The effects of a computer drill and practice program and a computer simulation program on students content aquisition and retention scores
by Sharon Ziegler Hulett

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Education
Montana State University

Abstract:
This study was designed to investigate the effects of a computer drill and practice program and a computer simulation program on students' content acquisition and retention scores.

The researcher's review, of the literature revealed disagreement as to the effectiveness of using a simulation approach for content acquisition. Very little information was found on the effectiveness of the drill and practice approach.

Fourth grade students at Emerson Elementary School, Bozeman, Montana, were randomly assigned to one of three treatment groups for instructional computing lessons in science-related material. The treatment groups were: 1.) drill and practice done individually (DP), 2.) simulation done individually (SI), and 3.) simulation done in a group of three (SG). Analysis of a pretest administered before treatment indicated that the treatment groups were equivalent.

Treatment consisted of two ten-minute instructional computing sessions. A posttest was administered immediately following each student's second round of treatment. The retention test was administered two weeks after the posttest.

Results of the data analysis indicated that students in all . three treatment groups showed significantly higher scores after treatment and retention. As there were no other apparent experiences with the subject matter at that time, it is reasonable to conclude that these gains were a result of the two ten-minute treatment sessions.

Comparisons of gain scores between each treatment group were made to determine if any treatment was superior. A significant difference between the pretest to posttest gain scores of the DP and SI treatment groups was observed. This difference favored the SI treatment technique. No differences were observed on any other gain score comparisons between treatment groups'.

The researcher concluded that all three instructional computing techniques were effective in promoting content acquisition and retention. The SI treatment appeared to be more effective than the DP treatment for promoting content acquisition. It is also evident that learning occurred even with the brief time on task allocated each of these instructional computing techniques.

STATEMENT OF PERMISSION TO COPY

In presenting this thesis in partial fulfillment of the requirements for an advanced degree at Montana State University, I agree that the Library shall make it freely available for inspection. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by my major professor, or, in his absence, by the Director of Libraries. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Signature Sharon Hulett

Date June 17, 1982

THE EFFECTS OF A COMPUTER DRILL AND PRACTICE PROGRAM AND A COMPUTER SIMULATION PROGRAM ON STUDENTS' CONTENT ACQUISITION AND RETENTION SCORES

by

SHARON ZIEGLER HULETT

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Education

Approved by:

Committee Chairman

Head, Major Department

Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana
June, 1982

ACKNOWLEDGEMENTS

The advice, guidance, and cooperation of many people were necessary for the completion of this study. The writer is particularly grateful to Dr. L. W. Ellerbruch for his professional expertise and time so generously given in the writing of this thesis. A sincere thank you is extended to Dr. Elnora Old Coyote and Professor Janis Bruwelheide for their suggestions and support.

The writer also thanks Nonnie Hughes, principal of Emerson School, for permission to conduct the study at Emerson School. The cooperation of Jon Johnson, July Kuhl, Doug Whitmer, and their very special students is greatly appreciated.

Special appreciation is expressed to the writer's husband and children for their cooperation, patience, and encouragement.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

ABSTRACT

This study was designed to investigate the effects of a computer drill and practice program and a computer simulation program on students' content acquisition and retention scores.

The researcher's review of the literature revealed disagreement as to the effectiveness of using a simulation approach for content acquisition. Very little information was found on the effectiveness of the drill and practice approach.

Fourth grade students at Emerson Elementary School, Bozeman, Montana, were randomly assigned to one of three treatment groups for instructional computing lessons in science-related material. The treatment groups were: 1.) drill and practice done individually (DP), 2.) simulation done individually (SI), and 3.) simulation done in a group of three (SG). Analysis of a pretest administered before treatment indicated that the treatment groups were equivalent.

Treatment consisted of two ten-minute instructional computing sessions. A posttest was administered immediately following each student's second round of treatment. The retention test was administered two weeks after the posttest.

Results of the data analysis indicated that students in all three treatment groups showed significantly higher scores after treatment and retention. As there were no other apparent experiences with the subject matter at that time, it is reasonable to conclude that these gains were a result of the two ten-minute treatment sessions.

Comparisons of gain scores between each treatment group were made to determine if any treatment was superior. A significant difference between the pretest to posttest gain scores of the DP and SI treatment groups was observed. This difference favored the SI treatment technique. No differences were observed on any other gain score comparisons between treatment groups.

The researcher concluded that all three instructional computing techniques were effective in promoting content acquisition and retention. The SI treatment appeared to be more effective than the DP treatment for promoting content acquisition. It is also evident that learning occurred even with the brief time on task allocated each of these instructional computing techniques.

CHAPTER 1

Introduction

There is little doubt that instructional computing has come to the attention of educators, students and the public. It is widely recognized that instructional computing via the microcomputer has great potential to affect education.

Even though schools are experiencing a budget depression, the nation's schools are purchasing microcomputers at an astounding rate. According to an editorial in "Educational Technology," January, 1981, the pessimists say the microcomputer will experience the same burst of interest and be followed by the same abandonment as did the learning and teaching machines of the late 1950's and early 1960's. It is stated in the editorial that this time the pessimists are wrong because computers are already too much a part of our lives to be eliminated from schools.

Although more and more schools are using microcomputers (Dickerson and Pritchard, 1981), there is still a significant amount of concern about how to make the best use of instructional computing in schools. Educators will need to give serious attention to the role of instructional computing in the schools.

