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The Effects of Adjunct Questions on a Computer-Based Interactive Video Lesson.

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Abstract

The aim of this thesis was to assess the effect of the use of a question sheet as an adjunct aid in a computer-based interactive video instructional program. The instructional program, which taught techniques in studio lighting, was designed to give the learner maximum control over the instruction.

Research in textually-based instruction has established that adjunct questions improve learning. There is controversy, however, as to whether these findings may be extrapolated to computer-based interactive video instruction. In the present study 40 Dawson College Institute of Photography students were randomly assigned to one of two conditions - presence or absence of a question sheet during the instruction. No significant difference was found as a result of the treatments. However, high prior knowledge students performed better on the achievement test and completed the instruction faster. Another finding was that students who chose to do the practice questions embedded within the computer-assisted instruction performed better on the achievement test than those students who chose not to do any practice questions. Suggestions are provided for further research as to the relative effectiveness of adjunct aids versus embedded practice strategies.

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CHAPTER 1

INTRODUCTION

There has been considerable research recently on the locus of instructional control in computer-based instruction. Locus of instructional control can range from total program control to total learner control. During the course of a program-controlled lesson, at each decision point, the computer program makes the decision as to where the student is branched. During a learner-controlled lesson, the student decides in which manner she or he will proceed. The purpose of much of the research in this domain is to find out which kind of control is more effective.

It is a widely held belief that the use of learner-controlled computer-based instruction should be advantageous because it individualizes instruction to each student's needs and preferences. However, research does not generally support this, though a wide variation in the results has been obtained. In many instances, program-controlled instruction has been proven to be more effective.

Yet, outside the instructional context, information-disseminating systems allow maximum user control. For example, database systems are often designed in such a way as to accommodate users' different methods of accessing information. They allow quick access to the information each user requires. People normally look for particular information in order to answer specific questions they may have aoout a topic. With a system that is designed to allow maximum learner control, they can find this information effectively.

In learner-controlled computer-assisted instruction, students often do not have enough knowledge about the contents of the instruction to be able to look for information effectively. Moreover, they do not feel the need to find specific information. This study was designed in the belief that such a need might be replicated in an educational context.

More specifically, it was the author's contention that the use of a question sheet as an adjunct aid during instruction would improve the effectiveness and efficiency of learner control instruction in CBIV. Students who control their own learning often tend to stray and browse through a lesson. However, a question sheet, to which they can refer during the instruction, should maintain them in an efficient learning mode where they learn the required knowledge effectively and yet retain control of their learning.

CHAPTER 2

LITERATURE REVIEW

Computer-Based Interactive Video Instruction

As a new instructional technology, computer-based interactive video (CBIV) has been followed by exaggerated claims of effectiveness. Floyd (1980) claims that interactive video will have "the most long ranging impacts of any new delivery systems" (p. 73). Jonassen (1984) states that CBIV is "the most potentially powerful communication device in the history of instructional communication" (p. 21). Gindele and Gindele (1984) predict that "the interactive videodisc may become one of the most revolutionary developments in the history of entertainment, information processing, education, and training" (p. 97), and Reigeluth and Garfield (1984) consider the videodisc to be the most significant breakthrough in instructional technology since the invention of the printing press. More articles which lay claim to the effectiveness of CBIV are listed in Martorella (1983).

Though the above claims are far from being substantiated, many other researchers have attempted to empirically prove the effectiveness of CBIV as a medium (Abrams & Streit, 1986; Andrews, 1985; Balson, Manning, Ebner, & Brooks, 1985; Clark, 1986; Dalton, 1986; Ebner, 1984; Estrem, 1985; Henderson et al., 1983; Holmgren, Dyer, Hillgoss, & Heller, 1980; Smith, Jones, & Waugh, 1986). The results are usually positive but sometimes not definitive. For example, a meta-analysis by Bosco (1986) showed that sometimes CBIV instruction appeared to be more effective, and sometimes it did as well as the comparison form of linear video instruction, computer-assisted instruction (CAI), or traditional instruction (which can be textbook, teacher or any other delivery system).

Clark (1983), however, discourages research on medium effectiveness. When he analyzed research on computer-based instruction (CBI) effectiveness, he found that other

factors probably caused the learning gains that were reported. The most important factor was the greater effort expended in the designing of the CBI presentation than to its competitor medium. This greater effort results in a better instructionally designed presentation, hence its positive effect on learning. Another important factor, he claims, is the effect of novelty where a new type of medium is more effective simply because it is novel to the student. Once these variables are controlled, no significant learning advantages for the use of CBI are found. Though Clark notes that CBI may have advantages in terms of cost benefits and student enjoyment, he stresses the importance of instructional design as a factor in determining the effectiveness of an instructional product. Clark's findings are also relevant to CBIV effectiveness research.

Because CBIV is most often an individualized form of instruction, another reason that lends support to the importance of instructional design is that given by Gagné and Briggs (1979): "The purpose of designed instruction is to activate and support the learning of the individual student" (p. 4). According to their definition, instructional design takes the diversity among the individuals into account, and "help(s) each person develop as fully as possible, in his or her own individual directions" (p. 4). Thus, a critical issue for research in the CBIV field should be to find out which types of instructional strategies are best suited for CBIV instruction.

Several aspects of instructional strategies in CBIV have been researched. Studies have been carried out examining such strategies as the effectiveness of: the amount of practice the student receives (Hannafin & Colomaio, 1987; Hannafin, Phillips, & Tripp, 1986; Phillips, Hannafin, & Tripp, 1986), different pacing rates (Hannafin et al., 1986), the amount of interactivity (Andrews, 1985), and the amount of feedback (Andrews, 1985; Teather & Marchant, 1974). Most of these studies reported significant effects, and design recommendations have been offered. These will be discussed in the design section as they are applied to the present study.

Orienting Activities

An orienting activity is a mediator through which new information is presented to the learner (Hannafin & Hughes, 1986). Orienting activities, or pre-instructional strategies as they are also called, enhance learning by directing the learner to attend to relevant content (Hartley & Davies, 1976). Statements of objectives, pretests, overviews, and advance organizers can all serve as orienting activities.

Orienting Activities in Interactive Video Instruction

Phillips, Hannafin, and Tripp (1986) conducted an experiment in order to examine the combined effects of orienting activities and levels of practice on learning from interactive video. There were two levels of orienting activities (presence or absence of orienting activities) and three levels of practice (no practice, limited practice, or elaborate practice). The orienting activities were brief statements designed to assist learners in preparing for the information to come. There was one main effect: students learned better in both limited and elaborate practice conditions than in the no practice condition. There were no significant differences between the orienting activities conditions.

In a similar experiment, Hannafin, Phillips, and Tripp (1986) compared the combined effects of practice, orienting activities, access time, and processing activity. Access time was the amount of time allotted to utilize the orienting provided, either five or 20 seconds. Those who were not provided with an orienting activity were always prompted with the following "Use whatever way you remember and learn most effectively to prepare for the next section". The processing activity variable consisted of providing or not providing the student with a pause after each segment of instruction. A significant effect for practice was found whereas there was no effect for orienting activity. There was a marginal interaction between Orienting Activity and Access Time; students given an

orienting activity performed best under reduced time, whereas students not provided with an orienting activity performed best with extended time. One of the conclusions drawn from both experiments was that orienting activities alone are simply ineffectual in the presence of well-designed lessons featuring more powerful treatments.

Pre-Questions

Pre-questions are a type of orienting activity just as advance organizers and statements of performance expectations are (Hartley & Davies, 1976). Most of the research in the area has investigated the effectiveness of pre-questions in the use of prose as a form of instruction. Pre-questions improve learning and recall because they activate cognitive processes to focus on relevant information (Reynolds & Anderson, 1982; Walsh & Jenkins, 1973).

Research on the effect of adjunct questions often compares the effect of the use of pre-questions with that of post-questions (Frase, 1967; Frase, 1968; Sinnott & Alderman, 1977). Post-questions generally improve learning more than pre-questions because pre-questions improve the posttest achievement on intended knowledge questions to the detriment of the posttest achievement on incidental knowledge questions, whereas post-questions improve the posttest achievement on both intended and incidental knowledge questions. (Intended knowledge questions in the posttest are those which had occurred during the experimental conditions, and incidental knowledge questions are those which are related to the prose passage but were not in the experimental conditions). Frase theorizes that when students are presented with pre-questions, they tend to skim more in order to find the information relevant to those pre-questions, whereas, in the post-questions condition, students cognitively reprocess what they have just read. The negative effect of the pre-questions on incidental learning is even greater if the pre-questions are specific as opposed to integrative (Anderson, Spiro, & Anderson, 1960). Learning is

improved if more general pre-questions are used (Klauer, 1984). Rickards and Denner (1978) state that, if only verbatim learning is required, then the use of pre-questions is very effective in reading.

Pre-Questions in Interactive Video Instruction

The effect of pre-questions on learning from interactive video has not yet been investigated. Hannafin and Hughes (1986) and Hannafin, Garhart, Rieber, and Phillips (1985) suggest that, based on research in test-based instruction, pre-questions should improve both learning and motivation.

