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The effect of a weather satellite receiving station on eighth-grade student achievement and attitudes toward science

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THE EFFECT OF A WEATHER SATELLITE RECEIVING STATION ON EIGHTH-GRADE STUDENT ACHIEVEMENT AND ATTITUDES TOWARD SCIENCE

by

Richard P. Behrens, Jr.

A Dissertation
Submitted to Graduate School
of the University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

Approved:

Director

Dean of the Graduate School

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A thorough review of the literature suggested that a computer-assisted curriculum had a positive effect on student achievement and student attitudes toward science. The literature also claimed there was a gender bias in computer-assisted curriculums favoring male students. Therefore, the primary purpose of this study was to determine if student participation in an advanced computer-assisted weather curriculum would make a difference in student achievement and student attitude toward the subject.

The subjects in this study were 99 students in Earth Science classes from a rural middle school in Northeastern Georgia. The students were assigned to triads of all male

or all female mixed ability cooperative learning groups. The triads assigned to the experimental group participated in a computer-assisted weather curriculum and the triads assigned to the comparison group participated in a traditional weather curriculum.

Science attitude was measured with the Estes Attitude Scale. Student achievement was measured with the Weather Concepts Test (WCT) designed by the researcher. A two-way treatment by gender analysis of variance was used to analyze the data. The results showed that there was no significant difference in the two instructional methodologies, traditional and computer-assisted, on student achievement and student attitudes toward science. In addition, no significant difference was found between male and female scores measuring student achievement and student attitudes toward science.

The results suggest that future studies should ascertain whether common or mixed gender grouping would be most productive for computer-assisted and traditional science instruction.

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CHAPTER I

INTRODUCTION

Weather affects middle school students' daily lives more than any other area of science. When they watch the weather report on television, it is presented using advanced technology that until recently teachers could only dream about operating in their classrooms (Maurais, 1993).

In the past, the typical weather center at a middle school contained all of the standard instruments to measure local temperatures, winds, and rainfall (Gardner & Simmons, 1990). Currently, there are ground-based computer networks and weather satellite receiving systems available for teachers to use in science classrooms (Davidoff, 1990; Summers, 1989). These systems obtain up-to-the-minute weather data from around the world which allow students to work with computers as problem-solving tools (Tillery, 1990). With these systems, students can obtain real data from space which, in turn, can be organized, manipulated, tested, and interpreted to enhance their learning (Hindson & Temple, 1989).

Today, weather stations found in middle schools and high schools may include three basic components: local ground instruments, computer network capabilities, and a ground-based weather satellite receiving station (Behrens, 1990). These types of weather stations enable students to collect local, national, and international weather.

A major part of the weather station is the weather satellite image receiving equipment. This equipment receives and collects radio waves that are transmitted from American and Russian satellites (Bermann & Fletcher, 1991). The radio waves are analyzed by the computer, and images of the weather, as seen from space, are placed on the computer monitor. These satellite images and ground data may then be interpreted by the students to study the weather (Summers, 1989).

Justification for Study

There has been a major push by science organizations, scientists, and educators over the last thirty years to develop hands-on activities for students in science classrooms (American Geological Association, 1991; Atchley, 1993; Bates, 1982; Gardner & Simmons, 1990; National Science Teachers Association (NSTA), 1987; Perl, 1990).

Science educators have consistently recommended teaching activities and methods which encourage students to collect, organize, and interpret data (Cantu & Heron, 1978; Donnellan, 1981; Gardner & Simmons, 1990; National

Science Teachers Association, 1987). The computer is the primary tool for these types of skills and should be integrated into the science curriculum (Ellis, 1984). More research on the effectiveness of teaching methods with computer interaction has been encouraged by educators in an effort to determine their effectiveness in the science classroom (Johnson & Johnson, 1986; Lillie, Hannum, & Stuck, 1989; Sherwood & Haselbring, 1986).

Educators and researchers in both the science and computer fields have asked for computer training and software that encourages the use of higher order thinking skills (Bender, 1991; Morris, 1983; Robinson & Schonborn, 1991). There is general agreement that students should use the computer to solve real and simulated problems, but more research is needed to determine the effectiveness of computer activities on student achievement and student attitude toward science (Johnson & Johnson, 1986; Koballa & Rice, 1985; Sherwood & Hasselbring, 1986).

Weather satellite systems are just beginning to be implemented by teachers into middle-school and high-school classrooms throughout the United States and Europe (Behrens, 1993; Martin, 1987; Maurais, 1993). The decreased cost of a weather satellite receiving station and a computer network connection via a modem has potentially placed a plethora of information at the finger tips of students (Adams, 1989; Tillery, 1990). The weather station, operated by the students, offers a real life activity which allows them to collect data, interpret it, and then make predictions about the environment around them (Martin, 1988; Summers, 1989).

The question of gender bias in both science and computer-assisted instruction has been identified by several researchers. In most cases, research results favor males over females in science achievement and student attitude toward science, but the degree to which gender may influence learning and attitudes related to science is inconclusive (Becker, 1989; DeRemmer, 1989; Educational Testing Service, 1989; Fetler, 1985; Forsyth & Lancy, 1989; Handley & Morse, 1984; Linn, 1985; Simpson & Oliver, 1985). Also, research is needed to determine the most effective kinds of activities to use in science classrooms and the extent to which use of technology facilitates learning and attitude toward science. (Germann, 1988; Cannon & Simpson, 1985; Oliver, 1989). Only a few studies have been located which examined the effects of using technology to predict the weather on the achievement and attitudes of students in the science classroom (Gardner & Simmons, 1990).

Statement of Problem

The general purpose of this study was to determine if student participation in an advanced computer-assisted weather curriculum makes a difference in student achievement in science and student attitude toward the subject. A satellite-linked weather station was used to teach a weather unit to eighth-grade students enrolled in Earth Science classes in a middle school located in Northeastern Georgia.

The specific problem to which an answer was sought was: Do eighth-grade male and female students who participate in a traditional approach to the study of weather differ in student achievement and attitudes toward science from male and female students who study weather using a weather station with satellite image reception capabilities?

Hypotheses

The following hypotheses were proposed:

H1: There will be a significant difference between the science achievement scores of students who study weather using a satellite receiving station and students who study weather using traditional lessons.

H2: There will be a significant difference between the attitude toward science of students who study weather using a satellite receiving station and students who study weather using traditional lessons.

H3: There will be a significant difference between male and female average scores on tests that measure student achievement.

H4: There will be a significant difference between male and female average scores on tests that measure student attitude toward science.

Definition of Terms

Computer-Assisted Weather Curriculum. A program of study which allows students to collect and organize information about the weather using computers.

Satellite. A man-made object or vehicle intended to orbit the earth, the moon, or another celestial body. A celestial body orbiting another of larger size (Webster's New Collegiate Dictionary, 1980, p. 1018).

Satellite Image Reception. Weather satellites use a reciever to collect reflected light and heat readings from the atmosphere and surface of the Earth. This information is relayed to a ground station which collects the data and presents it to the operator as a picture or image (Hindson & Temple, 1990, pp. 15-17).

Student (Pupil) Achievement. The status of a student with respect to attained skills or knowledge as compared with other students or with the school's adopted standards (Good, 1959, p. 7).

Student Attitude Toward Science. The tendency to evaluate science in positive or negative terms or feelings (Koballa & Crowley, 1985, p. 223).

Traditional Science Instruction. Science instruction that includes the use of lectures, worksheets, group learning, and lab exercises but does not include the use of the weather station.

Weather Station. A system designed to assimilate weather data using a variety of standard instruments, a weather satellite receiving station, and a network of computers.

Weather Satellite Receiving Station. A system programed to input data from a weather satellite via radio waves through an antenna.

Delimitations

The limitations of this study were as follows:

1. The subjects were limited to eighth-grade Earth Science students in four classes who attended a middle school in Northeastern Georgia during the 1993-94 school year.

2. The variables of this study were limited to student achievement in weather, student attitude toward science, and gender.

3. Instruction was limited to one teacher.

4. All variables, conditions, and subjects not so specified were considered outside of this study.

CHAPTER II

REVIEW OF THE LITERATURE

On October 4th, 1957 a basketball-sized satellite named Sputnik I was launched into the outer regions of our atmosphere beginning the Space Age (Asimov, 1970; Sponsler, 1958). The space race has been one of the leading catalysts for technological growth and development over the past thirty-five years.

Satellites are now being used to observe the weather, predict crop yields, relay television broadcasts and telephone signals, and more (Berman & Fletcher, 1991; Carleton, 1991; Haynes, 1988; Scorer, 1986). This form of technology is influencing the lives of millions of people each day. The use of environmental satellite data in classrooms is the fastest growing application of satellite data in the world (Popham, 1992). It has been difficult for researchers and educators to obtain knowledge about these satellite systems because the information is buried in scientific texts and related technical journals (Davidoff, 1990). Satellite technology has now developed to a point where educational application should be researched.

Weather Satellite Image Interpretation in the Curriculum

Most of the educational literature published about weather satellite receiving stations deals with designing and building a station. A detailed step-by-step approach to building a satellite receiving station is outlined by NOAA (1989) and Popham (1984). Their emphasis is on the technical details of hardware and reception. Various ways of building a station are suggested and several ideas about how to raise the necessary funds needed to purchase the equipment are listed (Martin, 1987). Petit and Johnson (1982) described how to obtain and interpret satellite images from a high school physics perspective and outlined a program that told the reader how to design a weather receiving station. Their program focuses on the technical assembly of components or the actual building of a weather satellite receiving station.

Most middle school teachers do not have the time or the experience to assemble a weather satellite receiving station from various component parts (Behrens, 1993). The current systems can be purchased as a complete receiving station, ready to receive images (Lehrain & Lightfoot, 1985; Adams, 1989). As a result of this advancement in technology, an instructor can purchase a receiving station from one of several distributors that manufacture a complete system (Davis, 1992).

Historically, lessons about technology in space have primarily focused on space exploration (Magnoli, Douglas, & Ellis, 1983). This concept is important, but by its nature, does not involve the students in a hands-on experience with space technology. Teachers could only explain this concept using experiments and demonstrations. Science should be taught using interaction, manipulatives, and hands-on experience (Shavelson & Baxter, 1992).

Sprungman (1990) agreed with the idea of student involvement in space exploration problems and opportunities. He believes the federal government should develop programs that allow students to work with modern technology. Satellite receiving stations give today's students the chance to work with the basic tools and concepts that will foster interest in future space and satellite exploration (Allen, 1990).

In the late 1970's and early 1980's, the National Aeronautics and Space Administration (NASA) worked with several educators to outline objectives that should be considered when teachers design a weather satellite receiving station curriculum. These NASA recommendations were as follows:

1) Train students to operate station equipment.
2) Develop tracking maps and materials students can use to locate spacecraft as they orbit.

3) Analyze satellite photographs by studying local weather patterns, geographical studies, and severe weather development.
4) Maintain daily local weather information and correlate it to the satellite data received.
5) Compile the data received and develop daily weather reports.
6) Allow the facilities to be used for field trips of visiting students.

These recommendations allow for problem solving, the use of manipulatives, actual interaction with space and weather, and many other science teaching methods (Summers & Gotwald, 1981). Summers (1989b) later followed these guidelines and developed a high school research program that encouraged students to study contemporary problems that could be analyzed by a weather satellite receiving station. One such project allowed two students to capture pictures of Hurricane Gilbert as it passed through the Gulf of Mexico. At the culmination of the project, the two seniors published their pictures in Weatherwise magazine.

Martin (1987) states that students should work in cooperative learning groups that make all of the decisions pertaining to operation, raising funds to purchase equipment, and curriculum development. She followed these

NASA guidelines and developed a high school curriculum that involved the students in obtaining daily weather satellite images. Incorporated were all the guidelines listed by Summers and NASA. This approach enabled the students to feel that they were a productive part of a team building toward a common goal. Martin also felt that an international organization should be established to enable students from all over the world to obtain and share information.

The National Science Teachers Association (NSTA) (1982) published a position paper on Science, Technology, and Society. Their board of directors stated, "The goal of science education during the 1980's is to develop scientifically literate individuals who understand how science, technology, and society influence one another and who are able to use this knowledge in everyday decision-making"(p. 2). Emphasis was on problem solving, extending inquiry skills and relating science knowledge to everyday life.

Christieson (1986) recommends that students use mathematics, geography, computer science, English, and many other areas of learning that are not normally associated with the science curriculum. Any curriculum that is developed should consider implementing these peripheral subject areas (Berman & Fletcher, 1991).

Behrens (1993) states that when working with a limited amount of equipment and a full class of students (thirty or more), it is difficult to involve everyone in a hands-on experience. This is complicated in many cases by the wide range of student backgrounds and abilities. To ensure that each student is exposed to the appropriate teaching method, consideration should be given to the students developmental stage (Shepherd & Ragan, 1992; Ryan & Cooper, 1992).

A curriculum that introduces the students to concrete concepts and then evolves into formal patterns of reasoning was recommended by Zuhn (1987). He states that concrete exposure to abstract instruments and procedures enables students to move toward formal understanding of technology involving large quantities of data. Furthermore, students must learn to analyze and determine the relevancy of data. A weather satellite receiving station can be integrated into an existing program, (i.e., a general weather station) to help support the development of formal operations and abstract skills (Behrens, 1990).