If we agree that a major purpose of instruction is to facilitate learning, then it stands to reason that facilitation of learning should be one of the criteria in evaluating the role of instructional computing. Wade (1980), identified the following "instructional events". Those events were:

1. Gaining attention
2. Informing the learner of the objectives
3. Stimulating recall of prerequisite learnings
4. Presenting the stimulus material
5. Providing "learner guidance"
6. Eliciting the performance
7. Providing feedback performance
8. Assessing the performance
9. Enhancing retention and transfer

It is noted that not all of these events are contained in all instruction. The events contained in instruction depend upon the objectives intended (Wade, 1980).

Wade contended that evaluation of instructional computing programs falls into two categories. One category is the evaluation of programs as they are used. ". . . programs are good only as they are good for students." In that context, it was the intent of the author of this study to investigate two types of instructional computing programs as they are being used. One type is the drill and practice program and the other is the simulation program.

Statement of the Problem

In this investigation the effects of a computer drill and practice program were compared with a computer simulation program on cognitive acquisition and retention of science-oriented material for fourth grade students.

Need for the Study

The purpose of this investigation was to compare the test scores of students participating in a computer drill and practice program and students in a computer simulation program to see if one program indicated a propensity for cognitive acquisition and retention of content material.

In a review of the literature disagreement was indicated about whether a simulation approach promotes learning of factual knowledge (DeNike, 1976). DeNike cited four studies which compared simulation approaches to "traditional" techniques. Results from one study indicated that the simulation group outperformed the "traditional" group by a substantial margin on content tests. The results of another study proposed that the simulation approach is significantly related to gains in student achievement.

The opposite view was expressed in two other studies. In one study, students using a simulation approach were compared with a group whose treatment was similar except that the simulation periods were replaced by the lecture-discussion method. In this study, the control group made larger gains in factual and conceptual knowledge than the simulation group.

In the last study, it was reported that "the use of the simulation game 'Marketplace' resulted in a significant retardation of student learning of economics." According to DeNike, "It is unclear whether this state is due to the nature of the research or to the shortcomings of the instructional strategy."

It should be noted that these simulations are not computer simulations. In a search of the related literature very few studies were revealed comparing gains in or retention of factual knowledge by users of computer simulation programs. Many articles exist in which authors proclaim to recognize the potential of computer simulation programs as an instructional technique (Saltinski, 1981).

Critics of the drill and practice approach claimed that drill and practice with the computer does nothing that workbooks and worksheets are not already doing; and rather than actually freeing the user, the program locks the student into a fixed sequence of steps determined by the programmer.

Some of the benefits of drill and practice computer programs are described as individualizing the lessons to the student's need and giving immediate feedback. In a search of the literature, no studies were indicated as examining acquisition or retention of content using the computer drill and practice technique.

Drill and practice computer programs are the most frequently used type of instructional computing at this time (Billings, 1980). Computer simulation is referred to as one of the most promising areas of instructional computing. Because of the microcomputer's capabilities of rapid interaction, a new door is open for new experiences in learning. Through the use of computer simulations, we may have discovered a key to promote divergent thinking in learners (Steffin, 1981).

Instructional computing is here. If it is to serve the student effectively, we must investigate several aspects of that effectiveness. One of the major questions is whether or not certain types of instructional computing programs tend to promote content acquisition and retention.

In a search of the related literature a conflict was indicated as to whether or not a simulation approach promotes learning of factual knowledge. Very little information was found about retention of information gained by a simulation approach. It was the purpose of this study to investigate content acquisition and retention using a computer simulation approach. In this study it was also proposed to investigate the computer drill and practice approach as it relates to content acquisition and retention. At the time of this writing there appeared to be little information on content acquisition and retention using computer drill and practice programs.

Questions Addressed by This Study

Questions concerning students' performance through use of the instructional computing drill and practice and simulation techniques were investigated. The questions investigated were as follows:

1. Was there a difference in drill and practice scores from pretest to posttest?

2. Was there a difference in drill and practice scores from posttest to retention test?

3. Was there a difference in drill and practice scores from pretest to retention test?

4. Was there a difference in scores from pretest to posttest scores in the simulation done individually?

5. Was there a difference in scores from posttest to retention test scores in the simulation done individually?

6. Was there a difference in scores from the pretest to retention test in the simulation done individually?

7. Was there a difference in scores from pretest to posttest scores in the simulation done in a group?

8. Was there a difference in scores from posttest to retention test scores in the simulation done in a group?

9. Was there a difference in scores from pretest to retention test scores in the simulation done in a group?

10. Given a pretest and a posttest, was there a difference in students' content acquisition change scores for the following:

   a. the drill and practice program and the simulation done individually?

   b. the drill and practice program and the simulation done in a group?

   c. simulation done individually and simulation done in a group?

11. Given a posttest and a retention test, was there a difference in students' retention change score for the following:

   a. the drill and practice program and the simulation done individually?

   b. the drill and practice program and the simulation done in a group?

12. Given a pretest and retention test, was there a difference in students' retention change score for the following:

   a. the drill and practice program and the simulation done individually?

   b. the drill and practice program and the simulation done in a group?

c. simulation done individually and simulation done in a group?

Procedures Followed

The procedures of this study followed in chronological order.

Procedure One

Review of the literature. The first procedure was to complete an extensive review of the literature as it related to the use of drill and practice programs and simulation programs in instructional computing situations.