Locus of Instructional Control

Another design strategy which has attracted much attention in CBIV research is that of locus of instructional control. This factor can be defined as the degree to which a learner is allowed to make decisions concerning the content of the instruction she or he is to receive and the manner in which she or he is to receive it. In other words the learner may choose to see certain lessons only, and she or he may choose an instructional strategy which she or he believes best fits her or his learning style.

Theoretically, the parametric limits of the locus of instruction continuum are total learner control and total program control. In reality, it is rare that these extreme parameters are used; even in what is defined as program control, the learner will have some degree of control over such instructional factors as pacing or the option to quit.

The issue of giving the student control of her or his learning derives in part from the cognitivists' repudiation of the behavioristic view of learning. Cognitivists believe that the learner should take an active part in her or his own learning. Bruner (1973) states that learning essentially takes place when people actively select, retain, and transform information. Discovery learning is an extreme example of this activity where the student

not only has to direct her or his own learning but also has to discover the rules governing the sets of instances which she or he is exploring.

Learner Control in Computer-Based Instruction

Merrill (1980) states that allowing the learner the opportunity to make her or his own decisions is particularly important in CBI. This is because the nature of CBI is such that it already limits the control a learner has as compared to other forms of individual instruction such as the use of textbooks or tutors. Furthermore, he believes that learner control is an advantageous form of training because, outside of the educational setting, a person is not "spoon fed" information but has to actively seek it out; the student must learn how to adapt instruction to her or his own needs. Merrill states that program-controlled instruction is too adaptive and does not allow the student to develop metacognitive skills.

Experiments on the effectiveness of learner control have yielded contradictory results. Rubincam and Olivier (1985) tabled a list in which there was an equal number of studies resulting in significant positive results for learner control, in significant negative results for learner control, and in no significant difference between program control or learner control. In her review Carrier (1984) concludes that "there is little support from the research literature that offering students control will lead to increased learning" (p. 17), and Steinberg (1977) concludes in her review of learner control research that it is not possible to make generalizations regarding the locus of control in CAI because the experimental results are highly variant. Steinberg explained that, though some students achieved as much as students who did not have control, students who were poor performers were poor managers of time and did not use adequate instructional strategies; hence they learned less under student control.

Different observations and explanations are given for the varying results. Judd, Bunderson, and Bessent (1970) investigated the effectiveness of different levels of learner

control versus program control. One group could control the sequence of instruction, one group could control the amount of practice, and one group could control both; the program control group had no control on either strategy. They found no significant difference between the learner control and program control treatments. However, students who could control sequence of instruction consistently performed worse in one section of the instruction. After further investigation the researchers noticed that students avoided this section and its exercises because it was too long and they were not able to exit until they finished the section. They concluded that students are good judges of the amount of practice they need.

Other studies elaborate different reasons for mixed results of learner-controlled designs. Tennyson (1980) compared three instructional programs: learner control, program control, and learner control with advisement. He suggests that students under learner control performed worse that those under program control because they often terminated too early. The learner control group which was given advice performed as well as the program control group. Holmes, Robson, and Stewart (1985) found that although no differences were found between learner control and program control, positive effects of learner control might be long-term. They explain that "when initially confronted with a learner control facility, students may be distracted from learning the subject matter itself by having to cope with the additional task of making decisions about the instruction" (p. 106). Finally, in Olivier's (1971) study, students who had control of sequence of instruction performed as well as those who did not, but those learner control students who strayed from the optimum designer determined path performed worse.

More positive evidence for the use of learner-controlled CBI was noted in a study conducted by Campanizzi (1978). After each set of instruction the students received a formative evaluation instrument. Students in the program control condition were branched back to a review if they did not pass a set criterion whereas students in the learner control

condition were given the option to review if they did not pass the criterion. She explains that the aversion some students would have normally had towards CBI instruction was lessened in the learner control group because the instruction was more meaningful. Kinzie (1987) also compared a learner control with advisement condition with a program control condition. She gives the same reasons for the effectiveness of learner control found in her study. In a similar study, Newkirk (1973) found that the learner control group had a better attitude and obtained better results in the long term retention condition (two weeks later).

Learner Control in Interactive Video Instruction

Research on the use of locus of instructional control in CBIV has also led to inconclusive results. Balson et al. (1985) used a videodisc player with a built-in microprocessor which enabled either the instructors or the students to retrieve preprogrammed segments on the preparation and administration of intramuscular injections. All the students were taught verbally in class. However, in the practice session of the course, there were three conditions: the traditional method, which consisted of students injecting each other under the supervision of an instructor, an interactive video session where the videodisc segments were retrieved by an instructor, and an interactive video session where the segments were retrieved by the student. There were no significant differences in achievement between the conditions but there were differences in task completion time. The instructor-controlled group completed the instruction in 328 minutes, the student-controlled group finished in 366 minutes, and the traditional method group took 376 minutes. Balson and his colleagues state that the learner control group would have completed the task in less time if it had not been for the novelty effect sparking curiosity which in turn increased exploration.

Wicklein (1986) obtained similar results. He compared two instructional treatments: computer-based learner control video and computer-based program control

video. Though there was no significant difference between the two conditions, the program control students finished the instruction in less time.

In another study on CBIV, Laurillard (1984) did not obtain significant differences between the learner control and program control conditions, but she also gathered students' comments on their attitudes towards various control capabilities in a computer-based videotape instruction. From these data she concludes that learner-controlled instruction should be used unless it can be justified that program-controlled instruction is necessary. She even suggests that the control of the instructional processes should be forced upon the student, that is, the student cannot proceed until she or he has made a decision. This is to prevent the student from simply continuing on with the lesson in the order of sequence it was originally designed. She explains that the learner control condition is more democratic and more meaningful to the student. This is supported by Pask and Scott's (1972) view that, even though the particular route chosen by a student does not correspond to the kind of logical route a teacher would take, it is nevertheless effective because it is meaningful to that student.

Other Variables Factored with Locus of Instructional Control

So far, only the main effect of locus of instructional control has been discussed, but researchers have often included other variables in their learner control experiments and have obtained interesting interactions. These variables can be classified into two groups: individual differences and instructional design strategies. Studies in individual differences of particular interest to the present research are those on the effect of prior knowledge. Studies in instructional design strategies of particular interest to the present research are those on the effect of orienting activities.

Individual Differences

Interactions have been observed using individual student differences as the second independent variable. Individual differences such as ability (Kinzie, Sullivan, Beyard, Beidel, & Haas, 1987), learning style (Wicklein, 1986), computer anxiety (Hines & Seidman, 1988), and inquisitiveness (Fry, 1973) affected the locus of instructional control condition in varying degrees.

A more pronounced and consistent interaction effect is found between student locus of control and instructional locus of control (Carrier, Davidson, & Williams, 1985; Gagnon, 1986; Holloway, 1978). Generally, high internality students perform better than low internality students in the learner control condition, whereas no difference is seen in the program control condition. In a CAI tutorial on 12 edible plants native to Texas, Judd, Daubek, and O'Neil (1975) used photographs of the plants as a facilitator. The three conditions consisted of the presence of the facilitator, the absence of the facilitator, and the facilitator being optionally requested by the students. During the lesson, students received a test after each instructional segment and were given feedback on their performance. Both the facilitator-present and the optional facilitator groups performed better than the facilitator-absent group in the posttest. Furthermore, Judd, Daubek, and O'Neil's hypothesis - that the relatively independent subjects would tend to adjust their use of learner control options as a function of the feedback they received about their performance in the program while the less independent subjects' use of learner control would not be affected by feedback - was confirmed. High internality students who performed well on the first test reduced the frequency of their review requests whereas high internality students who performed poorly on the first test increased the frequency of their requests. Overall, high externality students reduced the frequency of their requests regardless of their first test performance.

Another interaction effect that has been most consistent is that of prior knowledge of the instructional content to be learned by locus of instructional control (Gay, 1986; Goetzfried & Hannafin, 1985; Holloway, 1978; Lahey, Rubincam, & Olivier, 1978; Olivier, 1971; Ross & Rakow, 1980). In these studies, students with low prior knowledge or low prior achievement performed worse in the learner control condition compared to the program control condition, whereas students with high prior knowledge or high prior achievement performed equally well in the program control and learner control conditions, and, in some cases, they performed better in the learner control condition. The most common explanation given by the researchers is that students with high prior knowledge in the learner control condition are able to skim over material they already know, and so are less bored by the material and more attentive.

A conclusion often reached by researchers as a result of the studies on the effect of prior knowledge in locus of instructional control is that the learner control condition should not be used for students with low prior knowledge (Judd et al., 1970; McCann, Lahey & Hurlock, 1973; Olivier, 1971). This means that, unless other design strategies which would improve the effect of learner control are found, it is best to have program control for low prior knowledge students, and either program control or learner control for high prior knowledge students.

In conclusion, though there have been many findings concerning the effectiveness of learner control, there are still many unexplored design strategies and combination of strategies, particularly when using the medium of CBIV, which may improve this effectiveness.

Instructional Design Strategies

Studies in instructional design strategies investigate the effects of different lesson designs. The lesson designs include those that have conditions that compare effects of the presence or absence of feedback, review, or lesson objectives.