Adams (1989) used a weather satellite receiving station in a technology course that was designed to introduce middle school students to the physics concepts of modern technology. They studied the technical aspects of satellite signal reception but, little or no emphasis was placed on weather interpretation or observation. His students retrieved satellite pictures from polar orbiting satellites.

A primary source of geographic information today and in the future is computer-based remote sensing (Estes, Jensen, & Simonett, 1980; Landgrebe, 1976; Richardson, 1978). Educators are now being encouraged to teach students geographic skills using ground based satellite image receiving stations (Martin & McIntyre, 1990).

The National Council for the Social Studies (1984), and the National Council for Geographic Education with the Association of American Geographers (1984) recommended a curriculum for middle school students that includes world geography with an emphasis on global mapping skills. These organizations also suggested that the fundamental theme of location (place on the Earth) should be taught to students. These skills should be taught using an inquiry method of teaching. An integrative approach should be implemented teaching geography skills in other disciplines like Earth Science (The Geographic Education National Implementation Project, 1989). The Educational Testing Service (1988) supported these objectives and recommended an emphasis on the application of skills for students. This application involves higher order thinking skills which should enhance the learning environment.

Stoltman (1992) claims specialized maps are ideal for the application of map skills. Weather maps, computer designed maps, and a world atlas are recommended when working on class projects. When these maps are used in a purposeful manner more meaning is given to lessons which in turn help motivate the students.

Johnson and Gondesen (1991) taught latitude and longitude to upper elementary grade students by tracking hurricanes on a world map. The students' map skills were reinforced by using a real life practice situations. Recommendations included a step-by-step instruction which starts with simple tasks allowing the students to develop more complicated skills until they can apply these skills in real situations.

Science Curriculum

Donnellan (1981) and Bates (1982) in two position statements by the National Science Teachers Association's (NSTA), emphasized the importance of laboratory experiences in the classroom. These experiences allow the students to become involved in direct hands-on activities that enable them to problem solve, use critical thinking, and reasoning skills.

Liepold (1986) reviewed the Carnegie Forum's report "A Nation Prepared." The Carnegie panel recommended that American educators should focus their attention on the relationship between economics and the skills future workers will need to be successful. Workers of the technologically advanced future will need to develop their thinking skills in a different way than their predecessors. Educators should place special emphasis on the critical thinking and science process skills.

Gabel (1986) discussed the findings of a National Science Teachers Association (NSTA) survey of junior high and senior high school teachers. Three hundred and forty-four teachers were questioned about which areas of science education they felt were most important. A questionnaire was completed by each teacher. The following were the top four selections:

1) Motivational techniques on learning and continued science involvement.
2) Effectiveness of laboratory experiences.
3) Influence of science courses on success in college courses.
4) Research on meaningful learning verses rote learning. (p. 18)

Only fifteen percent of the teachers surveyed listed gender differences as an area of science education that needed research.

The National Science Teachers Association (1987), in their search for excellence in science education, established a study called "Criteria for Excellence." Several major goals for a science classroom were listed:

1) Promote independent use of inquiry with practical problem identification and solution.
2) Emphasize the process of learning and include cognitive, affective, and psychrometer aspects of learning.
3) Provide an academic background which encourages career decisions and helps students who will not enter a science field.
4) Promote attitudes that result in appropriate decision making.
5) Emphasize science in interdisciplinary and working settings.
6) Develop an appreciation for and critical attitudes toward science and technology in society.
7) Provide opportunities to compare and contrast science and technology and appreciate how they contribute to new knowledge and power. (p. 4)

Yager and Bonnstetter (1990, p. 2) in a study of the National Science Teacher Association's Excellence Programs, compared six Iowa school districts to determine "exemplary" science teaching characteristics. The results showed teachers look beyond the textbooks and curriculum guides to define minimal concepts and activities to be used. They are also seen by their students, as learners themselves and facilitators and collaborators in student learning. Exemplary teachers are equipped with a vast amount of strategies that insure effective teaching.

The American Association for the Advancement of Science (1989) in their proposal, "Project 2061," identified general science literacy as the main goal for science education. The changing needs of a modern technological society dictate the need for all students to embrace science, mathematics, and technology. Project 2061 recommended six goals that should be included in future science curriculums. Students should:

1) be familiar with the natural world and recognize both its diversity and its unity;
2) understand key concepts and principles used in science;
3) be aware of the important ways that mathematics, science, and technology depend on one another;
4) know that science, mathematics, and technology are human enterprises and know what that implies about their strengths and limitations;
5) have a capacity for the scientific way of thinking; and
6) use scientific knowledge and ways of thinking for individual and social purposes. (p. 4)

Yager (1982b) suggested that science educators need to adjust their priorities. New goals should be established that take into account the future need for technological understanding by both scientists and the general public. Curriculums should be designed that include 1) direct student involvement, 2) technology, and 3) teach students how science impacts society.

Student Attitudes Toward Science

The major focus of most science teaching programs in recent years has been on facts and concepts (Hofstein & Rishpon, 1990). The influence of national reform on state and local curricula has placed a greater emphasis on the organization and presentation of subject matter (Atchley, 1993; Koballa & Crawly, 1993). During the past fifteen years there has been a growing interest in students attitude's toward science (Oliver, 1989; Yager, 1982a).

The study of attitudes toward science allows researchers to predict science related behaviors in students (Blosser, 1984; Gauld, 1982). For example, if a student likes science, performance on science tasks will be enhanced (Bloom, 1976). These attitudes can be measured by statements and behavior.

Germann (1988) evaluated the reliability of attitude instruments used by several major researchers who studied attitudes toward science. The purpose of this study was to clarify the definition of "attitudes toward science," as opposed to the term "scientific attitudes." Scientific attitudes refers to an approach someone takes to solve a problem. Attitudes toward science, as defined by Germann, are the "beliefs one has about the process, products, or relationships in science" (p. 690).

Attitudes are learned beliefs which are influenced by past experiences. Students who enjoy working with science related activities should develop a positive attitude toward science (Simpson & Troost, 1982). This suggests that if educators and researchers want to change attitudes toward science they must be prepared to deal with beliefs, behavior changes, and subject matter (Koballa & Crowley, 1985).

Yager and McCormack (1986) identified student attitude as one of five cognitive domains which should be used to assess science learning. Exemplary science teachers and science teachers identified as standard were compared. Exemplary teachers:

1) develop more student interest in specific courses from grade to grade;
2) help students become more curious about the material world;
3) act as a facilitator or guide while instructing; and

4) help students see science as a way of dealing with problems rather than just information. (p. 47)

Yager (1982a) reviewed the results of a survey distributed in 1978 by the National Assessment of Educational Progress (NAEP). This was one of the first national surveys that assessed affective outcomes of science education. The survey compared the attitudes of thirteen year-olds to seventeen year-olds toward the study of science. Results showed 1) the number of students who find science classes boring increases between the seventh and eighth grades; 2) more students in eleventh grade feel uncomfortable about science than the students in seventh grade; and, 3) students in the eleventh grade feel less successful in science than those in the seventh grade. Science programs need to avoid lessons that insist on just the memorization of facts. Curricula should be designed to motivate and interest the learner.

James and Smith (1985) studied attitudes toward science in 6082 students from grades four to twelve. The researchers found the greatest decline in attitude occurred between grades six and seven. Seventh grade was the first year science was taught as a separate subject in a separate classroom, suggesting that a specialized departmentalized environment was the cause of the decline in attitude. Students' attitudes were influenced by the nature of the subject. The researchers claimed poor attitudes were caused by poorly prepared, equipped, and supervised science experiences.

Cannon and Simpson (1985) studied 821 seventh grade students who were studying life science. This study found the positive attitude of both male and female students toward science decreased as the school year progressed. The students science achievement scores increased until the middle part of the school year and then leveled off. The researchers attributed this leveling phenomenon to a poor attitude toward science and suggested future research should focus on the affective influences of science achievement.

Simpson and Oliver (1990) tried to identify the major influences on attitudes toward science and achievement in science education. In 1985-86 the researchers returned to the school system to determine if the selection of science courses, participation in science activities, science achievement, and other high school decisions could be predicted from the data collected in 1980-81. Simpson and Oliver found that attitudes toward science drop every year as students progress through school. This finding was consistent with the research of Yager and Yager (1985).

Yager and Yager (1985) found that schools have a strong influence on students attitudes toward science achievement. Science success and self-concept in tenth grade students were strong predictors of subsequent science achievement in high school. It is important for educators to present science in a way that will promote positive interaction and develop positive attitudes toward science by the students (Hofstein & Rishpon, 1990; Reeve, 1985; Yager & Blosser, 1991).

Talton and Simpson (1985) looked at the relationship between friends' attitudes toward science and their effects on their peer group attitudes toward science. Approximately 4500 students in elementary, middle, and high schools were surveyed. A significant relationship was found between peer and individual attitudes towards science in grades six, seven, and eight. This relationship peaks in ninth grade at the beginning of the year. Attitudes toward science in the classroom were strongly influenced by the environment in the class (Simpson & Troost, 1982; Talton and Simpson, 1986).

Yager (1982b) recommended strategies for improving attitudes toward science.

1) Teachers should project an image of credibility by becoming a reliable source of information and direction.

2) Teachers can take advantage of social and environmental influences to help develop students confidence and attitudes toward science. 3) Female and

minority students should be encouraged to pursue science careers. 4) Each student has unique needs and each of these needs should be identified and a teaching strategy implemented that meets these needs.

Furthermore, Yager (1982b) recommended the use of discrepant events to introduce concepts and develop student curiosity. Students should be involved in active lessons that encourage interaction.

Computers in the Curriculum

Genishi (1988) stated that computer use was first introduced in the upper grades (7-12). The introduction of computers in the lower grades (K-6) was a result of the downward push by technology from the upper grades. This downward push was the result of an increased emphasis on society and the educational community placed on achievement tests in the primary grades.

Gardner and Simmons (1990), in a study of third graders, found the effects of computer use on student achievement was enhanced by the use of manipulatives. The combination of computer assisted instruction and hands-on concrete experiences increased the students' understanding and gave them a more positive attitude toward science.

Bender (1991) suggests that a computer-based learning experience can expose students to new and varied learning experiences. The teaching of basic skills is often tedious, but important. The computer can offer students additional experiences as they learn these skills which include a variety of multi-media components.

Like the elementary grade student, most middle grade students need hands-on experiences. Most of these students are in the concrete operational stage of development (Cantu & Herron, 1978). As students mature into higher levels of cognitive development more emphasis should be placed on higher-order thinking skills (London, 1988).

In secondary education computers can be used with, and without, concrete hands-on experiences. Choi and Gennaro (1987) in their study of junior high students compared computer simulated experiments to hands-on laboratory experiences. They found no significant difference between the computer simulated group and the hands-on laboratory group in retention as measured by test scores. They concluded that in the future, computer simulations can be used effectively in the class with junior high or high school students in the place of hands-on experiences.

Perl (1990) indicates that the computer has the same effect on cognitive development as manipulatives because it simulates or "mirrors" real objects. For example, a computer can show a student blocks and then let that student manipulate the blocks by measuring, observing, or moving the image. These types of computer exercises simulate a concrete experience. Whenever possible, computers should be coupled with manipulatives to enhance the learning experience.

Oakes and Schnieder (1984) and McMullen (1986) described three types of computer software programs: drill and practice, tutorials, and simulation/adventure formats (Lillie, Hannum, & Stuck, 1989; Robinson & Schonborn, 1991). Newman (1990) identifies another category for computer software use as an organization and communication mechanism. This type of software can be used for a multitude of tasks that organize data, communicate between local and long distant learners, and measure variables as a science tool (DeGroff, 1990; Roth, 1989). Many types of hardware and sensors can now be attached to computers which allow students to collect and categorize data in a science classroom (Ost, 1985; Roth, 1989; Summers, 1989).

Riel (1986) stated that the educational potential of computers will be realized only after educators shift their emphasis away from "technical connections." Educators need to determine which educational activities will make a significant contribution to education (Budin, Kendall, & Lengel, 1986). High schools over the last thirty years have changed their emphasis from computer science topics like writing programs (BASIC or LOGO) to computer literacy (Bitter, Cameron, Walters, & Satya, 1986). Computer literacy is defined as the ability to use application programs such as word processing, spreadsheets, and networking (Luehrmann, 1981). The ability to utilize or apply software programs should be considered when designing a computer curriculum for students. Computer literacy should be taught in the subject areas where students can work with their application skills (Ellis, 1984).

Computer hardware costs have dropped in recent years to a point where many schools can afford to purchase units with networking capabilities (Clark, Kurshan, & Yoder, 1989; Hopkins, 1991). Computers linked to modems, hooked into a standard telephone line, enable the user to communicate with other computers. This ability to network allows students to access information from on-site and off-site data bases (Budin, Kendall, & Lengel, 1986). This type of system increases the amount of potential information students can access. As students work with easier access to knowledge, they spend less time memorizing and more time manipulating knowledge on higher order tasks (Morris, 1983). Computer software that necessitates student use of higher-order thinking skills to solve problems encourages students to interact with one another and develops both academic and social development (Johnson & Johnson, 1986; Kacer, Weinholtz, & Rocklin, 1992).

DeGroff (1990) supports networking with computers and encourages teachers to consider integrating a whole language approach with computer lessons. Students should be introduced to networking as early as the primary grades.

