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ABSTRACT

To gain insight into the relationship between computer graphics (computer generated visuals used for the purpose of illustrating text) and computer assisted instruction (CAI), a study examined the effects of two levels of microcomputer graphics on three measures of reading comprehension using a teacher made CAI reading program. Subjects included seventh grade students who were randomly assigned to one of two groups. Prior to the day of the experiment, students completed a scale to identify their attitudes toward computers and CAI. The treatment consisted of a textual selection programmed for use on the TRS-80 color computer. All students read the identical selection as presented by the microcomputer. However, one program utilized computer graphics, whereas the other simply presented the text on the screen for the student to read. After the treatment, students were given a paper and pencil comprehension test on the reading selection and a postinstructional attitude scale. Results indicated that students using a CAI reading program with graphics did not show a greater increase in reading comprehension. Small negative correlations between the scores on the comprehension test together with treatment and with time suggest that the graphics had a slightly negative effect on the students' comprehension of the reading selection. However, the students who used the reading program with graphics showed a more favorable attitude toward CAI. (Author/HOD)

THE EFFECTS OF TWO LEVELS OF MICROCOMPUTER GRAPHICS ON READING COMPREHENSION

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Statement of the Problem

The acceptance of the microcomputer into the classroom is a trend that is gaining momentum. A cursory examination of professional journals, in-service training needs, and new equipment budgets will reveal the impact of recent advances of microtechnology in education. Braun (1980) notes that the purchase of microcomputers by schools on "a national basis will grow from 26,700 in 1978 to 105,000 in 1982." Further, he estimates "that 70% of the demand will originate in elementary and secondary schools" (p. 110). The microcomputer is becoming a necessary component of a sound educational program in the 1980's.

A primary consideration in choosing a microcomputer is deciding how it will be used in instruction. Then, the search begins for the microcomputer most capable of meeting the established needs. A need perceived by many educators is that the microcomputer must be capable of generating graphics. Graphics generally defined, and as used in this study, refers to computer generated visuals used for the purpose of illustrating text, concepts, etc. in computer-assisted instruction (CAI). Compared to other instructional media, the microcomputer is unique in its capabilities of producing graphics.

Microcomputers also have the potential of producing graphics that will allow student interaction.

Considering this potential a number of questions can be raised. Is the extra cost in acquiring and using a microcomputer with high resolution graphic capabilities an educationally sound investment? What effects do graphics have on CAI, and specifically on CAI reading materials? Are there certain conditions when high level graphics are useful in presenting materials?

Research regarding many aspects of the microcomputer and its educational applications is limited. Furthermore, the acceptance of the microcomputer has taken place without answers to these questions. Mason (1980) considers the whole point moot when he notes, "The challenge of the 1980's is in the development of CAI-reading software. The hardware is in the schools!" (p. 22). Unfortunately, the answers to the questions above have a direct impact on the development of educationally sound CAI reading materials.

In an attempt to respond to Mason's challenge and provide insight into the questions raised above, this study will examine the relationship between two levels of microcomputer graphics on three measures of reading comprehension using a teacher made CAI reading program.

Assumptions

To examine the effects of two levels of microcomputer graphics on three measures of reading comprehension in computer-assisted instruction, the following assumptions will be studied: 1. Students using a CAI reading program with graphics will show a greater increase

in reading comprehension when compared to students using a program with no graphics. 2. The time required to complete a CAI reading program with graphics will not be significantly different from the time needed to complete a program with no graphics. 3. After instruction, students who used a CAI reading program with graphics will show more favorable attitudes towards computers and CAI than students who used a program with no graphics.

CHAPTER 2

REVIEW OF THE LITERATURE

Pictures and Reading Comprehension

While the first use of pictures to illustrate a reading text in this country goes back to the New England Primer in 1729 (Samuels, 1970), the practice continues today without much positive research regarding the contributions pictures make to comprehension in reading. In an early study, Miller (1938) observed 100 children in the first half of grades 1-3. Using a basal textbook series, he pasted paper over book pictures to form a picture group and non-picture group for each teacher's class. He found that children understood what they read just as well with pictures as without. He observed, "The publishers of primary readers have increased the quality and quantity of illustrations, probably in the belief that the books are thereby improved and made more useful" (p. 676).

Several studies have found little or no difference in comprehension between groups using illustrated and non-illustrated materials (Vernon, 1953,1954; Koenke, 1969; Lindseth, 1969; Cole, 1977). Pictures have even been found to have negative effects on comprehension. In a study of second graders, Weintraub (1960) presented reading materials with and without a picture. After completing the reading, the students were given a multiple-choice test regarding details and

main ideas. He found that comprehension scores were higher when pictures were not present.

In a 1943 study, Halbert found that pictures aided recall, but qualified her findings by recognizing the difference between recall and comprehension.

In a complex experiment, Peeck (1974) studied 71 third and fourth graders using two versions of a reading selection, one with pictures and one without. To test the effects of text and pictures on recall, the reading material was constructed so that on some occasions conflicting information was presented between pictures and text. Students were tested for retention immediately after completing the story and after one day or after a week. He found that pictures facilitated retention when tested one day and seven days after reading passages, but not when tested immediately after presentation.

Haring and Fry (cited in Meyer, 1981) found similar results in their study of fourth and sixth graders. Three versions of an Aesop fable were presented. One group received text with line drawings depicting main ideas. A second group received text with line drawings depicting main ideas and included other information. The third group received text only. They found that immediately after reading and after five days, illustrations facilitated recall for the main idea, but not for details.

Certainly the most comprehensive studies of the relationship between illustrations and instructional effectiveness have been conducted by Francis Dwyer (1972). Dwyer tested a variety of

instructional media to test his hypothesis that the closer a illustration resembles reality the greater the student's comprehension of the lesson material.

