The Effect of Self-Regulated Learning Strategies on Performance in Learner Controlled Computer-Based Instruction

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The purpose of this study was to examine the effect of self-regulated learning strategies (SRLS) on performance in a learner-controlled and a program-controlled computer-based instruction (CBI). SRLS was measured using a self-regulated learning strategies questionnaire. Seventh-grade subjects were divided into high and low levels of SRLS and then randomly assigned to one of two versions of a CBI lesson: one allowing learner control over the sequence and content of the instruction and the other having the learners follow a linear instructional sequence. Results revealed that the performance differences between learners with high SRLS and those with low SRLS were greater under learner control than under program control ($p < .05$). Poor performance by subjects with low SRLS under learner control indicates a strong need for learners to possess self-regulatory learning strategies to achieve success under learner control. Program control, however, seems to minimize the performance differences between low and high levels of SRLS.

□ Since the advent of computer-based instruction (CBI), advocates have touted its ability to enhance learning through learner control (LC). Numerous instructional design theories support the claim that learners may benefit from having some degree of control over instruction (e.g., Carroll, 1963; Merrill, 1983; Reigeluth & Stein, 1983). In general, the argument poses that providing learners with control over various instructional decisions individualizes the lesson by allowing learners to choose the amount and/or type of instructional support they require, thus tailoring the lesson to meet their unique needs.

Despite its intuitive appeal, LC has not been fully supported in CBI research. For example, Williams (1993a), in a comprehensive review, found that LC produced inconsistent results when compared with program control (PC). This inconsistency has been attributed to a variety of factors including learner differences, the type of instructional objectives pursued, and the context of the learner-controlled CBI (Duchastel, 1986). Milheim and Martin (1991) report, however, that LC research, up until this point, has failed to provide a comprehensive theoretical framework for understanding why LC may (or may not) be beneficial in a given learning situation.

Unlike PC, where the instructional decisions are made for the learner, LC forces learners to make instructional choices as to the amount or type of instruction to receive. So, one possible mediating factor in LC studies is the learner's ability to make these instructional choices effectively when given control (Williams, 1993a). The effectiveness of learners'

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instructional decisions is influenced in part by their ability to accurately perceive their learning needs during the lesson (Tennyson & Park, 1984). In other words, making an effective instructional decision involves adopting a strategy to determine one's need for additional instruction. This strategy is what Garhart and Hannafin (1986) refer to as *comprehension monitoring.* In their study, some learners failed to apply such a strategy causing them to exit the instruction prematurely thus adversely affecting their performance in LC.

Self-regulated learning refers to learners' systematic use of metacognitive, motivational, and behavioral strategies to achieve academic goals (Zimmerman, 1990). Learners report different levels of self-regulated learning-strategy use in academic environments (Pintrich & De Groot, 1990). Learners who report using self-regulated learning strategies (SRLS) extensively have been shown to have higher academic achievement (Zimmerman & Martinez-Pons, 1986). The importance of SRLS would appear to be compounded in LC environments that require the ability to determine one's learning needs and proactively seek to fulfill them. So, learners' reported use of SRLS may play a strong role in predicting success in LC.

Statement of the Problem

The purpose of this study was to examine the influence of learners' reported use of SRLS on performance in learner-controlled and program-controlled CBI. Specifically, I attempted to determine whether the type of instructional control (LC versus PC) and learners' level of SRLS (high versus low) would interact to produce differences in posttest performance in a CBI lesson. I focused primarily on two research questions:

1. Will the performance of high SRLS subjects exceed that of low SRLS subjects in both instructional control conditions?
2. Will performance differences between high and low SRLS subjects be greater under LC than under PC?

Review of the Literature

A central principle inherent in the design of all LC instruction is providing the learner with the opportunity to make instructional choices. An understanding of the influences on a learner to make effective or ineffective decisions demands a theoretical understanding of why different learners respond differently in LC environments.