Budin, Kendall, and Lengal (1986) agreed with DeGroff and suggested that most students should be exposed to the word processing capabilities of computers. Students can arrange their writings in a neat and orderly fashion, which enables them to draft and edit their work at the same time.

Newman (1990) recommended several considerations for any curriculum that includes the use of computers. Determine the most effective ratio of students per computer. How can the computer enhance the material being taught? Do the teachers have enough training and support (Fullan & Pomfret, 1977)?

Luehrmann (1981) postulated that computer literacy should be the main goal of computer education but computer literacy must be defined before a curriculum can be designed. Computer literacy is often defined as computer awareness. This definition is incomplete and should include "the ability to do computing" (p. 683). A computer literate individual ultimately must be able to use the computer to solve problems (Ellis, 1984).

Ost (1985) took the idea of literacy a step further by defining "technologic literacy" as a skill and attitude which is basic to modern society. The teaching of this basic skill is the responsibility of all areas within the curriculum, especially science and math. The future belongs to those individuals who master these other skills (DiSessa, 1987).

Vockell (1990) feels computers must be mastered before they are effective tools; therefore, he recommends the use of the mastery learning approach. When computer skills are taught, a level of competency should be established. Students are then allowed to work at their own pace until they "master" the specified level of competency.

Sherwood and Hasselbring (1986) questioned which method of computer implementation would be the most effective. In their study of microcomputers in a science classroom, they compared the effect of three presentation methods on student achievement. Method one assigned two students to one computer. Method two assigned the entire class to one computer and allowed them to work together with the computer simulation. Method three was a noncomputer list game-type setting for the simulation. The researchers found no significant difference between these groups. However, they did claim a "tentative" indication that group instruction may be more beneficial than the other two types methods of presentation.

A cooperative environment for learning should be established for computer-assisted-instruction (Hopkins, 1991; Johnson, Johnson, & Stanne, 1985; Vokell, 1989). Computers offer students an excellent opportunity to work together. Watson (1991) claimed research shows the computer "doesn't have to be used by one student at a time" (p. 11). Small groups can solve simple to complex tasks as effectively as individuals (Slavin, 1980).

Gender, Science, and Computers

Wittig and Peterson (1979) stated that there is a general consensus among researchers supporting the claim that once students reach the age of adolescence males tend to score higher than females on tests which involve quantitative abilities (i.e., mathematics and science). Reyes and Padilla (1985) found high school girls are not as likely to study science as boys. The researchers were concerned about math and science differences between males and females. Since both of these subjects are learned together at the high school level any differences should show up in both subject areas. The differences in achievement in the early grades favors the boys by a narrow margin. As the students progress through school this achievement gap widens leaving the females well below the males by the time they reach middle school and high school (Jacobson & Doran, 1985).

The Educational Testing Service (ETS) (1989) compared mathematics, science, history, and reading scores of males and females in a study by the National Assessment of Educational Progress (NAEP). In this study male students at age nine scored slightly higher than females on a science achievement test and about the same as females on a math achievement test. In both subject areas, as the students grew older the difference gap increased favoring males (Erickson & Erickson, 1984). The ETS study also found fewer female students perceived that knowing science would help them make a living in their life's work. Over fifty percent of the males felt they would use science in their life's work.

Fetler (1985) studied students in grades six and twelve to determine the extent of computer literacy in the State of California. In this study the boys scored significantly higher in literacy achievement test than girls. The type of exposure to computers was found to vary by gender. The main source of computer exposure for girls was word processing and key entry; boys were likely to work with computers in mathematics and science. The gap between male and female students should be a major concern when developing future curriculums and computer-related research projects (Hawkins, 1985; Linn, 1985; Sherwood & Hasselbring, 1986).

Reeve (1985) stated that students will retain information longer if they understand there is a reason or purpose for a task. Curriculums should be designed which involve the students in real, purposeful activities that help them relate to the worth of an activity.

Zerega, Haertel, Tsai, and Walberg (1986) studied data from the 1976 Science Assessment of the National Assessment of Educational Progress (NAEP). No significant gender differences were found in early adolescent science achievement, but four years later a significant difference developed with males scoring higher than females on science achievement tests. It appears that the school years between thirteen and seventeen have a significant differential effect on scores between the males and females.

Becker (1989) reviewed two meta-analyses and found that in the studies reviewed there was agreement about gender difference, but not a consensus about the extent of the difference in science achievement. There appeared to be a gender bias favoring male students, however, each study varied in the degree of gender bias as measured by achievement. Becker felt a major reason for the inconsistent results was experimenter bias and differences in instructional intervention.

Owen (1991), in a national report compiled for the NAEP, reviewed scholastic achievement for nine, thirteen, and seventeen-year-old students. The report found small or no gender differences in the nine year olds, but when the students turned age thirteen and seventeen, males performed significantly higher than females in science achievement.

One possible explanation for this difference could be a fear or aversion toward science concepts and science related activities known as science anxiety (Mallow, 1981). Chiarelott and Czerniak (1987) studied 532 fourth, fifth, sixth, eighth, and ninth grade male and female students. Females consistently scored higher on an anxiety measuring instrument than males. This trend begins at fourth grade even though the females were handling the science content well (measured results from a content test). The researchers concluded that there is a link between science achievement, attitude, and anxiety.

Wilder, Mackie, and Cooper (1985) claimed anecdotal evidence suggests the technological world and computers are male dominated. In an effort to determine if this was true in schools, more than 1600 students were surveyed in grades kindergarten through twelve. It was found that as early as kindergarten, both boys and girls view video games and computers as more appropriate for boys. This view by both boys and girls continued throughout the grades. Boys liked computers and video games more than girls. The attitudes in both boys and girls declined toward computers as they reached middle school age (DeRemmer, 1989). The researchers in a effort to explain this drop in attitude described the middle grades computer curriculum as "rudimentary," involving students in more academic activities (i.e., programing verses game formats). The majority of software for early and middle grades students was designed around metaphors of war and sports, areas of traditional male interest. It was recommended that teachers preview software to determine if there is a gender bias.

Forsyth and Lancy (1990) were concerned about this gender bias in computer software. They tested 124 fifth grade students after they worked with a "gender neutral software" called "Winnie." They concluded that good quality, gender neutral, software programs will minimize the differences of gender.

Smail (1985) claimed female attitudes toward science could be changed by: developing materials that link females interest of a humanistic view of science to the curriculum, discussing with the students the effects of sex-role stereotypes, and continually discussing career choices in science fields. Smail's biggest concern was the classroom behavior of the teacher which are ingrained in traditional roles and reinforced by society daily (Handley & Morse, 1984).

Most researchers agree that males perform better in science than females (Becker, 1989; Reyes & Padilla, 1985; Simpson & Oliver, 1985). The big question is "Why?" (Archer & Lloyd, 1985; Seward & Seward, 1980). To better understand gender differences future science researchers should focus on science achievement and on attitudes toward science (Becker, 1989; Handley & Morse, 1984; Simpson & Oliver, 1985).

Cooperative Learning Strategies with Science and Computers

Johnson and Johnson (1974) identified four possible "goal structures" or teaching methods that can be implemented for a "learning situation: competitive, cooperative, individualistic, and no structure" (p. 213). Competitive learning situations separate learners and establish a climate in the classroom where students succeed at the expense of others (Deutsch, 1949; Slavin, 1983). Games playing and athletic competition reflect this method of teaching. An individual learning situation is one where the goals of the individual learner are independent of the others (Johnson & Johnson, 1991).

Slavin (1988) reviewed sixty studies that compared cooperative learning with traditional methods of teaching. He found controversy among these researchers concerning the conditions which are most effective for instruction. Questions were voiced about how effective cooperative learning can be in the upper grades (7-12). More research in this area was suggested (Slavin, 1990b).

McNergney and Haberman (1988) reviewed a synthesis of 27 studies on five cooperative learning techniques used in grades seven through twelve. In 68 percent of these studies cooperative learning was found to be successful in terms of student achievement. When grades seven through nine were analyzed without the higher grades the percentages increased in favor of the cooperative learning approach.

Johnson and Johnson (1974) classified the basic elements of effective cooperative learning as "positive interdependence" within the group, "face to face" interaction, individual accountability, and establishing an environment that requires students to use "interpersonal and small group skills" in an appropriate manner (p. 214). It is important that the students know they must rely on each other to achieve a common goal

(Brandt, 1987; Johnson, Johnson, & Scott, 1978; Logan, 1986; Slavin, 1981). Several studies of cooperative learning have found improvement in students' attitudes toward school, subject matter, and themselves (Allen & VanSickle, 1984; Johnson & Johnson, 1984; Slavin, 1990a).

Swing and Peterson (1982) investigated the relationship of student interaction in small group learning to student achievement. High and low ability students were found to benefit when placed in small heterogeneous ability groups but medium ability students did not benefit from this type of grouping. The researchers found the added support of the medium and high ability students improved the performance of the low ability student.

Johnson, Maruyama, Johnson, Nelson, and Skon (1981) in a meta-analysis comparing competitive, cooperative, and individualist goal structures on student achievement found the bulk of the studies analyzed showed cooperative learning groups appear to be superior to both competitive and individual learning styles. In addition they found cooperation without intergroup competition promoted higher achievement than cooperation with intergroup competition.

Johnson, Johnson, and Stanne (1985), in a study of computer-assisted instruction with eighth grade students, compared the three teaching methods: cooperative, competitive, and individualistic learning. Student achievement and attitudes were also measured. Cooperative learning groups significantly outperformed the other two groups when working on higher order problem solving situations like learning how to operate a computer. The researchers claimed the collaborative effort which involved discussions and debate about how to solve the problems related to computer operation enhanced the learning environment. All three groups had a positive attitude toward computer-assisted instruction.

Humphreys, Johnson, and Johnson (1982) studied 44 ninth-grade physical science students and compared the effects of cooperative, competitive, and individualistic learning on student attitudes and achievement. The student attitudes and achievement in the cooperative learning groups were found to be significantly higher than those in both the competitive and individualistic learning groups.

Summary

In general the literature supports the need for additional research concerning the following topics:

1) Should science be taught with a hands-on approach?

2) Can computers and other new technology enhance the science learning environment?

3) Is student achievement in science affected by the

student's attitude towards science?

4) Why is there a gender bias in science and computer instruction which favors males over females?

5) Will a cooperative group approach toward science instruction improve student attitude toward science and student achievement?

CHAPTER III

METHODOLOGY

The general purpose of this study was to determine whether using a weather station with a weather satellite image receiving capability to teach a unit on weather would make a difference in student's achievement and student attitudes toward science. Also, the effects of gender on achievement and attitudes were examined.

Subjects

The subjects for this study were eighth-grade Earth Science students attending a middle school in Northeastern Georgia. The sample consisted of 99 students distributed among four Earth Science classes.

The treatment and comparison groups in this study were selected by first rank ordering all of the male and female students by their science grades from the previous school year and designating the upper third as high level, the middle third as average level, and the bottom third as low level in terms of science performance. Students from each of these ability levels were randomly chosen to form cooperative learning triads within the two genders. Each class contained from 7 to 13 triads. In each class, three of the cooperative learning triads were randomly selected for the treatment group and the remainder served as the comparison group. A total of approximately 36 students (12 triads) participated in the treatment group and approximately 63 students (21 triads) composed the comparison group.

Instrumentation

This study utilized two tests: the Estes Attitude Scales and an instrument which measures academic knowledge of the weather (i.e. student achievement).

Measure of Academic Achievement

An academic achievement instrument, titled the Weather Concepts Test (WCT), was designed by the researcher to measure students' content knowledge of weather. The WCT was subjected to content analysis by a panel of three experts to determine its content validity. The panel was composed of two professors from the Geography Department of the University of Southern Mississippi and a middle-school teacher who had received the 1991 Georgia Middle School Science Teacher of the Year award. The review examined the content of the instrument in three areas: academic accuracy, appropriateness for age, and distribution of the items to cover the objectives of the weather unit (National Council for Geographic

Education, 1984; The Geographic Education National Implementation Project, 1989).

The instrument was tested for reliability in May of 1993, using the Kuder-Richardson reliability formula. A total of 86 eighth-grade students took part in the reliability study. An alpha coefficient of .75 was obtained.

Measure of Student Attitude Toward Science

The Estes Attitude Scale (EAS) was used to measure student attitude toward science. This instrument was designed as a comprehensive measure of attitudes held by high school students enrolled in grades seven through twelve. The EAS includes measures of five subject areas. Only three of the subject-areas were administered to the students: science, social studies, and English. It took approximately fifteen minutes to complete the questions for the three subject areas. Scoring was done with a computer according to the Estes Attitude Scales Manual.

The EAS required the students to respond to a five-point Likert scale which indicates agreement or disagreement with statements that identify a positive or negative bias toward science, social studies, and English (Estes, Estes, & Richards, 1985). In this study only science scores were computed for the individual students.

Internal consistency reliability for the EAS has been reported for the three subject areas, with the coefficients ranging from .76 to .93 (Estes, Estes, & Richards, 1985). The construct validity was examined by assessing extrinsic measures, (i.e., activity toward subject areas) and intrinsic measures (i.e., course grades, extracurricular involvement in subject related activities, and standardized achievement scores). The results indicated that both the convergent and discriminative validity of individual interests were met (Estes, Estes, & Richards, 1985).

Procedures

Permission to conduct the research was obtained from the school board of the middle school. The study began the second week of the 1993-94 school year.

