NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

An Investigation of Learner Characteristics and Instructional Control on Grade Five Students

Penelope Anne Nicholson

A Thesis

in

The Department

of

Educational Technology

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montreal, Quebec, Canada

August 1989

ISBN 0-315-51369-1

ABSTRACT

An Investigation of Learner Characteristics and Instructional Control on Grade Five Students

Penelope Anne Nicholson

Eighty five grade 5 subjects were randomly assigned to one of three treatment groups (learner, yoked, or program controlled) in order to investigate if the type of control affects achievement when using computer-assisted instruction. The study used one independent measure, four covariates, and three dependent measures. The independent variable was type of control which was the student's free choice, or forced viewing of some, or all of the five assistance options designed to enhance comprehension. The assistance options were aimed at improving the students' ability to answer multiple choice questions regarding four 150-300 word passages on a software called "The Comprehension Connection". The first and second covariate were ability as determined by the Verbal and Nonverbal Subtests of the Cognitive Skills Subtest of the Educational Development Series battery of tests. The third covariate was Age of the subjects at the time of the treatment, and the forth covariate was the personality characteristic of Locus of Causality as measured on the Intellectual Achievement Responsibility Questionnaire. The dependent variables were achievement as measured on a post test, the results of an attribution test which determined the subjects' causal belief about the computer situation, and the time required to complete all the passages in order to determine the efficiency of the three treatments. An analysis of covariance revealed a main effect for control, and the results indicated that program control produced higher achievement on the

post test than for the learner controlled group. No other significant differences were found.

Acknowledgments

The author wishes to thank the teachers, and grade five students of Hudson High School, and especially the Vice Principal Judy Grant, for their cooperation in the study's data collection. I am also indebted to Milliken Publishing for their assistance and kind donation of the Comprehension Connection Software. I would also like to extend my thanks to Dr. Phil Abrami and Dr. Lois Baron for their encouragement and moral support, and of course the invaluable assistance and patience provided by Dr. Mariela Tovar and Dr. Robert Bernard.

Contents

Figures

Tables

CHAPTER 1

With the increasing amount of information which technology makes available, it becomes essential to design learning systems which will meet the needs and individual differences of various learner types. Learner controlled instruction is an instructional strategy which attempts to optimize the learning situation by allowing the learner to make one or more of the key instructional decisions or selections. The learner can select options such as the pacing, sequencing, content, timing, amount of practice, and/or the difficulty level. With this design the learner controls the instruction, while the instructor or programmer controls the environment, the environment being the set of conditions which will produce predictable learning results even though the learner makes one, some, or many of the learning decisions (Wydra, 1980). Placing the control in the learners hands may appear to solve the problem of how to individualize instruction, but though some groups have been seen to strongly benefit from it, the research has shown that some groups do not react favorably towards this control.

The problem addressed by this study was what type of control should be provided to learners with various abilities and characteristics in order to create an effective and efficient instructional environment ? The issues investigated in this study are interesting and important because the designer of technologically based instruction, especially computer-based instruction, has the potential to provide as much, or as little control, as is required by the learner in order to optimize the learning environment (Hannafin, 1984). Teachers and designers must, therefore, be provided with information in order to determine how control

in a computer situation should be granted, to whom, and under what conditions. If teachers and designers are not provided with practical information about individualizing the learning situation, they may have to proceed on a trial-and-error basis which may lead to low motivation in the learner, or just as importantly give up any attempt to individualize instruction, thus failing to optimize the learning situation.

The purpose of this study was to gather practical information to assist teachers and designers in clearly determining the reaction of different groups towards the types of control available in computer software. This study was designed to gain answers to the questions of whether control affects students attributions, performance, and/or instructional time. The investigation was also designed to answer the questions whether the effective and efficient use of control was affected by the learner characteristics of ability and Locus of Causality. As all learners come to the teaching situation with various abilities and attributions, it is crucial to investigate how ability and Locus of Causality interact with different types of instructional control in order to determine what type of control is best for what type of learner.

This investigation attempted to gather practical information by investigating the reading comprehension of grade five students with a computer software, and looked at this issue from the perspective of learner versus program controlled instruction, and whether the use of this control was affected by perceived control, the strategy used, or learner characteristics.

CHAPTER 2

Literature Review

Mager (1963) conducted early work in the area of learner control, and emphasized that learners come to a teaching situation with varying amounts of relevant knowledge regarding a lesson. Mager stated that learners should, therefore, be given control over the sequence, pace, length, and/or content of the curriculum in order to achieve specified objectives. From his experiments, he concluded that providing the learner with control increased learning effectiveness by reducing the length of formal training, while at the same time improving the competence and confidence of the learner (Mager, 1963). Mager realized the potential of learner control in helping to individualize the learning situation and stated that;

> It is timely to begin thinking about curriculum-generating machines. These devices would be designed to detect what the student already knows, compare this body of knowledge with that required by the objectives of the program, and then generate a curriculum for the student. (1963, p.75)

Mager may have been forecasting the use of computers in education, and their role in individualizing instruction, when he wrote this statement in 1963. The computer of today is compact and relatively inexpensive, while having the capability not only to establish, record and manage information about individuals regarding their abilities, but also to meet learner's needs based on their various aptitudes, personality traits, cognitive styles, and performance results (Holmes, Robson, & Steward, 1985). The computer, therefore, can be effectively used as an educational tool to help in the difficult task of matching instruction to the learner.

If the learner is permitted to control some aspect of the learning situation, and actively participate in the learning process, then an optimum learning environment may be created. Early studies suggest that providing learner control is beneficial in terms of efficiency and effectiveness, and these early studies are discussed below.

Instructional Control: Effectiveness and Efficiency

The earliest computer-based educational system which attempted to involve the student in the instructional process, and emphasized a move away from the conventional program-controlled instruction, appears to be the PLATO (Programmed Logic for Automatic Teaching Operations) system. It was started at the University of Illinois in 1959 by researchers Alpert and Bitzer. The goal was to create a highly flexible instructional system which could be economically justified, and which would allow educators to modify their lessons to make them more learner-controlled. Evaluations of the PLATO system by Alpert and Bitzer found that students taught with this system scored as well as those who used conventional instruction but took only one-third to one-half the time (Alpert & Bitzer, 1970). They also claimed that the PLATO group showed greater retention than their conventional instruction counterparts. An evaluation of the system by Lahey (1978) and Lahey and Coady (1978) found no significant difference in performance, irrespective of retention and time, between three experimental treatment groups; learner control, learner control with advice, and program control, on the PLATO system. They also gathered information on the attitudes of the three groups, but found no significant difference toward the computer-based instruction.

A system which allowed a greater range of learner control was the TICCIT (Time Shared, Interactive, Computer-Controlled, Informative Television), a computer-based teaching system which allowed the learner to exercise control over the choice of the next content and next display type. Information on principles and concepts in Math and English were presented on a television screen which was connected to a keyboard. Students chose their own learning strategy by using special control keys on a terminal which presented instructional material including rule frames, examples, practice problems, and test items (Merrill, Schneider, & Fletcher, 1980). The user had access to Easy, Hard, and Help keys which presented frames which were modifications of the basic presentation form. The user also had access to an Adviser function key which allowed the student to acquire information or directions in the area of status, study suggestions, and system operations. The idea behind the system was that the learner could select a combination of displays that was most appropriate for his own unique combination of aptitudes or prior learning (Merrill, 1980).

Evaluations of TICCIT have been conducted in Community Colleges, Brignam Young University, and in the Navy. The results indicate that with adult learners those in TICCIT perform no worse than regular classroom students. Some students, however, did not complete all the lessons, but most found it more challenging, and preferred it to conventional instruction. Further research (Fredericks, 1976), manipulated the option of practice on TICCIT, and found that the learner control group was much more time efficient in completing the task.

Even though the results of the studies with PLATO and TICCIT suggest that providing learner control is beneficial, results of numerous

later research examining the effects of learner control have been mixed. Much of the recent research in computer assisted instruction and learner control has focused on its effect on academic performance, time efficiency, and attitudes.

One study which investigated instructional control and performance (Campanizzi, 1978) examined the effect of learner control and program control with and without overviews (organizational information regarding material that would be presented) on response latency and achievement. The significant difference found was that performance was greater under learner control than under program control, and it was concluded that providing learners with control of a computer-assisted task increased performance. Similar findings were found by Kinzie et al. (1987) who established that when grade eight students were given control of content review, performance was higher than those without this control, and the learner controlled group developed more favorable attitudes towards their treatment. Campanizzi's and Kinzie's et al. results support those found by the PLATO and TICCIT research and appear encouraging as to the benefits of providing control of instruction to the learner, however, results of numerous studies do not support these findings.

Several researchers have found learners to be ineffective in managing their own instruction (Olivier, 1971; Judd, 1972; Fisher, Blackwell, Garcia, & Greene 1975; Lahey, 1978; Lahey et al., 1978; Reinking & Schreiner, 1985; Sullivan, Beyard, Berdel, & Hass 1987), as subjects who were provided with instructional control performed poorly. In one such study Olivier (1971) investigated learner control by providing subjects with various instructional sequences, or allowing them to select

their own sequence. Olivier found that learner control of sequence failed to produce an increase in achievement. The learner controlled group was inferior in performance when compared to the other groups, and this control failed to foster more interest in the task.

