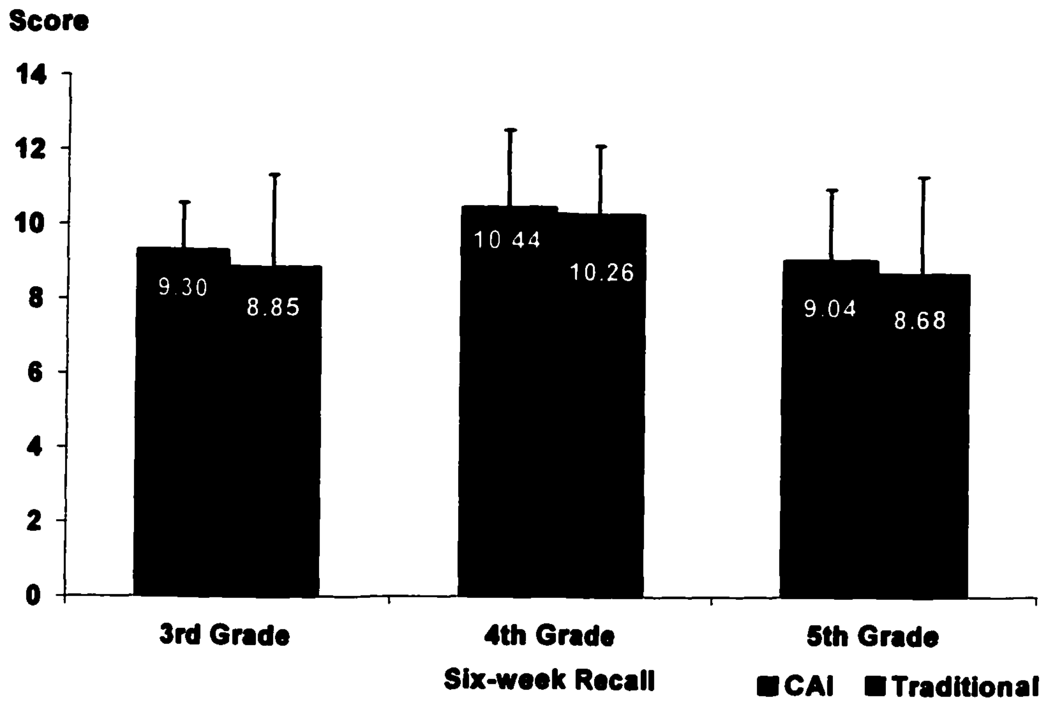
The results of a post hoc analysis using the Tukey HSD test indicated the mean difference of -1.27 between the third and fourth grades was significant with p = .03 and the mean difference of 1.46 between fourth and fifth grade was significant, p = .01. The difference between third and fifth grade was not significant.

Table 12.

Results for Tukey HSD Multiple Comparisons for Composite Test

Grade	Grade	Mean Difference	Standard. Error	p
3	4	-1.27	.50	.03
	5	.19	.49	.92
4	3	1.27	.50	.03
	5	1.46	.48	.01
5	3	-.19	.49	.92
	4	-1.46	.48	.01

No significant differences were noted between genders for the composite test, thus indicating that although males scored higher on the initial TCAP scores females learned the information at the same rate as males.



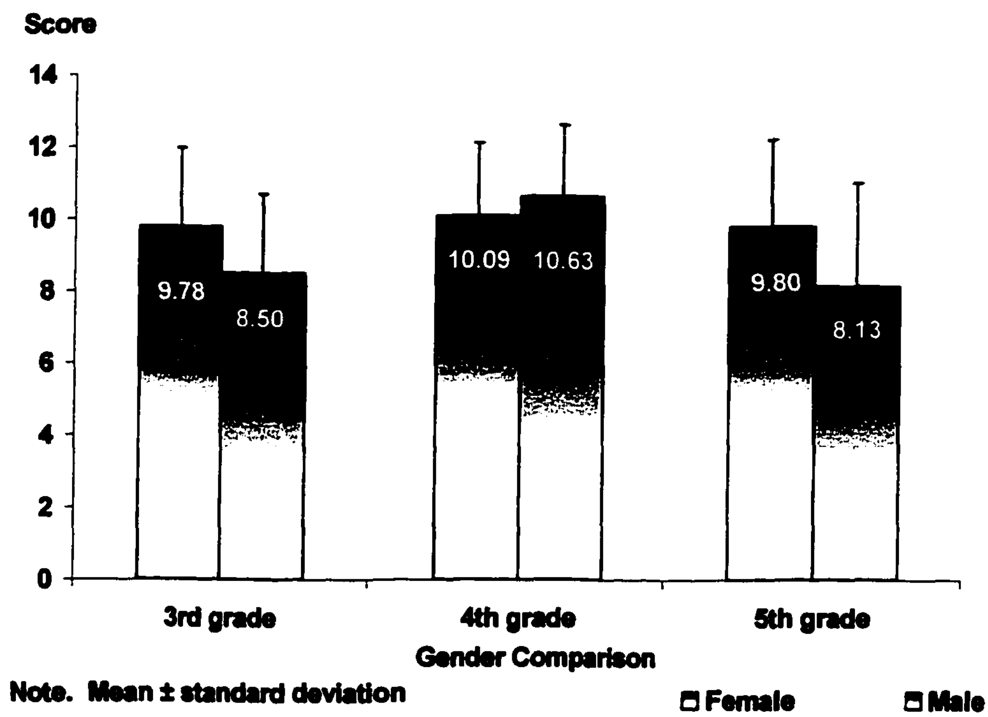


Figure 7. Comparison of CAI and traditional instruction (top bars) for six-week recall of knowledge and for gender differences (lower bars) for composite recall of knowledge.

CHAPTER 5

DISCUSSION

The purpose of this research was to determine the effectiveness of the use of computer-assisted instruction and interactive software in teaching anatomy of the human body to students at the elementary level. Participants were students in grades three, four, and five with one class at each grade level designated the traditional group taught using conventional methods. The other class in each grade was provided access to the computer lab and identified as CAI with information delivered via a software program on CD-ROM, The Ultimate Human Body 2.0. A knowledge instrument was completed by each student at the conclusion of each class and scores recorded and analyzed to determine immediate recall of information. Each group was tested at the next class session the following day for one-day recall of information. A composite knowledge instrument was administered at the conclusion of the project to measure six-week recall of knowledge. The results of analysis of data obtained from recall instruments of knowledge provided the information for the conclusions reached.

Statistics indicated that computer-assisted instruction produced higher mean scores than traditional instructional methods on immediate recall of information for all units included in the research for each grade. With the majority of the questions on the knowledge instruments consisting of identification by labeling indicated areas of the system studied, this increase of immediate recall for participants who received computer-assisted instruction is consistent with the theories that visual learning is more effective as noted by Campbell, Campbell, and Dickson (1996) and Wells and Kick (1996). These results concur with those reported by Szabo and Poohkay (1996) in an experiment with one hundred seventy-three university students. The research focus was to determine the effects of animation with a one-hour lesson on the construction of triangles using a compass. Subjects provided with text plus animated graphics demonstrated higher scores on the test administered at the conclusion of the lesson. Szabo and Pookay's (1996) results also indicated that no animated visuals for those in the traditional instruction group produced lower mean scores.

Results of one-day and six-week recall of knowledge scores were about equal indicating that both methods of instruction were equally effective. Similar results were reported by Jones and Kane (1984) in research at the university level over a period of several years. The number of subjects, freshmen enrolled in mechanical engineering, varied from one hundred to five hundred and were provided with either traditional or computer based instruction. Both methods of instruction were equally effective when a comparison of performance was determined at the end of each semester. Guthrie (1991) reached the same conclusion with a study of thirty-seven university physical education students over a semester. The students were provided with either traditional lectures or lectures plus computer-assisted instruction. Analysis of all test scores detected no significant difference between the two instructional treatments.