Both the treatment group and the comparison group received two units of weather training and one unit of theory training on weather satellites. Upon completion of two standard weather units and an introductory satellite unit, the treatment group was assigned to an interactive, ten-day instructional unit with the weather station. During the same ten-day period, the comparison group participated in cooperative learning activities which encouraged the application of weather concepts.

Treatment Group

The treatment group was exposed to two units which cover basic concepts related to weather. Also, they participated in an introductory lesson about weather satellites (Appendices A & B).

The treatment group participated in interactive activities at the weather station for ten school days. During the ten-day period, they followed a prescribed program of study as outlined in Appendix D.

Comparison Group

The comparison group received the same instruction as the treatment group during the initial study of the weather unit. However, during the ten-day period while the treatment group was working with the weather satellite, the comparison group worked cooperatively in their assigned triads on learning tasks related to weather which represented traditional kinds of learning activities. During the ten-day period, they followed a prescribed program of study. An example of one lesson is described in Appendix C.

Two posttests were administered to the treatment and comparison groups upon completion of the treatment period. One test measured student achievement and the other measured student attitudes toward science.

After the data for the study was collected, the participants in the comparison group were assigned a ten-day period to work with the weather station. All of the students in the study had an equal amount of contact time with the weather station during the school year.

Data Collection

Two posttests were given to the treatment and control groups. One of the instruments, the Weather Concepts Test (WCT), measured students' achievement related to weather knowledge (Appendix E), and the other instrument, the Estes Attitude Scale (EAS), measured students' attitudes toward science (Appendix F).

The WCT, which measures content knowledge of weather, was given to the students one day after the weather unit was completed. The EAS, which measures students' attitudes toward science, was be given to the students the last day of the unit before the administration of the WCT.

Data Analysis

A two-way treatment by gender analysis of variance with triads assigned to treatment within the gender group was used to analyze the data. The .05 alpha level of significance was be used as the acceptance level for all hypotheses. The statistical calculations were be performed at the University of Southern Mississippi, employing the SPSS-X statistical package.

CHAPTER IV

ANALYSIS OF THE DATA

This study was conducted to determine the effects of a computer-assisted weather satellite curriculum and gender on student achievement and on student attitudes toward science. The treatment group operated computers linked to land networks and weather satellites, which collected national and international data, and a ground weather system which collected local data. This group also collected and interpreted local data with a ground weather station composed of thermometers, barometers, rain gauges, and other traditional instruments. The control group participated in a traditional weather unit composed of lectures, workbook exercises, library research, and laboratory experiences. The posttests measuring students' achievement in weather and students' attitudes toward science were administered to both groups of students in October, 1993. After the students in the treatment group completed the science lesson, they were interviewed and answered questions about their experience.

Descriptive Data

Attitudes toward science were measured with the Estes Attitude Measure which tested students' general attitudes toward science. This instrument contained 15 questions that included a Likert scale of one to five. Students could record a maximum positive attitude toward science of 75, while those students who showed a dislike for science could score as low as 15 points. Table 1 contains the means, standard deviation, and cell number sizes for each combination of gender and teaching methodology. An example of reading cells in Table 1 (see Table 1) shows a number count of 36 males in the traditional group obtained a mean score of 55.53 with a standard deviation of 9.78 on the Estes attitude measure.

Student achievement, the second dependent variable, was measured with a 31 item multiple choice test. The highest score possible was 31 and the lowest score possible was zero. Table 2 contains the means, standard deviation, and cell number size for each group. An example of interpreting Table 2 shows 18 females in the computer group obtained a mean score of 16.89 with a standard deviation of 3.03 on the student achievement measure.

Test of Hypotheses

Hypotheses 1 through 4 were tested using an Analysis of Variance statistical methodology. The cell means, standard deviation, and number counts from Tables 1 and 2 were used in this analysis.

Table 1

Means and Standard Deviations of the Attitude Measure

(N = 99)

	Teaching Methodology							
	Traditional			Computer/Assist			Row	
Gender	M	SD	n	M	SD	n	M	n
Female	52.89	7.29	27	55.00	6.63	18	53.73	45
Male	55.53	9.78	36	52.17	13.32	18	54.41	54
Column	54.40		63	53.58		36	54.10	99

Table 2

Means and Standard Deviations of the Achievement Measure (N = 98)

	Teaching Methodology							
	Traditional			Computer/Assist			Row	
Gender	M	SD	n	M	SD	n	M	n
Female	16.31	4.27	26	16.89	3.03	18	16.55	44
Male	17.81	5.30	36	18.44	3.05	18	18.02	54
Column	17.18		62	17.67		36	17.36	98

A two-way analysis of variance was the statistical procedure used to test for differences between the two groups, traditional instruction (control group) and computer-assisted instruction (treatment group), and gender effects on student attitude toward science and student achievement. An alpha level of .05 was the rejection level set for all hypotheses.

Results from the ANOVA testing for student achievement are provided in Table 3. There were no significant main effects for treatment [$F(1,94) = 0.86$, $p = .502$] or gender [$F(1,94) = 2.99$, $p = .087$)], and no interaction between teaching methodology and gender [$F(1,94) = .001$, $p = .975$].

Hypotheses 1 and 3 dealt more specifically with the dependent variable of student achievement. Hypothesis 1 stated that, "There will be a significant difference between the science achievement scores of students who study weather using a satellite receiving station and students who study weather using traditional lessons." In hypothesis 1 there was no significant difference in the effects of the two different instructional methodologies, traditional and computer-assisted [$F(1,94) = .455$, $p = .502$].

Hypothesis 3 predicted that, "There will be a significant difference between male and female average scores on tests that measure student achievement." In hypothesis 3 gender did not provide a statistically significant difference in student achievement [$F(1,94) = 2.86$, $p = .087$].

Results from the ANOVA testing for student attitude are provided in Table 4. There were no significant main effects for treatment [$F(1,95) = 0.151$, $p = .699$] or gender [$F(1,95) = 0.106$, $p = .745$], and no interaction between teaching methodology and gender [$F(1,95) = 1.904$, $p = .171$].

Hypotheses 2 and 4 dealt more specifically with the dependent variable of student attitude. Hypothesis 2 predicted that, "There will be a significant difference between the attitude toward science of students who study weather using a satellite receiving station and students who study weather using traditional lessons." In hypothesis 2 no statistically significant difference was found between the traditional learning group and the computer-assisted group in student attitude toward science [$F(1,95) = .151$, $p = .699$].

Hypothesis 4 predicted that "There will be a significant difference between male and female average scores on tests that measure student attitude toward

Table 3

Summary of ANOVA Results on the Achievement Measure

Source	*df*	Mean Square	*F*	*p*
Treatment (T)	1	8.47	.455	.502
Gender (G)	1	55.63	2.986	.087
T x G	1	.02	.001	.975
Within	94	18.63		

Table 4

Summary of ANOVA Results on the Attitude Measure

Source	*df*	Mean Square	*F*	*p*
Treatment (T)	1	13.48	.151	.699
Gender (G)	1	9.48	.106	.745
T x G	1	170.22	1.904	.171
Within	95	89.39		

science." In hypothesis 4 no statistically significant difference was found between males and females in student attitude toward science [$F(1,95) = .106$, $p = .745$].

Summary

The preceding investigation attempted to determine if a science curriculum which used computer-assisted instruction to operate a weather satellite receiving station, which was linked to computer weather networks, would affect student achievement and student attitude's toward science. Achievement was measured with a 31-item posttest given to 99 students in October, 1993, after they participated in a 10-day unit of weather instruction. Attitude was measured by an attitude inventory that contained 15 items that covered the area of science. Ninety-eight students responded to the attitude posttest in October, 1993. An ANOVA provided the statistical analysis to test for hypotheses 1 through 4.

The ANOVA results revealed no significant difference between traditional and computer-assisted teaching methods on student achievement. In addition, there was no significant interaction found between teaching methods and gender.

No significant difference was found between traditional and computer-assisted teaching methods on attitude toward science. Likewise, no significant interaction was found between teaching methods and gender.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Generally educators support the use of computer-assisted curricula in a weather science class and feel this technology has tremendous potential for student learning (Gardner & Simmons, 1990; Martin, 1987; Summers & Gotwald, 1987; Tillery, 1990). As the rapid integration of technology in the schools takes place, educators need to develop effective ways to identify and implement these new tools in the science classroom.

This study was designed as a first step to determine the effectiveness of a computer-assisted weather satellite curriculum in the classroom. After a review of the literature the study focused on student achievement, student attitudes toward science, and the effect of gender difference. Therefore, the problem statement was formulated as, "Do eighth-grade male and female students who participate in a traditional approach to the study of weather differ in student achievement and attitude's toward science from male and female students who study weather using a weather station with satellite image reception capabilities"?

Several published articles related to science and computer-assisted teaching methods, Bender (1991), Choi and Gennero (1987), Clark, Kurshan, and Yoder (1989), DiSessa (1987), Ellis (1984), Gardner and Simmons (1990), Johnson and Johnson (1986), Koballa and Crawley (1993), Luehrmann (1981), Oakes and Schnider (1984), Sherwood and Hasselbring (1986), Simpson and Oliver (1990), Summers (1989), and Vockell (1990) investigated questions related to the effect of computers on student achievement and student attitudes toward science. In general, the findings of these studies have suggested that computers have a positive effect on student achievement and student attitudes toward science. The study reported here found that there was no significant difference between a computer-assisted and a traditional curriculum on science achievement and student attitudes toward science.

Archer and Lloyd (1985), Becker (1989), DeRemer (1989), Fetler (1985), Forsyth (1989), Hawkins (1985), Koballa (1985), Linn (1985), Wilder, Mackie and Cooper (1985), and Wittig and Peterson (1979) examined the effect of gender on student achievement and student attitudes toward science. Many of these studies reported that males were favored over females in both science and computer-assisted curricula. Contrary to most of these studies, the study reported here found no significant difference in student achievement and student attitudes toward science between males and females for the traditional and computer-assisted groups.

Subjects

Subjects for this study came from a rural, middle school in Northeast Georgia. Students from four Earth Science classes (n = 99) completed the attitude measure and 98 students completed the achievement measure because one student moved away from school before the achievement test was given. The treatment group (computer-assisted teaching method) sample for achievement and attitude included 36 students. The control group (traditional teaching method) included 62 students in the achievement analysis and 63 students in the attitude analysis.

All of the students were ranked by ability and then assigned to a group. The students were randomly placed in all male or all female groups called a triad. Each triad contained a high, medium, and low ability student. After the students were assigned to the triads, a total of 12 triads were randomly selected to participate in computer-assisted instruction (treatment group) and 21 triads were selected to participate in traditional instruction (control group).

Procedure

Data concerning student achievement was collected using the Weather Concept Test (Appendix E). This instrument was developed by the researcher and consisted of 31 multiple-choice items. The Weather Concept Test measured weather information that was taught to both the treatment and control groups during the ten-day study period in October, 1993. Each test item had four or five possible choices; however, only one choice met the full requirements of the question. The maximum possible score for the test was 31. The minimum possible score for the test was 0. The achievement measure was given to the students on a single day, following the completion of the weather unit.

Data concerning student attitudes toward science was collected with the Estes Attitude Scale for the senior high school grades (Appendix F). This attitude scale included 15 questions about science. Each question employed a Likert Scale ranging from 1 for "strongly disagree" to 5 for "strongly agree." Half of these questions were reversed in direction to avoid any positive or negative pattern. A maximum positive score of 75, and a minimum negative score of 15 could be achieved on this instrument. The Estes Attitude Scale was administered one day following the completion of the weather unit in October, 1993.

In addition to these quantitative measures, a qualitative measure was completed by twenty students randomly selected from the treatment group. These students were interviewed and then answered two questions about the computer-assisted weather curriculum.

Twenty students in the treatment group were interviewed and given a qualitative instrument that consisted of two questions.

These questions were:

1) Write down what you thought was good about the computer/satellite weather lesson.
2) What do you think needs improvement in this lesson? How? Suggest additions that would help you.

Results and Discussion

The scores for the student achievement measure and student attitude measure were compared using a two-way analysis of variance procedure to determine if there was a difference between the computer-assisted and traditional groups. In addition, gender differences were analyzed. The group means for the teaching methods and gender demonstrated no significant difference.

It appears that both methods of instruction were equally effective in the teaching of weather. There may be several reasons why this occurred.

A review of comments given by students in the qualitative instrument may give the reader some insight into these results. Several students mentioned that it, "took me some time to learn the computer." One student recommended that the students should "learn how to work the computers before going back there (to the weather station)." Others made comments like, they needed more directions on questions and how to get into a system on the computer. These statements and concerns suggest the students as a whole were not just concentrating on learning about weather but they were working on solving the problem of operating the computer.

Interviews with the students in the computer group after the study found that most of the subjects had limited prior experience with computers. They worked with Apple computers for at least one hour a week in elementary school, grades 1 through 5, but their middle school experience had been limited to only a few hours per year. Only four out of the thirty six students in the computer-assisted group had operated an IBM or compatible computer like the ones used in this study.

Even with the time restraints of ten days and their limited computer experience, the computer-assisted group managed to solve their computer operation problems and reach the same level of achievement as the traditional group. The traditional group was exposed to a familiar method of teaching which allowed them to focus on just learning the weather. The computer-assisted group not only worked on weather concepts but they spent a larger portion of their time acquiring additional computer skills which included interpreting images and problem solving.