In a 1967 study of 108 university freshman, Dwyer utilized four types of visual illustrations to present a lesson on the parts and function of the human heart. Each group received the same lesson with varying levels of illustrations. The four levels of illustrations used were: no illustrations, line drawings, detailed shaded drawings, and realistic photographs. Dwyer found that the realistic photographic presentation was no more effective than the no illustrations presentation. He further noted that the line drawing presentation was just as effective as the detailed shaded drawings presentation.

In a similar study, Dwyer (1968) examined the effectiveness of line drawings and realistic photographs in programmed instruction vs. verbal instruction alone. In this study of 141 ninth graders he found that the two groups receiving the programmed instruction required more time to complete instruction than did the verbal instruction group. No differences were found in achievement between the three groups when tested on drawing, identification, terminology, and comprehension.

In a comprehensive review of the literature on instructional graphics, Moore and Nawrocki, (1978) identified six explanations commonly given for the inclusion of visuals in instructional materials.

a) they are perceived as being more efficient
b) they are realistic

c) students prefer them
d) they unload overburdened channels
e) perceptual research has shown individual differences in visual ability to be an important variable
f) visuals are part of a larger, more advanced instructional system (p. 4)

They note, "Experiments designed in part to verify these explanations have failed to support them" (p.4). Hence, Samuels' (1970), conclusions after reviewing the literature still seem very valid, "Although the research, in general does not show that pictures aid comprehension, neither does it show that it hinders comprehension" (p. 405).

Computer Graphics and Learning

The whole question of the relationship between pictures and reading comprehension seems renewed with the development of the microcomputer with graphics capabilities. Will computer graphics parallel the traditional use of pictures in instruction or revolutionize instruction? A question which is perhaps more important in the development of computer graphics; does the research using traditional texts/pictures also reflect the usefulness of including graphics in computer-assisted instruction?

Only two studies were found in the literature dealing with the impact of computer graphics on computer-assisted instruction. In a 1975 study, King compared the effects of three graphic levels (no graphic display, still-graphic display, or animated graphic display) on the learning of the sine-ratio concept of 45 students at a Naval Training Center. Although the performance of the animated graphics group appeared higher, no significant differences were found between

the three groups on a posttest.

In a second study, (Moore, Nawrocki, and Simutis, 1979). three groups of 30 enlisted personnel were used to study the effects of three levels of graphics (alphanumerics and schematics, line drawings, and line drawings with animation) on instructional lessons on the psychophysiology of audition. They found that the level of computer graphics during the lesson had no effect on the final performance.

Student Attitudes Toward CAI

In a review of the literature regarding attitudes toward CAI, Clement (1981) found that in general, student attitudes at all levels have been positive towards computer based education. He identifies several factors that seem to relate to a positive student attitude toward computer based education and training:

1. Preparation of lesson materials that produce low student error rates during instruction and posttest may be beneficial to maintaining and producing positive attitudes toward computer based education.
2. Subjects exposed previously to computer-aided testing had significantly more favorable attitudes toward computer based education than subjects not so exposed.
3. Computer simulated games used as a teaching tool have brought about an attitude change among students. (p.29)

Additionally, Clement notes that two popular myths to discourage computer implementation appear to be reliably disproven. First, "that computer based education is dehumanizing," and second, "that high student acceptance of computer based education is due to the uniqueness of the experience" (p. 29).

One of the largest CAI systems in the country is PLATO, (Programmed Logic for Automatic Teaching Operations), developed by the University of Illinois. Magidson (1978) studied the survey responses of 758 college students at Kennedy King College in Chicago, Illinois, who had received PLATO instruction during the course of a fall semester. He found the students' attitudes highly favorable towards lesson characteristics, mechanical aspects of PLATO, and PLATO overall. When students were asked what they disliked about PLATO, the most common reply was "nothing". Other responses dealt with the mechanical aspects and failings of the computer and terminal.

CHAPTER 3

METHOD

Subjects

The subjects chosen for this study were the entire seventh grade class of Rock Falls Junior High School located in Rock Falls, Illinois. The researcher felt that a large public school population would provide valuable information currently not available in the literature. Further, the subjects could be considered computer non-literates as they have not been exposed to hands-on computer experience or computer literacy instruction. Due to absences, data was obtained from only 120 of the 126 students.

Procedure

Two computer programs were prepared using the story, "Getting the Goods to Market," by Karen O'Connor (Cobblestone--The History Magazine for Young People, September 1981, pp. 16-17). The first program, referred to as TREATMENT I, simply presented the text on the screen for the student to read. The second program, referred to as TREATMENT II, presented the identical text, but also utilized computer graphics. A preliminary check of the passage with the Fry Readability Formula found it to be within the seventh grade range.

With the cooperation of Radio Shack, ten TRS-80 Color Computers were used in this study. Accordingly, the computer program used for the study was written in TRS-80 Color Computer Basic. The program was of a closed-loop nature which only required the student to push the enter key to respond. Two frames were included at the beginning to introduce and explain the procedure. The reading selection consisted of 14 frames which included one frame for the selection title and author. The program prepared for TREATMENT II contained an additional 7 frames of graphics. A copy of the computer program is contained in Appendix A.

A random, two-group experimental design was used in this study. Each student was given an identification number, 1-126. Using a table of random numbers, the students were then assigned to one of the two treatments. Each treatment consisted of a reading program presented by the microcomputer on an individualized basis. All students read the selection identified above; the only difference being whether graphics were included or not.

Prior to the day of the experiment, a 25 item preinstructional attitude scale was administered to all students to identify their attitudes toward computers and computer-assisted instruction. At the same time, the students were told that they were going to participate in a study to see how well they could read with computers. Students were then allowed to ask questions about the proposed study. However, they were not told that the computer materials would be in two different forms or that they would be given a comprehension test after they completed their reading. They also were not told that they

would be taking the attitude scale again.

On the day of the experiment, (May 6, 1982) all students received the treatment either during their study lab or reading class. When a student entered the testing area, he received his identification number and was then directed to a computer appropriately programmed for one of the two treatments.