Procedure Two

Obtain permission. Permission from Bozeman School District 7 Administration was requested in order to carry out the study using fourth grade students from Emerson School. The school district's guidelines were followed in obtaining the permission. A meeting was held with the principal and participating teachers to explain what the study involved. A letter was sent to parents explaining the study and to assure them that the individual's data would remain confidential.

Procedure Three

Instrument development. An instrument was developed to use as a pretest, posttest, and retention test. The instrument was validated by Dr. Paul Markovits and Dr. Elnora Old Coyote, Montana State University elementary science education specialists. The instrument was tested for reliability by selection of students not used in the study. Two fourth grade classes at Longfellow School in Bozeman were used for reliability testing. The instrument was administered to them twice. The interval between the first and second administration was one week. A correlation coefficient was computed to determine the reliability.

Procedure Four

Assignment of students. Fourth grade students were randomly assigned with computer assistance to one of three instructional computing groups: 1.) drill and practice (DP), 2.) simulation done individually (SI), 3.) simulation done in a group of three (SG).

Procedure Five

Assignment of student numbers. Students in the study were assigned a student number which was used throughout the study for pretest, posttest, and retention test data gathering, recording, and analyzing. The purpose of the student number was to maintain confidentiality of individual scores and any other individual data collected throughout the study.

Procedure Six

Orientation of students. The students were told what was necessary for their involvement in the study. They were administered a pretest, which was then used to determine group equivalency and for later comparison with the posttest and retention test. A short introduction to the operation of the computer was given.

Procedure Seven

Treatment. Students were given the instructional computing lesson according to the group to which they were assigned.

Posttest. A posttest was given to the students one week after treatment.

Retention Test. A retention test was given to the students two weeks after the posttest.

Procedure Eight

Analysis. Using the data from the pretest, posttest, and retention test, means of all the groups were computed and compared statistically.

Procedure Nine

Summary. After all data had been compiled, a summary of the study was prepared.

Procedure Ten

Discussion, recommendations, and implications. Discussion of the study's findings, recommendations for further research, and implications for education complete this study.

Limitations

1. The site of the study was selected where the cooperation of the school district and the building principal could be obtained.

2. The simulation program was a modified version of a commercially prepared simulation. The modification was done by the researcher and a computer science graduate student.

3. The drill and practice program was created by a computer science graduate student under the direction of the researcher. The drill and practice program was created to coordinate with the subject matter contained in the simulation.

4. The classes used in the study were self-contained.

5. Because the study was conducted in only one school, in one city, the conclusions were applied only to that school.

6. The treatment and testing were administered by the researcher conducting the study.

Delimitations

The following delimitations of the study are identified:

1. This research did not attempt to compare classroom achievement and retention with the instructional computing achievement and retention.

2. The experimental treatment involved only two ten-minute lessons per student.

3. The study was limited to fourth grade students at Emerson School, Bozeman, Montana.

4. The posttest was administered immediately following each individual's last treatment session.

5. The retention test was administered two weeks following the treatment. The retention test was administered in the self-contained classroom to the entire class at one session. A one-day variation existed for some students from the end of posttesting to the retention testing.

6. This research did not attempt to measure divergent thinking that may have occurred in the simulation program.

Definition of Terms

The following key terms will be used in the study:

1. Drill and Practice Program. This type of program presents a problem for response by the user. The user is informed whether he is correct or incorrect. Depending upon the individual program, the user may be given another opportunity to try again or may be given the correct answer.

2. Instructional Computing. Instructional computing is information that is presented by some type of computer program with specific educational objectives.

3. Microcomputer. A microcomputer is an independent, self-contained unit. It does not depend upon any other computer system hookup for its operation.

4. Simulation Program. A simulation program sets up a choice of variables for the user to apply to an event that occurs or could

occur in a real-life situation. The user is given an opportunity to try out divergent approaches to situations.

Summary

Instructional computing is recognized as having great potential to affect education of students. At present time there are four types of instructional computing techniques. They are drill and practice, simulation, games, and tutorial. Currently simulation is looked upon as having potential to promote higher levels of thinking. There is conflict as to whether simulation can promote content acquisition.

If we are to realize fully the potential of instructional computing, we must know how it is affecting the students. To do this, it is necessary to explore how the various techniques are serving the students.

In this study, the test scores of students participating in a computer drill and practice program were compared with a computer simulation program. The comparison was made to see if it was indicated that one program might be more effective for cognitive acquisition or retention of content material. The results of this experimental study may be used to determine how each of the programs can be used to serve the student effectively.

Specific limitations, delimitations, procedures, and definitions were presented as they applied to the design and implementation of this study.

CHAPTER 2

Review of Literature

Education is a complex process. Educators face the task of providing learning situations that will benefit both the cognitive and affective domain of each student. Just what constitutes a successful learning situation for all children has not been resolved. New methods and media are continually being scrutinized as to the potential value they may have in contributing to the child's education. Curriculum committees revise, update, and innovate, hoping to meet the needs of the individual.