Steinberg, Baskin, and Hofer (1986) investigated the effects of feedback on locus of instructional control in CAI instruction. Students in the learner control condition could, if they so desired, retrieve an organizational memory aid which either gave them feedback on their responses or not. The learner control condition students performed better with the feedback condition than without, whereas program-controlled students who had feedback did not improve over those program-controlled students who had no feedback. In an interview, the program-controlled students who had feedback revealed that this feedback sometimes interfered with their thought processes whereas the learner control students who had requested the memory aid said that feedback did not interfere with their thought processes.

Hannafin and Colomaio (1987) investigated the effects of practice and locus of instructional control in CBIV. Three versions of an interactive video lesson on cardiopulmonary resuscitation were developed: designer imposed, learner selected, and linear. In the designer imposed condition, the students were branched to a review if they incorrectly answered any imbedded question. In the learner control condition, besides having control of sequence of instruction, the students had the option of reviewing after answering the embedded questions. In the linear version, students could not review after answering the questions. Students in all three conditions were given knowledge of results of their response after each question. Both the designer imposed and the learner selected conditions performed better than the linear condition. There was no significant difference between the designer imposed and the learner selected condition. Moreover, students performed better in answering questions in the posttest which had been practiced in the

lesson as compared to questions which had not been practiced. Hannafin and Colomaio conclude that "embedded practice exerts the most powerful influence among the treatment variables studied in learning from interactive video" (p. 7). The results of this experiment are similar to those of other research in program-controlled interactive video (Schaffer & Hannafin, 1986; Hannafin et al., 1986).

Orienting Activities in Learner-Controlled Instruction

In a computer-assisted instruction sequence, Campanizzi (1978) used a pretest-posttest 2 X 2 factorial design in which the independent variables were (a) locus of control: learner control or program control, and (b) presence or absence of learning objectives before each of six instructional sets. The learner control groups performed significantly better on the achievement test whereas the presence of the learning objectives appeared not to have a significant effect. She explains that the pretest may have had a pre-organizational effect which made the additional effects of these learning objectives not discernible.

Mayer (1976) used a blackboard diagram, which explained how a computer works, as an adjunct aid to text-based instruction. Half the groups could use this aid before and during instruction, whereas the other half did not have this aid available to them. In one of the experiments, the textual instruction was divided into 26 separate frames of 100 to 200 words each. Program control students saw the frames in the logical order, whereas learner control students could decide the order in which they saw the frames by consulting a table of contents. All groups could see each frame only only. Though there was no overall difference between the learner and program control groups, there were interaction effects between locus of instructional control and presence or absence of the aid for two of the dependent measures. The learner control group presented with the aid performed better than the program control group with the same aid when solving far-transfer problems in the posttest, whereas the program control group performed

better than the learner control group on problems they had seen during the instruction. Far-transfer problems are defined as new situations where the student has to solve the problem by applying what she or he has learned in other dissimilar situations. In this case, far-transfer problems consisted of material which had not been taught in the lesson.

Mayer explains that the aid acts as an advance organizer in that it provides the learners with a meaningful learning set that could be used to assimilate new information to existing meaningful concepts. He proposes that giving the subjects control "may result in deeper, more active encoding, which allowed subjects to struggle harder to relate the text to their own experience rather than memorize the information as presented" (p. 149).

Orienting Activities in Learner-Controlled Interactive Video Instruction

Research on interaction effects of orienting activities and locus of instructional control in CBIV is very limited. In an interactive video lesson, Ho, Savenye, and Haos (1986) examined the influences of presentation of behavioral objectives and the opportunity to review. Though the degree of learner control was very limited (learner control students could choose to see a review or not, whereas the program control group always saw the review), a significant interaction was observed between the objectives conditions and review conditions. For the learner control students, those with objectives performed better than those without. For the program control students, there was no difference for the objectives conditions. The experimenters explain that "objectives, as a type of prompt, may have guided learner metacognitive decisions regarding review because the subjects knew what had to be learned" (p. 128).

Adjunct Questions in Learner-Controlled Interactive Video Instruction

The effect of pre-questions on learner and program control effectiveness in CBIV has not yet been investigated. Hannafin and Hughes (1986) suggest that, in the absence of

well-founded research on the use of orienting activities in CBIV, the findings from orienting activity research with other media should be extrapolated to the design of interactive video lessons. However, in the case of pre-questions, Kirschner and Brink (1979) stress that the findings on the use of adjunct questions in prose are not generalizable to video instruction. In their study, incidental learning was not adversely affected by either pre- or post-questions. They explain that in video, the learners are not able to skim over the information and thus there is an overall improvement in learning because their cognitive processes are activated for the duration of the video segment. Although their experiment did not confirm this, they admit that the students might not learn whatever information comes after the intended information because the students' attention might wane.

Finally, DeBloois (1982) claims that interactive video is a unique medium quite unlike its two component media of video and computer and therefore presents new characteristics which need to be researched by using that medium only. Research on the effectiveness of adjunct questions in learner-controlled CBIV is needed.

Research Objectives

There is one independent variable in this study:

1. Type of instruction (presence or absence of a question sheet).

There is one covariate in this study

1. Prior knowledge.

There are two dependent variables in this study:

1. Achievement, which is the score on the post-test.

2. Task completion time, which is the amount of time the student takes to finish the CBIV instruction.

The objectives in this study are:

1. To determine if there is a significant difference in achievement between students who receive a question sheet as an adjunct aid during the instruction and those students who do not receive the question sheet.

2. To determine if there is a relationship between posttest achievement and prior knowledge.

3. To determine if there is an interaction effect in achievement between the type of instruction variable and the prior knowledge variable.

4. To determine if there is a significant difference in task completion time between students who receive the question sheet as an adjunct aid during the instruction and those students who do not receive the question sheet.

5. To determine if there is a relationship between prior knowledge and task completion time.

6. To determine if there is an interaction effect in task completion time between the type of instruction variable and the prior knowledge variable.

Hypotheses

1. It is hypothesized that students who receive a question sheet as an adjunct aid during instruction will perform significantly better on the achievement test than students who do not receive the question sheet.

2. It is hypothesized that students who receive a question sheet as an adjunct aid during instruction will finish significantly faster than students who do not receive the question sheet.

3. It is hypothesized that high prior knowledge students will finish significantly faster than low prior knowledge students.

This researcher believes that the use of a question sheet as an adjunct aid during instruction should improve the effectiveness of learner control instruction in CBIV. The question sheet condition is a form of advisement; Tennyson and Buttrey (1980) have demonstrated the effectiveness of learner control with advisement. A field of research that is related to the use of pre-questions during instruction is that of comparing open-book tests to closed-book tests. Boniface (1985) states that an advantage of using open-book tests is that learning is still taking place during the testing. He adds that open-book examinations more closely resemble the real-life application of knowledge and so should be better predictors of candidates' future abilities.

The question sheet as an adjunct aid during instruction should also improve the efficiency of learner control instruction in CBIV. Balson et al. (1985) conclude that students in the learner control treatment explore too much, and this results in a reduction of efficiency. Lahey, Crawford, and Hurlock (1975) observed that students take more time than necessary because they often want to learn more than is required. The use of the question sheet should alleviate this problem because students will tend to stay closer to the task they have been assigned: that of completing the question sheet.

Students who have high prior knowledge should finish faster than those students who have low prior knowledge because they will not have to consult the instructional program as much in order to answer the questions on the sheet.

CHAPTER 3

METHOD

Subjects

The subjects were 40 Dawson College students between the ages of 17 and 53 years who volunteered to take part in this study. In order to attract volunteers, classes were told that there were four prizes of $50 to be drawn at random after the testing was completed. The students were enrolled in the Continuing Education Programme at Dawson College Institute of Photography in Montreal.

The photography students were taking various courses in photography, one of which was studio photography. In this course, the students learned studio lighting techniques. This is the material which was taught in the CBIV instructional program used in this study. Nineteen students had already taken the course in studio lighting offered at Dawson College, whereas the other 21, who had just begun the two-and-a-half year programme, would take this course in a future semester. By choosing students in this way, I had hoped that both high and low prior knowledge students would be obtained.

Design

The design that was used was a one way design with two levels of the independent variable (presence or absence of the question sheet as an adjunct aid) and one covariate (prior knowledge).

Description of the Independent Variable and the Covariate

The independent variable is the presence or absence of a questions sheet as an adjunct aid during the treatment. The students in one condition were able to consult the question sheet during the treatment whereas the students in the other condition were not given a question sheet.

The intention here was not to assess the effect the question sheet has directly on achievement, but rather to assess the effect the question sheet has on the students' cognitive processes that take place during instruction. Mayer (1976) states that pretraining the students could provide the learners with a *meaningful learning set* that could be used to assimilate new information. Having a meaningful learning set is one of the conditions for meaningful learning to take place.

In the question sheet condition, the students were required to answer knowledge (recall and recognition) and application questions (Bloom et al., 1956). The questions were similar to those on the posttest because both were based on the same performance objectives.

Past research on pre-questions has been mainly on its effects on instruction in the form of prose, and usually only a few questions were presented. Pre-questions were meant to act as a type of orienting activity. Incidental learning was often depressed. The question sheet in this study was different in that it was comprehensive; most of what was presented in the instruction was included in the question sheet. Consequently, there was more intended learning and less incidental learning in this instruction.