Bandura's social cognitive theory (1986) provides one theoretical framework for investigating the many factors involved in learners' decision-making processes when faced with instructional choices. A critical attribute of this perspective is learners' ability to self regulate or control their behavioral responses. According to social cognitive theory, learners are not simply controlled by external circumstances but rather possess self-directed capabilities to influence their own behavioral responses (Zimmerman, 1989). In other words, learners have the ability (although not necessarily the willingness) to control their behavior by applying cognitive, metacognitive, and behavioral learning strategies.

What defines a self-regulated learner has been addressed by social cognitive theorists investigating self-regulated learning. The model of self-regulated learning proposed by Zimmerman (1989) states that "students can be described as self-regulated to the degree that they are metacognitively, motivationally, and behaviorally active participants in their own learning process" (p. 329). Such learners systematically use metacognitive, motivational, and behavioral strategies to achieve academic goals. For example, learners may behaviorally self regulate by choosing to adopt a self-evaluation strategy (e.g., "I check over my work to make sure I did it right") or cognitively self regulate by using a rehearsal strategy (e.g., "When I study for a test, I practice saying the important facts over and over to myself").

Supporting this general model, research by Pintrich and De Groot (1990) defined three components of self-regulated learning in the development of a Motivated Strategies for Learning Questionnaire. These include: learners' metacognitive strategies such as monitoring of their comprehension levels, learners' management of effort on academic tasks (i.e., task persistence), and the actual cognitive strategies learners use to learn material, such as rehearsing important information and identifying main ideas. For Pintrich and De Groot, these components collectively define self-regulated learning.

Learners' reported use of the strategies associated with self-regulated learning has been shown to be highly correlated with various achievement indicators. Pintrich and De Groot (1990) found self report of self-regulated learning was significantly correlated with a variety of performance indicators such as grades ($r = .36$), exam scores ($r = .28$), seatwork ($r = .22$), and essays/reports ($r = .36$). Zimmerman and Martinez-Pons (1986) found that students' achievement track could be predicted with 93% accuracy from reported use of self-regulated learning strategies. Further, Zimmerman and Martinez-Pons (1988) found that students' self-reports of SRLS correlated .70 with teachers' judgments of student self-regulatory behavior in the classroom. So, learners' reported use of SRLS is strongly associated with their actual use of SRLS in the classroom as well as with their performance on tasks and overall academic achievement.

Not surprisingly, several of the variables associated with self-regulated learning have also been shown to have a significant impact on the performance of learners in learner-controlled CBI. Research in LC has demonstrated that lack of effective metacognitive skills may lead to the ineffective use of instructional control (Garhart & Hannafin, 1986). The results of this research point to learners being unaware of when they need additional instructional support. If learners are unable to metacognitively monitor their learning, they may be unable to make effective instructional support decisions, and consequently LC becomes ineffective. Likewise, those using metacognitive skills to monitor their comprehension are more likely to use the control provided to their advantage and improve their performance.

Learners' application of learning strategies has also been shown to influence performance in learner-controlled CBI (Williams, 1993a). Many researchers who found performance in a PC environment superior to performance in LC (e.g., Tennyson, Park, & Christensen, 1985) point to learners' lack of effective strategies to manage the learning environment. In LC instruction, successful learning depends to some degree on learners' ability to make effective decisions throughout the lesson (Duchastel, 1986). Because of the linear nature of PC-CBI, however, the burden of decision making is taken away from learners so there is less need for them to adopt strategies to aid in effective decision-making.

Motivational factors are also strongly associated with the use of self-regulated learning strategies. Pintrich and De Groot (1990) found that learners motivated to learn the material (not just get a good grade), and those who found material interesting and important were more likely to be self-regulating and persistent in academic tasks. Self-efficacy, learners' belief in their ability to succeed at a given task, also contributes to the use of learning strategies (Schunk, 1985).