The microcomputer has surfaced as a medium that has captured the attention of educators. "Computers have become so prolific that educators can ignore them no longer" (Billings, 1980). Watts (1981) believes that, in order to reflect the needs of the students of today, computers must be implemented into the curriculum. According to Watts, "The challenge is there for all schools to successfully introduce computers and to develop their potential in education." The fact that the potential is there is emphasized by Stahl's statement (1979) that "The microcomputer is opening a fantastic array of possibilities for education." Ropes (1980), in his article "Bringing Microcomputers Into Schools," states that "Schools are on the threshold of the computer age . . . Those who have worked with microcomputers are strongly of the opinion that no other single piece of equipment can do as much for education." It is believed by those who have worked with microcomputers in education that the micro motivates students to a remarkable extent. Instructional computing via the microcomputer is unexcelled at providing opportunities for demonstration of student creativity and logical thinking. Application and value of instructional computing are possible in all areas of the curriculum. Instructional computing is effective in individualized review and practice of skills and can give immediate feedback on performance.

Drill and practice and simulations can be written to work in almost any curriculum. At the present time, drill and practice and games account for most of the instructional computer use in the elementary school (Billings, 1980). One explanation may be that drill and practice and games are easy to use with the traditional basic skills activities. Emphasis is being placed on the basic skills curricula by the developers of software for the microcomputer. Major publishers of textbooks and educational materials are in the process of producing basic skills curricula for use with the microcomputer (Holznagel, 1980). Science Research Associates has developed and is marketing mathematics and phonics programs. The mathematics program is a combination drill and practice with tutorial available when needed by the learner.

Teachers are under pressure to raise test scores and build skills. According to Billings (1980), drill and practice can "create better-skilled students. . ." Yoshida (1980) pointed out in his study that many educators tend to ignore the drill and practice technique needed to consolidate a concept. He feels that educators just move on to new concepts. In his study, he indicates three conditions that must be satisfied in order to have a successful drill and practice. The three conditions are sequencing, aptitude of the learner, and the type of drill and practice. The types of drill and practice, as he defines them, are "branched" or "fixed". A branched drill and practice is described as "adaptive to the ability of the learner." The fixed drill and practice is defined as one which "ignores the ability level of a learner and involves problems of all difficulty levels." Drill and practice through instructional computing can be set up as either branched or fixed. Instant feedback with opportunities for making corrections may be incorporated into drill and practice through instructional computing. Brisson (1980) points out one value of instructional computing as providing an opportunity to allow students to practice and learn on their own with immediate feedback on their progress. It is felt that a self-testing approach allows students the opportunity to improve on their own.

According to Taba (1967), "Curriculum is a system of teaching someone something by a process." It consists of the following elements:

1. The objective to be obtained
2. The selection and organization of content

3. The selection and organization of learning experiences to be provided.

4. The formulation and organization of the teaching strategies to be employed.

The three cognitive tasks involved in learning are: concept formation, interpretation, and application. A simulation can provide an opportunity to develop all three tasks defined by Taba. The primary emphasis of simulation, according to Cohen and Bradley (1978), is on "active rather than passive participation to give pupils a meaningful learning experience." The active participation leads to motivation which helps develop greater interest, which in turn leads to longer episodes for learning.

The increased sophistication in the development of graphics and animation adds another dimension to simulations. Important and novel kinds of learning experiences are possible through this method (Sagan, 1977). The future use of holographic images will add still another dimension to simulations. Holography incorporated into a simulation will make possible simulations which closely approximate real life. While the use of holography sounds like the ultimate in providing the learner with the best possible simulation, studies by Rigney and Lutz (1976) found that copying real life pictures were less effective in concept attainment than logical, animated or schematic representations of the real object. One of the strengths of simulation seems to be its ability to provide an abstract representation of the real event and allow students to analyze what occurs.

Simulation games have been in existence for some time. The microcomputer has made effective use of simulations by presenting situations that would otherwise be difficult to consider. The numerous variables and speed of processing and presenting the consequences of the user's decisions by the microcomputer makes simulations an area worth investigating.

Taba, Bloom and others remind us that to develop independent learners, the curriculum and instruction must contain goals and objectives that use higher-level thinking skills. Curriculum and instruction are still concerned with acquiring knowledge. According to Steffin (1981), "Much of elementary-secondary education today focuses on the development of convergent thinking skills. In many instances each student is expected not only to reach the same answer, but to apply precisely the same process as his or her classmates."

It is quite possible that the microcomputer is the vehicle which will promote divergent thinking in learners. Because of the microcomputer's capabilities of rapid interaction, a new door is opened for new experiences in learning. Through the use of computer simulations, we may have discovered a key to divergent thinking.

Steffin (1981) has set up three conditions which must be met to apply divergent thinking to intellectual/cognitive problems. These conditions are:

1. Rigerous criteria must be established to distinguish between acceptable and unacceptable solutions;
2. Strong, positive reinforcement must support both the problem solving process and those answers which increasingly approximate the criteria developed for an "ideal" response;
3. The instructional strategies which are employed must provide for immediate feedback to the learner, communicating the status of the particular process employed and of the solution obtained.

The microcomputer allows the learner to try out divergent approaches to problem solving. The learner discovers which approaches are most appropriate to achieve his objectives.

To evaluate computer simulations may neccesitate taking another look at the purpose of the particular simulation being used. It is possible that simulation may not be the method preferred if knowledge acquisition is the goal. Findings conflict on whether or not simulation promotes knowledge acquisition (DeNike, 1976).