The covariate, prior knowledge, was included in this study because, as has been explained in the rationale, it is an important factor to consider when examining a learner-controlled computer-based instructional program. It is also important to consider prior knowledge when researching the effects of orienting activities such as pre-questions. Hannafin and Phillips (1987) suggest that orientation be used when the relationship

between new and old knowledge is not evident. Mayer (1977) reports on a series of studies where advance organizers were useful for learners who lack prerequisite skills or knowledge. Tobias (1976) proposes research on the adaptation of instructional treatments according to students' achievements as an alternative to research on aptitude treatment interactions; no evidence has been found supporting the differentiating of instruction to students of different aptitudes (Glaser & Resnick, 1972). As a result of his research Tobias suggests the hypothesis that there is an inverse relationship between prior knowledge and the amount of instructional support needed in order to master educational objectives.

The level of prior knowledge was determined by a prior knowledge measure which was given before the treatments. This measure consisted of questions which were relevant to the content of the instruction. However, these questions were not similar to questions on the posttest nor did they give any information as to the specific contents of the instruction. This is because a pretest can in itself act as an advance organizer. Campanizzi (1978) explains that, in her study, no significant effects were found for the use of overviews because the pretest may have had a pre-organizational effect which made the additional effects of these overviews not discernible.

Ideally, it would have been best to use a pretest identical to the posttest and then evaluate the main effects of the pretest and interaction effects of the pretest with other experimental variables through the use of the Solomon (1949) Four-Group Design. In this study it would have meant having a design consisting of 8 cells. The number of students required in order to obtain significant results was beyond the scope of this study.

Materials

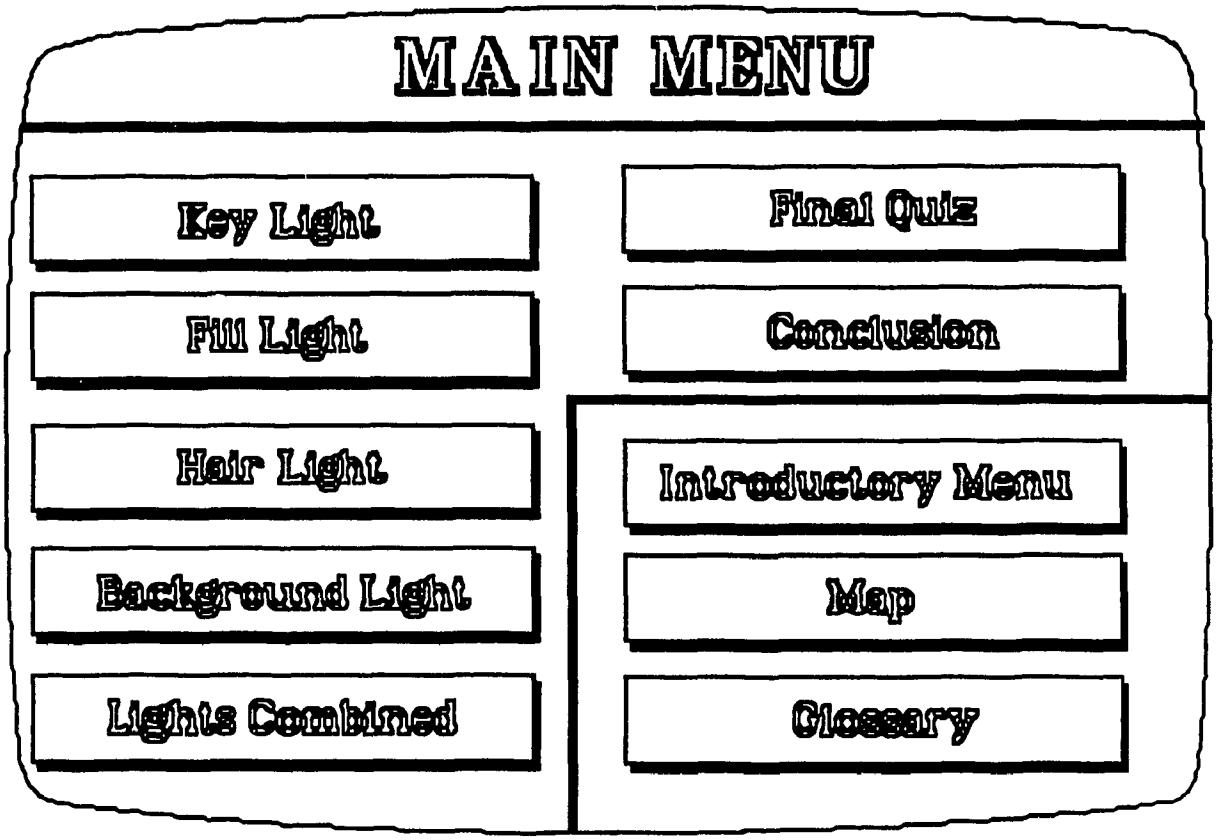
The interactive video system used in this experiment consisted of a Pioneer VC102 computer, a Pioneer LDV 4200 videodisc player, and a Pioneer TVM 1300 13 inch

monitor with a touch sensitive screen added in front of it. All the equipment was hidden under the table except for the monitor. The students never had to use the keyboard; they made their choices by touching different areas of the screen (see figure 1).

The videodisc consisted of 11 minutes of full motion video and 66 still frames. The material was originally produced by a team of students for a small format television production course taught by Paul Vinet in the Educational Technology Program at Concordia University. From the start, the intention was to produce an educational program which could be interactivated through the use of a computer. The content consists of teaching knowledge and procedures needed to achieve varying portrait photographic effects with the use of studio lights. For example, some light positions can make a person look younger, and other ones can accentuate some physical features of a subject.

I designed the computer program according to the guidelines which have been recommended in various articles on CBIV. Hannafin et al. (1986) compared the effects of orienting activities, processing time (time allotted to the students for processing information), and amount of practice in CBIV instruction. Results indicated that practice with feedback had the greatest effect. In Andrews's (1985) thesis on CBIV instruction, frequent feedback was more effective than infrequent feedback. Laurillard (1986) suggests the provision of these facilities: index map, content map, escape any time to index map, skip forward or backward, retrace chosen route, consult glossary, ask for explanation, etc. More advice is noted in research on screen-based instruction (Lorch, Anderson, & Levin, 1979). I have included much of the above facilities in the CBIV program while preventing the program from getting overly complex. Schaffer and Hannafin (1986) warn that the efficiency of learning from CBIV decreases as the amount of interactivity increases; in other words, too many facilities may slow down the learner's progress.

Figure 1: *Sample touch screen menu.*



The program used a menu-based approach as is shown in Figure 2. This means that the student had the choice of viewing any section she or he desired. The student could go up and down from menu to menu as often as she or he desired. The video introduction, which is what the student saw first, was the only segment which was not controlled by the student. In the introductory menu the student was able to choose to see the "How to Use this Program" section, which explained how to use the various facilities. In the main menu, the student could select the particular light about which he wished to learn.

For each light, there was a submenu where the student could choose to see an instructional video segment, a textually-based lesson, a selection of still frames with comments, or a quiz on that particular light. The student could return to the main menu anytime so that she or he could learn about another light. In the instructional video segment, the student could control the motion of the picture by touching boxes which were situated at the bottom of the screen. The student could move forward, move backward, fast forward, pause, jump back five seconds, or exit to the superordinate menu at any time. In the textually-based lesson section, the student could move forwards or backwards among the text frames, or exit at any time. In the quiz section, the student could choose the number of questions she or he would attempt. The student was told if her or his answer was correct or not, but was not given any corrective feedback nor given any advice. For each attempted question, the student was required to answer the multiple choice question correctly before proceeding. In the still frames section the student could see the effect of different light positions on a person's face. There were 12 different light positions for the key light, 5 positions each for the fill, hair, and background lights, and 12 frames consisting of different combinations of the key, fill, hair, and background lights for the combined lights section. For all the key, fill, hair, and background light frames, there were accompanying comments which described the properties of each light position.