Judd (1972) discussed several studies carried out at the University of Texas which also investigated the issue of providing control of instructional sequence to learners, and it's effect on performance. In one study a learner controlled group was given control over the sequence and selection of material in a pre-calculus math course, while a program controlled group was fixed in what was considered to be the optimal order. The conclusions drawn were that the learner control group scored lower on the post test than the program control group, perhaps because they took less time to complete one of the three topics. This topic they did not spend time on was considered to be the most difficult of the three, and the researchers noted that subjects in the learner control group used the control option to avoid this difficult topic instead of pursue it.

An experiment conducted by Fisher et al. (1975) investigated the effect of instructional control on performance with fourth and fifth grade students and assigned them to one of two treatments; a group with choice (selection of arithmetic problems based on difficulty level) and length of time they wished to work on them; and a group with no-choice. They found that children who had choice showed more task engagement, but completed fewer questions, and performed worse that the control group which was not provided with choice.

Reinking and Schreiner (1985) also used young subjects, learners in the fifth and sixth grades, and examined their reading comprehension on the computer versus the printed page, as well as the effect of textual manipulations on the computer. These manipulations were controlled by the computer (program control) or by the learner (learner control). The researchers found that the reading comprehension of good and poor readers was superior on the computer when manipulations of the computer text were under computer control, in which subjects were not permitted to choose which assistance options to view, rather they were required to view all the options. The difference was most evident for the high difficulty passages. The researchers cautioned that since the subjects had had little exposure to the computer before the treatment, a novelty effect may have increased interest on the computer, and thus accounted for differences in comprehension, and for some of the unusual and unexpected results not reported here.

Because of the possible confounding effect in his earlier study, Reinking (1988) replicated his study with the modification of using subjects who had been previously exposed to computers, and introduced a few minor modifications. The minor modifications included recording passage preference, estimation of self-learning, and the time taken to read the text. He also examined whether these factors affected performance on the post test. Reinking found that more time was taken on the computer-mediated texts with options for assistance, and performance on the post test was superior for this group. This held true even when scores were adjusted to control for reading time. The results were evident for the computer-mediated texts regardless of whether the learner could select which options to view, or whether the learner was

forced to view all the assistance options. There was no significant differences in passage preference or estimation of learning according to the mode of presentation, whether print or computer based. The study, therefore, failed to replicate the findings of superior performance for the program controlled group that was found in the 1985 study.

Some experiments which investigated computer-assisted instructional control found that providing learner's with control had no effect on performance (Alpert & Bitzer, 1959; Judd, 1972; Merrill et al., 1980; Goetzfried & Hannafin, 1985; Holmes et al., 1985; Reinking, 1988). In one such study Judd (1972) provided two specific instructional 'decisions' to the learner, both which concerned the subjects ability to evaluate his own performance. These 'decisions' were the option to enter or skip modules, and the option to repeat or not repeat practice problems. The learner control group was compared to a program control group who was not provided with this or any control, and it was hypothesized that the learner control group would select fewer modules, and that subjects given control of practice would make fewer responses to each problem than the program control subjects. The data failed to support the hypothesis of the study.

Another study, Goetzfried and Hannafin (1985), investigated the effectiveness and efficiency of a computer-assisted instructional tasks. The researchers investigated the effects of three treatments, adaptive control (computer controlled branching depending on the accuracy of responses), learner control with advisement, and linear control (which is equivalent to program control in other studies), on low and below average seventh graders. No difference was found for achievement between the

groups. The significant difference found was that subjects in the adaptive control and learner control with advisement groups required more time to complete the tasks, with no associated gain in achievement, while the linear control had comparable learning in less instructional time.

In a study conducted by Holmes et al. (1985) with 11 and 12 year olds', the difference between learner control and program control was investigated in a comparison of four treatment groups. These groups were learner control, learner control with pre-instructional advice, random program control in which the displays and selections were randomly made by the computer, and adaptive control in which display types were selected by a computer algorithm designed to simulate a good teacher. The results suggested that there was no difference on post test scores for the learner versus program control groups. There was no significant difference between the learner control, learner control with advice, and adaptive program control but all scored higher on the post test than those who were provided with random program control.

It is clear from the review of the research that the results are variant as to whether learners can effectively utilize control of their instruction in a computer-assisted instructional task. Results of some studies (Campanizzi 1978, Kinzie et al. 1987) suggest that providing learners with control increased performance. Other researchers found learners to be ineffective in managing their own instruction (Olivier, 1971; Judd, 1972; Fisher et al., 1975; Lahey, 1978; Lahey et al., 1978; Reinking & Schreiner, 1985). Other researchers found that providing learner's with control had no effect on performance (Alpert & Bitzer, 1959; Judd, 1972; Merrill et al., 1980; Goetzfried & Hannafin, 1985; Holmes et

al., 1985; Reinking, 1988). It is not possible, therefore, to make generalizations about the use of control in a computer-assisted task as it effects performance, and these findings raise questions as to the extent to which performance is affected by computer-assisted instructional control. Further research is needed in this area in order to gain useful information about instructional control as it affects performance.

It is clear from the research that findings of studies which dealt with instructional control as related to performance have been mixed, however, it is necessary not only to investigate the effectiveness of control, but also it's efficiency. Results of studies on the time efficiency of computer-assisted instructional control have also been mixed. Research has found that providing learner's control of instruction was more efficient than strategies that did not provide this control (Alpert & Bitzer, 1970; Fredericks, 1976), more time consuming (Goetzfried & Hannafin, 1985), or to make no difference (Lahey, 1978; Lahey et al., 1978). The researchers which found providing the learner with control of their instruction was more efficient, or that providing control made no difference in terms of time, carried out their research on the TICCIT and PLATO systems. These large systems allowed the learner to exercise choice over numerous facets of instruction, and it is difficult to determine which features of control were, or were not, efficient. The researchers which found learner control to be more time consuming (Goetzfried & Hannafin, 1985) conducted their study under more strict experimental conditions, and investigated the use of control by providing control of review and selection of examples to grade seven subjects. Results of the study indicated that the linear control group, which was not provided with control, had comparable learning in less instructional time. This

study's results are interesting and merit further investigation, because if school children cannot efficiently utilize the control provided in computer software they are likely not mastering the material, and this could be magnified by the often restrictive time available for the student on the computer. Questions arise as to whether instructional time is influenced by the use of different types of instructional control.

Results of research which investigated the affect of control on attitude has also been mixed as some researchers found that subjects developed a more positive attitude when provided with learner controlled instruction (Olivier, 1971; Merrill et al, 1980; Kinzie et al, 1987), while others found this control had no affect on attitudes (Olivier, 1971; Lahey, 1978; Lahey et al., 1978; Reinking, 1988). These results merit further investigation because if providing the learner control of some aspect of instruction does foster positive feelings toward the learning experience, then it serves as a motivational tool which can help to optimize the learning situation. Questions arise as to whether, and how, attitude is affected by different types of instructional control.

From the research it is not yet possible to determine what type of instructional control should be provided in order to increase performance, reduce instructional time, and improve attitudes, and questions arise as to whether the same type of control should be provided to learners with different characteristics. Are the teaching methods which are beneficial for high ability learners also beneficial for low ability learners ? Does a learner's attributions of his successes and failures, Locus of Causality, affect his performance on instructional tasks ? Is there a relationship

between Locus of Causality and instructional control ? The following sections will address these questions.

Instructional Control and Learner Characteristics

Researchers (Belland, Taylor, Canelos, Dwyer, & Baker, 1985) have looked at the question of ability and pacing, and have investigated whether providing learners with self-paced instructional material is superior in terms of performance. The researchers hypothesized that low achievers may not select options which would provide more instruction, but rather be forced into an elaborate feedback loop after making a series of errors. The researchers also hypothesized that moderate external pacing would improve performance and overall time efficiency for task completion. Their results support the hypotheses, and they concluded that students may not be the best judges as to how much, or what type, of instruction they need for effective learning to take place.

A study by Goetzfried and Hannafin (1985), investigated the issue of ability by examining grade seven learners with differing abilities. The researchers studied the effects of three treatments, adaptive control (computer controlled branching depending on the accuracy of responses), learner control with advisement, and linear control (which is equivalent to program control in other studies), on low and below average students. No difference was found for achievement between the groups. The significant difference found was that subjects in the adaptive control and learner control with advisement groups required more time to complete the tasks, with no associated gain in achievement, while the linear control had comparable learning in less instructional time. Thus, for the low ability

subjects the most efficient strategy was to receive a set sequence of instruction with no advisement, no control to review or select additional examples, and no externally imposed program decisions based on the accuracy of responses.