The two treatments were separated so that students could not come in contact with the other treatment. Each treatment had five computer stations set up in clusters of two or three computers each. Each station consisted of a 16K TRS-80 Color Computer and a 19" Color TV. Generally, students were not able to see the other computers in their cluster while receiving their computer reading instruction.

Once the student sat down in front of a computer, a previously trained student assistant helped orient him and assisted with the directions given on the first two frames of the program. Upon completion of the reading selection, a record was made of the time needed to complete the reading instruction. The students were then directed to another area to take a paper and pencil comprehension test and a postinstructional attitude scale.

The postinstructional attitude scale was identical to the preinstructional attitude scale (see Appendix B). Each item was scored with a value of 1-5, with 1 indicating a negative attitude and a 5 indicating a positive attitude towards computers and computer-assisted instruction. Both scales were totaled and compared for changes in attitudes.

The paper and pencil comprehension test consisted of 23 multiple-choice items. The three measures of reading comprehension included on the test were: Main Idea, Inferences, and Identification. Each subtest had 14, 5, 4 items respectively. After completing the comprehension test and postinstructional attitude scale, the students returned to class.

CHAPTER IV

RESULTS

The Statistical Programs for Social Sciences (SPSS) package was used to analyze the data. The programs produced information on regression analysis, analysis of variance, and correlations.

One hundred and twenty seventh grade students were placed into one of the two treatments based on random assignment. Tables 1 and 2 indicate that randomization was effective in producing two groups equal in the variables of IQ and sex for this study.

TABLE 1

SEX BY TREATMENT

Group	Female	Male	Total
TREATMENT I	31	30	61
TREATMENT II	29	30	59
TOTAL GROUP	60	60	120

TABLE 2

MEAN IQ BY TREATMENT

Group	n	Mean	Std. Dev.	Std. Error
TREATMENT I	61	103.54*	12.80	1.64
TREATMENT II	59	102.76*	11.47	1.49
TOTAL GROUP	120	103.15	12.12	1.11

*no significant difference

The assumption that students using a CAI reading program with graphics would show a greater increase in reading comprehension when compared to students using a program with no graphics failed to produce a significant difference at the .05 level. The means of the comprehension test total and the three subtests by treatment are included in Table 3.

A Pearson Product Correlation Coefficient of 0.57 was found between comprehension test total and IQ. The subtests also produced low to moderate correlations with IQ, (Main Idea, 0.39; Inferences, 0.30; Identification, 0.55).

A small negative correlation (-0.08) was found between the comprehension test total and treatment. Two subtests also showed small negative correlations, (Main Idea, -0.08; Inferences, 0.05; Identification, -0.15).

TABLE 3

MEAN RAW SCORES ON COMPREHENSION TEST AND THREE SUBTESTS BY TREATMENT

Group	n	Mean	Std. Dev.	Std. Error
TREATMENT I				
Comptotal[a]	23	7.15*	3.11	.40
Main Idea	14	3.74*	2.11	.27
Inferences	5	1.48*	1.09	.14
Ident[b]	4	1.93*	1.08	.14
TREATMENT II				
Comptotal[a]	23	6.66*	2.76	.36
Main Idea	14	3.44*	1.81	.24
Inferences	5	1.59*	1.07	.14
Ident[b]	4	1.63*	1.03	.13
TOTAL GROUP				
Comptotal[a]	23	6.91	2.94	.27
Main Idea	14	3.59	1.96	.18
Inferences	5	1.53	1.08	.10
Ident[b]	4	1.78	1.06	.10

[a] comptotal=comprehension test total

[b] ident=identification

*no significant difference between comprehension test total, main idea, inferences, identification and treatment

No significant difference was found between comprehension test total and sex, although small correlations were seen (Comprehension Test Total, 0.12; Main Idea, 0.16; Inferences, 0.05; Identification, -0.15).

When the comprehension test total and three subtests were compared to time, weak to moderate negative correlations were made (Comprehension Test Total, -0.29; Main Idea, -0.20; Inferences, -0.12; Identification, -0.32).

The second assumption, that the time required to complete a CAI reading program with graphics would not be significantly different from the time to complete a program without graphics, was not borne out. A significant difference at the .05 level was found between the two groups in the amount of time needed to complete the instruction. Table 4 indicates the mean completion time in seconds.

TABLE 4

MEAN COMPLETION TIME IN SECONDS

Group	n	Mean	Std. Dev.	Std. Error
TREATMENT I	61	329.03*	91.46	11.71
TREATMENT II	59	359.95*	88.94	11.58
TOTAL GROUP	120	343.22	91.35	8.34

*time with treatment $p < .05$

In a two-way analysis of variance, comprehension test total and treatment accounted for 31.5% of the variance in time needed for completion. The effects of time on comprehension test total and treatment were significant at the .001 level.

The third assumption that the students using a CAI reading program with graphics would show more favorable attitudes towards CAI after instruction than students using a program without graphics was significant at the .10 level. Table 5 indicates the mean scores on the pre and postinstructional attitude scales with the mean difference between the two scales.

A correlation of 0.69 was obtained between the pre and post-instructional attitude scales, which is significant at the .001 level. In regression analysis, the preinstructional attitude scale accounted for 48% of the variance in the postinstructional attitude scale. When treatment and preinstructional attitude scale were considered, a total of 49.3% of the variance of the postinstructional attitude scale could be accounted for.

The correlations between all variables examined in the study is included in Table 6.