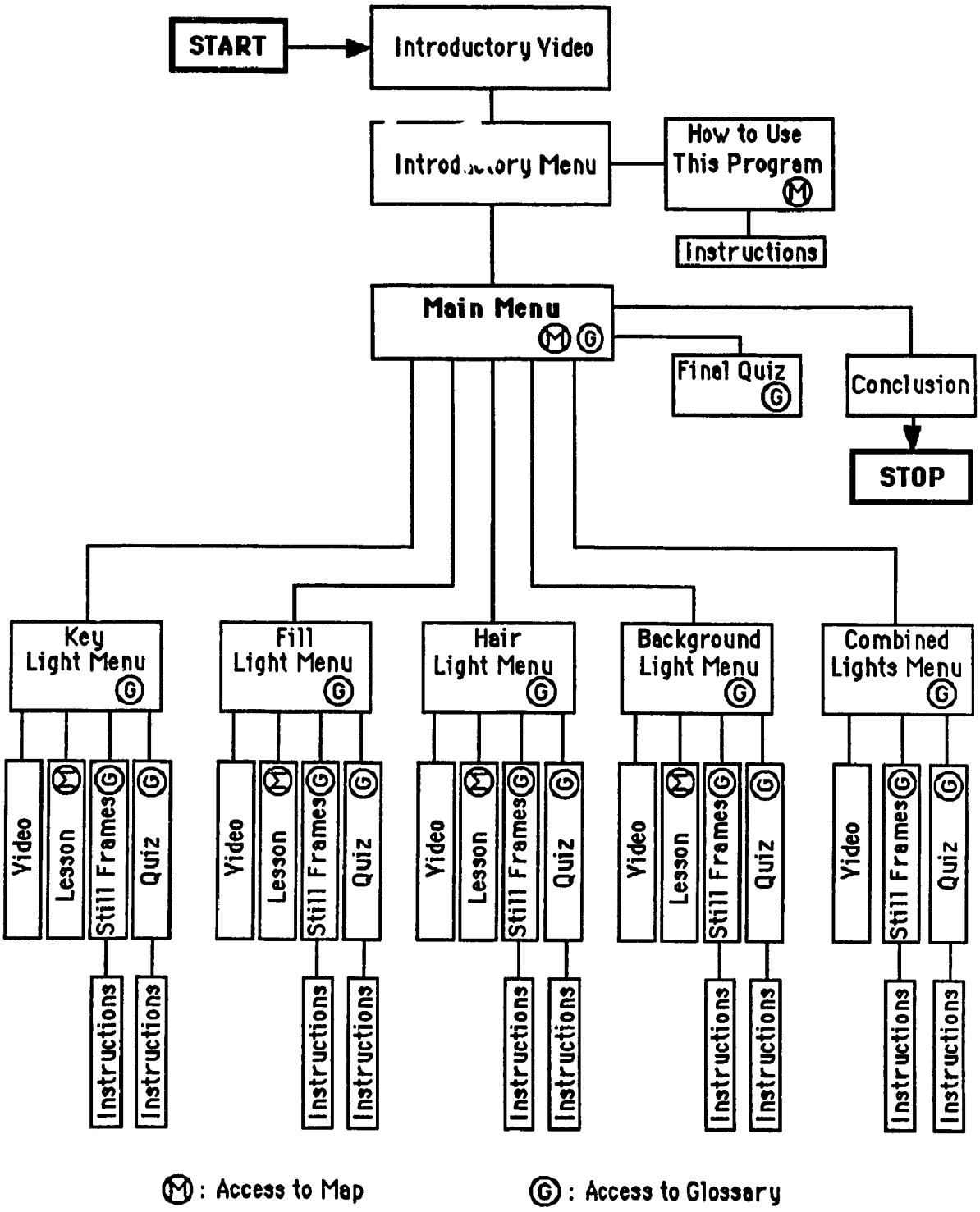
There were other choices the student could make at various points throughout the program. She or he could choose to see a glossary of terms to be learned. The student could also consult a content map which showed graphically where she or he was situated in the program (similar to Figure 2). The student could also obtain additional instruction on how to operate the section she or he was in at the time of the query. The student could choose to end the instruction whenever she or he wished by choosing to see the conclusion.

The CBIV instructional program was reviewed by a subject matter expert, and the content was found to be accurate.

Achievement was measured by a 40-item multiple choice power posttest; no time limit was imposed (see Appendix A for the test). There were 18 items which had accompanying photographs of a person with varying lighting conditions. The student had to choose the correct light position from the four choices given. The other 22 items consisted of asking the student which lights and positions should be used to accomplish particular effects.

Half of the questions on the posttest were included in the question sheet (see Appendix B for the question sheet) which was given to the students in the experimental condition. These questions tested for intended learning. Besides these 20 questions, there were 13 other questions on the question sheet which were more general in nature. All were short answer questions. Thus, for an intended learning question which required naming the light used for a picture, the student had to choose among the four options on the posttest, whereas the student had to find the name of that light for the equivalent question on the question sheet.

Figure 2: *CBIV Lesson Flowchart.*



The student was also given a guide to light positions. This four page guide graphically depicted the possible positions for each light relative to the subject and the camera. Each light position was given a number; thus the student did not have to learn the system of light position identification in terms of horizontal and vertical angles, as is commonly done in more intensive photography courses. The students also used this guide during the posttest.

The prior knowledge measure was a short written test consisting of eight short answer questions for a possible total score of 10 (see Appendix C). The test was marked in increments of half points. Although the questions were related to the topic, none appeared in the posttest.

Procedure

The experiment was carried out in a room at Dawson Institute of Photography. Subjects were assigned to one of the two conditions through the use of block randomization as they appeared for the lesson. Because the learning program was presented via computer, the subjects were treated on an individual basis. Two people shared the task of administering the treatments. For each student, one administrator was always present in the room.

The student was first given the prior knowledge measure. Then the student filled out a short personal information questionnaire. This asked the student if she or he had ever used a computer, if English was her or his second language, and it asked her or him which photography courses she or he had taken before, and in which semester she or he was presently enrolled. Then the administrator read the instructions (see Appendix D for the instructions). These instructions were read to the student in order to insure consistency among the students. The administrator explained to the student how to use the touch screen. He also told the student that she or he was responsible for choosing the path of

instruction and the amount of instruction. He also explained to the student how the material was organized. For example, he explained how one travels through a menu-based program. Finally, the student was given a guide which graphically showed, for each light, the possible positions of that light relative to a portrait subject and a camera. He was told that he would be able to use the guide during the posttest.

At this point, if the student was in the question sheet condition, she or he was handed a question sheet and told that she or he would be able to refer to it while viewing the program.

The student was then told that she or he was able could start the instruction by touching the box she or he saw on the screen. The instruction usually lasted between 45 minutes and one hour and 40 minutes, although one student took 32 minutes and another took just over two hours.

After completing the instruction, all material was removed except for the light position guide. The student was given math problems to solve for a period of three minutes. Then the student was given the posttest.

Finally the administrator debriefed the student on the purpose of the experiment, gathered general comments the student might offer, and answered any enquiries the student had.

While the student performed the experiment, the administrator kept track of the time and recorded the student's choices (see Appendix E). If the student asked questions during the course of the experiment, she or he was told that all questions would be answered at the end.

Data Analysis

A multivariate analysis of variance (MANOVA) with two dependent variables, one independent variable and one covariate was conducted. The purpose for using the

MANOVA was to ascertain that the two dependent variables were independent of each other. The dependent variables were posttest score and instruction time. The independent variable was type of instruction (presence or absence of the question sheet). The covariate was the score on the prior knowledge measure. The prior knowledge measure was used as a covariate in order to adjust for initial differences between groups, and to increase the sensitivity of the experiment by reducing the size of the experimental error.

If the overall multivariate F ratio was found to be significant, then a canonical correlation test would be conducted to see if there was an interdependency between the two dependent variables. If a high correlation was found, then the hypotheses would be tested through the use of discriminate function analysis. If a low correlation was found, then separate univariate analysis would be conducted for the effects of the independent variable on each of the two dependent variables.

CHAPTER 4

RESULTS

Evaluation of the Test

An item analysis was conducted on the posttest. It was found that students who scored high on the test performed poorly on question 31. Moreover, some students commented that they were confused by this question. This question asked which key light position would make a nose look longer. The question should have been more specific by asking which key light position made the *bridge* of the nose look longer. This is because a nose can be made to look longer either vertically or horizontally (outwards from the face). Key light position 3M (key light at eye level and off to the side) can make the nose look longer horizontally whereas key light position 1H (key light in front and above the subject) can make the nose look longer vertically. For this reason question 31 was excluded from all statistical analyses.

A Kuder-Richardson test (KR 21) was conducted on the posttest in order to get a measure of internal reliability. For the two treatment groups combined, an internal reliability of .78 was obtained.

Hypothesis Testing

A multivariate analysis of covariance (MANOVA) with two dependent variables, one independent variable and one covariate was conducted. The purpose for using the MANOVA as opposed to using two analyses of covariance (ANCOVA) was to ascertain that the two dependent variables were independent of each other. The dependent variables were posttest score and instruction time. The independent variable was type of instruction (presence or absence of the question sheet). The covariate was the score on the prior knowledge measure. The prior knowledge measure was used as a covariate in order to

adjust for initial differences between groups, and to increase the sensitivity of the experiment by reducing the size of the experimental error.

The overall multivariate F-ratio was not significant (Pillais $F = .36$, $df = 2.00$, $p = .699$); therefore, no canonical correlational or discriminant analyses were reported. The results of the Bartlett test of sphericity, $F(1) = .115$, $p > .05$ indicated that the hypothesis that the partial correlation between the dependent variables of posttest achievement and task completion time is zero was not rejected.

Table 1 shows the prior knowledge measure, posttest, and adjusted posttest means and standard deviations on the prior knowledge measure, achievement test, and task completion time by type of instruction.

The univariate test for the main effect of the question sheet treatment on posttest achievement was not significant $F(1,37) = 0.677$, $p > .05$. Having a question sheet as an adjunct aid during instruction had no effect on the students' achievement on the posttest. The univariate test for the main effect of the question sheet treatment on task completion time was not significant, $F(1, 1, 37) = 0.044$, $p > .05$. Having a question sheet as an adjunct aid during instruction had no effect on the length of time it took the students to complete the instruction.

The covariate prior knowledge was found to be a good predictor of both posttest achievement, $F(1, 1, 37) = 11.45$, $p < .005$, and task completion time, $F(1, 1, 37) = 7.58$, $p < .01$. Students who scored high on the prior knowledge measure tended to score high on the achievement posttest. Students who scored high on the prior knowledge measure tended to finish faster.