A significant difference was indicated between third and fourth grade retention of knowledge of the skeletal system, heart, and circulatory systems. The Tukey HSD comparison used to determine differences in grades displayed no significant differences among the grades for the muscular system. Possible explanations for this result are prior exposure to information about the muscular system in addition to the nature of the test. No significant differences were noted between the third and fifth grades or between the fourth and fifth grades for knowledge of the skeletal system, muscular system, and heart. There was a significant difference indicated between the third and fifth grades in retention of knowledge of the circulatory system. This trend was continued with a significant difference between the third and fourth grades demonstrated on the composite knowledge instrument. There was also a significant difference noted between the fourth and fifth grades on the composite with no significant difference determined between the third and fifth grades. Standard deviation was greater for the fifth grade indicating that participants were less focused. Grades three and five demonstrated lower scores for both methods of instruction on the heart unit. The software material was more difficult for third grade participants and this unit required the most technical terminology of all the material studied.

Gender had little or no effect on retention of knowledge. These data indicated that females learn as effectively as males using CAI. However, TCAP science scores for the males were significantly higher than those of the females.

Conclusions

Analysis of data led to the following conclusions. Computer assisted instruction produced an increase in immediate recall of information scores over traditional methods of instruction. Delayed recall at one-day and six-week score results achieved were comparable for both methods of instruction.

Personal Observations

The researcher noted that students were enthused about using computer-assisted instruction. Fourth grade was observed to be the optimal age to use for participants because they possessed greater computer skills, more mature cognitive abilities, and were less distracted that older students. Replication of the results of this study might not be possible in an average public school system. Many of the students at Homer Pittard Campus School are offspring of university faculty and staff and therefore have immediate access to more educational technology. Campus School also serves as a laboratory school for the teacher education program at Middle Tennessee State University so students were not apprehensive about the research process.

Recommendations for Future Investigation

1. Research should be conducted using a combination of computer-assisted and traditional methods of instruction.
2. Teaching and research should be extended from a six-week period to a twelve-week period.
3. Follow-up on retention of knowledge after one year.
4. Investigate the relationship between learning styles and methods of instruction.

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APPENDIX A

CONSENT FORMS

Elementary and Special Education Department

P.O. Box 69
Middle Tennessee State University
Murfreesboro, Tennessee 37132
(615) 898-2680

Mary Ann Guinn Carr
Box 96 MTSU
Murfreesboro, TN 37132

September 25, 2001

"Computer Assisted Instruction in Elementary Physical Education"
Protocol # 01-189

Dear Ms. Guinn Carr:

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed your research proposal identified above. It has determined that the study poses minimal risk to subjects and qualifies for an expedited review under 45 CFR 46.110 and 21 CFR 56.110.

Approval is granted for 200 subjects based on the number submitted in the protocol.

Final approval is for one (1) year from the date of this letter.

Please note that any change to the protocol must be submitted to the IRB or to your college representative before implementing the change.

Final Approval: September 25, 2001

Sincerely,

Nancy Bertrand

Nancy Bertrand
Chair, MTSU Institutional Review Board

cc: Dr. Powell McClellan

Elementary and Special Education Department
P.O. Box 69
Middle Tennessee State University
Murfreesboro, Tennessee 37132
(615) 898-2680

Mary Ann Guinn Carr
Box 96 MTSU
Murfreesboro, TN 37132

March 4, 2002

Dear Ms. Carr:

Your request to modify your proposal, "The Effectiveness of Computer-Assisted Instruction in Elementary Physical Education Currirulum", #01-189, has been approved. Thank you for providing the necessary documentation regarding your change.

Best of luck to you in pursuit of your study.

Nancy Bertrand

Nancy Bertrand, Chair
MTSU Institutional Review Board

c: Dr. Powell McClellan

Health, Physical Education, Recreation, and Safety

MTSU

P.O. Box 96
Middle Tennessee State University
Murfreesboro, Tennessee 37132
Office: (615) 898-2811

Mr. Hulon Watson, Superintendent
Rutherford County School System
2240 Southpark Boulevard
Murfreesboro, TN 37128

Dear Superintendent Watson:

I am a graduate student pursuing the Doctor of Arts Degree at Middle Tennessee State University in the Health, Physical Education, Recreation, & Safety Department as well as teaching at MTSU and working with the physical education department at Homer Pittard Campus School. My chosen research to complete my degree program concerns computer-assisted instruction used in the physical education curriculum. I would like your permission to conduct this research with the students at Campus School.

In order to determine the effectiveness of multimedia enhanced instruction my research will focus on students ranging from 7 to 12 years of age in grades 3, 4, and 5 at Campus School during regular physical education class sessions. One class at each grade level would be designated the control group and presented material on the human body – the muscular, skeletal system and the heart and circulatory system utilizing traditional methods of instruction. At each grade level, a second class would be considered the experimental group and presented with modified lessons, then provided time in the computer lab with interactive multimedia materials. Work in the computer lab would utilize the software, "My Amazing Human Body," an interactive, multimedia package for students to use as they learn about the human body. It features interactive challenges, animation, 3D graphics, and is packed with information about the human body and its systems. Tests would be given after completion of each theme and scores recorded and analyzed in order to determine the most effective method of instruction. This proposed research project would take place during the months of September and October 2001. All proper procedures would be followed, including obtaining parental permission. I have enclosed a copy of the informational letter and consent form that will be sent to parents or guardians. In addition, I have also included the oral script that would be used to obtain consent from each class member. Students as well as classes would not be identified by name and such information would be destroyed after completion of the project – only the resulting scores would be retained and data will be reported in aggregate form thereby eliminating any breach of confidentiality.

I have assisted with research at Campus School with Dr. David Rowe and Mr. Lee Allsbrook. Dr. Powell D. McClellan is my faculty supervisor for this research project. I feel very strongly about the need to impart the foundations for a healthy lifestyle at every educational level and therefore look forward to the results of this research and the implications that may ensue. As physical educators are often the last to take advantage of the many technological innovations for use in the curricula, my project may inspire others to implement enhanced instruction.

If you have any questions regarding my request, please contact by telephone (Work: 898-2910, Home: 893-1201) email (mguinn@mtsu.edu) or in person (Murphy Center, Office 130).

Sincerely,

Mary Ann Guinn

Mary Ann Guinn

RUTHERFORD COUNTY BOARD OF EDUCATION
2240 Southpark Boulevard
Murfreesboro, Tennessee 37128
Phone (615) 893-5812 Fax (615) 898-7940

J. Hulon Watson
Superintendent

June 1, 2001

Mary Ann Guinn
Dept. of Health, Physical Education, Recreation, and Safety
P.O. Box 96
Middle Tennessee State University
Murfreesboro, TN 37132

Dear Ms. Guinn,

Your research proposal, *"The Effectiveness of Computer-Assisted Instruction in Elementary Physical Education"*, has been reviewed by the Rutherford County Department of Instruction and has been approved with the understanding that any confidential information will be destroyed at the conclusion of the research.

One concern registered by a member of the committee was that students may be pulled from their academic class time to participate in the research project. It is my understanding that this will not occur.

Good luck with your research. We would like for you to share your findings and its implications for our system when the project is completed.