TABLE 5

MEAN SCORES ON PRE AND POSTINSTRUCTIONAL ATTITUDE SCALES WITH DIFFERENCE

Group	PRE	POST	DIFFERENCE
TREATMENT I			
Mean	91.21	92.13*	.92
Std. Dev.	9.67	11.90	7.39
Std. Error	1.24	1.52	.95
TREATMENT II			
Mean	92.25	96.14*	3.88
Std. Dev.	12.75	14.17	11.85
Std. Error	1.66	1.92	1.54
TOTAL GROUP			
Mean	91.73	94.10	2.38
Std. Dev.	11.26	13.48	9.91
Std. Error	1.03	1.23	.91

*post with treatment $p < .10$

TABLE 6

CORRELATIONS BETWEEN ALL VARIABLES

	SEX	IQ	PREATT	POSTATT	DIFF[a]	COMPTOTAL	MAIN IDEA	INFER	IDENT	TIME
TREAT	0.02	-0.03	0.05	0.15	0.15	-0.08	-0.08	0.05	-0.15	0.18
SEX		-0.06	0.12	0.19	0.12	0.12	0.17	-0.03	0.05	0.12
IQ			-0.08	0.03	0.12	0.56	0.39	0.30	0.55	0.12
PREATT				0.69	-0.19	0.02	0.09	-0.11	0.01	0.11
POSTATT					0.57	0.02	0.04	-0.06	0.03	0.05
DIFF[a]						0.00	0.00	-0.04	0.05	-0.05
COMPTOTAL							0.85	0.53	0.66	-0.29
MAIN IDEA								0.14	0.34	-0.20
INFER									0.20	-0.12
IDENT										-0.32

[a]DIFF=difference between pre and postinstructional attitude scale

CHAPTER V

DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

Discussion of Results

The lack of significant results between the graphics and no graphics groups are consistent with the literature (King, 1975; Moore, Nawrocki, and Simutis, 1979). The instructional effects produced by this teacher made CAI program remain unclear, although a number of observations can be made.

One issue in CAI has to do with the amount of student interaction, (high/low) with the program or computer itself. The level of student interaction in the CAI reading program used in this study would be characterized as low. This can be most directly attributed to the level of programming knowledge by the researcher. Several students indicated disappointment after instruction because they had expected to be actually typing on the computer keyboard.

Small negative correlations between the comprehension test total (-0.08) and the three subtests (Main Idea, -0.08; Inferences, 0.05; Identification, -0.15) with treatment, suggest that the graphics had a slight negative effect on the students' comprehension of the reading selection. Weak to moderate negative correlations between the comprehension test total (-0.29) and the three subtests (Main Idea, -0.20; Inferences, -0.12; Identification, -0.32) with time,

further suggest that the extra time spent reading the CAI program with graphics was not productive. This may be due, in part, to the fact that students had no control over the graphics and could not go backwards in the program.

A significant difference was found in the time needed to complete the instruction between the two groups. This may be explained by the author's decision to have the graphics drawn as the student watched. It was felt that student interest and motivation would be greater if they saw the graphics being drawn. However, it is possible to have the graphics drawn while the student is reading the preceding frame so that when he advances to the next frame the graphics are displayed in their final form. It seems that graphics may be less distracting and more productively utilized, if they are displayed in their final form as opposed to being drawn as the student watches.

Table 5 indicates that all students, in general, found the experience to be a positive one as measured by the overall positive increase in attitude towards computers and CAI after instruction. The students who used a CAI reading program with graphics showed significantly more favorable attitudes towards CAI on the postinstructional attitude scale than students who used a CAI reading program without graphics. It appears that while graphics, in this case did not increase comprehension, it had a positive influence on the students' attitudes toward computers and CAI.

Limitations of the Study and Suggestions for Further Research

In an attempt to understand why student achievement was relatively low on the CAI comprehension test a verification of the readability was completed. The entire story was typed into a TRS-80 Model III computer in four samples. The Readability Analysis Program from Random House School Division (Westminster, Maryland) provided the information contained in Table 7.

It appears that given the high readability level of the text used in this study, seventh graders would be expected to have some difficulty in comprehending the material. This factor is also seen in the high correlation between the comprehension test total and IQ. Certainly, in future studies, complete readability information should be available from the onset, when choosing material to program into the microcomputer.

Another consideration when choosing material is the memory capabilities of the machine. This study orginally intended to examine the effects of high resolution graphics also, but these plans had to be revised because of the tremendous amount of memory that would have been required. The story used in this study (approx. 600 words) required over 8K of memory alone. That is, 8,000 bytes of memory capability were required (of the 16,000 bytes available) just to program the material for presentation. This does not take into consideration the additional memory requirements for developing the graphics. Whereas, 16K memory capability would appear to provide more than adequate space for programming, factors such as the level and number of graphics, and the amount of student interaction increase

TABLE 7

READABILITY ANALYSIS PROGRAM

Factor	Sample 1	Sample 2	Sample 3	Sample 4
No. of Sentences	7	8	7	17
No. of Characters	573	617	646	1317
No, Chr/Word	5	5.1	5.2	5
Words 2 Syllables	16	25	21	46
No. of Syllables	180	205	206	432
No. of Words	113	119	123	260
No. Words/Sentence	16.1	14.8	17.5	15.2
No. Syllables/Word	1.6	1.7	1.6	1.6
No. One Syllable Wrds	66	64	60	149
Regular Analysis Grade 4-Adult				
1. Dale-Chall	4	3.9	4.2	3.9
2. Fog Index	12.1	14.3	13.8	13.1
3. Flesch Grade Level	11.4	14.1	13.9	12.6
4. Smog Index	9.5	10.9	10.1	10.2
Avg. Grade Level (for 1;2;3)	9.1	10.7	10.6	9.8

the demands on a limited memory. Therefore, guidelines should be developed to accurately estimate the memory required for programming based on length of the material, and types of graphics to be included.

An additional problem noted with the high resolution graphics of the TRS-80 color computer is that it does not permit text to be displayed concurrently with graphics. This certainly seems to limit the usefulness of high resolution graphics in developing interesting CAI reading materials.