According to Boysen and Thomas (1979), "Recent experiments have shown that the computer can be used effectively in simulation." Boysen and Thomas turned to computer simulation in order to overcome the problem of using students in the training of reading teachers. The simulation approach allowed incorporation of a wide variety of reading disabilities. Teachers practiced administering and evaluating informal reading inventory results through computer simulation. The teachers worked at developing skills at their own rate. The program allowed the teachers to repeat items as often as necessary in order to master the skills. In this particular simulation, teachers interacted with the simulated students by "correcting" the weaknesses. . .and observing changes in reading behavior. The program actually acted as a lab, giving the teachers the chance to experiment with the methods and theories learned in class. The program was evaluated "to determine its usefulness as a supplement to classroom instruction." The evaluation compared the mean posttest scores of trainees who received both computer and classroom instruction with those who received only classroom instruction. The mean pretest scores for both groups showed no significant difference. A significant difference appeared after treatment. Posttest scores showed a significantly higher mean score for the treatment group than for the control group. The control group then received the same treatment. After treatment, the control group received a second posttest. At that comparison, there was no significant difference between the two groups. An evaluation was made to discover the retention of the material over a four-week period. The results showed no significant loss of retention of the simulation material. Findings indicated that simulation was an effective method for the purpose described. According to Boysen and Thomas (1979), ". . .further plans call for the development of an instrument which will determine the extent of learning at the application level. It is at the application level where the simulation technique may have its greatest potential."

In a simulation study done by Shay (1980), which did not refer necessarily to computer simulation, he pointed out that there was skill acquisition for some in enhancing bargaining, persuasion, decision making, and communication. There was some evidence that simulation spurred integrative thought processes. As far as cognitive learning, Shay stated that, "If factual-intellectual outcomes are desired, simulation should not, perhaps, be the preferred teaching technique." On the other hand, there was no evidence from control-group experiments that simulations handicapped students in terms of cognitive learning and performance.

The commercially prepared program "Oregon Trail" was used with a group of students. In the program were simulated events that may have occurred as people made their way along the Oregon Trail. After completing the simulation, students were given a follow-up test. The test results indicated an increase in the students' recall of event-related facts (Osborn, 1981).

According to Shay (1980), ". . .while it cannot be proven that experience is the best teacher, it can certainly be said that the vicarious and partial experience provided by simulation may render knowledge more deeply relevant and personal."

To some, the term "game" is interpreted as not being related to "education". Using some of Bruner's ideas, Cohen and Bradley (1978) described some of the academic values of simulation. "Games go a long way toward getting children involved in understanding language, social organization, and the rest; they also introduce. . .the idea of a theory of these phenomena. We do not know to what extent these games will be successful but we shall give them a careful try. They provide a superb means of getting children to participate actively in the process of learning--as players rather than spectators."

Good and Beckerman (1978), along with many other educators, believe that children's academic achievement seems to be related to their involvement in tasks. If they are to master material, according to Good and Beckerman, ". . .they must engage in it and react to it--read, make response."

It is through simulation that the student may be able to perform at the higher levels of cognitive process. This may be the highest and best use of instructional computing.

To determine what effect simulation has on students may be difficult to measure. Cohen and Bradley (1978) cited that research on simulation games, especially in the elementary school, has been limited. Very few studies have focused on retention of material learned through simulation. One reason may be that doing research on simulations is difficult. According to the above authors, some of the problems that produce conflicting data are as follows: "the lack of a theoretical framework, the influence of the teacher or the director in setting the tone, the question of whether outsiders should evaluate the effectiveness of the simulation and their possible influence on the activity, the environment and the type of pupils who engage in the games, the difficulty of getting accurate and valid instruments to measure short-term changes in attitude, the consideration of the Hawthorne effect, and the immense problem of generalizing about simulations from one particular simulation."

Chen (1978) found in her study that junior high students overwhelmingly preferred the simulation games to the traditional classroom techniques. She cited that Wing used two computer simulation games with two groups of sixth graders. One group played the two simulation games individually at computer terminals. The control group worked with the subject matter by traditional classroom methods. Results showed that the experimental group outperformed the control group on the criterion test for one of the simulation games while the control group outperformed the experimental group on the test for the other simulation game.

Coleman, Livingston, Fennessey, Edwards, and Kidder (1973) have stated that simulations and other types of experiential learning are not always effective in helping students transfer to other areas the generalizations from the particular game experience. Cohen and Bradley (1978) stated that "It is probably because (generalizing) is the weakest link in experiential learning and that post-game discussions appear to be very important in the experiential learning that takes place in simulation games." They concluded that the "appropriate mix of experiential and information processing modes of learning" might make learning in school more effective.

Yoshida (1980) stated that "One of the principal objectives of education is the understanding of concepts. To consolidate a concept in a learner's cognitive structure it is necessary to develop problem-solving skills for that concept."

Yoshida's study dealt with the use of three drill and practice programs to determine which were superior in acquiring the skill of division. The results indicated that gains made from pretest to post-test were highest with the "fixed" drill and practice followed by the "mixed" drill and practice. The "branching" drill and practice was the least effective. The particular drill and practice programs used did not give feedback as to correctness. The students did not find out how they performed until answer sheets were returned on the following day. Researchers feel that if differences in student characteristics had been considered, the branching type (adaptive to learner's ability) would have been best, with the fixed drill and practice shown as the least effective.

Bloom (1981) believes that "most students become very similar with the regard to learning ability, rate of learning and motivation for further learning when provided with favorable learning conditions."

Bloom goes on to state that "Instruction consists of the implementation of teaching-learning activities."

As educators, we have the responsibility to find the appropriate teaching-learning activities to facilitate learning for each student. In the case of instructional computing, it is important that we understand its potential and then fit the computer to the student's needs, not force the student to fit the computer.