Sincerely,

Laura B. Harper
Assistant Superintendent
Curriculum and Instruction

LBH:jd

A Commitment to Excellence

07/18/2001 16:11 615-904-3757 INSTRUCTION PAGE 02

Health, Physical Education, Recreation, and Safety
MTSU

P.O. Box 96
Middle Tennessee State University
Murfreesboro, Tennessee 37132
Office: (615) 898-2811

Dr. Stan Baskin
Homer Pittard Campus School
923 E. Lytle Street
Murfreesboro, TN 37130

Dear Dr. Baskin:

To complete my requirements for the Doctor of Art's Degree from Middle Tennessee State University, I have proposed the following research to be conducted at Campus School with Superintendent Watson's and your approval:

In order to determine the effectiveness of multimedia enhanced instruction my research will focus on students ranging from 7 to 12 years of age in grades 3, 4, and 5 at Campus School during regular physical education class sessions. A class at each grade level would be designated the control group who would be presented material on the human body - the muscular, skeletal system and the heart and circulatory system utilizing traditional methods of instruction. The second class would be considered the experimental group and would receive time in the computer lab with multimedia enhanced lessons after modified instruction during class sessions. Work in the computer lab would utilize the software, "My Amazing Human Body," an interactive, multimedia package for students to use as they learn about the human body. It features interactive challenges, animation, 3D graphics, and is packed with information about the human body and its systems. Tests would be given after completion of theme and scores recorded and analyzed in order to determine the most effective method of instruction. This proposed research project would take place during the months of September and October 2001. All proper procedures would be followed, including obtaining parental permission. Data will be reported in aggregate form thereby eliminating any breach of confidentiality. Students as well as classes would not be identified by name and such information would be destroyed after completion of the project - only the resulting scores would be retained.

I have enjoyed my associations at Campus School and look forward to this project and its completion. Physical education specialists are often the last in many school systems to receive the technological advantages other faculty members have been implementing, therefore I look forward to this project which I feel will indicate that technology has a definite place in any school system's physical education curriculum.

Sincerely,
Mary Ann Guinn
Mary Ann Guinn

HOMER PITTARD CAMPUS SCHOOL

P.O. Box 4, MTSU
Murfreesboro, Tennessee 37132

615-898-1630 (office)
615-904-7502 (FAX)
Dr. Stan Baskin, Principal

"A Legacy in Teaching and Learning Since 1911"

Middle Tennessee State University
Rutherford County Schools

Mary Ann Guinn
Dept. of Health, Physical Education, Recreation, and Safety
P.O. Box 96
Middle Tennessee State University
Murfreesboro, Tennessee 37132

May 16, 2001

Dr. Stan Baskin
Homer Pittard Campus School
923 E. Lytle Street
Murfreesboro, TN 37130

Dear Dr. Baskin:

This letter is a revision of the letter I submitted to you on May 1, 2001 requesting permission to conduct a research study on students at Homer Pittard Campus School. A letter from you granting your permission for this project is necessary to receive full approval from the Internal Review Board.

To complete my requirements for the Doctor of Art's Degree from Middle Tennessee State University, I have proposed the following research to be conducted at Campus School with Superintendent Watson's and your approval:

In order to determine the effectiveness of multi-media enhanced instruction my research will focus on students aged 7 to 12 in grades 3, 4, and 5 at Campus School during regular physical education class sessions. A class at each grade level will be designated the control group who will be presented material on the human body - the muscular, skeletal system and the heart and circulatory system utilizing traditional methods of instruction. The second class will be considered the experimental group and will receive time in the computer lab with multi-media enhanced lessons after modified instruction during class sessions. Instruction in the computer lab will utilize the software packages, "My Amazing Human Body" and "The Ultimate Human Body 2.0," which are interactive, multi-media packages students use as they learn about the human body. These two software programs feature interactive challenges, animation, 3D graphics, and are filled with information about the human body and its systems. Tests will be given after completion of theme and scores recorded and analyzed in order to determine the most effective method of instruction. This proposed research project will take place during the months of September and October 2001. All necessary procedures will be followed such as ensuring confidentiality.

HOMER PITTARD CAMPUS SCHOOL

P.O. Box 4, MTSU
Murfreesboro, Tennessee 37132

615-[illegible] (office)
615-904-7502 (FAX)
Dr. Stan Baskin, Principal

"A Legacy in Teaching and Learning Since 1911"

Middle Tennessee State University
Rutherford County Schools

Students will be identified only by a number on a master list that will be kept in a locked file cabinet in my Murphy Center office. Data will be reported in aggregate form thereby eliminating any breach of confidentiality. All records of classes involved, students' names and assigned numbers will be shredded at the completion of the project with only the results of analysis retained.

I have enjoyed my associations at Campus School and look forward to this project and its completion. Physical education specialists are often the last in many school systems to receive the technological advantages other faculty members have been implementing; therefore, I look forward to this project which I feel will indicate that technology has a definite place in any school system's physical education curriculum.

Included are copies of the oral scripts for obtaining assent from the students, and information about the software packages that will be implemented in this research.

Sincerely,

Mary Ann Guinn

Mary Ann Guinn

Approved:
Stan W Baskin

Health, Physical Education, Recreation, and Safety

P.O. Box 96
Middle Tennessee State University
Murfreesboro, Tennessee 37132
Office: (615) 898-2811

Dear Campus School Parent:

I would like to include your child, along with his or her classmates, in a research project on computer-assisted instruction in the physical education curriculum. If your child takes part in this project, he or she would be part of a control or an experimental group while we are studying the physical education curriculum related to the muscular, skeletal system, heart, and circulatory system.

At each grade level, one class will be the control group and will be provided with traditional instruction during regular physical education class sessions. The other class, the experimental group, will have modified instruction, then computer-based instruction in the computer lab with interactive multimedia software for students. Testing will be conducted at the end of each unit.

For research purposes, your child will not be identified by name in any reference or records. You child's test scores will be assigned a number and this score will be used to determine the effectiveness of computer-assisted instruction compared to traditional instructional methods. Any information that is obtained during this research project will be kept strictly confidential and will not become a part of your child's school record. All 3rd, 4th, 5th, and 6th graders will receive instruction for these units. If you choose not to participate in this research, your child will remain with the rest of his/her class, but his or her scores will not be used for this research.

I have been working with the students at Homer Pittard Campus School since 1997 and look forward to spending this instructional time with them. This research will demonstrate the most effective way to enable each student to learn more about the human body and thereby contribute to a greater understanding of the value of physical activity.

MTSU

Health, Physical Education, Recreation, and Safety
P.O. Box 96
Middle Tennessee State University
Murfreesboro, Tennessee 37132
Office: (615) 898-2811

Please indicate your permission for your child to participate in this project by signing in the space provided below. If you have any questions about this research project, please feel free to contact me either by email or telephone at my office: magcarr@mtsu.edu or office telephone: 898-2910. If you would like to obtain the results of this research project, please indicate at the bottom of this letter and I would be happy to share my results with you.

Sincerely,

Mary Ann Guinn Carr
Doctoral Student
Middle Tennessee State University
Murfreesboro, TN 37132

Dr. Stan Baskin
Principal: Homer Pittard Campus School

Dr. Martha Whaley
Chair: MTSU HPERS Dept.

Dr. Powell McClellan
Chair: Dissertation

______ Yes, you may use my child's scores in this research project.

______ No, you may not use my child's scores in this research project.

Child's name: ____________________

Child's grade: ____________________

Child's teacher: ____________________

____________________ ____________
Signature of parent or guardian Date

INTERACTIVE
Learning

December 11, 2001

Mary Ann Guinn Carr
1122 Glasgow Drive
Murfreesboro, TN 37130

Enclosed please find

2 CDs of Ultimate Human Body 2.0 WIN
1 TG for Ultimate Human Body 2.0
2 CDs of Ultimate 3D Skeleton WIN
1 TG for Ultimate 3D Skeleton
2 CDs for My Amazing Human Body
1 TG for My Amazing Human Body

For the limited purpose of your dissertation research, I am granting you permission to make limited copies of the enclosed CD-ROMs. Upon completion of your dissertation, please destroy all copies.