Motivational factors also have been shown to affect performance in learner-controlled CBI. Such factors include: self-efficacy (Oliver & Shapiro, 1993), attributional style (Williams, 1993b), intrinsic motivation (Lepper & Chabay, 1985), and extrinsic motivation (Hicken, Sullivan, & Klein, 1992). In general, this research has demonstrated that learners who perform well under LC are intrinsically motivated, self-confident individuals who attribute the causes of their successes and failures to internally controllable factors.

Learners' self-regulatory skills and motivation seem to be linked to effectiveness of decision making within LC instruction. Thus, inconsistencies in the results of LC research may be attributed in part to learners' deficiencies in these areas. As suggested by Williams (1993a), a link needs to be made between self-regulation research and LC research. Because providing learners with control requires an ability to self-regulate behavior, whereas program control does not, it seems important for research to examine the interaction between SRLS and the type of instructional control provided in CBI lesson.

Given the assumed importance of SRLS on performance under LC, an interaction was expected between the type of instructional control and the learners' level of SRLS. High SRLS subjects were predicted to perform better overall than low SRLS subjects, but to a relatively greater extent under LC than PC. While subjects reporting low levels of SRLS were expected to perform more poorly under LC than under PC, subjects reporting high levels of SRLS were expected to perform equally well under both types of instructional control.

The interaction hypothesis is justified because previous research has demonstrated that LC exposes the self-regulatory weaknesses of learners by forcing them to make effective instructional decisions in order to succeed (Williams, 1993a). Learners reporting high SRLS should possess the necessary strategies to manage the control they are given. Because they are self-regulating their performance and seeking instructional support when necessary, they are likely to make more effective instructional decisions than their low-SRLS counterparts. Under PC, however, learners have less need to self-regulate because the CBI makes the instructional decisions for the learner; forcing them through the instruction. Therefore, the difference between high-SRLS and low-SRLS learners should be minimized under this condition.

Support for the main effect hypothesis comes from research in self-regulated learning showing a strong association between SRLS and superior academic functioning in a variety of settings (Pintrich & De Groot, 1990; Zimmerman 1990). This research provides sufficient evidence to predict that those lacking in SRLS will perform more poorly overall.

METHOD

Subjects

Subjects were 26 seventh-grade students enrolled in a social studies course at a middle school in a predominantly white, middle-class, small city school district in Florida. There were equal numbers of males and females, 5 Afro-American, 1 Middle Eastern, and 20 Caucasian subjects. Individual subjects' ability level and socioeconomic status were not determined for this study. Participation in the experiment was considered a course requirement, but subjects' level of performance was not counted in determining course grades.

Tasks and Materials

Two CBI lessons developed by Carrier and her associates were used for the instructional materials (Carrier, Davidson, Higson & Williams, 1984). Each lesson teaches four defined concepts associated with propaganda techniques in advertising: bandwagon, testimonial, transfer, and uniqueness. Bandwagon is a technique used to convince buyers that the use of a product is the prevailing custom, and by failing to buy it, you will be left out. A testimonial is an endorsement of a product by a famous person. Transfer uses a famous person for association to a product, but the person falls short of directly endorsing the product. Uniqueness attempts to persuade buyers by focusing on how special, popular, or unique they will be by using the product. The materials were slightly adapted from the original version. For example, to provide more up-to-date instances of verbal testimonials "Mr. T" was replaced with "Jay Leno"; "Billy Jean King" with "Martina Navratolova."

The instructional strategy used in the CBI included six initial instructional events for each of the four concepts: two definitions (one paraphrased); one example and one non-example of the concept in an advertisement; and two practice items asking whether the displayed advertisement represents an example of the given concept, with appropriate corrective feedback following the response. For example, for the concept of bandwagon, a definition explained the critical attributes of the concept (e.g., following an accepted custom; joining the crowd, etc.). An example was as follows: "All teens wear sunglasses by Cool Shades. Don't be left out of the crowd! Buy them!" A practice item displayed a verbal or visual instance of an advertisement and asked the subject whether or not it represented an example of bandwagon. Carrier and Williams (1988) used 35 sixth graders to assess appropriate difficulty level of the materials and to eliminate difficult examples.