In this study it is proposed to promote additional understanding of the effects that a drill and practice program and a simulation program have on students in the area of content acquisition and retention.

The limited amount of time that students were available for this particular study necessitated a review of the literature that discussed achievement and retention related to time on task.

In an article by Good and Beckman (1978), it is stated that "Pupils' achievement in school seems to be related to involvement in tasks. If they are to master material, they must engage in it and react to it--read, make response. It is suggested that achievement is related to time for learning and opportunity to learn." Just how much "time" is necessary was not specifically referenced in this article. In the article it was suggested that data indicate that "learning is positively related to low rates of time lost because of poor management of classrooms. . ."

The question seems to be whether a short amount of time on task can result in learning and retention. In a search of the literature, two articles were revealed that relate to short amounts of time spent on task and the learning that occurred. Huwiler (1979) says that "Quick learning is possible. . ." The basis for this type of learning may have come from television commercials and radio advertising.

Braden (1979) teaches a visual literacy and communication course that is structured around television commercials. He found that one can teach more than one might expect in 30 seconds or less. Braden asks, "What does it mean that today's students--and many of the rest of us for that matter--can spout advertising slogans, sing product jingles, and itemize what goes on a sesame seed bun?" According to Braden, what it means is that Madison Avenue is doing a successful teaching job. He also found that ten seconds to one minute may be adequate time to present certain types of information that is to be remembered. He suggested that educators study the dozen or so communication structures that are the basis of all commercials. Braden felt that educators should give "serious thought to new presentation strategies that draw upon self-contained, extremely brief perhaps repetitive learning messages. The obvious and simple message is 'brief, but often'." He felt that repetition to the point of mental saturation aids recall.

Braden also suggested some not-so-obvious things we should notice about commercials. They are:

1. well-organized
2. purposeful
3. based upon the analysis of the person the sponsor hopes will view them
4. designed with a concern for affective as well as cognitive impact
5. intent of capturing and holding viewer's attention
6. use a variety of techniques.

The list is representative of what educators advocate as good instructional practice.

To achieve success using the quick-learning idea, it is vital that a very clear objective be stated. The teacher must know what will be taught in that short time frame. The only material which may be included in the lesson must be limited to that which is critical to the objective. Huwiler (1979) advises that the vehicle to provide the information should present that information from multiple inputs. Using both sound and visual is an effective learning method. Quick drill and tutoring involving simple rule applications work well with this technique. It would appear that the microcomputer could be the vehicle to provide the information using both sound and visual approaches.

While no one claims that the microcomputer will be an educational panacea, its usage is a growing part of our educational system. We must investigate the impact of instructional computing as it is being used today in order to guide its use in the future.

Summary

In a review of the literature, it was indicated that the area of instructional computing holds strong potential to affect the education of our students. There are still conflicting thoughts as to how effective instructional computing is. Stahl's (1979) statement that "The microcomputer is opening a fantastic array of possibilities for education" is not disputed. What is needed are investigations to determine how well the microcomputer is actually succeeding in helping the student.

The use of microcomputers in the educational setting is increasing. Educators must investigate the impact of instructional computing as it is used today in order to guide its use in the future.

CHAPTER 3

Procedures

Introduction

In this study, the effects of a computer drill and practice program and a computer simulation program on students' content acquisition and retention scores were investigated. Data were analyzed to see if either program technique indicated more effectiveness in promoting content acquisition or retention of the material presented.

Site of the Research

The research took place in Bozeman, Montana, during the month of February, 1982. The school testing site was Emerson School. Emerson is one of the five elementary schools in Bozeman School District 7. All five elementary schools are composed of kindergarten through fourth grade. The classes are self-contained. Some students receive additional individual instruction through the resource room, speech therapist, gifted and talented program, and Title I. The students are taught music and physical education by a specialist in that particular area. Emerson School was selected because of teacher cooperation. Emerson was also selected because it has three fourth grade classrooms while some of the other schools have only two. The three fourth grade classrooms provided an adequate number of students for this study.

Assignment of Students

Fourth grade students were randomly assigned with computer assistance to one of three instructional computing groups: 1.) drill and practice (DP), 2.) simulation done individually (SI), 3.) simulation done in a group of three (SG).

Assignment of Student Numbers

All fourth grade students were assigned a student number which was used throughout the study. The purpose for the student number was to maintain confidentiality of individual scores and any other individual data that were collected during the study. The student number was used on the pretest, posttest and retention test. The students' names were not used at any other time during the study other than assigning each to the instructional computing group.

Testing Procedures

Pretesting. All students who participated in the study received a pencil and paper pretest. The pretest was given in the regular classroom by the researcher.

The pretest results were subjected to analysis of variance (ANOVA) to determine equivalency of the three instructional computing groups. If the instructional computing groups were shown not to be equivalent, the students would have been reassigned until equivalency occurred. The pretest data were subjected to ANOVA. The pretest showed the three treatment groups to be equivalent.

Posttesting. The end of the treatment occurred when all students in the study had completed the two instructional computing lessons to which they had been assigned. All students who completed the treatment were given a paper and pencil posttest. The posttest was the same instrument as the pretest. The posttest was administered immediately after an individual had finished round two of the lesson. The decision to posttest immediately after treatment was made to insure the same amount of time for each student between treatment and posttesting. Because only one computer was used, the amount of time between treatment and posttesting could have varied from one day to one week if posttesting had occurred after all students had completed the treatment. It was felt that that much variation might affect the accuracy of the study. To have designed the testing period differently would have extended the time necessary for the study. Because the researcher was already causing a certain amount of interruption of the students' schedules, this course was not taken.