If you have any further questions, please contact me at 212-213-4800 x453 or linda.fung@dk.com

Thanks.

Linda W. Fung

Linda Fung
School Sales & Marketing Manager

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VERBAL INSTRUCTIONS PROVIDED TO STUDENTS IN TRADITIONAL INSTRUCTION GROUP PRIOR TO BEGINNING PROJECT

I am Mrs. Carr and I have been working with the physical education department here at Campus School since 1997 as well as teaching university students. I am asking for your help with an important research project.

PURPOSE: In our physical education class sessions we are going to be learning about our bodies and how they work.

PROCEDURES: We are going to talk about the bones and muscles that make up the framework of our bodies and how important this framework is. It allows you to enjoy activities and do lots of fun things like riding your bike, jumping rope, or just playing on the playground equipment. We have to take care of our muscles and bones and keep them strong and healthy so that we can continue to be active as we grow older. Then we are going to study our heart and the circulatory system. This system is what takes the blood throughout your body in order for us to breathe, walk, run, or do any activity. Taking care of our hearts and circulatory system is very important as we grow! We've talked a little bit in the past about your heart rate and what makes that rate go faster or slow down. A healthy heart is very important and we need to understand how we can take care of our hearts. We will talk about these themes, then I will want to see just how much you have learned about your framework and your circulatory system.

POSSIBLE RISKS OR DISCOMFORT: There will be no risks or discomfort while we are studying this material.

POSSIBLE BENEFITS: The way we learn is very important and this project will give us information about the best way to learn material that we all need to know to take better care of our bodies.

FINANCIAL CONSIDERATIONS: No financial rewards will be given.

CONFIDENTIALTIY: Your name will never be used. You will be given a number and any test scores will be recorded next to that number – never referred to by name. The scores will be combined with others then compared with other scores recorded by students the same age as you are.

TERMINATION OF RESEARCH STUDY: This study will only take a short time- time that you will be with your physical education class. If your parents do not want your scores recorded, then you will do the work, take the tests, but the scores will not be recorded.

AVAILABLE SOURCES OF INFORMATION:
Principal Investigator: Mary Ann Guinn Carr, MTSU telephone 898-2910, Home 893-1201 will be glad to answer any questions that you may have. Do you think that you would be able to help me with this project?

VERBAL INSTRUCTIONS PROVIDED TO STUDENTS IN COMPUTER-ASSISTED INSTRUCTION GROUP PRIOR TO BEGINNING PROJECT

I am Mrs. Carr and I have been working with the physical education department here at Campus School since 1997 as well as teaching university students. I am asking for your help with an important research project.

PURPOSE: In our physical education class sessions we are going to be learning about our bodies and how they work.

PROCEDURES: We will be learning about the bones and muscles in computer lab where we will use a CD-ROM with The Ultimate Human Body 2.0. Then we are going to study our heart and the circulatory system. This system is what takes the blood throughout your body in order for us to breathe, walk, run, or do any activity. We've talked a little bit in the past about your heart rate and what makes that rate go faster or slow down. A healthy heart is very important and we need to understand how we can take care of our hearts. We will see how our hearts work and how the blood vessels carry blood to all parts of the body. We will talk about these themes, then I will want to see just how much you have learned about your framework and your circulatory system.

POSSIBLE RISKS OR DISCOMFORT: There will be no risks or discomfort while we are studying this material.

POSSIBLE BENEFITS: The way we learn is very important and this project will give us information about the best way to learn material than we all need to know to take better care of our bodies.

FINANCIAL CONSIDERATIONS: No financial rewards will be given.

CONFIDENTIALTIY: Your name will never be used. You will be given a number and any test scores will be recorded next to that number – never referred to by name. The scores will be combined with others then compared with other scores recorded by students the same age as you are.

TERMINATION OF RESEARCH STUDY: This study will only take a short time- time that you will be with your physical education class. If your parents do not want your scores recorded, then you will do the work, take the tests, but the scores will not be recorded.

AVAILABLE SOURCES OF INFORMATION:
Principal Investigator: Mary Ann Guinn Carr, MTSU telephone 898-2910, Home 893-1201 will be glad to answer any questions that you may have. Do you think that you would be able to help me with this project? Do you think that you would be able to help me with this project?

APPENDIX B

KNOWLEDGE INSTRUMENTS

Skeletal System

Name ____________

Teacher ____________ Grade ______

Male / Female

1. Why do you have a skeleton?

____

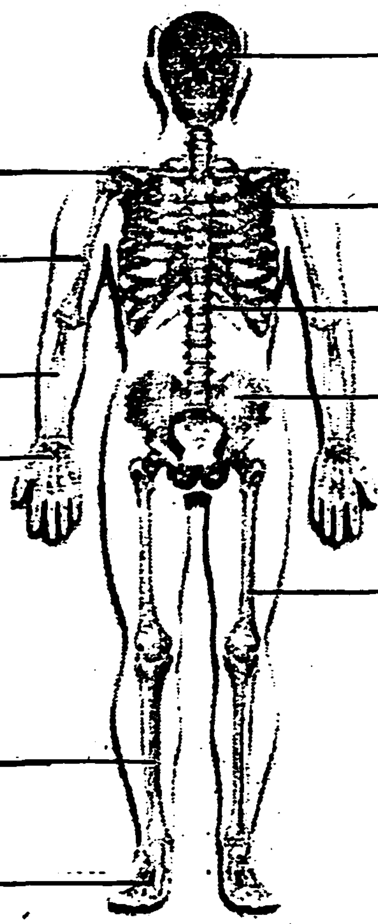
2. How many bones are there in the human body?

____

3. What is the function of the skeleton?

____

Label the following diagram.