In all, there were 24 total instructional events followed by a summary practice session. The multiple-choice summary practice session mimicked the posttest by using all four concepts combined and requiring the learner to discriminate between examples of each of the four concepts.

Independent Variables

The independent variables used for the study included type of instructional control, that is, LC and PC versions of the CBI lesson described above, and subjects' scores on a questionnaire measuring SRLS.

Type of instructional control

The LC condition allowed subjects to control which instructional events they wished to view, the sequence of these events, the pace at which they wished to view them, and whether or not they wanted to review the instruction from the summary practice session. Subjects in the LC condition were able to choose the order of presentation of the four concepts by selecting from a menu. Once a concept was chosen, they were presented with an additional menu of the instructional events available to learn about the given concept. Subjects could choose to view a definition, an example, a practice item, or to return to the main menu. After selecting one of the instructional events, subjects were given the option to select one additional event of the same type. After selecting a definition, learners were asked, "Would you like this technique to be explained in another way?" After an example they were asked, "Would you like to see another example?" And after a practice item, they were asked, "Would you like to try another practice item before moving on?"

The PC condition presented subjects with the same instructional events in a fixed linear sequence. For each concept, the subject received 2 definitions (one paraphrased), 2 examples, 2 practice items with corrective feedback and a summary practice item. This paralleled the amount of instruction provided to the LC condition given the LC subject selected all of the 24 possible instructional events. Both conditions were allowed control over the pace of the instruction.

Self-regulatory strategies questionnaire

The Self-Regulatory Skills Measurement Questionnaire (SRSMQ) has been used in previous research to measure subjects' cognitive strategy use and self-regulatory abilities (Yang, 1991). The SRSMQ was adapted by Yang from Pintrich and De Groot's (1990) Motivated Strategies for Learning Questionnaire (MSLQ) and Zimmerman and Martinez-Pon's (1986) Self-Regulated Learning Interview Schedule to focus specifically on self-regulated learning strategies and eliminate a motivational beliefs scale. The motivational beliefs items address learners' beliefs of self-efficacy, their intrinsic value for learning, and test anxiety. Because the focus of the present study was learners' reported use of cognitive and self-regulatory strategies and not their motivational beliefs for learning, the elimination of the motivational beliefs scale for the SRSMQ was appropriate.

The SRSMQ consists of 33 items including statements such as, "When I study, I put important ideas into my own words" and "Even when study materials are dull and uninteresting, I keep working until I finish" to measure self-regulatory learning strategies. Subjects were directed to respond to how true each statement was to them. Although previous research using these items used college students, inspection of the items found them appropriate for the middle school subjects.

A five-point Likert scale was used for each item ranging from A (*Not at all true of me*) to E (*Very true of me*), with B and D representing intermediate beliefs and C equaling *I do not know*. Responses for each item were assigned a point value between 1 and 5, creating a range of total scores from 33 (low SRLS) to 165 (high SRLS). Reliability measures on the questionnaire proved adequate. Test-retest reliability for the SRSMQ was determined by Yang (1991) to be .78. Post-hoc, internal consistency reliability of the SRSMQ for this study was measured to be .85.

Dependent Variables

Dependent measures for the study included a 15-item posttest, the amount of time subjects spent on the lesson, as well as the number of instructional events viewed by the learners in the LC condition.

A 15-item paper-based posttest was used for a dependent measure of immediate recognition of the concepts taught in the lessons. This posttest was used in previous LC research using the same instructional materials (Klein, 1988). The format of the posttest was identical to that used in the summary practice session in the CBI. Subjects were presented with sample advertisements and asked in multiple-choice format which propaganda technique was being used. They responded by selecting one of five choices: one of the four propaganda techniques or "none of the above." The internal consistency reliability for the posttest was determined to be .84.

The amount of time each learner spent on the CBI was recorded by the computer. Because both LC and PC conditions were allowed to control the pace of the instruction, this duration variable was necessary to provide an indication of learning time.