Currently, the amount of time and programming knowledge required to produce CAI materials appears to be out of the reach of most teachers. Newly developed tools like "Graphics Tablet" and "Versa-Writer" will greatly enhance programs and reduce the need for extensive programming knowledge. Also useful, but as yet undeveloped, would be subroutines that could be copied and plugged into a program to draw graphics, provide graphic-sound reinforcement, and so on. School districts should be encouraged to examine the possibility of establishing a computer cooperative (similar to the special education cooperative) to study and share commercial CAI materials. The cooperative could also be more cost-effective in terms of employing a programmer and developing their own materials.

Considering the cost of microcomputers with high resolution capabilities, more research is needed on the instructional effectiveness of graphics in CAI. Assuming that graphics provide a notable aid to learning, guidelines should be established on the optimum use of graphics in CAI instructional materials. Additional attention should also be given to developing the competencies

necessary for teachers to produce interesting and effective CAI programs.

Educational Implications of the Study

It appears that the students in this study enjoyed their work with the microcomputer, even though the task was somewhat frustrating, as a result of the high readability of the passage. It is clear that finding materials appropriate for programming into the microcomputer will be a considerable challenge.

A new style of children's books now being published allows students, at a given point, to make a choice of what they would like to happen next in a story. They are then directed to a particular page and continue reading until another choice is needed. This individualized interaction between the student and story is ideally suited for use on the microcomputer.

More research is needed on the effects of graphics with students of special needs. Motivation to work with the computer is high for these students, and may produce reading gains not possible by utilizing traditional instructional methods.

Certainly there is a tremendous need for in-service training on the uses and potential of the microcomputer. The development of simpler programming techniques will provide teachers with greater control over the content of CAI materials. As Grady (1982) notes, with a tone of urgency, "teachers, underpaid and overworked or not, must master the tools of [computer] literacy as a fundamental and non-negotiable part of their job" (p. 24).

Conclusions

Undoubtedly, one of the unique features of the microcomputer is its graphic capabilities. While graphics are generally perceived as a useful aid to learning in CAI, this study found that graphics did not appear to increase the general reading comprehension of seventh graders on a programmed textual selection. However, the graphics did produce a significant positive increase in attitudes towards computers and CAI. The instructional effects produced by this teacher made CAI program remain unclear.

Whereas, computer skeptics may be asking, "Do we have more technology than we know how to use, can use, or need to use?" more research is needed to establish the instructional effectiveness of graphics in CAI materials. Considering the potential of the microcomputer to produce graphics that will allow student interaction, the challenge is before us.