The question of the effect of learner and program control on groups with differing ability was also examined by Ross and Rakow (1983) with undergraduate subjects, though not with CAI. They hypothesized an aptitude-treatment interaction in which subjects with low prior achievement would do best with program control, and worst with learner control, while the performance of high prior achievement subjects would be best or comparable under learner control. The researchers formed four groups which had access to supporting examples which were either chosen by the program (workbook style) or the learner(self study), were nonadaptive (kept constant) or nonadaptive through lecture (same information as self study presented in lecture format). They failed to support their hypothesis, but found on tests of achievement that overall the program controlled group obtained superior performance while the learner controlled group consistently had the lowest post test score.

The reason for the poor performance for low ability subjects with learner control has not been fully investigated, but it may be attributed it to the student's lack of ability to determine when remedial help was needed; a skill which Judd (1975) stated was a reason for learner control being superior over program control in average and above average adults. Tobias (1981) and Bovy (1981) predicted similar results and stated that it is logical to expect an inverse relationship between prior achievement and the amount of instructional support the learner needs.

Owings, Petersen, Bransford, Morris, & Stein (1980) conducted an interesting study, though without learner controlled CAI, with high and low ability fifth graders. They found that when text was presented which was appropriate (i.e. The hungry boy ate) versus inappropriate (i.e. The hungry boy slept), high ability subjects were able to note the appropriateness of the text to demonstrate their knowledge that inappropriate text took longer and was more difficult to learn. High ability subjects regulated their study effort adaptively, but low ability students, though they could distinguish between appropriate and inappropriate text, did not correctly evaluate its difficulty, nor adapt their study effort accordingly.

Snow (1980a) also supports this observation that low ability subjects perform poorly when they are provided with instructional control, and stated that high and low ability subjects,

> ... differ in their efficiency in assembling a systematic strategy for the task, their control of its application, and their flexibility in changing strategies as item characteristics demand. (Snow, 1980b, p. 49)

Snow (1980b) further stated that "directed learning", or program control, may do for low ability students what they cannot do for themselves, but that this type of control may be dysfunctional for more able students who are capable of organizing their own learning. Program controlled microcomputer instruction may be a superior method in teaching young and less able learners, but further research must be conducted in order to gain support for this hypothesis.

Another area which merits attention is whether achievement is affected by a perceived causal relationship between one's actions and the

consequences that follow. Attribution Theorists propose that there are three major dimensions of causality -locus, stability and controllability- and that one's perception of these dimensions affects one's emotional experiences (Weiner, 1985). Locus of Causality is of particular importance to the educator because of its perceived relationship to an individuals self-worth and self-esteem. Attribution Theorists claim that success attributed to internal causes, such as ability or effort, generates feelings of pride and positive self-esteem, while failure attributed to internal causes generates a negative self-image. They also state that positive and negative outcomes attributed to external causes, such as luck or unfairness, do not affect self-esteem. It is especially important to investigate how children view their academic experience as it is believed that learners who attribute failure as being due to internal causes are less likely to consider adverse circumstances as surmountable, and will, perhaps, give up in the face of failure.

It is further hypothesized by Holloway (1978) and Hannafin (1984) that learners with internal attributions may achieve higher performance than those with external attributions, and that externals may perform better in situations where structure is provided for them, while internals may best perform when little structure is provided. The researchers also state that these factors may be affected by learner characteristics. Holloway's 1978 study failed, however, to support these hypotheses.

From the review of the attribution research, questions arise as to whether differences in performance would be evident in subjects with an internal or external locus of causality. Further research is needed in the

area of attribution and instructional control in order to gain information to help optimize the learning situation.

It is evident from past research that there is still no conclusive answer as to how to optimize the learning situation by individualizing instruction for learners with different abilities and characteristics. What is apparent from past research is how little has been investigated in the area of instructional control with elementary school learners. It seems appropriate to extend the investigation to younger learners as it is unknown whether the findings with adults will be applicable to immature learners. It is inconclusive whether young learners can effectively utilize control in a computer situation, and what factors influence the effective and efficient use of this control. Research in this area is needed in order to assist teachers in clearly distinguishing the reaction of different groups towards the type of control available in computer software, thus helping educators match the learner situation to the student to optimize the learning environment. The present study, therefore, investigated the affect of computer-assisted instructional control on young learners in an attempt to answer the following questions and support the following hypotheses.

Research Questions and Hypotheses

The questions this thesis attempted to answer were:

1. Is there a difference in performance on the post test between groups provided with different types of instructional control; learner controlled, program controlled, and yoked controlled ?

2. Is there a relationship between performance on the post test and subjects with different learner characteristics (verbal ability, nonverbal ability, age, locus of causality) ?

3. Is there an interaction between the learner characteristics and the type of control provided ?

4. Is there a relationship between the time taken to complete the reading task and groups provided with different types of instructional control ?

5. Is there a difference in the time taken to complete the reading task between subjects with different learner characteristics (verbal ability, nonverbal ability, age, locus of causality) ?

6. Is there an interaction between learner characteristics and the time taken to complete the reading task ?

7. Is there a difference in attribution between the learner controlled, program controlled, and yoked controlled groups ?

It was hypothesized that there would be an aptitude - treatment interaction (ATI) between ability and program control, and that subjects with low ability would perform poorly in the learner controlled treatment, and be out-performed by low ability subjects in the computer control treatment. A further hypothesis was that subjects with high prior achievement would perform best in the learner controlled treatment

It was also hypothesized that subjects who took responsibility for their intellectual academic successes and failures (internals) would out perform those who failed to take this responsibility (externals) on the post test.

CHAPTER 3

Method

Subjects

The subjects in this study were 85 upper-middle and middle class children of mixed ability, between the ages of 10 and 12 with a mean age of 10 years 7 months. They were drawn from four grade five classrooms in a public, off-island school called Hudson High School. The elementary section of this school has had microcomputers in its possession for several years so no novelty effect was expected when the computer treatments were introduced.

Design

The study used one independent variable, four covariates, and three dependent variables in order to investigate computer assisted instructional control.

The independent variable in the study was control, and the subjects were randomly assigned to one of three treatments, either program controlled (n = 27), learner controlled (n = 29), or yoked control (n = 29). The three treatments are discussed below.

1. The subjects in the program control group were required to view a software designed to enhance reading comprehension, read an on-line passage, and then view five assistance options in a preset order. The assistance options were meant to aid the subjects in

comprehending four reading passages in order to answer five multiple choice questions per passage.

2. The subjects in the **learner control group** controlled the choosing of assistance options, and were required to read an on-line passage, and then choose which of, and in what order, the five available assistance options would be viewed. The assistance options were meant to help the subjects in comprehending the four reading passages in order to answer five multiple choice questions per passage.

3. The subjects in the **yoked control group** were required to read an on-line passage, and then view a limited number of assistance options in a preset order in order to aid in comprehending the four reading passages and answer five multiple choice questions per passage. The options which were viewed by the yoked group depended on the options which the randomly matched learner in the learner control treatment chose to help him comprehend the passage. In other words if a learner in the learner control group chose to view the option Return to Passage option, and Graphics option for passage number one, then the subject he was yoked with would be provided with only these options for the first passage. This procedure was repeated for all four passages.

The yoked group in this study was used in order to help answer the questions of whether perceived control of events would have an effect on attitude towards the computer experience, on performance on an achievement test, and on the amount of instructional time needed to complete the task. In order to answer these questions subjects in two

groups, the learner controlled group and the yoked group, were matched according to instructional strategies. The difference between these groups was that the learner control group had the option to choose the strategy, while the yoked group was given the strategy used by his matched subject in the learner control group. Therefore, the yoked group was used in an attempt to separate for analysis the effect of 'choice' from the 'strategy' employed. The use of the yoked group helped to determine if potential differences could be caused by the learner controlled group having the choice of options, or by the strategy used by the learners.

Four covariates were used in the study. The first and second covariate in the study were ability, which helped to determine if ability influenced achievement in completing learner, yoked, or program controlled software. Ability was determined by the results of the Verbal and Nonverbal subtests of the Cognitive Skills Subtest of the Educational Development Series (EDS) battery of tests (Scholastic Testing Service, 1984).

The third covariate was the Age of the subjects at the time of testing, and the forth covariate was the personality characteristic of Locus of Causality (I) as measured on the attribution style test, the Intellectual Achievement Responsibility Questionnaire (IAR). The IAR scale is aimed at assessing children's beliefs that they, rather than other people, are responsible for their intellectual-academic successes and failures.

Three dependent variables were used in the study. The dependent variables were performance on a post test which tested the reading comprehension of the subjects following their treatment, an attribution

test which determined the subjects' causal beliefs about the computer situation, and the time taken to complete the designated task. The reading comprehension post test contained the same reading passages and questions as those provided by the software, with the exception that the latter was in a pencil and paper format. The attribution test was made up of questions that looked at four causes shown to be important to children in achievement situations; ability, effort, task difficulty, and luck, as they relate to the microcomputer experience, and questions were asked about the enjoyment of certain aspects of the treatments (see Appendix A).

The time required to complete all the passages was also collected in order to determine the efficiency of the three treatments. This was done by simply noting down the time taken for each subject to complete the four passages after all instructions were provided.