In addition, in the LC condition only, decisions to select instructional events (definitions, examples, and practice items) were recorded by the computer program. Each time the subject chose to view an event about one of the lesson concepts, the computer recorded this decision. A tally of the total number of instructional events viewed provided an indication of the amount of instruction selected by the learners in the LC condition. If the subject selected all possible instructional events, the tally would be 24, indicating the learner selected all the available instruction.

Procedures

Subjects completed the SRSMQ in their social studies class one day prior to receiving the instruction. In order to assure honest and accurate responses to the questionnaire, specific instructions were read aloud to the subjects informing them that their instructor would not see the results of the questionnaire and that their names were only to be used for identification purposes.

Upon completion of the SRSMQ, subjects were categorized into low and high levels of SRLS around the median score (M = 113.2, Mdn = 115.0, SD = 13.4). Subjects within each level were then randomly assigned to one of the two treatment conditions, LC or PC.

The CBI was presented in a computer laboratory with 26 individual workstations. Subjects were assigned to a specific computer containing the appropriate version of the CBI. Subjects were unaware that there were different versions of the CBI installed on the different computers. They were briefed about the content of the instruction and told to work silently at their own pace. At the end of the lesson, they were prompted by the CBI to raise their hand to receive the posttest.

Design and Data Analysis

The study used a 2 × 2 factorial design with two levels of instructional control (LC and PC) and two levels of SRLS (low and high). A two-way Analysis of Variance (ANOVA) was used to test for main effects and the interaction hypothesis between SRLS and type of control on mean posttest performance. Comparisons among the four group means were accomplished using Fisher's least significant difference test (LSD).

RESULTS

An inspection of the scatterplot generated for posttest scores did not indicate any serious violation of the normality assumption required for linear regression analysis. Testing for the

Table 1 ☐ Means and Standard Deviations of Posttest Scores Across Treatment Conditions

	Type of Control								
	Program Control			*Learner Control*			*Totals*		
SRLS Level	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
High	64.7	30.3	7	73.2	16.7	6	69.0	24.4	13
Low	67.7	30.7	6	37.0	12.1	7	52.3	26.8	13
Totals	66.1	29.2	13	53.7	23.3	13	59.9	26.6	26

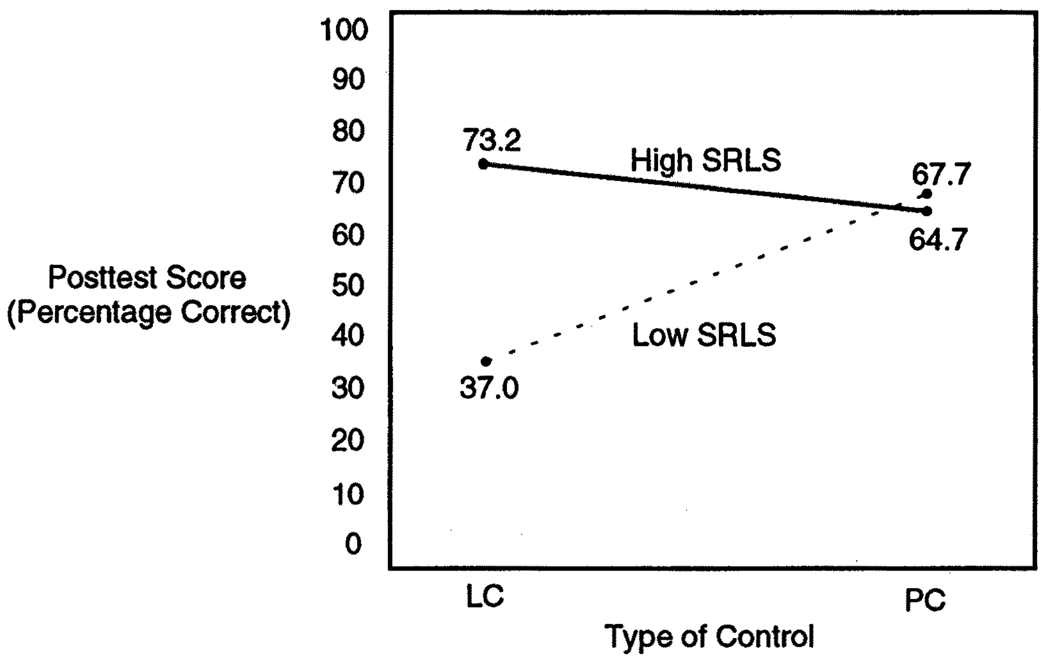
Note: Scores are reported in percentage correct.