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APPENDIX A

COMPUTER PROGRAM FOR

GETTING THE GOODS TO MARKET

```
5   N=15

10  FOR X=1 TO N: NEXT X

30  ON N GOSUB 100, 110, 120, 130, 140, 150, 160, 170, 180,
    190, 200, 210, 220, 230

100 ?"                    HI!"

101 ?

102 ?"    TODAY YOU ARE GOING TO
      READ A STORY WITH THE HELP OF A
      COMPUTER.  BUT, BEFORE WE START
      YOU NEED TO KNOW HOW TO WORK"

103 ?"WITH ME."

104 ?

105 ?"    AFTER YOU FINISH READING
      EACH FRAME PUSH THE ENTER KEY
      TO GO ON.. TRY IT NOW..."

106 INPUT A: CLS: RESTORE

110 ?"                    VERY GOOD!!!"

111 ?

112 ?"    ALL YOU HAVE TO DO IS PUSH
      THE ENTER KEY AFTER YOU FINISH
      READING EACH FRAME."

113 ?

114 ?"    WITH THAT OUT OF THE WAY,
      PUSH THE ENTER KEY AND"

115 ? @ 266,"AWAY": ? @ 335,"WE": ? @ 402,"GO..."

116 INPUT A: CLS: RESTORE

120 ?

121 ?

122 ?
```

```
123 ?"     GETTING THE GOODS TO MARKET"

124 ?

125 ?

126 ?"     BY KAREN O'CONNOR"

127 INPUT A:  CLS:  RESTORE

130 ?"     IN THE EARLY 1700'S,
      FARMING WAS AN IMPORTANT WAY
      FOR AMERICAN COLONISTS TO MAKE
      A LIVING.  EVEN THOUGH FARMING"

131 ?"METHODS AND TOOLS WERE CRUDE,
      MANY FARMERS COULD PRODUCE
      ENOUGH VEGETABLES, GRAIN, AND
      MEAT TO FEED THEIR FAMILIES AND"

132 ?"STILL HAVE SOME LEFT OVER FOR
      SALE."

133 ?

134 ?"     GETTING THE GOODS TO
      MARKET, HOWEVER, WAS NOT EASY.
      PEOPLE STAYED CLOSE TO HOME
      BECAUSE ROADS WERE POOR AND"

135 INPUT A:  CLS: RESTORE

140 ?"TRANSPORTATION DIFFICULT.  TO
      GET WHAT THEY WANTED, SETTLERS
      USUALLY TRADED PRODUCTS WITH
      EACH OTHER.  MANY ITEMS CAME"

141 ?"FROM THE INDIANS, WHO TRADED
      FURS AND HIDES FOR CLOTHING,
      GLASS BEADS, GUNS, LIQUOR, AND
      METAL GOODS."

142 ?

143 ?"     AS COMMUNITIES GREW, BLACK-
      SMITHS, CABINETMAKERS, AND
      SILVERSMITHS OPENED SHOPS IN
      THE VILLAGE SQUARE, OR SOLD"

144 ?"THEIR GOODS AND SERVICES BY
      TRAVELING FROM ONE TOWN TO"

*145 INPUT A:  GOSUB 300
```

```
146  INPUT A:  CLS:  RESTORE

150  ?"ANOTHER."

151  ?

152  ?"     ONE POPULAR CHARACTER OF
       EARLY COLONIAL TIMES WAS THE
       YANKEE PEDLAR.  WITH HIS PACK
       ON HIS BACK OR LEADING A PACK-"

153  ?"TRAIN, HE VISITED THE VILLAGES
       AND FARMS, BRINGING SCISSORS,
       TABLEWARE, BOOTS, AND BOTTLES--
       WHATEVER HE KNEW WOULD SELL."

154  ?"IN MANY PLACES, HE WAS THE ONLY
       OUTSIDER THE FARMER SAW FOR MONTHS."

155  ?

156  ?"     WAGONS SOON REPLACED THE"

*157 INPUT A:  GOSUB 400

158  INPUT A:  CLS:  RESTORE

160  ?"SLOW-MOVING PACK-TRAINS.
       AMERICAN PIONEERS USED THESE
       STURDY AND OFTEN COLORFULLY
       COVERED WAGONS TO MOVE GOODS"

161  ?"AND PEOPLE WEST OVER THE
       ALLEGHENY MOUNTAINS FROM THE
       MID-1700'S UNTIL ABOUT 1850."

162  ?

163  ?"     BY 1775, TWO AND ONE HALF
       MILLION PEOPLE LIVED IN THE
       THIRTEEN COLONIES.  AS THE
       POPULATION GREW, TRADE"

164  ?"DEVELOPED QUICKLY AND CENTERED
       MAINLY IN TOWNS THAT HAD GOOD
       HARBORS.  SHIPBUILDING BECAME"

165  INPUT A:  CLS:  RESTORE

170  ?"THE LEADING INDUSTRY.  BY THE
       TIME THE COLONISTS DECLARED
       THEIR INDEPENDENCE IN 1776,
       ABOUT ONE-THIRD OF ALL BRITISH"
```

```
171  ?"SHIPS WERE BEING BUILT IN
       AMERICA.  SCHOONERS, FERRIES,
       BRIGANTINES, BARGES, AND OTHER
       SEA VESSELS CARRIED PASSENGERS"

172  ?"AND FREIGHT ACROSS RIVERS, BAYS,
       AND COASTAL WATERS."

173  ?

174  ?"     AS SEA TRAVEL EXPANDED,
       LAND TRAVEL ALSO GREW.  COLON-
       ISTS PUT MUCH EFFORT INTO
       IMPROVING THE CRUDE ROADS USED"

*175 INPUT A:  GOSUB 500

176  INPUT A:  CLS:  RESTORE

180  ?"BY CARTS AND WAGONS.  BY THE
       LATE 1700'S, HARD-SURFACED ROADS
       OPENED BETWEEN NEW HAMPSHIRE
       AND GEORGIA, AND STAGECOACH"

181  ?"LINES LINKED SEVERAL LARGE
       EASTERN CITIES."

182

183  ?"     FROM THE BEGINNING OF
       COLONIAL TIMES, SETTLERS ALSO
       TRADED GOODS WITH ENGLAND.
       SHIPS SAILED DIRECTLY TO THE"

184  ?"MOTHER COUNTRY SENDING IRON,
       TOBACCO, TAR, PITCH AND OTHER
       RAW MATERIALS AND IMPORTING
       GLASS, LEAD, SUGAR, PAPER, TEA,"

*185 INPUT A:  GOSUB 600

186  INPUT A:  CLS:  RESTORE

190  ?"TOOLS AND OTHER FINISHED
       PRODUCTS.  AT FIRST THE ENGLISH
       GOVERNMENT TRIED TO LIMIT
       COLONIAL TRADE TO ENGLAND"

191  ?"ALONE.  EVENTUALLY, THE COLON-
       ISTS CREATED TRADE ROUTES WITH
       AFRICA, THE WEST INDIES, AND
       SOUTHERN EUROPE.  THEY EXPORTED"
```

```
192 ?"FOOD PRODUCTS, FISH, GRAIN,
      LUMBER, AND MEAT.  THE MIDDLE
      COLONIES EXPORTED SO MUCH WHEAT
      AND FLOUR, THEY BECAME KNOWN"

193 ?"AS THE 'BREAD COLONIES'."

194 ?

195 ?"     THE WAR OF 1812 MADE THE

*196 INPUT A:  GOSUB'700

197 INPUT A:  CLS:  RESTORE

200 ?"GREATEST IMPACT ON THE INDUSTRI-
      AL REVOLUTION IN THE UNITED
      STATES.  IT WAS FOUGHT MAINLY
      TO STOP THE BRITISH FROM INTER-"

201 ?"FERING WITH UNITED STATES TRADE.
      AS A RESULT, OVERSEAS TRADE
      NEARLY SHUT DOWN, ALTHOUGH THE
      WAR RUINED MANY NEW ENGLAND"

202 ?"SHIPOWNERS AND PUT THOUSANDS OF
      SAILORS OUT OF WORK, IT DID
      STIMULATE AMERICAN MANUFAC-
      TURING."

203 ?

204 ?"     RAPID INDUSTRIAL GROWTH
      BEFORE THE CIVIL WAR WAS MADE"

206 INPUT A:  CLS:  RESTORE

210 ?"POSSIBLE BECAUSE OF INCREASED
      POPULATION AND IMPROVED TRANS-
      PORTATION.  THE INVENTION OF THE
      STEAMBOAT OPENED UP THE GREAT"

211 ?"LAKES REGION TO SETTLEMENT AND
      THE TRADING OF MANUFACTURED
      GOODS.  CANALS WERE BUILT TO
      PROVIDE MORE DIRECT WATER"

212 ?"ROUTES FOR CHEAPER AND FASTER
      TRANSPORTATION OF GOODS."

213 ?
```

```
214 ?"     RAILROADS CAME NEXT, AND
        BEFORE LONG THEY PUT THE CANAL
        SYSTEM OUT OF BUSINESS.  AS
        EARLY AS 1835, MORE THAN 1,000"

*215 INPUT A:  GOSUB 800

216 INPUT A:  CLS:  RESTORE

220 ?"MILES OF RAILROAD LINE HAD BEEN
        OPENED, AND IN 1869, AMERICA'S
        FIRST CROSS-COUNTRY RAIL LINE
        WAS COMPLETED."

221 ?

222 ?"     AS THE INDUSTRIAL REVO-
        LUTION PROGRESSED, EXPERIMENTS
        CONTINUED, AND IMPROVEMENTS ON
        MANUFACTURING TECHNIQUES WERE"

223 ?"MADE QUICKLY.  BY 1913, THE
        UNITED STATES CLAIMED 35.8% OF
        THE WORLD'S TOTAL OF MANUFAC-
        TURED PRODUCTS."

224 ?

225 ?"     FROM THE VILLAGE PEDLAR TO"

*226 INPUT A:  GOSUB 900

227 INPUT A:  CLS:  RESTORE

230 ?"THE RAILROADS AND AIRPLANES WE
        USE TODAY, WE HAVE COME A LONG
        WAY IN GETTING OUR GOODS TO
        MARKET DURING THE LAST 250"

231 ?"YEARS."

232 ? @ 300,"THE END"

233 INPUT A:  CLS:  GOTO 5
```