The instructor worked with both groups in one partitioned classroom at the same time. It was decided that the instructor would spend an equal amount of time with both groups. It was the researcher's intent to avoid unbalanced interaction with the groups that would bias the results. The teacher assumed the role of mentor with the computer-assisted but on several days lectured or presented demonstrations to the traditional class. This had the effect of focusing a larger proportion of the teacher's time on the traditional group. Many times the teacher was delayed or unavailable to assist the computer-assisted students when they had questions. This may have compounded the difficulties the computer-assisted group experienced with the computers.

One of the more interesting results of the study was that no significant difference was found in the mean scores for male and female students on science achievement and student attitudes toward science. The majority of studies reviewed in the literature indicated that there would be a gender difference favoring males over females at the eighth grade level (Becker, 1989; Erickson & Erickson, 1984; Jacobson & Doran, 1985; Owen, 1991; Reyes & Padilla, 1985; Simpson & Oliver, 1985; Wittig & Peterson, 1979). Two variables may have influenced these results: the instructor and the type of grouping. Several of the studies related to gender identified teacher behavior as an important variable. The instructor's teaching style in this study may have helped to equalize the gender results. Another possible explanation for finding no gender bias may have been the way the groups were assigned. Unlike most normal, classroom instructional settings, each student in the study was assigned to an all male or all female group.

Casual observation of the group behaviors by the researcher indicated that as females worked together, they demanded less attention and cooperated well with one another. The males had a harder time focusing on the task and complained more among themselves. Segregated gender grouping may give females a chance to work with other students who have similar learning styles. The cooperative, single gender grouping may allow females to learn in a more effective manner.

There was no significant difference found between any of the groups for student attitudes toward science. However, when the computer-assisted students were interviewed all of them stated they preferred working with the computers versus working in a traditional classroom. Several subjects stated they liked the computer/satellite lesson because it helped them understand weather and satellites better. Other students stated that they enjoyed working in the computer-assisted group because they "got to learn about the weather," even though they admitted the computer lesson was "harder."

These remarks seem to contradict the results found with the attitude measure. A possible explanation for this contradiction could be that the Estes Attitude Scale was designed to measure a general attitude toward science. Only two of the items in the instrument were directly related to weather. The computer-assisted curriculum may have improved the student attitude's toward a specific area of science like computers or weather, but the Estes measure was not designed to measure those specific areas.

Another possible consideration for no change in the attitude among students could have been the time element. More time is needed to influence students' attitude toward a general field of study like science.

Recommendations

The effective use of weather satellite technology and computers in a science classroom requires additional research. This study was a first effort to identify an effective way of teaching weather using current technology. Future research needs to address several factors and limitations identified in this study, such as the students' limited computer experience, lack of diversity in the student population, inequitable student interaction with the instructor, duration of the study, design of an instrument that measures specific skills, and design of an instrument that measures attitude toward the weather.

The students' lack of computer experience was a limiting factor in this study. Lack of computer experience is the norm rather than the exception in most of the middle schools throughout the United States. Future research should identify students' computer background and teach them basic computer skills before they participate in a lesson or study. This will allow students in a computer-assisted group to focus the same amount of time on the content portion of a lesson as the group that is studying in a traditional method group. In addition it may improve the researcher's ability to identify the effectiveness of the content portion of a curriculum.

Student population and the lack of ethnic diversity was a limiting factor. The students in this study came from a rural middle class population who were primarily middle class and Caucasian. Approximately four percent of the students were classified as a minority. This limited the generalizability of the study. A future study should include a larger pool of students from a wider geographic area with greater cultural and socio-economic diversity. This would better represent the pluralistic society.

The limited number of computers (3) available to the study may have compromised the results. Each classroom included both treatment and control groups. The teacher's efforts were divided and focused on both groups in one classroom. Future studies should arrange separate classrooms for control and treatment groups. This would allow the teacher to focus his/her energy on one group's needs and avoid possible inequities of time and attention.

The time duration of this study may have been a limiting factor. The treatment and the control group were taught basic weather concepts with the same method of instruction for twenty-five days during the initial stages of the weather unit. Future studies should design a curriculum that would allow researchers to separate the computer-assisted group from the traditional groups at the beginning of the weather unit. The computer-assisted group should be exposed to a unit of study longer than the ten days in this study.

Many of the articles reviewed in the literature section of this study claimed a computer-assisted curriculum program would enhance the learning of higher order thinking skills. The computer-assisted students may have been exposed to more higher-order tasks than the traditional group; however, the achievement instrument was not designed to measure these skills. The content measure in this study was designed to measure overall achievement. Future studies should design an instrument that focuses on higher-order skills, such as problem solving. These items should then be assessed with the univariate analysis procedure.

The attitude measure in this study was designed to measure students' attitudes toward science in general. A future study should design a quantitative instrument to measure attitude towards the study of weather. This type of instrument would better reflect the researcher's efforts.

A final recommendation of this study concerns the inability of the researcher to find a gender difference in student achievement and student attitudes toward science. These results should be studied further. Studies should be designed that include all male and female cooperative learning groups as well as combined male and female cooperative learning groups, so that the issue of gender may be thoroughly investigated. Subject areas, like science and math, which have been viewed as areas favoring males should be used to investigate the effectiveness of different kinds of gender groups on achievement and attitude.

APPENDIX A

UNIT I

Introduction: This unit will be taught to both the treatment and comparison groups to prepare them for unit two.

Title of Unit: Weather Satellite Theory and Operation

Grade Level: 7-9

Length of Unit: Ten Days

Unit Description and Goal:

This unit will expose the students to scientific theory and practice that will enable them to operate a weather station and receive weather satellite information from space. Satellite technology, satellite flight characteristics, and geography concepts will be reviewed so the students will better understand how the weather data is transmitted, received, and interpreted.

Objectives of the Unit:

The students will:

-- illustrate the difference between the way APT and GOES satellites operate.

-- list the missions and the types of data gathered by the various available satellites.

-- describe the role of the federal government in the satellite industry.

-- build an astrolabe.

-- determine the latitude of the students' home town within an accuracy of plus or minus five degrees using an astrolabe which the students have built.

-- identify the coordinates for some major cities and locations of the world.

-- draw land areas in their appropriate places, and plot major cities and locations of the world on a map.

-- complete a series of time conversions from GMT (Zulu) to Eastern Standard Time (EST) and back.

-- describe how information is acquired by weather satellites and interpreted by scientists.

-- explain the effect that the size of the basic unit of information sent from the weather satellite has on picture detail.

-- explain how satellite imagery can be made with visible-radiation and with infrared-radiation given off by the earth.

-- describe the advantages and disadvantages for visible-light and infrared-radiation

-- plot and predict windows for polar orbiting satellites using the Apple computers and Joe Summers software.

Unit Outline:

Lesson 1 - Weather System Introduction

Lesson 2 - Astrolabe Lab

Lesson 3 - Longitude and Latitude

Lesson 4 - Time Zones

Lesson 5 - Satellite Orbit Prediction

Lesson 6 - Imagery Investigation

Lesson 7 - Visible and Infrared Satellite Imagery Investigation

Unit Test

Teacher Activities:

Start the planning for this unit by reading through the material in the appendices that relate to each lesson. This material should help the teacher understand how weather satellites developed and operate. Most of the general science background material has been introduced to the students in previous lessons, but not in the context of satellite technology. While presenting the material, relate each key concept to the students' experience background and then present it in the context of the new lesson. The concept of a satellite orbiting over our head is abstract and should first be presented in a concrete manner. Several hands-on exercises have been included to help move the students from the concrete level of thought into an abstract or formal operations level. Whenever possible, the lessons should be completed in cooperative learning groups.

Student Activities:

The students will participate in a series of lectures, labs, and discussions. Each of these activities will include directions from the teacher. As the students follow these directions and work through the activities they should be encouraged to discuss with the other members of their group how they arrived at their conclusions and answers. Discussion of the abstract principles covered by this unit will help the students understand the basic principles that are being presented.

Evaluation:

Labs:

-- Work Sheets - Longitude and Latitude, Imagery, Weather.

-- Station Daily Report, with supporting documents.

-- Build an Astrolabe.

-- Plot coordinates and locate cities on world map.

Calculate Times:

-- Greenwich Mean Time (GMT) Zulu and Eastern Standard.

-- Predict polar orbiting satellite window.

Unit Exam:

Materials:

Handouts, A-V equipment, lab materials, maps, overhead material, Satellite Video Films, GOES Transmission Schedule, orbit prediction chart, and the weather station.

APPENDIX B

UNIT 2

Introduction: The students in this unit will be assigned to a treatment or comparison group. The treatment group members will operate the weather station for ten days while the comparison group participates in group of traditional lessons. The following unit outlines the activities of each group.

Title of Unit: Weather Satellite Theory and Operation

Grade Level: 7-9

Length of Unit: Ten days

Unit Description and Goal:

This unit will permit the students to operate a the weather center and the satellite receiving system. This final lesson of ten days allows the students to apply their weather knowledge by receiving and interpreting weather data on a daily basis.

Objectives of the Unit:

The students will:

- -- collect local weather information.
- -- complete a series of time conversions from GMT (Zulu) to Eastern Standard Time (EST) and back.
- -- obtain and plot regional and national weather.

-- plot and predict windows for polar orbiting satellites.

-- make a weather prediction.

-- apply basic weather forecasting knowledge skills to problem situations.

Unit Outline:

Treatment Group:

Operation of the Weather Station.

Comparison Group:

Lesson 1 - Relative Humidity

Lesson 2 - Measuring Dew Point

Lesson 3 - Making a Cloud

Lesson 4 - Effects of Air Mass on Weather

Lesson 5 - Meteorology Demonstration

Lesson 6 - Cloud Identification and Critical Thinking

Lesson 7 - Review of Terms

Lesson 8 - Interpreting Diagrams

Teacher Activities:

Organize students into groups of three each. These groups will be selected heterogeneously by ability.

Treatment Group

When the students begin their assignment time on the center hand them a copy of the Weather Station Daily Report and the Student Guide to Weather Satellite Image Interpretation. These instruction sheets and the guide instruct students on how to operate the weather center with minimal assistance from the instructor.

Comparison Group

Follow the instructions outlined in each lesson. Make a concerted effort to present the material in a thorough and interesting manner. Make a special effort to cover all of the objectives listed in the lesson plans (see Appendix C, sample lesson).

Student Activities:

This is a cooperative effort by the students. Each member of the group will be graded individually and as part of their group. They should work together and help each other to insure a good group grade.

Treatment Group

Follow the instructions that are listed on the Weather Station Daily Report. They will be graded on how well they answer the questions in the Weather Station Daily Report.

Comparison Group

Follow the instructions of the teacher and participate in the labs and lectures presented each day of the experiment.

Evaluation:

Treatment Group

-- Weather Station Daily Report.

Comparison Group

-- Workbook sheets and written papers

Materials:

Treatment Group

-- The weather station, Weather Station Daily Report, Student Guide to Weather Satellite Image Interpretation.

Comparison Group

-- Sliver Burdett Earth Science Teacher Resource Package, overhead projector, Televison-VCR, Media Center, miscellaneous lab materials.

APPENDIX C

COMPARISON GROUP SAMPLE LESSON

LESSON PLAN 5

Title of Lesson: Meteorology Demonstration

Topic: Presentation of a meteorology demonstration to the entire class.

Preview: This lesson is designed to involve the students in science research. The students will pick a weather related demonstration, research it in the media center, and then present it to the class.

Curricular Connections/Integration: Science (hands-on, inferring, recording, applying, predicting, and hypothesizing), Language Arts (vocabulary, writing, research skills, speaking), Mathematics (measuring).

Objectives of the Lesson:

The students will:

-- use the Scientific Method to locate and prepare a teacher approved weather related laboratory demonstration or weather instrument for an oral presentation in front of the class that answers all five of the data iterpretation questions listed on the Lesson Plan 5 lab sheet.

Suggested Time: 50 minutes.

Materials/Resources: Defined by the project that is chosen. Specialized lab and safety equipment should be available from classroom equipment. All other materials should be provided by the students.

SUGGESTIONS FOR TEACHING THE LESSON:

Opening the Lesson: Assign a group to this lab. Instruct them to select a weather related demonstration that must be presented to their classmates. Discuss choices like hurricanes, types of clouds, barometric pressure, and tornadoes. Then approve the topic they will present. Instruct the students to go to the media center or use classroom resources to develop and organize their presentation. The demonstration should be outlined in writing using the scientific method as taught in a previous lesson. Tell them that they must have their demonstration prepared within two days. This will insure that all the presentations are developed in time to present after the labs have been completed.

Developing the Lesson: When the students have developed a plan, help them locate any material that can be furnished from the school's supplies. Any other supplies, such as balloons, candles, cups, and dowel rods should be brought from home. The students should decide who will present each part of the demonstration.

Closing the Lesson: Review with the group how they plan to present the demonstration. Check to see that the project they are presenting is the one that was approved. Offer any suggestions you may have. Review any additional material needs that may have developed. When the groups have finished the Unit 1 Labs, allow them to present the demonstrations the day before the Unit 1 test.

EVALUATING THE LESSON:

Key questions or activities for the students:

1) Written Outline - check to see that they have completed their outline of the presentation using the scientific method.
2) Did the students use the appropriate procedures and safety precautions to complete the demonstration?
3) Observe the oral presentation and demonstration methods.