Table 1

Prior Knowledge Test, Posttest, and Adjusted Posttest Means and Standard Deviations by Type of Instruction

Type of Instruction	Prior Knowledge	Posttest	Adjusted Posttest	Time (min.)	Adjusted Time
Question Sheet					
M	5.1	30.4	30.65	80.8	79.9
SD	3.5	6.5		24.8	
No Question Sheet					
M	5.1	32.2	31.95	77.5	78.4
SD	5.8	4.6		24.0	

The results of univariate test of significance for the dependent variable *posttest achievement* are shown in Table 2. The results of univariate test of significance for the dependent variable *task completion time* are shown in Table 3.

Homogeneity of regression for the covariate by treatment was tested for the dependent variable *posttest achievement* and was found not to have been violated, $F(1, 36) = 1.57, p > .05$. Homogeneity of regression for the covariate by treatment was tested for the dependent variable *task completion time* and was found not to have been violated, $F(1, 36) = 0.83, p > .05$.

Table 2

Analysis of Variance: Posttest by Type of Instruction with Prior Knowledge

Source of Variation	Sum of Squares	DF	Mean Square	F	p
Covariate Prior Knowledge Measure	285.74	1	285.74	11.45	.002
Main Effect	16.83	1	16.84	0.67	.416
Explained	302.57	2	151.28	6.09	.005
Residual	919.83	37	24.86		
Total	1222.4	39	31.34		

Table 3

Analysis of Variance: Task Completion Time by Type of Instruction with Prior Knowledge

Source of Variation	Sum of Squares	DF	Mean Square	F	p
Covariate Prior Knowledge Measure	3852.03	1	3852.03	7.58	.009
Main Effect	22.22	1	22.22	0.04	.836
Explained	3874.25	2	1937.12	3.81	.031
Residual	18808.13	37	508.33		
Total	22682.37	39	581.60		

Additional Research Results

Of the 39 questions on the posttest, 20 were intended learning questions, meaning that they were also present in the question sheet given to the students in the question sheet treatment. The other 19 questions were incidental learning questions, meaning that they were not present in the question sheet. An ANOVA was conducted with type of instruction as the independent variable, prior knowledge as the covariate, and type of question (intended knowledge vs incidental knowledge) as the within-subjects dependent variables. The treatment by type of question interaction was not significant, $F(1, 38) = 1.00$, $p > .05$. The students who received the question sheet did not perform differently in either the intended or incidental knowledge questions from the students who had not received the question sheet. Means and standard deviations for type of question by treatment are shown in Table 4.

Table 4

Type of Question (Intended vs. Incidental) by Treatment (Question Sheet vs. No Question Sheet) Posttest Means and Standard Deviations

Condition	M	SD
Question Sheet		
Intended	15.0	3.1
Incidental	15.4	3.7
No Question Sheet		
Intended	15.9	2.6
Incidental	16.6	2.5
Total Intended	15.3	2.8
Total Incidental	16.0	3.1

Note: There were 19 intended questions and 20 incidental questions.

Two-tailed *t*-tests were conducted on some of the data collected from the personal information questionnaire and from the observation sheet. The results are shown in Table 5 for achievement in the posttest and in Table 6 for task completion time. The manner in which these students were assigned to the two groups of each variable is explained as follows:

Took Lighting Course at Dawson. The students took a studio lighting course during the first semester. Twenty-one students were tested at the beginning of their first semester and hence, had not taken the course yet. The rest had taken this course, and some had also taken more advanced courses on related topics.

Chose Options in Order. For each light section, the student could choose to see an instructional video segment, a textually-based lesson, a selection of still frames with comments, or a quiz on that particular light. The choice boxes for those options were arranged on the video screen in that same order. This arrangement might have suggested that the student follow that order. This form of advisement was unavoidable. The dependent variable results of the students who followed this order were assigned to the *Yes* column.

Took Courses Outside Dawson. Some students indicated on the questionnaire that they had taken photography courses prior to enrolling at Dawson Institute of Photography.

Has Computer Experience. Students indicated on the questionnaire if they had ever used a microcomputer for any purpose.

Has Trouble Reading. The administrators noticed that three students read very slowly and did not seem to comprehend more difficult vocabulary.

Chose Light Sections in Order. The order in which the option boxes for each light was arranged on the video screen may have advised the student to follow that particular

sequence (see Figure 1). The dependent variable results of the students who followed this order were assigned to the *Yes* column.

Did Quizzes in Light Sections. In each light section there was a quiz that the students could choose to do. Three students did not do any of the quizzes; their dependent variable results were assigned to the *No* column.

Did Final Quiz. Fifteen students chose not to do the final quiz; their dependent variable results were assigned to the *No* column.

Read Comments. For every still frame in all the light sections, students could chose to see comments, which described the properties of each particular light position. Six students did not choose to see any comments; their dependent variable results were assigned to the *No* column.

Read Lessons. For each light there was a textually-based lesson, which the student could choose to see. One student did not read any of the lessons.

Reviewed. Four students decided to review part or all of each light section after completing each quiz; their dependent variable results were assigned to the *Yes* column.

Used Glossary. Most students accessed to the glossary at least once. However, after having seen the contents, some did not use it any further. Students assigned to the *Yes* column were those who accessed to the glossary more than once.

Used Map. Four students consulted the map; their dependent variable results were assigned to the *Yes* column.

Table 5

Achievement t-Test Results for Additional Observations

Independent Variable	Yes M (n)	No M (n)	p
Took Light Course at Dawson	32.4 (19)	30.4 (21)	>.05
Chose Options in Order	31.8 (35)	27.6 (5)	>.05
Took Courses Outside Dawson	32.9 (22)	29.4 (18)	<.05 *
Has Computer Experience	31.7 (15)	31.0 (25)	>.05
Has Trouble Reading	20.7 (3)	32.2 (37)	<.001 ***
Chose Light Sections in Order	31.5 (33)	31.5 (5)	>.05
Did Quizzes in Light Sections	32.0 (37)	23.0 (3)	<.01 **
Did Final Quiz	32.8 (25)	28.8 (15)	<.05 *
Read Comments	31.8 (34)	28.7 (6)	>.05
Read Lessons	31.6 (39)	21 (1)	>.05
Reviewed	30.5 (4)	31.4 (36)	>.05
Used Glossary	30.2 (16)	31.2 (24)	>.05
Used Map	30.3 (4)	31.4 (36)	>.05

* : significance at .05 level
** : significance at .01 level
*** : significance at .001 level

Table 6

Task Completion Time t-Test Results for Additional Observations

Variable	Yes M (n)	No M (n)	p
Took Light Course at Dawson	67.0 (19)	90.1 (21)	<.01 **
Chose Options in Order	78.9 (35)	81.0 (5)	>.05
Took Courses Outside Dawson	69.1 (22)	91.4 (18)	<.01 **
Has Computer Experience	82.0 (15)	77.4 (25)	>.05
Has Trouble Reading	91.7 (3)	78.1 (37)	>.05
Chose Light Sections in Order	82.4 (33)	68.6 (5)	>.05
Did Quizzes in Light Sections	80.0 (37)	68.7 (3)	>.05
Did Final Quiz	87.2 (25)	65.7 (15)	<.01 **
Read Comments	81.3 (34)	70.3 (6)	>.05
Read Lessons	78.9 (39)	88 (1)	>.05
Reviewed	97.5 (4)	77.1 (36)	>.05
Used Glossary	79.5 (16)	78.8 (24)	>.05
Used Map	82.2 (4)	78.8 (36)	>.05

* : significance at .05 level
** : significance at .01 level
*** : significance at .001 level

The following significant differences were noticed:

Though students more advanced in the programme at Dawson College did not score better on the achievement test, they finished the instruction faster. Students who had taken courses outside Dawson College scored better and finished faster. The three students who had trouble reading scored worse but did not complete the instruction faster or slower. Students who did the embedded practice scored better, however, the students who chose to do the final quiz, which consisted of review questions, also took longer to complete the instruction. When interpreting the significance of these results, some weaknesses of the method of analysis should be taken into account. Because in many cases the cell sizes contain very few subjects, the within-group variances may not be representative of the actual variances that would be obtained if the groups were larger. The error induced when comparing these small samples with large samples is not taken into account when using *t*-test analysis.

Non Statistical Observations

The administrators observed that the students in the question sheet condition used that question sheet in different ways. Some students read a few questions, then looked for the relevant information, and then returned to the question sheet to read more questions. Other students, after having read the whole question sheet, went through the instruction completely, returned to the question sheet, and then went back to the CBIV instruction in order to find information they had missed. Finally, a few students did not read the instruction sheet until the end, whereupon some of these students returned to the CBIV instruction in order to find information they had missed.

The administrators observed that students spent a large portion of time doing the quizzes. Many students answered all questions in all sections. However, several students

who were more advanced in the program at Dawson College did not attempt all questions. Some commented afterwards that they had especially enjoyed doing the quizzes.

The administrators observed that, apart from attempting all questions, most students learned in an efficient manner; they did not tend to pause too long on any frame, nor did they review material without cause.