This concludes the program for the treatment without graphics.

*lines are included in the graphics program only.

Subroutines for Graphics Program

300 Village Square

400 Covered Wagon

500 Hard Surfaced Roads Open

600 Trading with England

700 New Trade Routes

800 Transcontinental Rail Line

900 Manufactured Products Graph

```
300 CLS(1)
319 ? @ 160,"OTHER": ? @ 192,"SHOPS"
320 ? @  171,"THE": ? @ 203,"VILLAGE": ? @ 235,"SQUARE"
321 ? @ 73,"BLACKSMITH"
322 ? @ 184,"CABINET": ? @ 216,"MAKER"
323 ? @ 329,"SILVERSMITH"
325 GOTO 146
400 CLS
401 FOR H=11 TO 37: FOR V=13 TO 19
405 SET(H,V,2): NEXT V,H
410 FOR H=11 TO 41: FOR V=19 TO 25
415 SET(H,V,3): NEXT V,H
420 FOR H=11 TO 21: FOR V=27 TO 31
425 SET(H,V,4): NEXT V,H
427 FOR H=27 TO 37: FOR V=27 TO 31
430 SET(H,V,4): NEXT V,H
435 ? @ 35,"THE COVERED WAGON REPLACED
          THE SLOW PACK-TRAINS"
440 GOTO 158
```

```
500  CLS(1).
505  FOR H=45 TO 55: FOR V=1 TO 11
507  SET(H,V,7): NEXT V,H
510  FOR H=7 TO 17: FOR V=1 TO 11
512  SET(H,V,7): NEXT V,H
515  ? @ 192,"HARD SURFACED ROADS OPEN
           BETWEEN NEW HAMPSHIRE AND
           GEORGIA"
520  GOTO 176
600  CLS(1)
610  ? @ 3,"THE COLONISTS TRADE WITH ENGLAND"
616  FOR H=3 TO 63: FOR V= 5 TO 13: SET(H,V,2): NEXT V,H
617  ? @ 67,"EXPORTS"
618  ? @ 99,"IRON"
619  ? @ 131,"TOBACCO"
620  ? @ 163,"TAR & PITCH"
621  ? @ 195,"RAW MATERIALS"
625  FOR H=0 TO 63: FOR V=17 TO 27: SET(H,V,4): NEXT V,H
627  ? @ 273,"IMPORTS"
628  ? @ 305,"LEAD"
629  ? @ 337,"PAPER"
630  ? @ 369,"SUGAR & TEA"
631  ? @ 401,"TOOLS"
632  ? @ 433,"FINISHED GOODS"
639  ?
640  GOTO 186
700  CLS(2)
705  ?"NEW TRADE ROUTES DEVELOPED
       BETWEEN THE U.S. AND..."
```

```
710  FOR H=3 TO 19: FOR V=15 TO 23
713  SET(H,V,5): NEXT V,H
715  FOR H=23 TO 39: FOR V=15 TO 23
717  SET(H,V,5): NEXT V,H
720  FOR H=43 TO 59: FOR V=15 TO 23
722  SET(H,V,5): NEXT V,H
725  ? @ 386,"SOUTHERN": ? @ 397,"AFRICA":
     ? @ 407,"WEST": ? @ 418,"EUROPE":
     ? @ 439,"INDIES
730  GOTO 197
800  CLEAR
805  CLS(6)
810  FOR H=0 TO 63: FOR V=22 TO 31
815  SET(H,V,1)
820  NEXT V,H
825  FOR H=0 TO 63 STEP 2
830  RESET(H,22)
835  NEXT H
840  FOR V=20 TO 21: FOR H=0 TO 15
845  SET(2+H,V,5): SET(20+H,V,5)
850  NEXT V,H
855  ? @ 32,"AMERICA'S FIRST CROSS COUNTRY RAIL LINE"
860  IF F>26 THEN 216
865  FOR V= 20 TO 21
870  FOR H=0 TO 1
875  SET(2+F+H,V,6): SET(20+F+H,V,6)
880  SET(18+F+H,V,5): SET(36+F+H,V,5)
885  F=F+2:  GOTO 860
900  CLS(8)
```

```
910  ? @ 416,"U.S. SHARE OF THE WORLD'S
          TOTAL MANUFACTURED PRODUCTS
          IN 1913"

915  ? @ 64,"     35.8%"

920  FOR H=5 TO 25: FOR V=7 TO 15

922  SET(H,V,2): NEXT V,H

925  FOR H=27 TO 57: FOR V=7 TO 15

927  SET(H,V,4): NEXT V,H

935  GOTO 227
```

APPENDIX B

Name_____

WHAT DO YOU THINK ABOUT COMPUTERS?
ATTITUDE SCALE

This scale is designed to see what your feelings are towards computers. It is not a test, so there are no right or wrong answers.