Student Lab Sheet for Lesson Plan 5

Time Suggested: 50 minutes

Objectives: Using the Scientific Method locate and prepare a teacher approved weather related laboratory demonstration or weather instrument for an oral presentation in front of the class that answers all five of the data interpretation questions listed on the lab sheet.

Materials: Defined by the project chosen. Specialized lab equipment should be available from the classroom materials. Other materials should be provided by the students.

Procedures: Your team should select library books or sample texts to find appropriate weather related activities to present to your classmates. When you have decided on your project, you should obtain teacher approval and establish the dates of completion and presentation to the class. You should decide which one of you will be responsible for completing each part of the assignment. The entire project should be completed in five class days. Specialized materials may be used from the class laboratory. Other materials such as candles, balloons, jars, or dowel rods should be brought from your home or the home of your teammates. You should not choose a project that you will be unable or unwilling to complete within the specified time so find something which piques your interest. The project should be outlined using the scientific method. A copy of the book page showing the project should be made so that you will be able to refer to it as needed. Make sure your project has been approved by your teacher.

Data and Investigation Interpretations:

1. What is the name of your activity?
2. What is the purpose of your demonstration?
3. What were the materials needed?
4. How did you participate in the project? What did your teammates do?
5. How long did the project take?

Evaluation: Did you enjoy the learning activity? How would you change it to improve learning?

APPENDIX D

TREATMENT GROUP SAMPLE LESSON

WEATHER STATION DAILY REPORT

Student Team Names ______________________________

____

____

Duty Date: __________ Time: From ________ To ________

Welcome weather specialist !!!! Now that you and your team members have been licensed to operate the weather center, you are about to start your ten day assignment. You have plenty of time to complete this project so take your time.

Read each section carefully.

If you have any additional questions ask your teacher for help. Good Luck, and enjoy your assignment.

**** Weather Station Daily Report Instructions ****

Turn to the next page. Collect the local weather information requested each day using the sheets on pages 2 thru 11 labeled:

LOCAL WEATHER INFORMATION

Once you have completed the LOCAL WEATHER INFORMATION sheet, place this data on the chart labeled LOCAL MONTHLY WEATHER REPORT on page 12.

LOCAL WEATHER INFORMATION

DAY 1

TODAY'S DATE __________

YOUR DUTY TIME ___________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current ___________

24 hr. High ___________

24 hr. Low ___________

2) Barometric Pressure Reading ___________

3) Rainfall (only 1st period records) ___________

4) Windscope readings

Direction ___________

Speed ___________

5) Relative Humidity

Dry Bulb ___________ Wet Bulb ___________

Relative Humidity ___________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 2

TODAY'S DATE ________

YOUR DUTY TIME ________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current ________

24 hr. High ________

24 hr. Low ________

2) Barometric Pressure Reading ________

3) Rainfall (only 1st period records) ________

4) Windscope readings

Direction ________

Speed ________

5) Relative Humidity

Dry Bulb ________ Wet Bulb ________

Relative Humidity ________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 3

TODAY'S DATE ________

YOUR DUTY TIME ________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current ________

24 hr. High ________

24 hr. Low ________

2) Barometric Pressure Reading ________

3) Rainfall (only 1st period records) ________

4) Windscope readings

Direction ________

Speed ________

5) Relative Humidity

Dry Bulb ________ Wet Bulb ________

Relative Humidity ________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 4

TODAY'S DATE ________

YOUR DUTY TIME ________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current ________

24 hr. High ________

24 hr. Low ________

2) Barometric Pressure Reading ________

3) Rainfall (only 1st period records) ________

4) Windscope readings

Direction ________

Speed ________

5) Relative Humidity

Dry Bulb ________ Wet Bulb ________

Relative Humidity ________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 5

TODAY'S DATE __________

YOUR DUTY TIME __________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current __________

24 hr. High __________

24 hr. Low __________

2) Barometric Pressure Reading __________

3) Rainfall (only 1st period records) __________

4) Windscope readings

Direction __________

Speed __________

5) Relative Humidity

Dry Bulb __________ Wet Bulb __________

Relative Humidity __________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 6

TODAY'S DATE __________

YOUR DUTY TIME __________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current __________

24 hr. High __________

24 hr. Low __________

2) Barometric Pressure Reading __________

3) Rainfall (only 1st period records) __________

4) Windscope readings

Direction __________

Speed __________

5) Relative Humidity

Dry Bulb __________ Wet Bulb __________

Relative Humidity __________

6) Compile data on the Local Monthly Weather Report

____

LOCAL WEATHER INFORMATION

DAY 7

TODAY'S DATE __________

YOUR DUTY TIME ___________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current ___________

24 hr. High ___________

24 hr. Low ___________

2) Barometric Pressure Reading ___________

3) Rainfall (only 1st period records) ___________

4) Windscope readings

Direction ___________

Speed ___________

5) Relative Humidity

Dry Bulb ___________ Wet Bulb ___________

Relative Humidity ___________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 8

TODAY'S DATE __________

YOUR DUTY TIME ___________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current ___________

24 hr. High ___________

24 hr. Low ___________

2) Barometric Pressure Reading ___________

3) Rainfall (only 1st period records) ___________

4) Windscope readings

Direction ___________

Speed ___________

5) Relative Humidity

Dry Bulb ___________ Wet Bulb ___________

Relative Humidity ___________

6) Compile data on the **Local Monthly Weather Report**

____

LOCAL WEATHER INFORMATION

DAY 9

TODAY'S DATE __________

YOUR DUTY TIME __________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current __________

24 hr. High __________

24 hr. Low __________

2) Barometric Pressure Reading __________

3) Rainfall (only 1st period records) __________

4) Windscope readings

Direction __________

Speed __________

5) Relative Humidity

Dry Bulb __________ Wet Bulb __________

Relative Humidity __________

6) Compile data on the Local Monthly Weather Report

____

LOCAL WEATHER INFORMATION

DAY 10

TODAY'S DATE __________

YOUR DUTY TIME __________

Fill in the correct weather measurements listed below and then complete the Local Monthly Weather Report in this packet.

1) Temperature

Current __________

24 hr. High __________

24 hr. Low __________

2) Barometric Pressure Reading __________

3) Rainfall (only 1st period records) __________

4) Windscope readings

Direction __________

Speed __________

5) Relative Humidity

Dry Bulb __________ Wet Bulb __________

Relative Humidity __________

6) Compile data on the Local Monthly Weather Report

____

LOCAL MONTHLY WEATHER REPORT

MONTH AND YEAR ______________________________

DATE	TEMP	BRMTR	HUMID	W DIR	W SPD	CLOUD	PRECP	Your Forecast for Tomorrow ****
Ex.	56F	30.19	98%	NW	12	strat	R 1.3	Clear & Cool
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								

DAY = Day of the month of the observation
TEMP = Temperature - Fahrenheit
BRMTR = Barometric Pressure reading - inches
HUMID = Relative Humidity - percent
W DIR = Wind Direction
W SPD = Wind Speed
CLOUD = Cloud Cover - major type: cumulus, stratus, etc.
PRECP = Precipitation - type and amount in inches.

LOCAL MONTHLY WEATHER REPORT

MONTH AND YEAR ______________________________

DAY	TEMP	BRMTR	HUMID	W DIR	W SPD	CLOUD	PRECP	Your Forecast for Tomorrow ****
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

Design a graph using the attached graph paper that allows you to compare the measurements listed above. If the month is not complete use the figures for the previous month.

STATE AND NATIONAL WEATHER INFORMATION

Instructions on how to go to the Weather Brief directory. Use the following instructions to locate the weather information you will need to complete questions 7 thru 11.

Turn on the IBM computer. Wait for the screen to show the C:\> prompt. Type in cd\wb5 and hit the <ENTER> key. C:\WB5> will appear on the screen. Type in: runwb.

A blue screen will appear with the menu listing several options. Choose the DISPLAY INFORMATION option by hitting the down arrow key. When the shadow box covers the DISPLAY INFORMATION option hit the <ENTER> key.

Review the directory. Each one of these files will be used to answer questions 7 thru 11.

7) To answer question 7 press the number 2 key and then hit the <ENTER> key. A list of the major cities throughout the state of Georgia will appear on the computer screen. Use these statistics to complete your answers.

Complete the weather information for the following cities:

Savannah, Ga.

Barometric Pressure ________ Temperature ________

Precipitation Amount ________ Humidity ________

Wind: Speed ________ Direction ________

Augusta, Ga.

Barometric Pressure ________ Temperature ________

Precipitation Amount ________ Humidity ________

Wind: Speed ________ Direction ________

Valdosta, Ga.

Barometric Pressure	________	Temperature	________
Precipitation Amount	________	Humidity	________
Wind: Speed	________	Direction	________

Atlanta, Ga.

Barometric Pressure	________	Temperature	________
Precipitation Amount	________	Humidity	________
Wind: Speed	________	Direction	________

Compare this data to the readings you have collected in your school. How are they alike and different? Why?

____

____

____

____

____

8) To answer question 8 press the number 3 key and then hit the <ENTER> key. A radar picture of the Southeastern United States should appear on the screen.

What areas will receive rainfall today?

____

____

____

____

____

9) To answer question 9 press the number 4 key and then hit the <ENTER> key. The US fronts map should appear on the computer screen.

What type of front is covering your area today? Will there be a change in the next two days? Why?

10) To answer question 10 press the number 6 key and then hit the <ENTER> key. The US Lows temperature forecast map should appear on the screen.

What part of the U.S. will be experiencing freezing temperatures? Where are the coldest low temperatures?

11) Pull up the US pressure systems map and compare it to the US fronts map you used to answer question 9. Is there any relationship between the two? What is the weather like behind a cold front?

SATELLITE WEATHER INFORMATION

12) Compute the fly over time for the following polar satellites "EACH DAY" using the directions for the Bird-dog prediction software below.

NOAA 9	________
NOAA 10	________
NOAA 11	________
NOAA 12	________
A current METEOR	________

- Instructions for Bird-dog satellite prediction program -

a. After the C:\WB5> prompt type in cd\bird-dog. Press <ENTER>.

b. After the C:\Bird-dog> prompt type in bd. Press <ENTER>.

c. When BIRD DOG appears on the screen, press the space bar.

d. The program will draw a map of the world complete with latitude and longitude lines. After this map is drawn, the system is ready for use.

e. The function key F4 will predict the path of a satellite.
The arrow keys near the numeric key pad at the lower left
hand side of the keyboard allow you to pick which satellite you wish to predict. Choose the satellite that you want a prediction for with these keys and then press the F4 function key at the top of the key board.

f. The satellite on the screen will begin moving over the world map on your screen. Each time that the satellite passes within range of your receiving station a box will appear on your screen. After the satellite passes over and creates the box that you wish to view, press "Esc" to obtain a listing of the times and the coordinates of the pass. Press F6 to print each of the predictions you have obtained. When this is completed press "Esc" once to return to main menu.

g. Pressing shift and F2 will clear the screen of prediction lines. Repeat this process for each satellite that you are tracking. To exit Bird-dog press the End Key.

13) Once you have obtained your satellite over pass predictions, plot the satellite pass each day on a world map. These maps are labeled World Maps and located in the back of this packet.

****

Image Interpretation Training

14) Take out the "**STUDENT GUIDE TO WEATHER SATELLITE IMAGE INTERPRETATION**". Turn to page 7 and follow the instructions in the guide. This section will explain how to load and manipulate satellite images.

You must complete each part of section A and then answer the questions in section B on the answer sheets in the back of this packet (pages 20, 21, and 22).

NOTE: Do not capture an image until you have completed all three answer sheets in the back of this packet.

****

Capture an Image

NOTE: Use "**THE STUDENT GUIDE TO WEATHER INTERPRETATION**" if you need help. Turn to section B for instructions that will help you capture the images requested below.

15) Follow the directions for ONE of the following:

a) If an APT satellite is passing over during your watch capture the image. Save the image with a name using the format in the guide. ________

b) If an APT satellite is not passing over capture the most recent image from the VCR. See the satellite guide for instructions. Save this image with your team name as the title. ________

16) The Geostationary satellite Meteosat is on loan to the U.S. Weather service at this time. Our station is receiving images from this satellite located over the Atlantic Ocean. A time table for the Meteosat image broadcasts is located in the back of this work sheet.

Ingest and save any U.S. Meteosat Images that are broadcast during your watch. Compare todays images to todays Weather Brief information.

____

17) Loop the last five Meteosat or GOES-WEFAX images and look for weather systems that will effect your area.

____

18) Is the weather center working correctly?

Yes ________ No ________

If no, what repairs are needed?

____

SIGNED________________________

POLAR SATELLITE VISUAL IMAGE QUESTIONS AND CONSIDERATIONS ANSWER SHEET

Fill in the answers for questions 1 thru 8 in the spaces furnished below.

1) ________________________ 5) ________________________

2) ________________________ 6) ________________________

3) ________________________ 7) ________________________

4) ________________________ 8) ________________________

Fill in the answers for questions 9, 10, and 11 in the space furnished below. Make sure that your answers are complete and specific.

9) ____

____

____

____

____

10) ____

____

____

____

____

11) ____

____

____

____

____

POLAR SATELLITE INFRA-RED IMAGE QUESTIONS AND CONSIDERATIONS ANSWER SHEET

Fill the answers for the following questions in the spaces furnished below. Write neatly.