The overlaid video buttons, which allowed the students to control the motion of the video sequences, were rarely used. Each separate video sequence was short, usually between one or two minutes long. The students preferred to watch the whole sequence without stopping, and then, if they so wished, watch the whole sequence again.

Several students commented that they had found the instruction interesting. Students in their first semester said that, though they had found the instruction intensive, they had learned much about portrait lighting. More advanced students commented that the instruction consolidated knowledge they had learned gained from various courses.

CHAPTER 5

DISCUSSION

The findings in this study do not support the first hypothesis, which states that giving the students a question sheet during learner-controlled CBIV instruction positively affects posttest achievement. There was no difference in achievement between the group which received the question sheet and the group which did not receive the question sheet.

The use of a question sheet as an adjunct aid during learner-controlled CBIV instruction may not be effective for several reasons. One reason may be due to good lesson organization. Hannafin and Hughes (1986) state that "in general, the power of advance organizers increase as the availability of prerequisite knowledge and quality of lesson organization decrease" (p. 241). This may also be true for the effectiveness of the question sheet used in this study because it is similar to an advance organizer in that it prepared the student for assimilation of new knowledge.

Moreover, I believe that the lesson used in this study was well organized. In learner-controlled instruction, the learner usually accesses the contents of the lesson by making choices in menus and submenus. This kind of lesson organization forces the designer of the lesson to subdivide the subject matter into sections and subsections of related ideas which have to be evident to the learner. As a consequence, learner-controlled instruction tends to be well organized.

Another reason that the effects of the question sheet may not have been discernible is that there were other orienting strategies within the instructional program itself. The practice sections, the content map, the glossary, and the choice menus may have acted as orienting activities, and guided the student to learn relevant information. In the case of the practice sections, students who attempted some or all questions in either the light section quizzes or the final quiz performed significantly better in the achievement posttest than students who did not attempt the quizzes. All these aids and activities were included

because the aim of this research was to evaluate the effectiveness of the use of a question sheet with a well-designed CBIV instructional program. Further research is needed in order to find out the effectiveness of a question sheet as an adjunct aid with one or more of these instructional aids left out.

The results of this study support those of Hannafin, Phillips, and Tripp (1986). They compared the effects of orienting activities, practice, and processing time, and they found that practice was the dominant influence in the instructional effectiveness of interactive video.

Finally, the use of the question sheet may have not been effective because this was the first time the students had used interactive video as a form of instruction and the first time they had used learner-controlled instruction. Because of this, the students may have attached less importance to the question sheet and instead concentrated more on learning from the new medium. Robson, Steward, and Whitfield (1987) reported more positive results for learner control when the instruction was long-term. Judd et al. (1970) concluded that students need training in the use of learner control strategies in order to be able to use learner-controlled instruction effectively.

The findings in this study do not support the second hypothesis, which states that students in the question sheet condition will finish faster than students in the no-question sheet condition. There was no difference in task completion time between the group which received the question sheet as an adjunct aid and the group which did not receive this aid.

It is possible that the use of the question sheet had no effect on task completion time because of the organization of the lesson. Students were able to travel through the lesson efficiently. Also, because this was the first time that the students had undergone this kind of instruction, the students were well motivated and did not tend to stray or browse. Further research on long-term learner-controlled CBIV instruction is required to find out if

the use of a question sheet as as adjunct aid may be effective in reducing task completion time.

The findings in this study support the third hypothesis, which states that students with high prior knowledge will finish faster than those with low prior knowledge. The student's prior knowledge is a good predictor of her or his task completion time.

From these findings and from the observation that high prior knowledge students tended to cover less material, it appears that high prior knowledge students are good judges of the amount of instruction they need. This supports the findings of Judd et al. (1970) who observed that students who had the capability to withdraw from instruction segments did as well as those students who had to complete the current segment before being able to continue on to another segment. The findings are also a good indication that learner-controlled CBIV instruction might be a good strategy to use with high prior knowledge learners. To validate this assumption, further research is needed to compare the use of learner control CBIV instruction with program control instruction or with adaptive program control instruction using prior knowledge as a covariate. The findings described above also support those of Gay (1986), and Goetzfried and Hannafin (1985) in CAI research.

There were no interaction effects between type of question (intended knowledge or incidental knowledge) and treatment (presence or absence of question sheet). This is probably because the presence of the question sheet did not have a main effect on posttest achievement. In studies on pre-question effects in textually-based material, when an interaction is found there is also a significant main effect (Frase, 1967; Frase 1968). On the other hand, there was a main effect on achievement between students who did the embedded practice questions and those who did not. This main effect probably confounded the effect of the question sheet on the posttest scores. Considering the findings of this study, it would have been more interesting to define intended knowledge posttest questions as those which also appeared in the embedded quizzes.

The practice sections (the quizzes) in the instruction had significant effects on achievement. Students who did some or all of the light section quizzes performed significantly better on the posttest than students who did not attempt any questions on the quizzes, and students who did some or all of the final quiz performed significantly better on the posttest than students who did not attempt any questions in the final quiz (see Table 5). This supports Hannafin and Colomaio's (1987) findings about embedded practice being "the most powerful influence among the treatment variables studied in learning from interactive video" (p. 7). However, in the case of the final quiz, students also took significantly longer to complete the instruction (see Table 6). This supports Schaffer and Hannafin's (1986) contention that too many facilities may slow down the learner's progress.

Another interesting finding is that those students who had taken photography courses prior to enrolling at Dawson College performed significantly better on the achievement test and completed the instruction in significantly less time. This may be due to these students' higher prior knowledge or greater motivation.

The present results on the effectiveness of a question sheet as an adjunct aid in learner-controlled CBIV instruction are inconclusive. It cannot be ascertained whether the use of a question sheet is effective or efficient until research on long-term instruction is done, and it cannot be ascertained whether the use of a question sheet in learner-controlled CBIV instruction can be a viable alternative to embedded practice or other strategies until further research is performed with comparisons of treatments which have a varying number of these strategies.

In the design of interactive video instruction, courseware designers may be limited by constraints such as the impossibility of designing practice items for videodiscs which already exist and are readily available. Designers may also wish to make instruction as efficient as possible and thus look for an alternative to embedded practice, which is often

time consuming. Further research is needed in order to determine if question sheets as an adjunct aid may be of use in CBIV.

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Appendix A

Posttest Achievement Measure.

TEST

Please write your choices on the answer sheet.

For questions 1 to 18, refer to the pictures.

1. What is the position of the key light in picture 1?

a) 1H b) 4M c) 1M d) 2L

2. What is the position of the key light in picture 2?

a) 1M b) 1L c) 4M d) 2H

3. What is the position of the key light in picture 3?

a) 3H b) 2H c) 1L d) 4L

4. What is the position of the key light in picture 4?

a) 4H b) 1M c) 1L d) 2L

5. What is the position of the fill light in picture 5?

a) 1 b) 2 c) 4 d) 5 (No fill light used)

6. What is the position of the fill light in picture 6?

a) 1 b) 2 c) 3 d) 5 (No fill light used)

7. What is the position of the hair light in picture 7?

a) 1 b) 2 c) 3 d) 4

8. What is the position of the hair light in picture 8?

a) 1 b) 2 c) 4 d) 5 (No hair light used)

9. What is the position of the hair light in picture 9?

a) 1 b) 2 3) d) 5 (No hair light used)

10. What is the position of the background light in picture 10?

a)1 b) 3 c) 4 d) 5 (No background light used)

11. What is the position of the background light in picture 11?

a) 1 b) 2 c) 3 d) 4

12. Which lights are used in this picture 12?

a) Key and hair lights.

b) Key, fill, and background lights.

c) Key and background lights.

d) Key, hair, and background lights.

13. Which lights are used in this picture 13?

a) Key and fill lights.

b) Key, fill, hair, and background lights.

c) Key light.

d) Key, fill, and hair lights.

14. Which lights are used in picture 14?

a) Key and fill lights.

b) Key, fill, and background lights.

c) Key and hair lights.

d) Key and background lights.

15. Which lights are used in picture 15?

a) Key.

b) Key, fill, and hair.

c) Key and hair.

d) Key and fill.

16. Which light is <u>not</u> used in picture 16?

a) Key. b) Fill. c) Hair. d) Background.

17. Which light is <u>not</u> used in picture 17?

a) Key. b) Fill. c) Hair. d) Background

18. Which light is <u>not</u> used in picture 18?

a) Key. b) Fill. c) Hair. d) Background.

19. Which light could be used to add a rim of light on a subject's shoulder?

a) Key. b) Fill. c) Hair. d) Background.

20. How can a face be made to look younger than it actually is?

a) By using a fill light and a key light in position 1M.

b) By using a fill light and a key light in position 3M.

c) By using a hair light and a key light in position 1M.

d) By using a hair light and a key light in position 3M.

21. What is high-key lighting?

a) Lighting the subject with a key light placed high.

b) Lighting the subject with an intense key light.

c) Lighting the subject with intense key, fill, hair, and background lights.

d) Lighting the subject with an intense key light and with a dark background.

22. How can one achieve a soft transition from the lit to the dark areas of the face?

a) By using two key lights.

b) By using a background light.

c) By using natural light as the filler.

d) By using a diffused key light.