Name ____________________

Teacher ____________ Grade ______

Muscular System

Male / Female

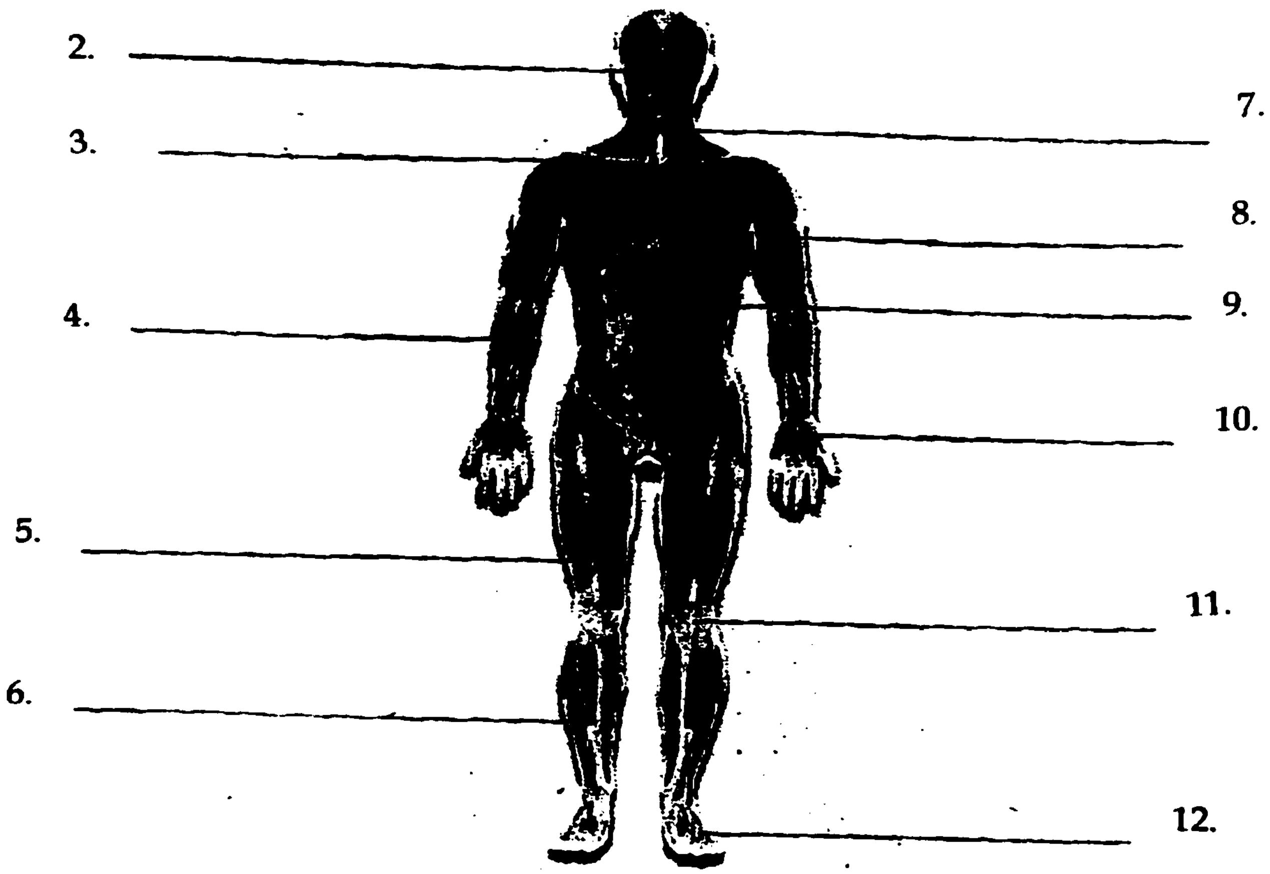
1. What is the muscular system?

____

____

____

Label the following diagram.



How Often Does Your Heart Beat?

Name ______________________

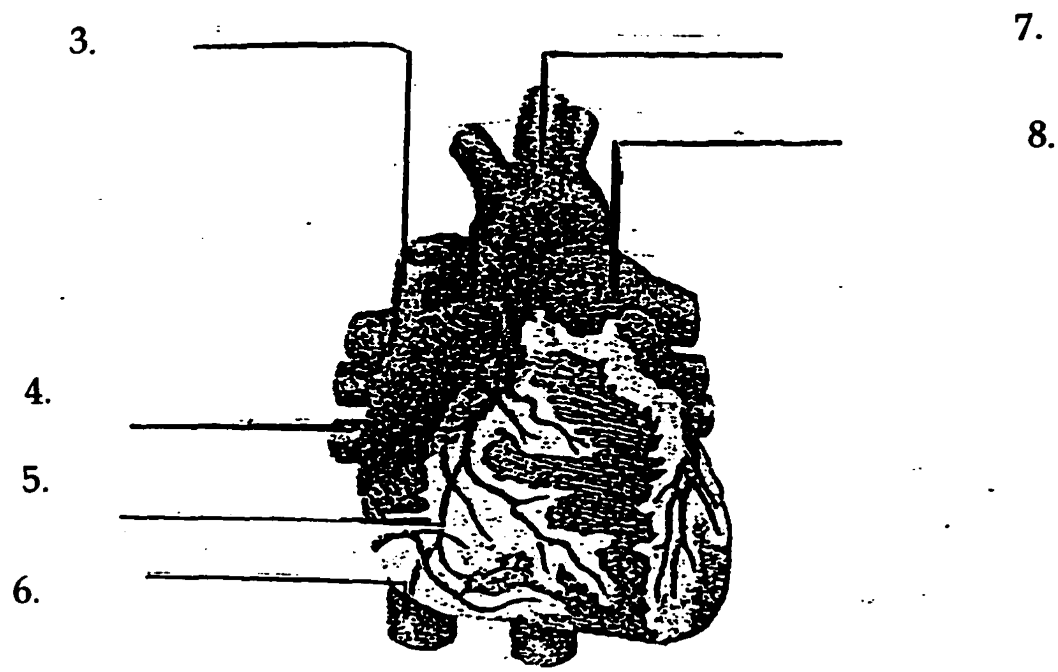
Teacher ____________ Grade ______

Male / Female

1. How would you describe the sound of a heart beat? ____

2. Describe what's happening as your heart beats. ____

On the diagram below, label the indicated areas of the heart.



9. What factors might change the rate at which your heart beats? ____

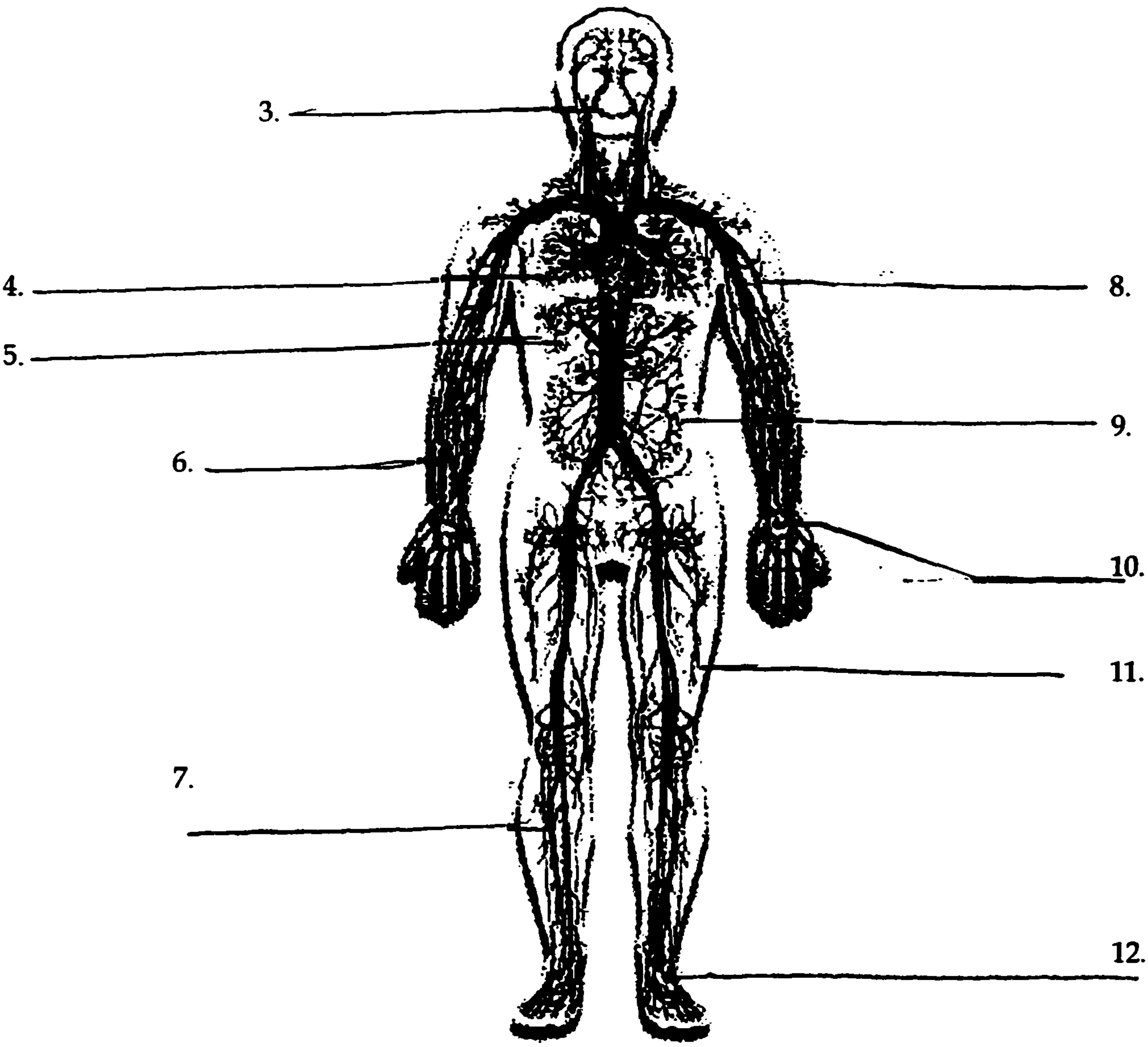
Circulatory System

Name ______________________________
Grade ____________ Teacher ____________
Male / Female