1) Altocumulus ____________ Cirrus ____________

2) Cloud Height ____________ Cloud Type ____________

3) ________________________

4) a) Baltimore approx. temperature: ____________

Washington approx. temperature: ____________

b) Approx. temperature of countryside: ____________

5) ________________________

6) ________________________

7) ________________________

8) a) ____

b) ____

9) ________________________

____

GOES-WEFAX INFRA-RED IMAGE QUESTIONS AND CONSIDERATIONS ANSWER SHEET

Fill the answers for the following questions in the spaces furnished below. Write neatly.

1) a) ------------------------------------

b) ------------------------------------

c) -------

2) ------------------------------------

3) ------------------------------------

4) ------------------------------------

5) a) ------------------------------------

b) ------------------------------------

6) ------------------------------------

7) ------------------------------------

8) ---

----

9) ---

APPENDIX E

WEATHER CONCEPT TEST

DIRECTIONS. Read each statement and question carefully. Choose the correct answer from the list below each statement and then fill in the blank space on the answer key with a number two pencil.

1) Which satellite would a scientist use to determine the temperature variations of ocean currents.

    a) WEFAX
    b) GOES
    c) Communication
    d) TIROS

2) Longitude lines measure the distance:

    a) west and east of the equator.
    b) east and west of the prime meridian.
    c) north and south of the equator.
    d) east and west of the ZULU parallel.

<u>Use the following information to answer question 3.</u>

Sir Francis Bacon once stated, "every wind has its weather". He believed each change in wind direction brought changes in temperature and moisture conditions. Assume that you have been observing the weather in your area during the month of February for twenty-four hours.

You have noticed:

- It has rained for the last twelve hours and just now stopped.
- The wind started blowing out of the east before the rain and then shifted to southerly and finally northwest.
- The temperature is dropping at a steady rate.

3) What type of system is moving into the area?

    a) low pressure
    b) a cyclone
    c) high pressure
    d) wind system

4) A jar is filled half way with luke warm water. You insert a thermometer into the water in the jar and then add ice in the water until the glass sides start to show condensation. The temperature that you recorded at this point reflects the:

a) dew point
b) wind speed
c) relative humidity
d) air pressure.

Use the following information to answer questions 5 and 6.

Picture # 5

5) What type of cloud is pictured above?

a) cumulus
b) stratus
c) cirrus
d) Cumulonimbus

Picture # 6

6) What type of cloud is pictured above?

a) cumulus
b) stratus
c) cirrus
d) Cumulonimbus

7) Hurricanes are:

a) large high pressure systems.
b) large low pressure systems.
c) small pressure cells.
d) anti-cyclones

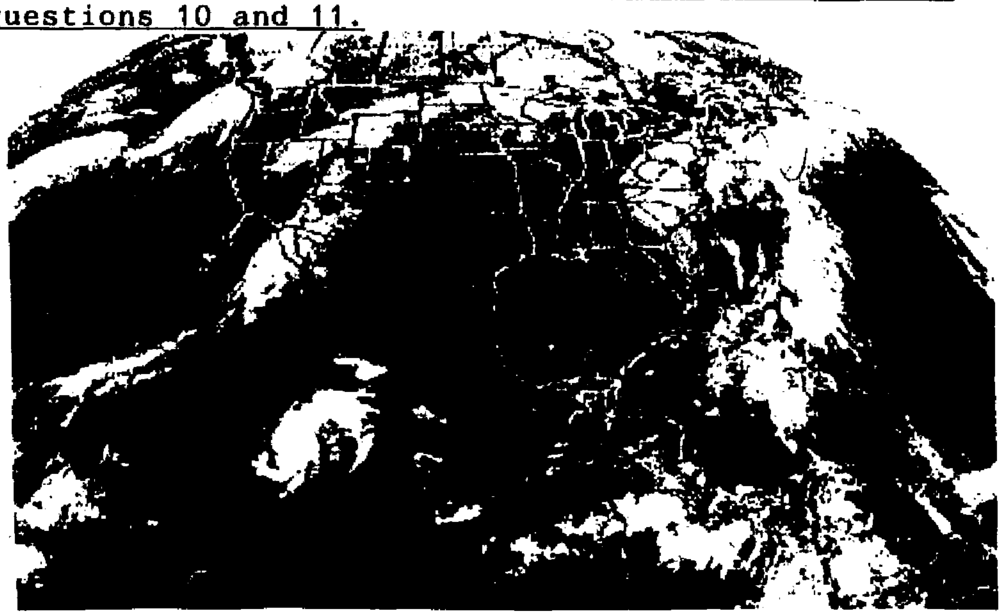
8) You have been given Greenwich Mean Time for two satellites that will pass over your ground station. They are 15:25 and 22:16. What is the Eastern Standard Time that these satellites will pass over?

a) 10:25 A.M. and 5:16 P.M.
b) 10:25 A.M. and 6:16 P.M.
c) 10:25 A.M. and 5:16 A.M.
d) 11:25 A.M. and 6:16 P.M.

9) Tell the approximate wind speed and direction for the following symbol.

a) southeast, 5 knots
b) northeast, 58 knots
c) southwest, 2 knots
d) northwest, 2 knots

Use the GOES satellite picture below to answer questions 10 and 11.



10) The Pacific Ocean has a tropical storm forming south of the Baja Peninsula. What general direction will the prevailing winds push it?

a) north
b) west
c) east
d) south

11) What type of pressure system is covering the east coast of the United States?

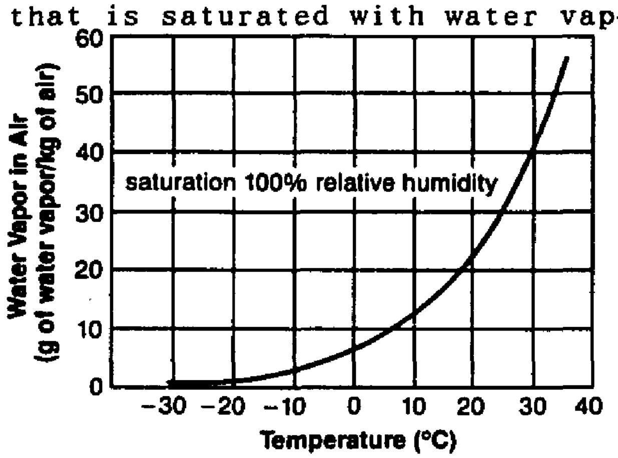
a) low
b) occluded
c) high
d) ridge

12) Tell the approximate wind speed and direction for the following symbol.

a) northwest, 10 knots
b) northwest, 49 knots
c) northeast, 10 knots
d) northeast, 49 knots

<u>Use the following chart to answer questions 13 and 14.</u>

This Relative Humidity-Saturation Curve shows how much water vapor (in grams) can be contained in 1 kilogram of air that is saturated with water vapor.



Taken from: Earth Science - Teacher's Resource Center
Macmillian Publishing Co., 1989.

13) The warmer the air temperature, the ______________ water vapor the air can hold.

a) greater the amount
b) lesser the amount of
c) same amount of
d) cannot tell

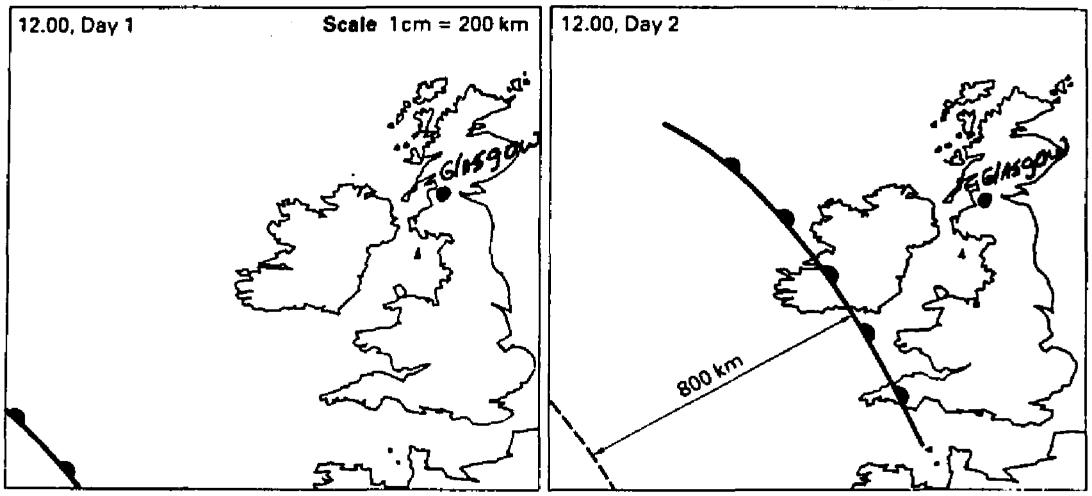
14) One kilogram of air holding 25 grams of water vapor would be saturated at about:

a) 18 degrees Celsius
b) 20 degrees Celsius
c) 23 degrees Celsius
d) 27 degrees Celsius

15) You have determined that each pixel on your screen represents an area equal to four square miles. How many pixels would be needed to represent an area of 244 miles.

a) 61
b) 71
c) 244
d) 610

Use the following map to answer question 16.



16) What type of front is this?

a) occluded front
b) cold front
c) stationary front
d) warm front

<u>Use the following picture to answer questions 17 and 18.</u>

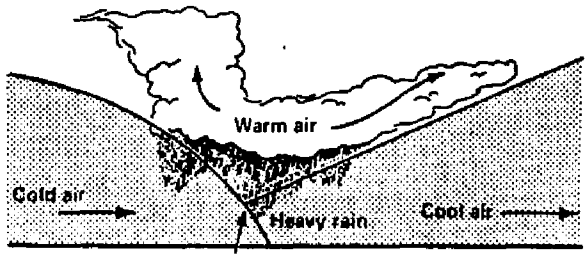
17) A general description of the probable weather for the coastal area of Louisiana, for the next 24 is:

a) heavy rain, winds 5 to 10 m.p.h.
b) light rain, winds 35 to 45 m.p.h.
c) heavy rain, winds reaching over 74 m.p.h.
d) clear skies, winds 15 to 20 m.p.h.

18) The weather forecast for Phoenix during the next 24 hours will be:

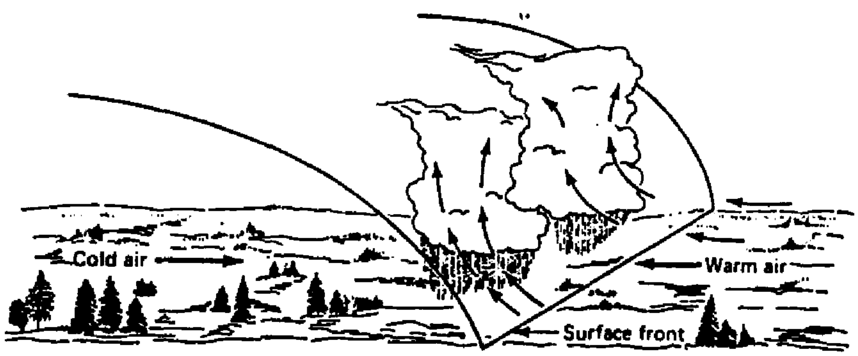
a) hail
b) rainy
c) clear
d) snow

<u>The pictures shown below are cross sections of various types of fronts. Use these pictures to answer questions 19, 20, and 21.</u>



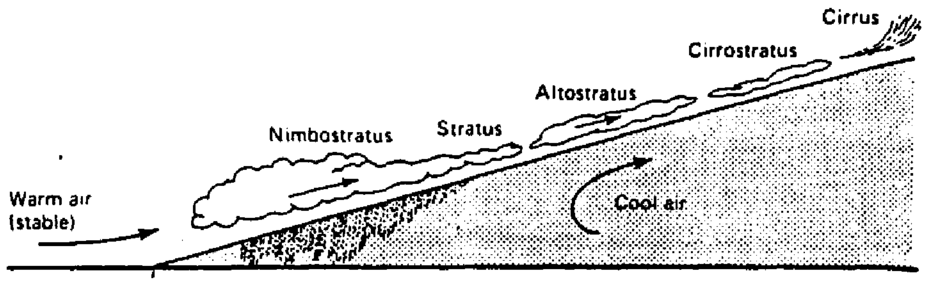
19) Match the picture above to the correct name of the front.

a) cold
b) warm
c) stationary occlusion
d) cold front occlusion



20) Match the picture above to the correct name of the front.

a) cold
b) warm
c) stationary
d) occluded

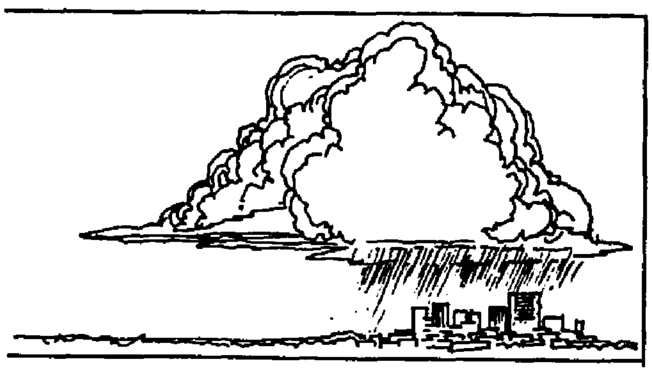


21) Match the picture above to the correct name of the front.