Materials

The computer software which was used in the study was a program called "The Comprehension Connection" created by Milliken Publishing Company (1987). The software package contains a management disk and five passage disks (E1 - E5). Each passage disk contains four reading passages which range in reading level from grade 4.6 through to 5.9. The difficulty of the reading passages was determined by the readability formulas of Spache, Dale-Chall, Fry, Raygor, Flesh, and the Gunning-FOG (Milliken, 1987). These formulas have been used widely to classify the difficulty of written materials by providing a grade-level estimate of difficulty.

The Comprehension Connection software is designed to improve students' reading comprehension and is based on Reinking's and Schreiner's research (1985) on the use of interactive text in aiding comprehension development. Reinking has published articles about the use of computers in reading, and the control of textual manipulations on the microcomputer and its affects on the reading comprehension for both high and low difficulty passages, on both good and poor readers (see Literature Review). The software used in Reinking's study was the pilot version of the The Comprehension Connection software and was composed of short reading passages (140-180 words) followed by five assistance options with both a strong emphasis on graphics, and five comprehension questions.

The software used in this study provides students with a 150-300 word passage which students' read. The student then utilized five assistance options in order to comprehend the passage, in order to answer five multiple-choice questions. The assistance options provided by the software were:

1. an easier, less technical version of the original passage
2. context-specific definitions of difficult vocabulary
3. the main idea of each paragraph in the passage
4. graphic aids associated with the content of the passage, and
5. the opportunity to reread the passage

These assistance options were either learner controlled in which the student chose to use whichever options he felt he needed to understand the passage, or computer controlled, where the student was forced to see, some of (yoked control), or all (program control) of the available assistance options in a certain order before attempting to answer the

multiple choice comprehension questions. It should be noted that a student could not change the type of control he was provided with, as he did not have access to the management disk which has this function.

The ability test used in this study was the Cognitive Skills subtest of the Educational Development Series (Level 15A) which is made up of a Verbal test and a Nonverbal test. The reliability measures of the Verbal test is reported to be .82 - .88 and .74 - .83 for the Nonverbal test (Scholastic Testing Service). This test is published by Scholastic Testing Service, Inc., Bensenville, IL 60106-8056, copyright 1984 and may be purchased from the publisher.

The attribution test used in the study (see Appendix B) was the IAR scale which is composed of 34 forced-choice items that describe either a positive or negative, hypothetical achievement experience followed by two alternatives; one that states an event was caused by the subject's own behavior, the other which states that an event was caused because of the behavior of someone in the child's environment (i.e. parents, teachers, peers). The IAR scale provides the researcher with three scores; the subject's belief in personal responsibility for success (I+), the subjects internal responsibility for failure (I-), and the total self-responsibility score (I) (I = I+ + I-). The test-retest reliability of the IAR is .47-.74, and the internal consistency is .54-.60 (Stipek and Weisz, 1981, p. 105).

Procedure

The type of control the subject was provided with was preset with the use of a management disk. The presetting procedure was quite simple. A management disk was provided with the software package which

allowed the researcher to make an assignment for a subject based on the availability of the five assistance options. This was possible by choosing a 'yes' or 'no' for each of the options listed in the computer menu. If a 'yes' was provided for an option then the learner would be able to view that option, if a 'no' was provided the learner would not have access to that option. Figure 1 is a sample screen of the menu from the management disk which was used to create the assignments.

FIGURE 1. Sample student assignment

Jane Smith

Change Assignment

Which options for help may be used?

Return to Passage	Y
On-disk dictionary	Y*
Easier Version	N
Vocabulary	N
Main Idea	Y
Graphics	Y

Make help optional ? (Y or N) Y

---

* The On disk dictionary was not an option which was manipulated in this study as it was not one of the five assistance options which were presented to the students at the end of the passages.

According to Figure 1, Jane Smith would be provided with the assistance options of Return to Passage, On-disk Dictionary, Main Idea, and Graphics, but would not have access to an Easier Version, or Vocabulary. Since it was quite likely that subjects in the learner control group would choose different options for each of the four passages, the procedure in figure one was repeated for each passage. It was solely this manipulation of assistance options which was used to create the yoked controlled treatment.

The presetting of assignments for the learner, yoked, or program controlled groups were done by answering 'yes' or 'no' to the question in the computer menu "Make help optional ?" (see Figure 1). If answered yes the subject would be provided with the learner controlled treatment, if answered no the subject would be provided with the program controlled treatment. Assignments for subjects in the yoked group were provided with a no for this option in order to force the yoked subjects to view all of the options that their matched subject in the learner controlled group chose to view.

Before the start of the study the grade five students were provided with parental permission slips. Subjects who had received written parental permission were randomly assigned to treatment groups, dismissed from their regularly scheduled classroom activities, and asked to complete the Cognitive Skills subtest of the Educational Development Series, and the IAR Scale (see Appendix B). The subjects completed the tests individually and the only assistance provided were the instructions for each of the tests. The instructions for the Cognitive Skills Test were provided with the test and were carefully followed. The instructions for

the IAR scale were; "Pick the answer that best describes what happens to you or how you feel." The subjects were told that there were no right or wrong answers on the IAR, and that responses for either test would not be given to anyone at the school.

After completing the tests 7 subjects were brought down to the computer room and told to sit at a computer. When all students were seated, one student per computer, they were instructed how to use the computer program and told they had as much time as they needed to complete the four passages, and that they could begin. The students were required to read four passages, each of which was on a separate disk, view assistance options, and answer the multiple choice questions for each passage. Once the student had correctly completed the comprehension questions within the predefined parameters on one disk the student requested the next passage disk and repeated the procedure. The researcher circulated around the computers helping with any computer problems that arose, and answered questions regarding the program, but refrained from answering any questions which pertained to the information presented by the software.

After completing the four passages, the subjects were returned to their classrooms, and another group of subjects were brought down to the computers. This procedure continued until all the subjects of one class had been exposed to the computer treatment. A short time was provided for the subjects memory to clear, and they were then asked to complete a pencil and paper attribution test which determined their beliefs about the microcomputer experience (see Appendix A), and a pencil and paper achievement post test (see Appendix C). The procedure was then repeated

with the next class and continued until all four classes were exposed to the treatment and tested.

Data Analysis

The cell means and standard deviations were calculated for all variables and the data were analyzed in three steps in order to answer the questions posed in Chapter Two. First an analysis of covariance was used in order to compare achievement between the groups as measured on the post test. This analysis was conducted in order to answer questions number one and two. Homogeneity of regression was tested to determine if an interaction was evident in order to answer question number three.

Second an analysis of covariance was used to compare the "time" needed by each group to complete the four passages. This analysis was conducted to answer questions number four and five. Homogeneity of regression was again tested in order to determine if an interaction was evident thus answer question number six.

Lastly, cell means and standard deviations were calculated for the attribution questions and a one-way (ANOVA) was used on each of the 14 questions in order to evaluate the attribution data and answer question seven.

CHAPTER 4

Results

The cell means and standard deviations were calculated for the post test, verbal score, nonverbal score, age and time and are reported in Table 1. The data were analyzed in three steps. First an analysis of covariance (ANCOVA) was conducted on post test scores. Three of the four covariates were found to be good predictors of achievement as measured on the post test; Verbal $F(1,78) = 63.34$, $p < .05$, Nonverbal $F(1,78) = 4.89$, $p < .05$, and Age $F(1,78) = 4.60$, $p < .05$, while "I" (Locus of Causality) was not a significant predictor of achievement; $F(1,78) = 2.59$, $p < .05$. A significant main effect for achievement as measured on the post test was found $F(2,78) = 3.41$, $p < .05$ between learner control and program control $F_T(2,78) = 2.31$, $p < .05$. Homogeneity of regression was tested and was found not to have been violated. These results are illustrated in Table 2.

Second an analysis of covariance was conducted on the "time" required to complete the four passages, and no significant difference was found between learner control, program control and yoked control. Three of the four covariates were utilized and the results were; Verbal $F(1,79) = 3.52$, $p < .05$, Nonverbal $F(1,79) = .025$, $p < .05$, and Age $F(1,79) = .029$, $p < .05$, while "I" (Locus of Causality) which was not a significant predictor of achievement was not used. These results are illustrated in Table 3.

Third, cell means and standard deviations were calculated for the attribution questions (see Appendix D) and a one-way (ANOVA) between

attribution and control was conducted (see Appendix E). No significant differences were found between learner control, program control, and yoked control on the attribution data.