assumption of homogeneity of variance, a Bartlett-Box test revealed appropriate homogeneity of the posttest scores, $F(3, 856) = 1.93$, $p = .123$. All statistical tests were conducted using an alpha level of .05. With alpha set at .05 and a sample size of 26 (6 or 7 subjects per cell), it was determined that the power for determining moderate effects was .51.

Table 1 presents the means and standard deviations for posttest scores across all four treatment conditions. The results of a two-way factorial ANOVA revealed a significant interaction between the group means, $F(1, 22) = 4.35$, $MSe = 568.24$, $p < .05$. Post-hoc effect size showed the magnitude of the interaction to be small to moderate ($h^2 = .165$). No significant main effects were found.

With alpha set at .05, post-hoc multiple range tests (LSD) showed that the mean of the LC/low SRLS group ($M = 37.0$) was significantly lower than the other three group means: LC/high SRLS ($M = 73.2$); PC/high SRLS ($M = 64.7$); and PC/low SRLS ($M = 67.7$). None of the other group means differed significantly from one another. This interaction is displayed in Figure 1.

Figure 1 ☐ Mean posttest scores for high and low self-regulated learning strategies (SRLS) across type of instructional control (LC and PC).



The amount of time subjects spent viewing the instruction did not differ across type of control $F(1, 22) = .839$, $MSe = 43438.3$, $p = .37$ or SRLS level $F(1, 22) = .073$, $MSe = 43438.3$, $p = .79$. The low SRLS subjects averaged 13.0 minutes while the high SRLS subject averaged 12.7 minutes. Subjects in the LC condition averaged 12.0 minutes on the lesson while subjects in the PC condition averaged 13.6 minutes. The interaction also was not significant $F(1, 22) = .145$, $MSe = 43438.3$, $p = .71$. Subjects in the LC/low SRLS group averaged 12.2 minutes, the LC/high SRLS group averaged 12.3 minutes, the PC/low SRLS group averaged 14.0 minutes, and the PC/high SRLS group averaged 13.1 minutes. Additionally, instructional time failed to account for a large proportion of the variability in posttest scores across all subjects ($R^2 = .00297$).

The number of instructional events selected by subjects in the LC condition did not differ between high and low SRLS subjects (M = 10.0 and 10.6, respectively). This is, however, fewer than half the 24 total events available to the subjects in this condition and mandatorily viewed by those in the PC condition. Additionally, this measure failed to account for a large proportion of the variability in posttest scores across all subjects in the LC condition ($R^2 = .00124$).

DISCUSSION

Supporting the primary hypothesis of the study, the mean posttest performance of the low SRLS subjects receiving LC was significantly lower than the other three group means. This result indicates that learners who reported low SRLS performed more poorly under LC than PC conditions. Those who reported high SRLS, however, performed equally well regardless of the type of control provided.

This finding underscores one of the primary problems associated with the use of an LC strategy with all learners. Many authors finding PC superior to LC (e.g., Tennyson et al., 1985) explain their results in terms of learners not possessing or knowing how to use appropriate learning strategies when left to themselves to manage their own learning. Tennyson and Park (1984) and Hannafin (1984) both point to learners' ability to appraise the demands of the task and their own learning needs as critical abilities to enable success under LC.