Retention Testing. Two weeks after taking the posttest, the students received a retention test. The instrument was the same as the pretest and posttest. It was administered in the individual classrooms.

All the tests were administered, scored, and recorded by the researcher.

Testing Instrument. An instrument was developed to use as a pretest, posttest, and retention test. The objectives of the instructional computing program were analyzed and the instrument was developed from the objectives established by the program.

Validity and Reliability of Instrument

Validity. The instrument was validated by Dr. Paul Markovits and Dr. Elnora Old Coyote, Montana State University elementary education science specialists. The validity was established according to the content of the lesson.

Reliability. The instrument was tested for reliability by giving it to a selection of students not used in the study. The instrument was administered to the group twice. The interval between the first and second administration was two weeks. A Pearson correlation coefficient of .63 was computed with a probability of .00 which was significant at the .01 level. Because the correlation was low, one must use caution in making generalizations.

Treatment

There were three different treatment groups. The content information for each group was the same. The instructional computing technique used to present the content information was what constituted the difference in treatment for the groups. The three instructional computing groups were as follows: 1.) drill and practice (DP), 2.) simulation done individually (SI), and 3.) simulation done in a group of three (SG). A sample listing of each program is included in the appendix of this study. The content material was fish survival. Three species of fish were used in this program.

The DP program presented a question that asked whether a particular species of fish could eat certain other species of fish. The student responded with a yes or no answer. The student was then informed of the correctness of his response. If the response was incorrect, the correct answer was given. After making several comparisons of fish, the student was asked questions about the survival of the different species of fish when encountering an osprey and an otter. The same response-feedback pattern used in the other questions was followed for this part of the program. The combinations of the two comparisons for each question were generated at random. Therefore, if a student responded incorrectly to a question, that combination was likely to be presented again.

The simulation program used in the study was adapted from ODELL LAKE. ODELL LAKE, produced by Minnesota Educational Computing Consortium, is a simulation about fish survival. Both the SI and SG groups used this program. The adaptation was made to reduce the number of fish from six to three. The length of time for the treatment was not long enough to accommodate the program containing six fish. Some other modifications were made so that amount of information on the screen was less than in the original program. This was done to accommodate the reading ability of the fourth graders in the study. The simulation program used animated graphics and text. The student was given a choice of which fish he wanted to role play. An animated representation of that fish appeared on the screen. The student was told he was that fish. Representation of a different fish then appeared on the screen. The student was told what species the fish was. He was then given options of chasing it, ignoring it, eating it, escaping deeper, or escaping to shallow water. After several options concerning fish, the student determined what options to take when encountering an osprey or an otter. After selecting an option, the result was shown through animated graphics. For example, the osprey might fly down and snatch the fish if the decision was to ignore the osprey. A written description of what happened followed the graphic presentation.

The difference in treatment for the SI and SG groups was as follows: the members of the SI group received and responded to the simulation lesson individually. The members of the SG group received and responded to the simulation lesson in groups of three. SG members were allowed to discuss the alternatives provided by the lesson before making a response.

Students in both drill and practice and simulation groups had control of advancing the program to new information by pressing the spacebar when they were ready to go on. This was done so that different reading rates could be accommodated.

Students were given two instructional computing sessions according to the type of program to which each had been assigned. The program for each session was the same. Each session was ten minutes. A timer was set when the session began. Sessions which extended beyond the ten-minute limit would have been eliminated from the study. No session exceeded the ten-minute limit. Construction of the program did not constitute stopping and starting. Both programs presented various and continual combinations of the content information. Therefore, students were not aware of the number of times they may have gone through the information. The treatment took place in a separate room set aside for this study.

Because this study involved using two ten-minute sessions, it was necessary to cite research in which it was indicated that learning and retention can occur within short time frames. Huwiler (1979) believes that "quick learning is possible." He based this thought on research that he had done involving learning that comes from television and radio commercials. Braden (1979), who teaches a visual literacy course that is structured around television commercials, has found that one can teach more than one might expect in thirty seconds or less. He has found that ten seconds to one minute may be adequate time to present certain types of information that is to be remembered.

Good and Beckerman (1978) believe that student's academic achievement is related to task involvement. According to Good and Beckerman, if students are to master material, they must "engage in it and react to it--read, make response." Huwiler advised that the vehicle to provide the information should present the information from multiple inputs. Using both sound and visual methods is effective. It would appear that the microcomputer could be an effective vehicle by which information is presented in this manner.

Organization of Data

The data gathered during this study were organized and presented in the following manner.

1. Pretest scores. The pretest scores of the individual students, using their student number rather than their name, were compiled. Descriptive statistics for each instructional computing group was computed and the results were presented. The groups were compared by use of analysis of variance (ANOVA).

2. Posttest scores. The posttest scores were compiled for individuals. Group means for the DP, SI, and SG groups were determined. Gain scores from pretest to posttest were analyzed for each group. Comparisons of treatment group gain scores were made. When a significant difference occurred, further analysis using Scheffe was performed to isolate the difference. A significance level of .05 was chosen.

3. Retention scores. Retention scores were compiled for individuals. Group means for the DP, SI, and SG were computed. Gain scores from pretest to retention test and from posttest to retention test were analyzed using analysis of variance (ANOVA), LSD, defined by the SPSS manual as least significant difference, and t-test. The analysis was made within each treatment group and between each treatment group.