TABLE 1

Cell Means and Standard Deviations

Variable .. Post Test

Factor	Mean	Std.Dev.	N
Learner Control	13.76	3.897	29
Program Control	16.07	3.463	27
Yoked Control	14.86	3.739	29
For Entire Sample	14.87	3.785	85

Variable .. Verbal

Factor	Mean	Std.Dev.	N
Learner Control	26.66	9.370	29
Program Control	31.44	10.364	27
Yoked Control	29.38	9.966	29
For Entire Sample	30.13	9.821	85

Variable .. Nonverbal

Factor	Mean	Std.Dev.	N
Learner Control	33.45	8.588	29
Program Control	35.44	7.154	27
Yoked Control	35.90	8.789	29
For Entire Sample	34.92	8.206	85

Variable .. Age*

Factor	Mean	Std.Dev.	N
Learner Control	10.61	.551	29
Program Control	10.72	.601	27
Yoked Control	10.73	.457	29
For Entire Sample	10.68	.535	85

Variable .. Time in Minutes

Factor	Mean	Std.Dev.	N
Learner Control	44.24	6.864	29
Program Control	42.56	8.126	27
Yoked Control	39.41	10.841	29
For Entire Sample	42.06	8.914	85

* Age is represented in years (i.e. 10) and the %-tage of months

TABLE 2

Analysis of Variance Post Test By Control with Verbal, Nonverbal, Age and I

Source of Variation	Sum of Squares	DF	Mean Square	F	p
Covariates	689.089	4	172.272	28.403	<.01
Verbal	368.563	1	368.563	63.340	<.01
Nonverbal	29.680	1	29.680	4.893	<.05
Age	27.918	1	27.918	4.603	<.05
I	15.725	1	15.725	2.593	>.05
Main Effects	41.390	2	20.695	3.412	<.05
Control	41.390	2	20.695	3.412	<.05
Explained	730.479	6	121.747	20.072	<.01
Residual	473.097	78	6.065		
Total	1203.576	84	14.328		

TABLE 3

Analysis of Variance Time in Minutes by Control with Verbal, Nonverbal and Age

Source of Variation	Sum of Squares	DF	Mean Square	F	p
Covariates	370.948	3	123.649	1.649	>.05
Verbal	264.231	1	264.231	3.523	>.05
Nonverbal	1.865	1	1.865	.025	>.05
Age	2.171	1	2.171	.029	>.05
Main Effects	378.837	2	189.418	2.526	>.05
Control	378.837	2	189.418	2.526	>.05
Explained	749.784	5	149.957	1.999	>.05
Residual	5924.92	79	74.999		
Total	6674.706	84	79.461		

CHAPTER 5

Discussion

The findings of this study do not support the hypothesized aptitude-treatment interaction between prior ability and control. It was found that regardless of prior ability, the program control group was superior in terms of performance when compared to the learner controlled group. This suggests that not only do low ability students benefit from program control, but so do most learners in this age group regardless of ability.

There is strong evidence to suggest that the significant difference in performance found between the learner and program controlled groups was caused by the effectiveness of the strategy which was determined by the software designer, and consisted of viewing all assistance options in a predetermined sequence. The effectiveness of the designer strategy is supported by the fact that there was a significant difference found between the program controlled group which utilized the designer strategy, and the learner controlled group whose subjects utilized their own strategy. The effectiveness of designer strategy is supported by the means of the three groups in which the program controlled group obtained the highest score ($\underline{M}$ =16.07), followed by the yoked group ($\underline{M}$ = 14.86) and then the learner controlled group ($\underline{M}$ = 13.76). Though the difference between the program and yoked controlled group was not significant, the trend in the means seems to suggest that utilizing the designer strategy is best in terms of performance. Furthermore, it appears that perception of choice was not a fundamental factor in affecting performance as there

was no significant difference found between the learner and yoked controlled groups. As the only difference between these groups was the availability of choice, it appears that the perception of choice did not serve as a motivational factor. It also appears that having choice did not affect the learners motivation as measured on the attribution test as no difference was found for preference of the software program between groups.

The poor performance in the learner controlled group may be because these young learners do not actively apply effective strategies when they are given control of instruction because they have not yet developed the cognitive skills required to make effective judgments. This conclusion is supported by Reinking and Schreiner (1985) who obtained similar findings, and concluded that perhaps younger learners are less adept at managing the contingencies of their reading and study and benefit from external control, in this case being forced to view all the assistance options instead of being given the choice of which options to choose.

These conclusions are also supported by Markman's (1977, 1979) research, which investigated elementary school childrens' comprehension, though without the use of CAI. Markman concluded from his research with subjects in grade one through six, that children may be frequently misled into thinking that they understand information which in fact they fail to comprehend. Though she concluded that older children realize this misconception before younger children (Markman, 1977), it was evident that when inferences were required to discover information which was intentionally inconsistent, even six graders failed to realize the

inconsistencies, and thus their failure to comprehend the information (Markman, 1979).

The hypothesized difference between Locus of Causality and achievement as measured on the post test was not evident in this study. Locus of Causality was not found to be a significant predictor of achievement as measured on the post test. The reason why the predicted relationship between internals and externals was not evident may have been caused by the fact that very few students (5/85) were truly external. This may be caused by Locus of Causality being affected by social class, in which researchers have stated that there is a lesser-belief in social-responsibility among lower-class children. Though Crandall, Katkovsky, & Crandall (1965) claim that social class only accounts for a small proportion of the variance in IAR scores, other scales which look at locus of control, such as the Locus of Control Scale and the Children's Picture Test of Internality-Externality (Crandall et al., 1965), state that social class is indeed a contributing factor. The difference between these scales and the IAR, however, lies in the fact that the IAR looks at very specific social situations (i.e. school associated situations), while the other scales look at general social experiences, and this may account for the difference in the effect of social class.

If social class was not a contributing factor, or the only contributing factor, to the lack of external students in the sample, it may have been that the students were pulled towards the internal responses on the scale due to the responses social desirability. Crandall et al. (1965) tried to eliminate this "pull" by carefully wording the internal and external responses, and determining the lack of correlation between the

IAR and the Children's Social Desirability (CSD) Questionnaire. A pull, however, may have been evident and contributed to the lack of external individuals being identified.

The findings further suggest that the amount of time to complete the task was independent of the type of control provided. This does not support previous research (Alpert and Bitzer, 1970, Fredericks, 1976) which suggests that program control is more time consuming, but supports the findings reported by Lahey (1978) and Lahey et al. (1978). The amount of time required to complete a task is very dependent on the task and type of control provided. In this study most students appeared to enjoy the program as the mean on the question "How much did you enjoy using the Comprehension Connection Program ?" was 4.6/5.0. Because the students enjoyed using the Comprehension Connection software they preferred to use the software for as long as they could instead of doing the minimal and returning to their classroom. The manipulations the three groups spent the most time viewing was the Graphics option, and the learner control group often chose to view this option more than once per passage.

There is certainly some suggestion for further study to be made from these results. One interesting question for further research would be to introduce the issue of advisement, giving learners meaningful information regarding their learning development while they are performing a task, in order to see if learners need information about the progress of their learning in order to effectively use the control they are provided with. Some researchers (Holmes et al., 1985; Tennyson, 1980, Johansen & Tennyson, 1983; Tennyson & Buttrey, 1980) feel that simply providing

control to the learner is not sufficient as learners often terminate the instruction too early, and make poor decisions. These researchers feel that providing advisement will help the learners utilize the control provided to them, thus helping to optimize the learning situation. The results of these studies utilizing advisement suggest that providing learners with information regarding their progress made towards mastering an objective helped learners both learn faster and use less instruction than learner control groups without this advisement.

Few of the above studies, however, have been carried out with young learners and it is unknown whether similar findings would be found with younger learners. One study Goetzfried and Hannafin (1985) introduced the issue of advisement with grade seven learners (see Literature Review) and found that advisement was neither more effective nor efficient than learner or program control without advisement.

Another interesting direction for further study would be to investigate the assistance options chosen by subjects in the learner controlled group in order to identify unnecessary options, as well as those options that were most frequently used by effective versus ineffective learners (Hannafin, 1984). It would also be interesting to note whether the options were consistently chosen or differed depending on the difficulty of the reading passage. This would help to identify effective and ineffective learning strategies as well as help plan future lessons.

In summary, this study found that regardless of the type of control provided, or the ability of the subjects, the best performance on the post test occurred when the designer's instructional strategy was utilized. Time to complete the task was independent of the type of control

provided, and according to the attribution test data most students found the computer software to be very enjoyable to use.

Continued research in the area of computer-assisted instructional control is needed in order to more fully understand the effect of control and its influence on learners with different characteristics. Future studies may also introduce the issue of advisement, and instructional strategies and their impact on optimizing the learning situation.

References

Alpert, D. & Bitzer, D.L. (1970). Advances in computer-based education. Science, 167, 1582-1590.

Bell-Gredler, M.E. (1986). Learning and instruction, theory into practice. MacMillan Publishing Company, Chapter 11, 274-313.

Belland, J.C., Taylor, W.D., Canelos, J., Dwyer, F. & Baker, P. (1985). Is self-paced instructional program, Via microcomputer - based instruction, the most effective method of addressing individual learning differences? Educational Communication and Technology Journal, 33, (3), 185-198.

Bovy, R.C. (1981). Successful instructional methods: A cognitive information processing approach. Educational Communication and Technology Journal, 29, (4), 203-217.

Campanizzi, J.A. (1978, Fall). Effects of locus of control and provision of overviews in a computer-assisted instruction sequence. AEDS Journal, 21-30.

Carrier, C. (1984, February). Do learners make good choices. Instructional Innovator, 15-17.