a) cold
b) warm
c) stationary
d) occluded

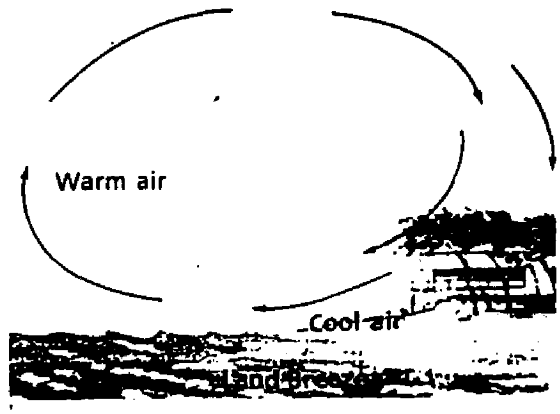
22) What type of satellite has a stationary equatorial orbit.

a) American GOES
b) Russian METEOR
c) American TIROS
d) Russian MIR



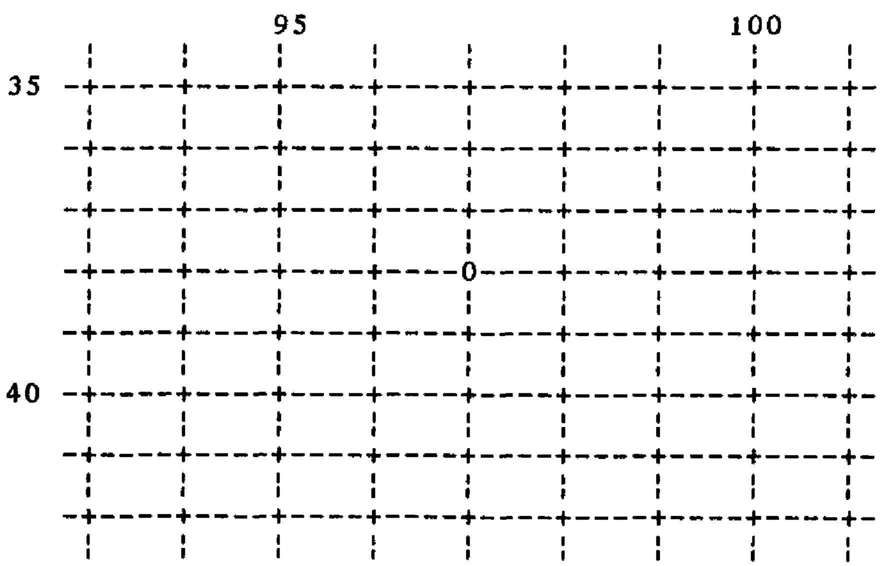
23) The cloud type pictured above is often associated with two types of precipitation.

a) snow and sleet
b) snow and hail
c) rain and hail
d) frost



24) In the summer months, what time of day would the conditions illustrated in the picture above usually occur?

a) 10:00
b) 19:00
c) 13:00
d) 05:00



25) If the chart above was a grid section from a world atlas, identify the approximate coordinate for the 0 mark.

a) 38 degrees S, 97 degrees E
b) 38 degrees S, 97 degrees W
c) 38 degrees N, 97 degrees W
d) 38 degrees N, 97 degrees E

26) Compared with the air pressure at higher altitudes above 6,000 feet, the air pressure at sea level would be:

a) the same
b) greater
c) less
d) cannot determine

B. MATCHING ITEMS

DIRECTIONS. Match each of the following definitions in COLUMN A with the appropriate term in COLUMN B and then fill in the blank space on the answer key with a number two pencil. Each term in COLUMN B is used only one time or not at all.

COLUMN A - DEFINITION	COLUMN B - TERMS
27) instrument that measures air temperature.	a. anemometer
28) movements of air caused by the warming and cooling of air.	b. relative humidity
29) instrument that measures wind speed.	c. air pressure
30) weight of the atmosphere pressing down on the earth's surface.	d. thermometer
31) amount of water vapor in the air compared with the amount that could be held in the air at a given temperature.	e. convection currents

APPENDIX F

The Estes Attitude Scales

Please darken the appropriate space on the accompanying answer sheet to match your response to the following questions. If you have any questions please ask. Do not mark on the attitude scale, only the answer sheet.

5 will mean "I strongly agree"

4 will mean "I agree"

3 will mean "I cannot decide"

2 will mean "I disagree"

1 will mean "I strongly disagree"

English

1. Work in English class helps students do better work in other classes.
2. The study of English is a waste of time.
3. Writing papers for English class is good practice.
4. Almost any subject is better than English.
5. English courses are some of the worst courses.
6. Studying English is less tiring than studying other subjects.
7. English is a subject with very little real value.
8. English is boring.

9. Studying English in college would be valuable.

10. Students should be required to take English every year.

11. Most literature is dull.

12. English is fun.

13. Time spent in English class is time well spent.

14. English is one class I can do without.

15. English class is too short.

Science

16. Field trips in science are more fun than those in other subjects.

17. An understanding of how the Earth changes helps make a better world.

18. Studying science is a waste of time.

19. A deeper love of nature comes from the study of science.

20. There is too much memory work in science.

21. Science is interesting.

22. Science class is usually fun.

23. Science courses are worth the time and effort they take.

24. Cutting up animals in class is silly.

25. It is fun to figure out how things work.

26. Books about science are boring.

27. Many good hobbies come from the study of science.

28. Science teaches people to think.

29. Students should not be required to take science courses.

30. Exploring outer space may prove useful to mankind.

Social Studies

31. Much of what is taught in social studies is not important.

32. There is too much to worry about in the present for us to worry about the past.

33. Knowledge of the past helps us understand the present.

34. Social studies teachers are usually good teachers.

35. Social studies is the same year after year.

36. The study of history in college would be a good choice.

37. Social studies courses should not be required courses.

38. Social studies is dull.

39. Studying the history of different people of the world helps us understand them.

40. A student can often use what he learns in a social studies course.

41. Man profits little from the study of the past.

42. Social studies is interesting.

43. Social studies has little to offer the average student.

44. Almost any course is better than a social studies course.

45. If social studies changes, it is from bad to worse.

APPENDIX G

March 30, 1993

Martha Rossnagle
Silver Burdett & Ginn
250 James St.
Morristown, NJ 07960

Re: Silver Burdett & Ginn
EARTH SCIENCE
Review and Skill Masters
ISBN 0-382-13470-2 (1987)

Dear Ms. Rossnagel,

Per your instructions I am sending this letter to request written permission to use several of your master sheets from Chapters 18 and 19 in my dissertation. I will be comparing the effectiveness of a unit that includes the use of a computerized weather center to a traditional unit that includes your Review and Skill Master sheets.

The purpose of this study is to determine if the weather center is an effective teaching tool. I would be willing to share my results with you when I have completed the study. If you would like a summary of results please say so in your letter.

I appreciate your assistance in this matter and look forward to your reply. Thanks!

Sincerely Yours,

Richard Behrens
Doctoral Student
University of Southern Mississippi
Dept. of Curriculum and Instruction
SS Box # 5026
Hattiesburg, MS 39406-5026

April 5, 1993

Permission is granted to use the above requested material for the purpose stated. It is understood that no commercial use will be made and that this permission applies only to your dissertation. We woulld appreciate a copy for our files.

Martha Rossnagel
Rights & Permissions

APPENDIX H

University of Southern Mississippi
Office of Research and Sponsored Programs

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

DATE: July 20, 1993

TO: **Richard Behrens**

Your Project, **The Effect of a Weather Satellite Receiving Station on Eighth Grade Student Achievement and Attitudes Toward Science**, has been determined to fall under one of the following categories:

1. Approved under the provisions for Expedited Review.
2. Approved by the HSPRC.
3. Disapproved by the HSPRC.

XXX 4. Exempt from formal HSPRC action.

The approved project period is from **10/15/93 - 11/15/93**. If your project is continued after this period, please resubmit another application for review.

CRITERIA FOR REVIEW

- o risks to subjects are minimized;
- o risks to subjects are reasonable in relation in anticipated benefits;
- o selection of subjects is equitable;
- o informed consent is adequate and appropriately documented;
- o where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of subjects;
- o where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of data; and
- o appropriate additional safeguards have been included to protect vulnerable subjects.

Donald R. Cotten
Chairman

7/20/93
Date

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VITA

PERSONAL DATA:

Name:	Richard P. Behrens, Jr.
Address:	Rt. 3, Box 3110 Cleveland, GA 30528
Born:	Miami FL, 31 Dec 1950
Marital Status:	Married March 1972; two daughters
Other:	Health: Excellent; Height: 6' 1"; Weight: 188 Lbs.

EDUCATION:

Present:	Doctoral student at The University of Southern Mississippi, Hattiesburg, Mississippi Major: Elementary Education Minor: Science Education Degree: Ed.D. (graduation date: May, 1994)
Aug 1991	The University of Southern Mississippi, Hattiesburg, Mississippi; Major: Elementary Education Degree: Specialist in Education
June 1988	North Georgia College Major: Middle Grades Education Degree: Master of Education
March 1973	University of South Florida Major: Elementary Education Degree: Bachelor of Arts Honors: Dean's List; Studied the English Infant Schools at The University of London

Sep 1969- Jul 1970	Attended Miami Dade Junior College.
June 1969	Miami Killian Sr. High School - Diploma. Primary and Secondary Education - Dade County, Florida.

LICENSES:

State: Georgia Middle School teaching certificate.

FELLOWSHIPS:

1989 summer:	ERIM/NOAA Weather Satellite Seminar: Attended program sponsored by National Oceanic and Atmospheric Administration and NASA, to develop a curriculum for land-based satellite receiving stations in classrooms.
1987 summer:	EARTHWATCH Fellowship: Worked with the Smithsonian Institute on a study of the Arenal Volcano, in Costa Rica.

PUBLICATIONS:

National/ International (ref)

Behrens, R. P. (1993). Student guide to weather satellite image interpretation [simplified VGA version for schools]. Cleveland, MN: Satellite Data Services.

Behrens, R. P. (1993). Teacher's Lesson Guide to Weather Satellite Image Interpretation. Cleveland, MN: Satellite Data Services.

Behrens, R. P. (1993). Student guide to weather satellite image interpretation [Super VGA version] (Rev.). Cleveland, MN: Satellite Data Services.

State:

Behrens, R. P. (1990). Tomorrow's technology and weather in today's classroom. The Georgia Science Teacher, 31(1), 11-12.

Local:

Monthly astronomy articles for local community newspaper, The White County News.

EMPLOYMENT:

Aug 1993-Present:	White County Middle School. Teach Earth Science, Life Science, and Math.
Jan 1993-Aug 1993:	The University of Southern Mississippi. Graduate Assistant - Taught Introduction to Education; Participated in several educational research studies.
Aug 1986-Jan 1993:	White County Middle School - Taught eighth grade Earth Science, Math, Social Studies, Finance, and an exploratory archaeology class; coached eighth grade football.
May 1985-Aug 1986:	Self-employed - While working on my Georgia teaching certification, I bought and sold heavy construction equipment in the United States, the Caribbean, and South America.
Jul 1982-May 1985:	Florida Georgia Tractor Co., Inc. - A retail outlet for heavy construction equipment. Held position of Southeast Regional Manager.
Jun 1981-Jul 1982:	Miami Crushed Rock Co. - Held position of Sales Manager.

May 1979-Jun 1981: Florida Georgia Tractor Co., Inc. -Held position of heavy construction Equipment Salesman.

May 1973-May 1979: International Harvester Co. - Started work in the truck division as retail salesman; worked my way up to retail Sales Manager of the Tampa, FL branch, and District Sales Manager of Georgia and South Carolina.

Jul 1969-May 1973: Palmetto Ford Truck Sales, Inc. - Part-time work as truck driver to help finance undergraduate studies.

PRESENTATIONS:

State:

Behrens, R. P. (1992). Computers and weather in the classroom. Paper presented at the annual meeting of the Georgia Science Teachers Association, Columbus, GA.

Regional:

Behrens, R. P. (1993). Technology in the classroom. Paper presented at the annual meeting of The University of Southern Mississippi Educational Field Experience, Hattiesburg, MS.

Behrens, R. P. (1991). Weather satellite technology for today's classroom. Paper presented at the annual District meeting for the Georgia Science Teachers Association, Dahlonega, GA.

Behrens, R. P. (1990). Hands-on activities in sound for elementary students. Paper presented at the annual district meeting of the Georgia Science Teachers Association, Dahlonega, GA.

HONORS and AWARDS:

1993:	Recognized by Governor Zell Miller for contributions to the use of technology in education.
1992-1993:	White County Teacher of the Year. Semi-finalist for Georgia State Teacher of the Year.
1989-1990:	Recognized by Governor Joe Frank Harris for contributions to the use of technology in education.
	Taught Science for the Governor's Honor Program in the state of Georgia.

CONSULTATIONS:

1992:	Consultant to the Environmental Research Institute of Michigan, Inc. (ERIM), Ann Arbor, MI (organization of a national consortium for satellite education).
1992:	Science consultant for the Georgia Statewide Curriculum-Based Assessment Test, Atlanta, GA (item construction).

ASSOCIATION MEMBERSHIPS:

Kappa Delta Pi
Phi Delta Kappa
Georgia Science Teachers Association
National Science Teachers Association
National Earth Science Teachers Association
Professional Association of Georgia Educators

HOBBIES: Running; mountain hiking; and reading