Please circle the words that most clearly indicates your feelings about each statement.

1. I would like to learn how to use a computer.

   strongly agree agree no opinion disagree strongly disagree

2. It is harder to read on the computer than in a book.

   strongly agree agree no opinion disagree strongly disagree

3. I would encourage my friends to use the computer.

   strongly agree agree no opinion disagree strongly disagree

4. I would not sign up for a class in computers.

   strongly agree agree no opinion disagree strongly disagree

5. The computer lets you make mistakes without making you feel bad.

   strongly agree agree no opinion disagree strongly disagree

6. I will have to know how to use a computer to get a job.

   strongly agree agree no opinion disagree strongly disagree

7. I would not like to learn how to use a computer.

   strongly agree agree no opinion disagree strongly disagree

8. Our school should buy a computer.

   strongly agree agree no opinion disagree strongly disagree

9. Being able to use a computer will be important in my life.

   strongly agree agree no opinion disagree strongly disagree

10. I would do more reading if it was on the computer.

    strongly agree agree no opinion disagree strongly disagree

11. Computers are always making mistakes.

    strongly agree agree no opinion disagree strongly disagree

12. I would not like a job that involves working with computers.

strongly agree agree no opinion disagree strongly disagree

13. I would not volunteer to help other students learn about the computer.

strongly agree agree no opinion disagree strongly disagree

14. I would stay after school to use the computer.

strongly agree agree no opinion disagree strongly disagree

15. It is very hard to learn how to run a computer.

strongly agree agree no opinion disagree strongly disagree

16. I would like to do all my homework with a computer.

strongly agree agree no opinion disagree strongly disagree

17. I can read faster on the computer than in a book.

strongly agree agree no opinion disagree strongly disagree

18. A computer could help me with alot of things.

strongly agree agree no opinion disagree strongly disagree

19. Not everyone will have to know how to use a computer.

strongly agree agree no opinion disagree strongly disagree

20. I can not think of five things I would use a computer for.

strongly agree agree no opinion disagree strongly disagree

21. Computers will not help me learn more.

strongly agree agree no opinion disagree strongly disagree

22. If I could afford it, I would buy a computer.

strongly agree agree no opinion disagree strongly disagree

23. The computer makes learning fun.

strongly agree agree no opinion disagree strongly disagree

24. I would volunteer to work in the computer lab.

strongly agree agree no opinion disagree strongly disagree

25. All students should have to take a class in computers.

strongly agree agree no opinion disagree strongly disagree

APPENDIX C

NAME_____

GETTING THE GOODS TO MARKET TEST

Circle the best answer to each question.

1. Most families in the early 1700's got their food by

   a) growing it
   b) trading for it
   c) buying it from the pedlar
   d) buying it at the market

2. On the village square, you could probally find

   a) the village pedlar
   b) Indians trading furs and hides
   c) the gunsmith's shop and the general store
   d) a cabinetmaker

3. Choose the correct order of transportation development.

   a) pack-trains, wagon trains, railroads, airplanes
   b) wagon trains, pack-trains, bicycle, railroads
   c) pack-trains, wagon trains, schooners, railroads
   d) wagon trains, pack-trains, railroads, barges

4. The village pedlar could be found trading

   a) clothing, glass beads, and liquor
   b) meat, grain, and vegtables
   c) silverware, boots, and bottles
   d) tobacco, sugar, paper, and tools

5. Which of the following was <u>not</u> exported to England?

   a) iron
   b) tar
   c) lead
   d) raw materials

6. The covered wagon replaced the pack-horse trains because

   a) they were cheaper to use on the long trip west
   b) the settlers needed more protection in the Allegheny Mountains
   c) they could hold many people with supplies
   d) they were reliable

7. Compared to the United States, what percent did the rest of the world contribute to the world's total of manufactured products in 1913?

   a) 64.8%
   b) 57.4%
   c) 35.8%
   d) 45.2%

8. The steamboat was invented

a) in the early 1700's
b) during the Industrial Revolution
c) in 1835
d) in the late 1700's

9. The most common form of travel in the eastern U.S. in the late 1700's was by

a) covered wagon
b) stage coach
c) horse carts
d) railroads

10. Which was not an effect of the War of 1812?

a) many New England shipowners went broke
b) it was fought to stop British interference
c) thousands of sailors were out of work
d) overseas trade improved

11. Which of the following was imported from England?

a) lumber
b) raw materials
c) finished products
d) tobacco

12. As a result of the War of 1812

a) the British allowed the Americans to trade with Africa and the West Indies
b) the steamboat came into widespread use
c) relations with England improved
d) American manufacturing increased

13. Which is something a farmer in the 1700's would not raise?

a) cattle
b) horses
c) wheat
d) vegetables

14. Canals were important because

a) shipowners had to compete with the railroads
b) they permitted the settlement of the Great Lakes region
c) raw materials could be shipped from the Great Lakes back East
d) they provided direct water routes for shipping

15. The biggest change in getting goods to market since the 1700's has been in the

a) way goods are shipped
b) routes used for shipping
c) speed of shipping
d) cost of shipping goods to market

Place the following main ideas in order as they were presented in the story. (The first event should be labeled one, the last four)

_____Shipbuilding became the leading industry.

_____Getting goods to market was difficult.

_____Roads were improved. Stage coach lines linked several large eastern cities.

_____The covered wagon replaces pack-trains.

Choose the best meaning for the underlined word.

20. The first transcontinental railroad was built in 1869. The prefix trans means

a) transferring b) one place to another c) across d) beyond

21. Farm machinery in the 1700's was crude.

a) raw b) dirty c) natural d) simple

22. The pedlar sold his goods door to door.

a) seller b) to carry from place to place c) a traveling salesman d) a pusher

23. New manufacturing techniques were developed.

a) exactly b) methods c) skills d) technical