Crandall, V.C., Katkovsky, W. & Crandall, V.J. (1965). Children's belief in their own control of reinforcements in intellectual - academic achievement situations, Child Development, 36, 91-109.

Cronbach, L.J. & Snow, R.E., (1977). Aptitudes and instructional methods, A handbook for research on interactions, New York: Irvington Publishers, Inc

Fisher, M.D., Blackwell, L.R. Garcia, A.B. & Greene, J.C. (1975). Effects of student control and choice on engagement in a CAI arithmetic task in a low-income school, Journal of Educational Psychology, 67, 776-783.

Fredericks, P.S. (1976). The effects of locus of control on CAI performance, Navy Personnel Research and Development Center, ERIC Document, # ED 125 545.

Fry, J.P. (1972). Interactive relationship between inquisitiveness and student control of instruction. Journal of Educational Psychology, 63, (5), 459-465.

Goetzfried, L. & Hannafin, M.J. (1985, Summer). The effect of the locus of CAI control strategies on the learning of mathematics rules. American Educational Research Journal, 22, (2), 273-278.

Greene, J.C. (1985, Spring). Relationships among learning and attribution theory motivational variables. American Educational Research Journal, 22, (1), 65-78.

Hannafin, M.J. (1984). Guidelines for using locus of instructional control in the design of computer-assisted instruction. Journal of Instructional Development, 7, (3), 6-10.

Holloway, R.L. (1978). Task selection and locus of control in two ability groups recall. Contemporary Educational Psychology, 3, 118-126.

Holmes, N., Robson, E.H. & Steward, A.P. (1985). Learner control in computer-assisted learning, Journal of Computer Assisted Learning, 2, 99-107.

Horak, V.M. & Horak, W.J. (1982, Fall). The influence of student locus of control and teaching method on mathematics achievement. Journal of Experimental Education, 51, (11), 18-21.

Johansen, K.J. & Tennyson, R.D. (1983) Effect of adaptive advisement on perception in learner-controlled, computer-based instruction using a rule- learning task. Educational Communication and Technology Journal, 31, (4), 226-236.

Judd, W.A. (1972). Learner-controlled computer-assisted instruction, The University of Texas at Austin, ERIC Document, # ED 072 635.

Judd,W.A., Daubek, K. & O'Neil, H.F. Jr. (1975). Individual differences in learner controlled CAI, The University of Texas at Austin, ERIC Document, # ED 107 215.

Keppel, G. (1982). Design and analysis, Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Kinzie, M.B., Sullivan, H.J., Beyard, K.C., Berdel, R.L. & Haas, N.S. (1987). Learner versus program control in computer assisted instruction, Arizona State University, ERIC Document, # ED 287 445.

Lahey, G.F. (1978). Learner control of computer-based instruction: A comparison to guided instruction, ERIC Document, # ED 165 716.

Lahey, G.F. & Coady, J.D. (1978). Learner control of instructional sequence in computer-based instruction: A comparison to programmed control, ERIC Document, # ED 211 049.

Louie, S. (1985). Locus of control among computer-using school children, A report of a pilot study, ERIC Document, # ED 260 692.

MacGregor, S.K. (1985). Research issues in computer-assisted learning environments, Louisiana State University, ERIC Document, # ED 265 823

Mager, R.F. & Clark, C. (1963). Explorations in student - controlled instruction, Psychological Reports, 13, 71-76.

Markman, E.M. (1977). Realizing that you don't understand: A preliminary investigation. Child Development, 48, 986-992.

Markman, E.M. (1979). Realizing that you don't understand: Elementary school children's awareness of inconsistencies, Child Development, 50, 643-655.

Merrill, M.D. (1980). Learner control in computer based learning. Computers and Education, 4, 77-95.

Merrill, M.D., Schneider, E.W., Fletcher, K.A. (1980). The instructional design library, TICCIT, 40, Englewood Cliffs, N.J.: Educational Technology Publications.

Mevarech, Z.R. (1985). Computer-assisted instructional methods: A factorial study within mathematics disadvantaged classrooms, Journal of Experimental Education, 54, (1), 22-27.

Olivier, W.P. (1971). Learner and program-controlled sequences of computer-assisted instruction, Ontario Institute for Studies in Education, ERIC Document, # ED 046 246

Owings, R.A., Petersen, G.A., Bransford, J.D., Morris, C.D. & Stein, B.S. (1980). Spontaneous Monitoring and regulation of learning: A comparison of successful and less successful fifth graders. Journal of Educational Psychology, 72, 250-256.

Reinking, D. (1988, Fall). Computer-mediated text and comprehension differences: The role of reading time, reader preference, and estimation of learning. Reading Research Quarterly, 23, (4), 484-498.

Reinking, D. & Schreiner, R. (1985, Fall). The effects of computer-mediated text on measures of reading comprehension and reading behavior. Reading Research Quarterly, 536-552.

Ross, S.M. (1984, Spring). Matching the lesson to the student: Alternative adaptive designs for individualized learning systems, Journal of Computer - Based Instruction, 11, (2), 42-48.

Ross, S.M. & Rakow, E.A. (1983). Learner control versus program control as adaptive strategies for selection of instructional support on math rules. Journal of Educational Psychology, 745-753.

Rubincam, I. & Olivier, W.P. (1985, Summer). An investigation of limited learner-control options in a CAI mathematics course. AEDS Journal, 18, (4), 211-226.

Snow, R.E. (1980a). Aptitude, learner control, and adaptive instruction, Educational Psychologist, 15, 151-158

Snow, R.E., Aptitude Processes, in Snow, R.E., Federico, P.A. & Montague, W.E. (1980b). Aptitude, learning and instruction, Volume 1: Cognitive process analyses of aptitude, New Jersey: Lawrence Erlbaum Associates, Publishers, 27-63.

Steinberg, E.R. (1977). Review of student control in computer-assisted instruction. Journal of computer-based instruction, 3, (3), 84-90.

Stevens, J. (1986). Applied multivariate statistics for the social sciences, Analysis of covariance, New Jersey: Lawrence Erlbaum Associates, Publishers.

Stipek, D.J. & Weisz, J.R. (1981, Spring). Perceived personal control and academic achievement, Review of Educational Research, 15, (1), 101-137.

Taylor, R. (1987). Selecting effective courseware: Three fundamental instructional factors. Contemporary Educational Psychology, 12, 231-243.

Tennyson, R.D. (1980). Instructional control strategies and content structure as design variables in concept acquisition using computer-based instruction, University of Minnesota, ERIC Document, # ED 189 134

Tennyson, R.D. & Buttrey, T. (1980). Advisement and management strategies as design variables in computer-assisted instruction. Educational Communication and Technology Journal, 28, (3), 169- 176.

Tobias, S. (1981). Adapting instruction to individual difference among students. Educational Psychologist, 16, (2), 111-120.

Waydra, F.T. (1980). The instructional design library, Learner controlled Instruction, Volume 26, Englewood Cliffs, N.J.: Educational Technology Publications.

Weiner, B. (1985). An Attributional theory of achievement motivation and emotion. Psychological Review, 92, (4), 548-573.

Appendix A

Please circle the number that best shows how you feel.

1) How intelligent (smart) do you think you were using the Comprehension Connection program ?

1	2	3	4	5
not smart		sort of smart		very smart

2) How hard did you try to do well when using the Comprehension Connection program ?

1	2	3	4	5
not hard		sort of hard		very hard

3) How lucky do you think you were using the Comprehension Connection program?

1	2	3	4	5
not lucky		sort of lucky		very lucky

4) How hard (difficult) do you think the paragraphs on the Comprehension Connection program were ?

1	2	3	4	5
not hard		sort of hard		very hard

5) How much did you enjoy using the Comprehension Connection Program ?

1	2	3	4	5
not at all		some		very much

6) How intelligent (smart) do you think you were in using the five help options ?

1	2	3	4	5
not smart		sort of smart		very smart

7) How hard did you try to do well using the five help options ?

1	2	3	4	5
not hard		sort of hard		very hard

8) How lucky do you think you were in using the five help options ?

1	2	3	4	5
not lucky		sort of lucky		very lucky

9) How hard (difficult) do you think the help options were ?

1	2	3	4	5
not hard		sort of hard		very hard

10) How intelligent (smart) do you think you were in answering the multiple choice questions on the computer ?

1	2	3	4	5
not smart		sort of smart		very smart

11) How hard did you try to do well in answering the multiple choice questions on the computer ?

1	2	3	4	5
not hard		sort of hard		very hard

12) How lucky do you think you were in answering the multiple choice questions on the computer ?

1	2	3	4	5
not lucky		sort of lucky		very lucky

13) How hard (difficult) do you think the multiple choice questions on the computer were ?

1	2	3	4	5
not hard		sort of hard		very hard

14) Did the Comprehension Connection program make understanding the paragraphs easy ?

1	2	3	4	5
not much		some		very much

Appendix B

Circle the answer that best describes what happens to you or how you feel.

NAME _____

1. If a teacher passes you to the next grade, would it probably be
   (a) because she liked you, or
   (b) because of the work you did ?