The interaction between the reported use of SRLS and type of instructional control reveals the importance of learners possessing high levels of such strategies when receiving LC instruction. Learners possessing a high level of self-regulatory strategies seem more likely to perform well on LC instruction. Success in PC instruction, on the other hand, does not necessarily demand high levels of these skills. As was expected, the LC condition required the learner to possess a greater repertoire of self-regulatory skills to succeed. Because PC guides the learner through the instruction without requiring any decision-making or navigational initiative, learners of both skill levels perform equally well.

The hypothesis predicting a main effect for level of SRLS was not supported by the data. As shown in Figure 1, the difference between high and low SRLS subjects was evident under LC (36.2 percentage points), but under PC, high SRLS subjects' performance was essentially equal to that of the low SRLS subjects.

Why a high level of SRLS failed to be beneficial under PC can be explained from a variety of standpoints. First, research has demonstrated a variety of individual learner variables are increased by allowing learners control over instruction. An abbreviated list of these variables include: interest in the material (Cambell & Chapman, 1967), attitude toward the instruction (Hintze, Mohr, & Wenzel, 1988), amount of invested mental effort during the instruction (Salomon, 1983) and continuing motivation to pursue similar topics later (Kinzie & Sullivan, 1989). If allowing control positively affects these factors in learners, failing to allow control (PC) could potentially produce a negative affect. In other words, forcing learners to proceed through a prescribed instructional sequence may decrease interest, attitudes, and mental effort during instruction. This assumption is supported in the instructional design theories of Merrill (1983) and Reigeluth and Stein (1983).

A second explanation for SRLS failing to predict performance in PC involves the "leveling" effect of PC instruction. In PC, all learners receive the same instruction in the same sequence. Aside from the pace at which the learner chooses to view the instruction (which didn't vary across groups in this study), all learners are treated equally. It is therefore impossible for learners to select instructional events to match their individual needs and preferences. Instead, they receive both instruction that suits them and instruction that does not suit them. Because high SRLS generally facilitates decision-making, given no instructional decisions to make, high SRLS should provide no learning benefit.

The data also revealed no significant differences between overall performance under LC or PC conditions. This finding is somewhat puzzling due to the drastic differences in the amount of material viewed by the subjects in each condition. Subjects in the PC condition received all 24 instructional events while those in the LC condition averaged only 10.3. The absence of a main effect in LC/PC comparisons is, however, consistent with much of the previous LC research (Williams, 1993a). As stated by Williams in his comprehensive review of LC research, "I believe it is now time to stop asking the research question 'which is better: learner or program controlled CBI?' It seems that enough research has been produced to date to justify the conclusion of 'take your pick.'" (p. 1105). There are simply too many moderating variables that have been shown to influence the effectiveness of LC to expect main effect differences between LC and PC.

The number of events selected in the LC condition and instructional time served as additional variables to help interpret the findings. The number of events selected in the LC condition did not differ between high and low SRLS subjects. This data also failed to predict subsequent posttest performance, contradicting previous research claiming the number of options selected leads to improved performance in LC (Carrier & Williams, 1988). Morrison, Ross, and Baldwin (1992), however, found no relationship between the amount of instructional support selected and posttest performance in LC. As pointed out by Carrier and Williams, it is not just the selection of more instruction, but rather the active processing of what is selected that should be beneficial for the learner. Simply selecting an instructional event doesn't guarantee attention and effort is being directed toward learning the instructional content. Furthermore, given that learners in the PC condition viewed over twice as many instructional events as those in the LC condition yet failed to out perform them, the number of events selected proved not just to be a poor indicator of the amount of processing by the learner, but also a poor predictor of subsequent performance.

The failure of amount of time learners spent on the instruction to predict posttest performance can also be explained on the same grounds. The CBI measured the amount of time to complete the lesson from start to finish, but failed to serve as an accurate measure of learners' engagement or processing during the time. Although task persistence has been shown to be a valid measure of motivation related to the amount of instruction chosen, the depth at which it is processed, and the length of task engagement (Carrier & Williams, 1988), there is no reason to believe time on task provided a valid measure of task persistence.