23. Which key light position would mimic an effect of sensationalism?

a) 4M b) 1H c) 2L d) 1M

24. Which light set-up would you use to mimic a moonlit scene?

a) Low intensity key and fill lights, relatively intense hair light.

b) Low intensity fill and key lights.

c) Low intensity key light in position 1M.

d) High intensity key, fill, and hair lights.

25. With the use of a diffused key light, which key light position would simulate the glow of a fireplace?

a) 1H b) 3M c) 3L d) 4M

26. Which fill light position would make a face look younger but without giving it a flat-looking effect?

a) 1 b) 2 c) 3 d) 4

27. Which hair light position do you use to produce the halo effect?

a) 1 b) 2 c) 3 d) 4

28. Which background light position would direct the viewer's attention towards the subject?

a) 1 b) 2 c) 3 d) 4

29. Which background light position produces a uniform looking background without it looking too bright?

a) 1 b) 2 c) 3 d) 4

30. Which key light position would make a wide face look thinner?

a) 3H b) 1M c) 3M d) 1H

31. Which key light position would make a nose look longer?

a) 3H b) 1H c) 3M d) 4M

32. What is the main purpose of the fill light?

a) To fill the background with light.

b) To make the picture look less empty than it actually is.

c) To lessen the darkness of the shadows caused by the key light.

d) To make the face very bright by filling it with light

33. How can we add texture to an otherwise flat-looking background.

a) By lighting the background as intensely as possible.

b) By lighting the background obliquely so as to lengthen shadows of the irregularities of the surface of the background.

c) By lighting the background from the front so as to have as few shadows as possible.

d) By lighting the background very faintly.

34. How do we add texture to a subject's hair?

a) By making it contrast strongly with the background.

b) By aiming a light at it.

c) By not aiming a light at it so as to keep it as dark as possible.

d) By using a brightly lit background.

35. In which key light position would cast and attached shadows be opposite their usual expected positions?

a) 1M b) 4H c) 4M d) 2L

36. Which key light position would make a face look more masculine?

a) 4M b) 1M c) 3L d) 2L

37. Which key light position is called the Rembrandt lighting position?

a) 4M b) 3M c) 3H d) 1H

38. Which key light position would create a profile effect?

a) 1M b) 2H c) 4M d) 3H

39. Which fill light position would reduce tonal contrast the most without creating its own shadows?

a) 1 b) 2 c) 4 d) 5 (No fill light used)

40. Which of the following would make a person look older?

a) By using a key light in position 1M, and a fill light in position 2.

b) By using a key light in position 1M, and a fill light in position 4.

c) By using a key light in position 3H, and a fill light in position 2.

d) By using a key light in position 3H, and a fill light in position 4.

Appendix B

Question Sheet Given to the Students
in the Question Sheet Condition

LIST OF QUESTIONS

After working through the interactive video program, you should be able to answer the following questions:

1. What is three-point lighting?
2. What are the names of the lights used in three-point lighting?
3. What is the main purpose of the key light?
4. What is the main purpose of the fill light?
5. What is the main purpose of the hair light?
6. What is the main purpose of the background light?
7. What are the two kinds of shadows called?
8. What is diffused lighting?
10. Which key light positions give a more n ıtural lighting effect?
11. Which key light positions would give an unnatural effect to a face?
12. In which key light positions would cast and attached shadows be opposite their usual expected positions?
13. Which key light position is called butterfly lighting?
14. Which key light position would make a face look flat?
15. Which key light position would be used to imitate the glow of a fireplace?
16. Which key light position is called the Rembrandt lighting position?
17. Which key light position would make a nose look longer?
18. How can one achieve a soft transition from the lit to the dark areas of the face?
19. Which light set-up would you use to mimic a moonlit scene?
20. How can a face be made to look younger than it actually is?

21. Which fill light position would reduce tonal contrast the most without creating its own shadows?

22. Which hair light position adds just enough light to set the hair off from a dark background without altering the overall effect?

23. Which background light position would direct the viewer's attention towards the subject?

24. What is high-key lighting?

For the following questions, please refer to the pictures in the album.

25. What is the position of the key light in picture 1?

26. What is the position of the key light in picture 2?

27. What is the position of the fill light in picture 3?

28. What is the position of the hair light in picture 4?

29. What is the position of the hair light in picture 5?

30. What is the position of the background light in picture 6?

31. Which lights are used in picture 7?

32. Which lights are used in picture 8?

33. Which light is <u>not</u> used in picture 9?

Appendix C

Prior Knowledge Measure

PORTRAIT PHOTOGRAPHY LIGHTING

Please answer the following questions in one or two sentences.

1. What are the names of the lights usually used in three-point lighting?

.....

.....

2. What is the function of the fill light? .....

.....

.....

3. What is high-key lighting?

.....

.....

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4. How do you make the transition from the dark to the bright areas of a person's face more gradual?

.....

.....

5. What is the name of the principal lamp lighting the subject?

.....

6. Which lights would you use to make a person's face look younger, and what would be the positions of these lights?

.....

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.....

7. Where is the hair light usually placed? .....

.....

8. Look at the accompanying picture. Which lights have been used to create this picture?

.....

.....

Appendix D

Instructions Read to the Student
Prior to the Lesson

Instructions

This program will teach you about studio lighting techniques. You will go through the instruction, and then you will take a written multiple choice test.

The way you use this program is by pressing the touch screen. You will sometimes see boxes on the screen; you make your choice by pressing a box.

This program uses a technique called learner control. In other words, you, the learner, have control over what you want to see in this program. You also have control over the order you want to see the different lessons in the program. For example, in the program, there is a lesson for each different light which is used in studio photography. You may choose the order which you want to see these lessons.

Note that nothing ever disappears from the program. Whatever you see in the program, you will be able to see it again. You can do any lesson as many times as you wish, or you may do a quiz before a lesson and do it again after the lesson. You may choose to skip certain parts. It's your decision.

The only way you can finish is by pressing the STOP button, which is located in the part called CONCLUSION.

What I'm telling you now, by the way, may also be found in the program if you press the "HOW TO USE THIS PROGRAM" button. There are also other buttons called INSTRUCTION, which tell you how to go about the lesson.

Each lesson on a particular light is divided into four parts. There is different information in each of those parts. You will see four boxes on the screen.

There's one box called VIDEO. Here you can see a video segment which is about the particular light that you're working on.

There's one box called VIDEO. Here you can see a video segment which is about the particular light that you're working on.

There's a box called LESSON. Here you can pages of written instruction. Note that the page number will be indicated at the top right (Show them where). For example it might say page 3 of 5. To go to the next page you press the arrows pointing to the right (>>) (Show them where this box would be situated.) To go to the preceding page press the arrows pointing to the left (<<).

There's a box called STILL FRAMES. Here you will be able to choose a light position and you will be able to see a picture of a face where that light position was used. You can also read comments on each particular light position.

There's a box called QUIZ. Here you will be able to judge yourself how well you know the material.

There are also other boxes which you can press when you need help. There is a GLOSSARY box. When you press this box, you will be taken to a glossary of terms which are arranged alphabetically on three pages. After getting an explanation of a term, you will be returned to exactly where you were before you asked for the glossary. For example, if you are asked a question in the quiz, and you don't know the answer, you can consult the glossary. After that you will be taken back to exactly the same question.

There is also a MAP button. This will graphically show you where you are situated in the program.

This program uses a menu based approach. (Show them the example. Show them how they go from the main menu to a submenu. Show them how they can go from point X to point Y.)

Note that this program was meant to teach video lighting specifically. However, that the principles are the same for studio photography.

I'll be able to answer any questions about the purpose of this experiment after you've finished.

Note that sometimes, the computer is not ready to accept your response. You may push and nothing happens. In that case, wait a second and just push again. Also, for buttons at the bottom, you shouldn't press too low on the screen (show them).

Again, when you want to stop, push the STOP button which is in the conclusion section.

Appendix E

Observation Record

Time student came in..... Time treatment started.....

Time treatment finished.....

Time student finished posttest. .....

Did the student follow this pattern: KEY, FILL, HAIR, BACKGROUND, COMBINED? yes ( ) no ( )

If no, then which one?

.....

.....

Did he repeat any videos, lessons, still frames, quizzes? yes ( ) no ( )

Did he use the HOW TO USE THIS PROGRAM ? no ( ) partially ( ) completly ( )

Did he use INSTRUCTIONS? no ( ) once ( ) 2-4 ( ) 5 or more ( )

Did he use the MAP? no ( ) once ( ) 2-4 ( ) 5 or more ( )

Did he use the GLOSSARY at all? yes ( ) no ( )

If yes: From the main menu: no ( ) once ( ) 2-4 ( ) 5 or more ( )
From the still frames: no ( ) once ( ) 2-4 ( ) 5 or more ( )
From the quizzes: no ( ) once ( ) 2-4 ( ) 5 or more ( )
From the final quiz: no ( ) once ( ) 2-4 ( ) 5 or more ( )

Did he use the COMMENTS? no ( ) once ( ) sometimes ( ) often ( ) always ( )

Did he watch the VIDEOS? no ( ) once ( ) often ( ) all of them ( )

Did he do the QUIZZES? no ( ) once ( ) often ( ) all of them ( )

COMMENTS:

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