2. When you do well on a test at school, is it more likely to be
   (a) because you studied for it, or
   (b) because the test was especially easy ?

3. When you have trouble understanding something in school, is it usually
   (a) because the teacher didn't explain it clearly, or
   (b) because you didn't listen carefully ?

4. When you read a story and can't remember much of it, is it usually
   (a) because the story wasn't well written, or
   (b) because you weren't interested in the story ?

5. Suppose your parents say you are doing well in school. Is it likely to happen
   (a) because your school work is good, or
   (b) because you are in a good mood ?

6. Suppose you did better than usual in a subject at school. Would it probably happen
   (a) because you tried harder, or
   (b) because someone helped you ?

7. When you lose at a game of cards or checkers, does it usually happen
   (a) because the other player is good at the game, or
   (b) because you don't play well ?

8. Suppose a person doesn't think you are very bright or clever.
   (a) Can you make him change his mind if you try to, or
   (b) are there some people who will think you're not very bright no matter what you do ?

9. If you solve a puzzle quickly, is it
   (a) because it wasn't a very hard puzzle, or
   (b) because you worked on it very carefully ?

10. If a boy or girl tells you that you are dumb, is it more likely that they say that
    (a) because they are mad at you, or
    (b) because what you did really wasn't very bright ?

11. Suppose you study to become a teacher, scientist, or doctor and you fail. Do you think this would happen
    (a) because you didn't work hard enough, or
    (b) because you needed some help and other people didn't give it to you ?

12. When you learn something quickly in school, is it usually
    (a) because you paid close attention, or
    (b) because the teacher explained it clearly ?

13. If a teacher says to you, "Your work is fine," is it
    (a) something teachers usually say to encourage pupils, or
    (b) because you did a good job ?

14. When you find it hard to work arithmetic or math problems at school, is it
    (a) because you didn't study well enough before you tried them, or
    (b) because the teacher gave problems that were too hard ?

15. When you forget something you heard in class, is it
    (a) because the teacher didn't explain it very well, or
    (b) because you didn't try very hard to remember ?

16. Suppose you weren't sure about the answer to a question your teacher asked you, but your answer turned out to be right. Is it likely to happen
    (a) because she wasn't as particular as usual, or
    (b) because you gave the best answer you could think of ?

17. When you read a story and remember most of it, is it usually
    (a) because you were interested in the story, or
    (b) because the story was well written ?

18. If your parents tell you you're acting silly and not thinking clearly, is it more likely to be
    (a) because of something you did, or
    (b) because they happen to be feeling cranky ?

19. When you don't do well on a test at school, is it
    (a) because the test was especially hard, or
    (b) because you didn't study for it ?

20. When you win at a game of cards or checkers, does it happen
    (a) because you play real well, or
    (b) because the other person doesn't play well ?

21. If people think you're bright bright and clever, is it
    (a) because they happen to like you, or

(b) because you usually act that way ?

22. If a teacher didn't pass you to the next grade, would it probably be
(a) because she "had it in for you," or
(b) because your school work wasn't good enough ?

23. Suppose you don't do as well as usual in a subject at school. Would this probably happen
(a) because you weren't as careful as usual, or
(b) because somebody bothered you and kept you from working?

24. If a boy or girl tells you that you are bright, is it usually
(a) because you thought up a good idea, or
(b) because they like you ?

25. Suppose you become a famous teacher, scientist or doctor. Do you think this would happen
(a) because other people helped you when you needed it, or
(b) because you worked hard ?

26. Suppose your parents say you aren't doing well in your school work. Is this likely to happen more
(a) because your work isn't very good , or
(b) because they are feeling cranky ?

27. Suppose you are showing a friend how to play a game and he has trouble with it. Would this happen
(a) because he wasn't able to understand how to play, or
(b) because you couldn't explain it well ?

28. When you find it easy to work arithmetic or math problems at school, is it usually
(a) because the teacher gave you especially easy problems or
(b) because you studied your book well before you tried them ?

29. When you remember something you heard in class, is it usually
(a) because you tried hard to remember, or
(b) because the teacher explained it well ?

30. If you can't work a puzzle, is it more likely to happen
(a) because you are not especially good at working puzzles, or
(b) because the instructions weren't written clearly enough?

31. If your parents tell you that you are bright or clever, is it more likely
(a) because they are feeling good, or
(b) because of something you did ?

32. Suppose you are explaining how to play a game to a friend and he learns quickly. Would that happen more often
(a) because you explained it well, or
(b) because he was able to understand it ?

33. Suppose you're not sure about the answer to a question your teacher asks you and the answer you give turns out to be wrong. Is it likely to happen
    (a) because she was more particular than usual, or
    (b) because you answered too quickly ?

34. If a teacher says to you, "Try to do better, " would it be
    (a) because this is something she might say to get pupils to try harder, or
    (b) because your work wasn't as good as usual ?

CHECK THAT YOU HAVE ANSWERED EVERY QUESTION

Appendix C

POST TEST
Name _____

The Elephant's Trunk

No other animal is quite like an elephant. Elephants are the largest animals that live on land. Elephants are also special in another way. They have trunks. No other animal has this useful appendage.

The elephant uses its trunk in many ways. You may have seen a circus elephant use its trunk as a hose. A trunk can help an elephant to drink and wash itself. The end of the trunk is sensitive. This helps the elephant feel things. Like our fingers, the elephant's trunk is flexible. It can pick up objects.

Elephants also use their trunks to communicate with each other. When they play, they jostle each other with their trunks. To show affection, they use their trunks to give each other a big hug. A mother can guide her calf with her trunk. Sometimes a trunk may even be used to spank a mischievous baby elephant. So you see, elephants can communicate in many ways with their trunks.

1. How does an elephant drink water ?
   a) Elephants jostle each other when they want a drink.
   b) An elephant sits down to drink.
   c) An elephant uses its trunk like a hose.
   d) An elephant laps up water like a dog.

2. What does it mean to say that an elephant has a sensitive trunk ?
   a) An elephants trunk is very useful.
   b) An elephant can feel things with its trunk.
   c) An elephant's trunk cannot feel cold objects.
   d) An elephants trunk is strong.

3. Why is the elephant a special animal ?
   a) No other animal has a trunk.
   b) The elephant is the most popular circus animal.
   c) No other animal eats peanuts.
   d) The elephant is the smartest animal.

4. According to this passage, what is one way a mother elephant communicates with her calf ?
   a) She uses her trunk to guide her calf.
   b) She carries her calf in her trunk.
   c) She touches her trunk to the calf's trunk.
   d) She beats her trunk on the ground.

5. According to this passage, how do elephants show affection ?
   a) They make loud noises at each other.
   b) They squirt water at each other with their trunks.
   c) They use their trunks to hug each other.
   d) They spank each other with their trunks.

How Do We Talk ?

Have you ever wondered what makes sounds come out of your mouth or where your voice comes from ? Speech begins with air in your lungs. The air moves from your lungs, up the trachea, and into the larynx. The larynx is often called the voice box. It contains vocal cords. Vocal cords are muscles. The air passes by the vocal cords and makes them vibrate. Many speech sounds are produced by this movement.

After passing your vocal cords, air goes into your mouth, or nose. Your voice sound different, depending on where the air goes. Close your mouth and hum. You have produced the "m" sound. Put your upper teeth on your lower lip to make the "f" or "v" sound. Your nose, lips, teeth, and tongue all work together to make your speech sounds. These parts of the body are called articulators.

When you were a baby, you probably made sounds like "ma ma" and "da da". As you grew, you learned that when you said "ma" or "da" one of your parents came. You learned that everything had a name. You listened to people around you and copied their words. Soon you put sounds together to make your own words. Later you learned to put the words together in sentences.

Most of us don't think about how we speak. Talking seems easy now that you have been doing it for many years. Making speech sounds, however, is very complicated.

6. What are the vocal cords ?
   a) lung tissue
   b) tracheae
   c) muscles
   d) articulators

7. What must happen to your vocal cords so that you can speak ?
   a) They must fold up.
   b) Air must make them vibrate.
   c) They must enter the trachea.
   d) Muscles must make them vibrate.

8. What is another name for the voice box ?
   a) windpipe
   b) lung
   c) trachea
   d) larynx

9. What do articulators help do ?
   a) lower the sound of your voice
   b) vibrate the vocal cords
   c) form speech sounds
   d) breathe air into the lungs

10. How are babies first able to speak ?
   a) They make sounds that are like words.
   b) They grow vocal cords when they are about two years old.
   c) Their parents must teach them to say sentences.
   d) They learn words from television.

The Story of Levi Jeans

One brand of jeans is known all over the world. Maybe you are wearing a pair today. Levi's are the original jeans, first made more than 130 years ago. Today they outsell all others. But Levi's have changed since they were first made.

During the Gold Rush of 1849, a German peddler joined the move to California. His name was Levi Strauss. He made his money by selling supplies to prospectors. There was a popular request for something he didn't have - pants. He did have canvas. Thinking that the prospectors needed durable pants, he hired a tailor to make pants out of his canvas. Soon his canvas pants were wanted by prospectors and railroad workers throughout the state.