1. What makes up the circulatory system? ______________________________

2. What does the circulatory system do? ______________________________

Label the following diagram for the circulatory system



ʃame ______________________ Male / Female

ɟrade __________ Teacher ______________________

1. Why do you have a skeleton? ______________________

2. How many bones are there in the human body? ______________________
3. Describe what happens as your heart beats. ______________________

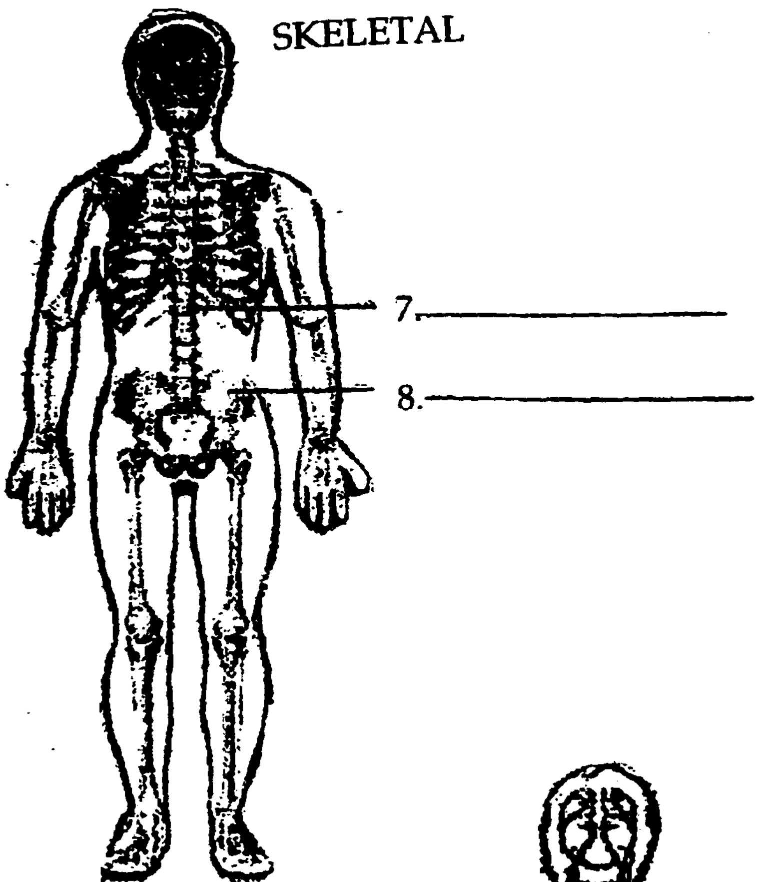
4. What might you do to change the rate at which your heart beats? ______________________

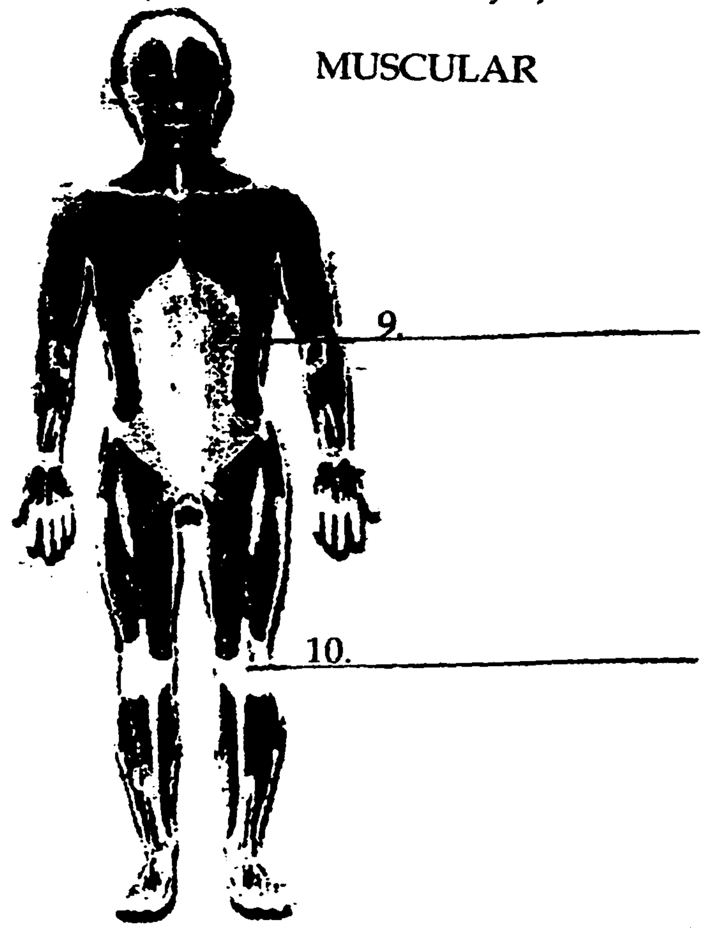
5. What makes up the circulatory system? ______________________

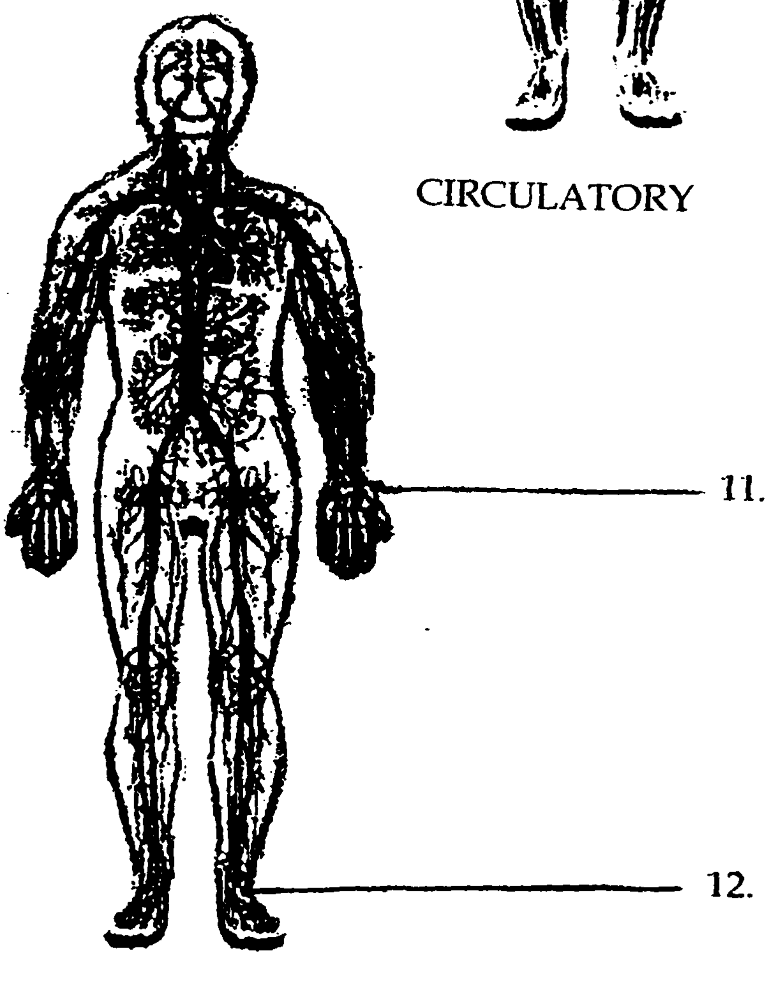
6. Label the following area of the heart:

ↃVER)

Label the indicated areas of the skeletal system, muscular system, and circulatory system:







APPENDIX C

DESCRIPTIVE STATISTICS

Descriptive Statistics for TCAP Scaled Science Scores

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	622.43	23.28	7
		m	623.00	39.73	11
		Total	622.78	33.46	18
	TRAD	f	640.40	44.76	10
		m	670.50	26.06	6
		Total	651.69	40.68	16
	Total	f	633.00	37.59	17
		m	639.76	41.79	17
		Total	636.38	39.29	34
4	CAI	f	633.00	34.86	4
		m	664.50	27.27	10
		Total	655.50	31.84	14
	TRAD	f	640.40	44.76	10
		m	666.00	26.60	7
		Total	650.94	39.51	17
	Total	f	638.29	40.98	14
		m	665.12	26.16	17
		Total	653.00	35.74	31
5	CAI	f	654.92	15.44	12
		m	660.09	24.08	11
		Total	657.39	19.74	23
	TRAD	f	640.44	34.89	9
		m	660.85	25.76	13
		Total	652.50	30.79	22
	Total	f	648.71	25.92	21
		m	660.50	24.46	24
		Total	655.00	25.56	45

Note. CAI = Computer assisted instruction, TRAD = Tradition instruction f = female, m = male

Descriptive Statistics Immediate Recall of Knowledge for Skeletal System

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	13.75	0.46	8
		m	13.42	0.90	12
		Total	13.55	0.76	20
	TRAD	f	10.80	1.81	10
		m	11.33	2.83	9
		Total	11.05	2.30	19
	Total	f	12.11	2.03	18
		m	12.52	2.18	21
		Total	12.33	2.09	39
4	CAI	f	13.56	0.53	9
		m	13.83	0.39	12
		Total	13.71	0.46	21
	TRAD	f	12.38	1.39	13
		m	13.10	0.88	10
		Total	12.70	1.22	23
	Total	f	12.86	1.25	22
		m	13.50	0.74	22
		Total	13.18	1.06	44
5	CAI	f	13.90	0.32	10
		m	13.08	1.16	12
		Total	13.45	0.96	22
	TRAD	f	11.38	2.83	8
		m	11.93	2.27	14
		Total	11.73	2.43	22
	Total	f	12.78	2.24	18
		m	12.46	1.90	26
		Total	12.59	2.03	44
Total	CAI	f	13.74	0.45	27
		m	13.44	0.91	36
		Total	13.57	0.76	63
	TRAD	f	11.61	2.03	31
		m	12.12	2.19	33
		Total	11.88	2.11	64
	Total	f	12.60	1.84	58
		m	12.81	1.77	69
		Total	12.72	1.80	127

Note. CAI=Computer assisted instruction, TRAD=Tradition instruction

f = female, m = male

Descriptive Statistics for One-day Recall of Knowledge of Skeletal System

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	12.75	0.71	8
		m	11.83	2.21	12
		Total	12.20	1.79	20
	TRAD	f	11.50	1.65	10
		m	11.67	2.40	9
		Total	11.58	1.98	19
	Total	f	12.06	1.43	18
		m	11.76	2.23	21
		Total	11.90	1.89	39
4	CAI	f	12.89	1.05	9
		m	12.83	0.94	12
		Total	12.86	0.96	21
	TRAD	f	12.15	1.21	13
		m	12.70	1.16	10
		Total	12.39	1.20	23
	Total	f	12.45	1.18	22
		m	12.77	1.02	22
		Total	12.61	1.10	44
5	CAI	f	11.90	1.97	10
		m	11.42	3.32	12
		Total	11.64	2.74	22
	TRAD	f	11.88	1.64	8
		m	12.57	1.65	14
		Total	12.32	1.64	22
	Total	f	11.89	1.78	18
		m	12.04	2.57	26
		Total	11.98	2.26	44
Total	CAI	f	12.48	1.42	27
		m	12.03	2.37	36
		Total	12.22	2.02	63
	TRAD	f	11.87	1.45	31
		m	12.36	1.76	33
		Total	12.13	1.63	64
	Total	f	12.16	1.46	58
		m	12.19	2.10	69
		Total	12.17	1.83	127

Note. CAI=Computer assisted instruction, TRAD=Tradition instruction f=female,

m=male

Descriptive Statistics for Immediate Recall Knowledge of Muscular System

Grade	Instruction	Gender	Mean	Standard. Deviation	n
3	CAI	f	11.88	0.35	8
		m	11.42	0.51	12
		Total	11.60	0.50	20
	TRAD	f	9.40	2.76	10
		m	9.60	1.35	10
		Total	9.50	2.12	20
	Total	f	10.50	2.38	18
		m	10.59	1.33	22
		Total	10.55	1.85	40
4	CAI	f	11.89	0.33	9
		m	12.00	0.00	11
		Total	11.95	0.22	20
	TRAD	f	10.58	0.90	12
		m	11.08	1.73	12
		Total	10.83	1.37	24
	Total	f	11.14	0.96	21
		m	11.52	1.31	23
		Total	11.34	1.16	44
5	CAI	f	11.92	0.28	13
		m	11.85	0.38	13
		Total	11.88	0.33	26
	TRAD	f	10.67	1.73	9
		m	11.00	2.63	14
		Total	10.87	2.28	23
	Total	f	11.41	1.26	22
		m	11.41	1.93	27
		Total	11.41	1.64	49
Total	CAI	f	11.90	0.31	30
		m	11.75	0.44	36
		Total	11.82	0.39	66
	TRAD	f	10.23	1.93	31
		m	10.64	2.10	36
		Total	10.45	2.02	67
	Total	f	11.05	1.62	61
		m	11.19	1.61	72
		Total	11.13	1.61	133

Note. CAI=Computer assisted instruction, TRAD=Tradition instruction f=female, m=male

Descriptive Statistics for One-day Recall Knowledge of Muscular System

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	9.88	1.25	8
		m	10.25	1.29	12
		Total	10.10	1.25	20
	TRAD	f	9.70	1.70	10
		m	10.00	1.33	10
		Total	9.85	1.50	20
	Total	f	9.78	1.48	18
		m	10.14	1.28	22
		Total	9.98	1.37	40
4	CAI	f	10.11	1.27	9
		m	10.18	0.87	11
		Total	10.15	1.04	20
	TRAD	f	10.33	1.23	12
		m	11.25	0.87	12
		Total	10.79	1.14	24
	Total	f	10.24	1.22	21
		m	10.74	1.01	23
		Total	10.50	1.13	44
5	CAI	f	9.46	2.03	13
		m	9.15	2.41	13
		Total	9.31	2.19	26
	TRAD	f	10.67	1.66	9
		m	11.29	1.44	14
		Total	11.04	1.52	23
	Total	f	9.95	1.94	22
		m	10.26	2.21	27
		Total	10.12	2.08	49
Total	CAI	f	9.77	1.61	30
		m	9.83	1.73	36
		Total	9.80	1.67	66
	TRAD	f	10.23	1.52	31
		m	10.92	1.34	36
		Total	10.60	1.46	67
	Total	f	10.00	1.57	61
		m	10.38	1.63	72
		Total	10.20	1.61	133