Statement of Hypotheses

The hypotheses of this study dealt with the performance of the students in the three instructional computing groups.

The hypotheses were as follows:

1. There is a difference in drill and practice scores from pretest to posttest.

2. There is a difference in drill and practice scores from posttest to retention test.

3. There is a difference in drill and practice scores from pretest to retention test.

4. There is a difference in scores from pretest to posttest scores in the simulation done individually.

5. There is a difference in scores from posttest to retention test in the simulation done individually.

6. There is a difference in scores from pretest to retention test in the simulation done individually.

7. There is a difference in scores from pretest to posttest in the simulation done in a group.

8. There is a difference in scores from posttest to retention test in the simulation done in a group.

9. There is a difference in scores from pretest to retention test in the simulation done in a group.

10. Given a pretest and a posttest, there will be a difference in students' content acquisition change scores for:

a. the drill and practice program and the simulation done individually

b. the drill and practice program and the simulation done in a group

c. simulation done individually and simulation done in a group.

11. Given a posttest and a retention test, there will be a difference in students' retention change score for:

a. the drill and practice program and the simulation done individually

b. the drill and practice program and the simulation done in a group

c. simulation done individually and simulation done in a group.

12. Given a pretest and retention test, there will be a difference in students' retention change score for:

a. the drill and practice program and the simulation done individually

b. the drill and practice program and the simulation done in a group

c. simulation done individually and simulation done in a group.

Statistical Analysis

Descriptive Statistics. Descriptive statistics was used to describe each instructional computing group's pretest, posttest, and retention test.

ANOVA. In order to compare all three instructional computing groups, analysis of variance (ANOVA) was used.

Precautions Taken for Accuracy

The testing done in this study was conduted by the researcher. The researcher also scored and recorded the tests. Students' test scores were recorded on test score sheets using student numbers instead of student names.

The data analysis was conducted under the direction of the researcher's major advisor, Dr. L. W. Ellerbruch. The analysis was done on the Honeywell level 66 computer at Montana State University using SPSS.

The final data set was verified against the raw data.

Management of Situations Beyond Researcher's Control

The following situations were considered in order to properly manage this study:

1. Scores that may have been recorded for a student were deleted if the student left school, decided not to participate in the study, or was absent, which resulted in missing any of the required treatment or testing.

2. Testing, scoring, and recording were done by the researcher.

3. Presentation of the instructional computing lessons did not vary because of their nature. What was contained in the computer program could not unintentionally be changed to vary the presentation.

4. Verification of data occurred at each stage by the researcher's major advisor, Dr. L. W. Ellerbruch.

Summary

This study was designed to examine the effects of a computer drill and practice program and a computer simulation program on students' content acquisition and retention scores.

Three instructional computing groups were established. The groups were as follows: 1.) drill and practice (DP), 2.) simulation done individually (SI), 3.) simulation done in a group of three (SG). The groups were composed of the fourth grade students at Emerson School in Bozeman, Montana. The experimental period was during the month of February, 1982.

All three of the instructional computing groups subjects received the same amount of time on the computer program to which they were assigned.

Data collection included pretesting, posttesting, and retention testing. The instrument used for those purposes was developed by the designer of this study. Validation was done by Dr. Paul Markovits and Dr. Elnora Old Coyote, Montana State University elementary science education specialists. Reliability was established by administering the instrument to subjects not involved with the study.

Steps to insure confidentiality were taken. The study also included precautions for accuracy.

Statistical analysis was supervised by Dr. L. W. Ellerbruch, Montana State University elementary math education specialist. The University's computer was used for the statistical process.

CHAPTER 4

Data Analysis

This study was designed to examine the effects of three instructional computing approaches on students' content acquisition and retention scores.

Overview of Design

In order to examine the effects of instructional computing, three treatment sequences were designed and implemented at Emerson School in Bozeman, Montana. The treatment groups were composed of fourth grade students from three self-contained classrooms.

Students were randomly assigned to one of three instructional computing treatment sequences by the aid of a random number program implemented on the Honeywell Level 66 computer at Monana State University. The instructional computing treatment sequences used in this study are designated as: 1.) *individual drill and practice* (DP), 2.) individual simulation (SI), and 3.) group simulation composed of three students per treatment group (SG).

After students had been assigned to an instructional computing treatment sequence, the students were assigned individual code numbers. Those code numbers were used for scoring, recording and analyzing the data collected in this study.

A pretest was administered to all students participating in this study. Based on this pretest, equivalency of the three treatment groups was verified.

Students received two ten-minute sessions of an instructional computing lesson according to the treatment group to which they had been assigned. The amount of time between the first and second session was five to six days.

After the instructional period, a posttest was administered to determine if the instruction had produced any change in scores from pretest to posttest as a result of treatment. The posttest was also used to determine if a difference occurred between groups.

The same instrument was used two weeks after the last instructional session as a retention test. All tests were administered, scored and recorded by the researcher. The analysis was done on the Honeywell Level 66 computer at Montana State University using SPSS under the direction of Dr. L. W. Ellerbruch, Montana State University elementary math education specialist.

Organization

In Chapter Four is contained the presentation and discussion of the results of the data analysis. The results are presented and discussed in the following order:

1. Pretest results to establish equivalency of treatment group
2. Posttest results for each treatment group