Levi Strauss wanted to improve his product. He began making the pants from a stronger cloth called denim. The fabric was named for the French town where it was made. Strauss dyed the material dark blue. His blue denims were a big success. People began to call his pants "Levi jeans" because of his name and Genoa, the name of a town in Italy where the cloth was also made.

Today the Levi Strauss company is the largest clothing manufacturer in the world. Levi jeans have come a long way from their first use as work pants. Levi's now come in many different styles and colors. They can be worn just about anywhere, anytime, by anyone.

11. According to the story, how are today's Levi's different from the first Levi's ?
    a) They can be washed in machines without being ruined.
    b) They are made of canvas
    c) They are worn for purposes other than work.
    d) They are made in France instead of Italy.

12. What did Levi Strauss do as a peddler ?
    a) He sewed canvas clothes.
    b) He traveled around selling goods.
    c) He rode a bicycle around from place to place.
    d) He searched for gold and silver.

13. Where did the name "jeans" come from ?
    a) a town in Italy where denim was made
    b) Levi Strauss's wife
    c) a town in France
    d) a valuable rock found by prospectors

14. Why did Levi Strauss change the cloth he used from canvas to denim ?
    a) He could no longer get canvas from France.
    b) Denim was easier to dye than canvas.
    c) Denim was cheaper to buy than canvas.
    d) Denim was stronger than canvas.

15. Why did prospectors like the pants that Levi Strauss sold ?
    a) The pants were cheaper than others.
    b) The pants protected them form insect bites.
    c) The pants kept them warm in the mines.
    d) The pants wouldn't wear out easily.

Lighthouses

The ancient Egyptians were the first people to build lighthouses. They built them to guide ships at night along the dangerous coasts. Later, the Romans also had lighthouses. The first lighthouse in North America was built in 1716 in Boston Harbor. By 1900, there were 1,500 lighthouses in the United States. But there are only about 340 of them still in use. Most ships today have modern navigational aids that make lighthouses unnecessary.

Lighthouse keepers took care of the first American lighthouses. They had several important jobs. Their most important duty was to light the wick. A lighthouse keeper had to make sure there was enough oil to keep the light burning. He or she also had to clean the mirrors and windows. Sometimes the lighthouse keeper rescued shipwrecked sailors. Another duty was to fire a cannon when there was a lot of fog.

Most lighthouses are shaped like towers. But each lighthouse is distinctive. These features help sailors identify them. At night, each lighthouse has its own pattern of light signals. A light list describes each light house's pattern. When sailors see a pattern, they look for that pattern in the light list. Then they know where they are. In areas where many lighthouses are built alike, each lighthouse is painted with its own design of checks and stripes. The colors of the designs are different for each of these lighthouses.

16. What is the light list ?
    a) a list of lighthouse keepers
    b) a list describing lighthouses
    c) a list of ships passing a lighthouse
    d) a book telling when to turn on the lighthouse light

17. What makes each lighthouse distinctive ?
    a) its shape
    b) the kind of wick it uses
    c) its pattern of light
    d) the age of the lighthouse keeper

18. Why are the checks and stripes different for each lighthouse?
    a) to make the lighthouse easier to see when it is foggy
    b) to make the lighthouse colorful
    c) to match the pattern of light signals
    d) to help sailors identify the lighthouse

19. According to this passage, which statement is true ?
    a) Lighthouses have existed for a long time.
    b) There are more lighthouses in the U.S. today than in 1900
    c) Lighthouses were first used in the U.S.
    d) There are no lighthouses in use today.

20. Why are there fewer lighthouses today ?
    a) It is hard to find lighthouse keepers.
    b) Sailors don't need them as much.
    c) Many lighthouses have been destroyed in storms.
    d) The lights on today's lighthouses are brighter.

Snow Monkeys

Not all monkeys live in hot, humid jungles. There are snow monkeys that live in the mountain forests of Japan. Winters in the Japanese mountains are long and frigid. Strong, freezing winds blow through the trees. Deep snow covers the ground.

Snow monkeys have long, thick fur. They snuggle together to keep warm. During the day, rocks shield the snow monkeys from freezing winds. At night, snow monkeys climb trees for safety. With their backs to the wind, they cling tightly to th · branches.

Some snow monkeys have a special way of keeping warm. They sit in natural pools of hot water. These pools are heated by water from inside the earth. They can be 100 degrees warmer than the air.

In winter, food is scarce. Snow monkeys go from tree to tree searching for vines, bark, and pine needles. Food is easier to find during warm weather. Then, the snow monkeys eat fresh grass, moss, berries, and leaves. They can forget the harsh winter weather for a few months.

21. What are winters like in the mountains of Japan ?
    a) short and warm
    b) long and warm
    c) short and very cold
    d) long and very cold

22. Where do the snow monkeys live ?
    a) in the Japanese mountains
    b) in the rain forest of Japan
    c) inside the earth
    d) in the mountains in Colorado

23. How do the snow monkeys keep warm at night ?
    a) They sleep behind big rocks to keep warm.
    b) They sleep in hot water pools.
    c) They turn away from the wind while they sleep on branches.
    d) They dig a big hole under the snow.

24. What do snow monkeys eat in the winter ?
    a) grass
    b) vines, bark, and pine needles
    c) leaves and berries
    d) mice and other small animals

25. What makes the pools of hot water natural ?
    a) They were made by humans to keep the snow monkeys warm.
    b) The pools contain medicine for the sick snow monkeys.
    c) The pools have magic powers.
    d) They were made by nature.

CHECK THAT YOU ANSWERED EVERY QUESTION

Appendix D

Cell Means and Standard Deviations for Attribution Data

Variable .. Question 1

Mean	Std.Dev.	N
3.659	.765	85

Variable .. Question 2

Mean	Std.Dev.	N
3.788	1.206	85

Variable .. Question 3

Mean	Std.Dev.	N
3.847	1.129	85

Variable .. Question 4

Mean	Std.Dev.	N
2.224	.943	85

Variable .. Question 5

Mean	Std.Dev.	N
4.607	.745	84

Variable .. Question 6

Mean	Std.Dev.	N
3.776	.822	85

Variable .. Question 7

Mean	Std.Dev.	N
3.679	1.043	84

Variable .. Question 8

Mean	Std.Dev.	N
3.576	1.127	85

Variable .. Question 9

Mean	Std.Dev.	N
2.165	1.122	85

Variable .. Question 10

Mean	Std.Dev.	N
3.847	.893	85

Variable .. Question 11

Mean	Std.Dev.	N
3.965	1.107	85

Variable .. Question 12

Mean	Std.Dev.	N
3.631	1.084	84

Variable .. Question 13

Mean	Std.Dev.	N
2.536	1.145	84

Variable .. Question 14

Mean	Std.Dev.	N
4.071	.967	84

For Entire Sample

Mean	Std.Dev.	N
43.00	24.677	85

Appendix E

Analysis of Variance for Attribution Data

Variable Attribution Question 1 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.0510	.0255	.0426	.9583
Within Groups	82	49.0549	.5982		
Total	84	49.1059			

Variable Attribution Question 2 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.4360	.2180	.1468	.8637
Within Groups	82	121.7522	1.4848		
Total	84	122.1882			

Variable Attribution Question 3 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3.8623	1.9312	1.5352	.2215
Within Groups	82	103.1494	1.2579		
Total	84	107.0118			

Variable Attribution Question 4 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1.7287	.8643	.9706	.3832
Within Groups	82	73.0243	.8905		
Total	84	74.7529			

Variable Attribution Question 5 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2.3740	1.1870	2.2021	.1171
Within Groups	81	43.6617	.5390		
Total	83	46.0357			

Variable Attribution Question 6 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	3.1233	1.5617	2.3878	.0982
Within Groups	82	53.6296	.6540		
Total	84	56.7529			

Variable Attribution Question 7 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.7843	.3922	.3548	.7024
Within Groups	81	89.5371	1.1054		
Total	83	90.3214			

Variable Attribution Question 8 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.0275	.0138	.0106	.9895
Within Groups	82	106.7254	1.3015		
Total	84	106.7529			

Variable Attribution Question 9 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.0798	.0399	.0310	.9695
Within Groups	82	105.6143	1.2880		
Total	84	105.6941			

Variable Attribution Question 10 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.1101	.0551	.0675	.9348
Within Groups	82	66.9017	.8159		
Total	84	67.0118			

Variable Attribution Question 11 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	.2760	.1380	.1103	.8957
Within Groups	82	102.6181			
Total	84	102.8941			

Variable Attribution Question 12 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	1.6936	.8468	.7155	.4920
Within Groups	81	95.8659	1.1835		
Total	83	97.5595			

Variable Attribution Question 13 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2.1355	1.0677	.8101	.4484
Within Groups	81	106.7574	1.3180		
Total	83	108.8929			

Variable Attribution Question 14 By Variable Control

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob
Between Groups	2	2.7761	1.3880	1.5032	.2286
Within Groups	81	74.7953	.9234		
Total	83	77.5714			