Note. CAI=Computer assisted instruction, TRAD=Tradition instruction f=female, m=male

Descriptive Statistics for Immediate Recall of Knowledge for Heart

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	9.00	.000	8
		m	8.70	.675	10
		Total	8.83	.514	18
	TRAD	f	4.00	1.936	9
		m	4.67	2.739	9
		Total	4.33	2.326	18
	Total	f	6.35	2.914	17
		m	6.79	2.800	19
		Total	6.58	2.822	36
4	CAI	f	7.78	1.986	9
		m	8.54	.776	13
		Total	8.23	1.412	22
	TRAD	f	5.83	1.115	12
		m	6.18	1.940	11
		Total	6.00	1.537	23
	Total	f	6.67	1.798	21
		m	7.46	1.841	24
		Total	7.09	1.844	45
5	CAI	f	8.75	.622	12
		m	9.00	.000	12
		Total	8.88	.448	24
	TRAD	f	5.00	2.646	9
		m	4.50	1.557	14
		Total	4.70	2.010	23
	Total	f	7.14	2.575	21
		m	6.58	2.548	26
		Total	6.83	2.548	47
Total	CAI	f	8.52	1.243	29
		m	8.74	.611	35
		Total	8.64	.949	64
	TRAD	f	5.03	2.008	30
		m	5.09	2.123	34
		Total	5.06	2.054	64
	Total	f	6.75	2.418	59
		m	6.94	2.400	69
		Total	6.85	2.401	128

Note: CAI = Computer assisted instruction, TRAD = Traditional instruction f = female, m = male

Descriptive Statistics for One-day Recall of Knowledge of Heart

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	4.25	1.282	8
		m	4.80	2.821	10
		Total	4.56	2.229	18
	TRAD	f	4.00	1.871	9
		m	6.11	2.667	9
		Total	5.06	2.485	18
	Total	f	4.12	1.576	17
		m	5.42	2.755	19
		Total	4.81	2.340	36
4	CAI	f	5.78	2.048	9
		m	4.92	2.216	13
		Total	5.27	2.142	22
	TRAD	f	7.17	1.528	12
		m	6.91	2.468	11
		Total	7.04	1.988	23
	Total	f	6.57	1.859	21
		m	5.83	2.496	24
		Total	6.18	2.229	45
5	CAI	f	5.42	1.730	12
		m	4.58	1.730	12
		Total	5.00	1.745	24
	TRAD	f	6.11	2.088	9
		m	4.64	1.906	14
		Total	5.22	2.066	23
	Total	f	5.71	1.875	21
		m	4.62	1.791	26
		Total	5.11	1.891	47
Total	CAI	f	5.21	1.780	29
		m	4.77	2.197	35
		Total	4.97	2.016	64
	TRAD	f	5.90	2.203	30
		m	5.76	2.450	34
		Total	5.83	2.320	64
	Total	f	5.56	2.019	59
		m	5.26	2.362	69
		Total	5.40	2.207	128

Note: CAI = Computer assisted instruction, TRAD = Traditional instruction f = female, m = male

Descriptive Statistics for Immediate Recall Knowledge of Circulatory System

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	11.63	.518	8
		m	11.78	.441	9
		Total	11.71	.470	17
	TRAD	f	7.67	3.162	9
		m	4.80	3.910	10
		Total	6.16	3.775	19
	Total	f	9.53	3.044	17
		m	8.11	4.533	19
		Total	8.78	3.914	36
4	CAI	f	12.00	.000	7
		m	11.67	.707	9
		Total	11.81	.544	16
	TRAD	f	7.92	3.353	13
		m	8.40	3.534	10
		Total	8.13	3.362	23
	Total	f	9.35	3.329	20
		m	9.95	3.045	19
		Total	9.64	3.166	39
5	CAI	f	12.00	.000	11
		m	11.77	.439	13
		Total	11.88	.338	24
	TRAD	f	10.25	1.581	8
		m	7.55	3.142	11
		Total	8.68	2.888	19
	Total	f	11.26	1.327	19
		m	9.83	3.002	24
		Total	10.47	2.491	43
Total	CAI	f	11.88	.326	26
		m	11.74	.514	31
		Total	11.81	.441	57
	TRAD	f	8.47	3.037	30
		m	6.94	3.741	31
		Total	7.69	3.472	61
	Total	f	10.05	2.805	56
		m	9.34	3.589	62
		Total	9.68	3.247	118

Note: CAI = Computer assisted instruction, TRAD = Traditional instruction f = female, m = male

Descriptive Statistics for One-day Recall of Knowledge for Circulatory System

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	8.38	2.925	8
		m	7.44	3.779	9
		Total	7.88	3.333	17
	TRAD	f	7.11	2.848	9
		m	6.30	3.592	10
		Total	6.68	3.198	19
	Total	f	7.71	2.867	17
		m	6.84	3.625	19
		Total	7.25	3.272	36
4	CAI	f	9.71	3.729	7
		m	9.33	3.122	9
		Total	9.50	3.286	16
	TRAD	f	8.08	3.095	13
		m	9.20	2.898	10
		Total	8.57	2.997	23
	Total	f	8.65	3.329	20
		m	9.26	2.922	19
		Total	8.95	3.112	39
5	CAI	f	10.73	1.679	11
		m	8.46	3.045	13
		Total	9.50	2.719	24
	TRAD	f	9.50	2.976	8
		m	10.18	1.601	11
		Total	9.89	2.233	19
	Total	f	10.21	2.323	19
		m	9.25	2.592	24
		Total	9.67	2.495	43
Total	CAI	f	9.73	2.808	26
		m	8.42	3.264	31
		Total	9.02	3.108	57
	TRAD	f	8.17	3.030	30
		m	8.61	3.169	31
		Total	8.39	3.084	61
	Total	f	8.89	3.007	56
		m	8.52	3.192	62
		Total	8.69	3.098	118

Note: CAI = Computer assisted instruction, TRAD = Traditional instruction f = female, m = male

Descriptive Statistics for Composite Test

Grade	Instruction	Gender	Mean	Standard Deviation	n
3	CAI	f	10.50	0.53	8
		m	8.50	2.28	12
		Total	9.30	2.03	20
	TRAD	f	9.20	1.40	10
		m	8.50	2.84	10
		Total	8.85	2.21	20
	Total	f	9.78	1.26	18
		m	8.50	2.48	22
		Total	9.08	2.10	40
4	CAI	f	10.78	1.48	9
		m	10.11	2.52	9
		Total	10.44	2.04	18
	TRAD	f	9.62	2.36	13
		m	11.10	0.88	10
		Total	10.26	1.98	23
	Total	f	10.09	2.09	22
		m	10.63	1.86	19
		Total	10.34	1.98	41
5	CAI	f	9.50	2.11	12
		m	8.62	2.72	13
		Total	9.04	2.44	25
	TRAD	f	10.25	1.58	8
		m	7.55	3.14	11
		Total	8.68	2.89	19
	Total	f	9.80	1.91	20
		m	8.13	2.91	24
		Total	8.89	2.62	44
Total	CAI	f	10.17	1.67	29
		m	8.97	2.54	34
		Total	9.52	2.25	63
	TRAD	f	9.65	1.89	31
		m	9.00	2.88	31
		Total	9.32	2.43	62
	Total	f	9.90	1.79	60
		m	8.98	2.68	65
		Total	9.42	2.34	125

Note. CAI=Computer assisted instruction, TRAD=Tradition instruction f=female, m=male