The failure of event selection and time on task to predict posttest performance may lead one to conclude that something other than task persistence was responsible for the poor posttest performance of the low SRLS subjects in the LC condition. However, persistence is only one component of self-regulation (Pintrich & De Groot, 1990). The self-regulatory strategies reported by high SRLS learners such as "I isolate myself from anything that distracts me" and "I ask myself questions to make sure I know the material I have been studying" may lead to increased performance but not necessarily greater task persistence as measured in this study. Furthermore, general learning ability could have served as a confounding factor. Highly able learners need less instruction and less learning time than low ability learners to achieve the same level of performance (Carroll, 1963). So, from this perspective one wouldn't expect measures of task persistence to serve as accurate predictors of performance.

There were several limitations to the findings of this study that merit attention. First, subjects may not have had the motivation to perform to the best of their ability. Because performance on the posttest were not calculated into course grades, subjects participating in the study had little extrinsic motivation to perform well. Only subjects finding the topic of propaganda techniques intrinsically interesting had the motivation to "give it their best." Had posttest scores been given some extrinsic value, low SRLS subjects might have exerted more effort and performed better under LC.

An additional limitation comes from the self-report nature of the SRSMQ. Self-report of strategy use does not guarantee that the subjects actually used such strategies throughout the CBI. Behavioral measures or think-aloud protocols during the CBI would have enabled more certainty as to whether subjects were actually using self-regulatory strategies during the course of the experiment.

Another limitation of this study concerns the elimination of motivational factors from the self-regulation measure (SRSMQ). Pintrich and De Groot's (1990) Motivated Strategies for Learning Questionnaire, from which the SRSMQ was adapted, contained motivational beliefs items measuring self-efficacy, intrinsic value, and test anxiety. These items were removed to limit the size and scope of the SRSMQ to focus specifically on self-regulated learning strategies. However, because motivation plays such an important role in learners' self-regulatory behavior (Pintrich & De Groot, 1990; Zimmerman, 1990; Schunk, 1990), the choice to ignore this factor forfeited the opportunity to account for more unexplained variance within the study. It is important to note the rather small post-hoc effect size of the interaction finding ($h^2 = .165$). There were obviously additional factors working to account for the variance in the posttest scores.

A final limitation concerns the convenience sample used for the study. With a sample of only 26 subjects (6 or 7 per group), the interaction finding, while statistically significant, lacked adequate statistical power to create confidence in its replicability in the future. Had more subjects been used, and had prior achievement or other ability measures been accounted for, the magnitude of the finding probably would have been greater.

Additional research is needed to fill the gaps in our understanding of the dynamics of learners' instructional decision-making processes during LC. The use of qualitative research methods could help to uncover learners' thoughts and actions as they proceed through the different elements of LC instruction. Future research should also attempt to determine differences in the decision-making patterns of learners with high and low levels of self-regulated learning strategies as they proceed through CBI. Additionally, because CBI use in the schools is often done cooperatively, research might also begin to explore how social factors influence a learner's decision-making processes.

The implications of this study for K–12 educators involves the importance of self-regulated learning strategies on instructional methods. Educators should begin to focus on the self-regulatory strategies adopted by learners in LC environments and foster the development and use of them when necessary.

With the current proliferation of such computer-based learning tools as CBI, multimedia, and hypertext into the educational market, it is important to realize the problems some learners have controlling their own learning. Although attempts to individualize instruction through LC may prove beneficial for some, it is simply not effective for all learners. Before throwing learners into a self-controlled environment, one must be certain they possess the appropriate repertoire of strategies to use the control to their advantage. □

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REFERENCES

Bandura, A. (1986). *Social foundations of thought and action.* Englewood Cliffs, NJ: Prentice Hall.

Cambell, V., & Chapman, M. (1967). Learner control versus program control of instruction. *Psychology in the Schools, 4*(2), 121–130.

Carrier, C., Davidson, G., Higson, V, & Williams,

M. (1984). Selection of options by field independent and dependent children in a computer-based concept lesson. *Journal of Computer-Based Instruction, 11*, 49–54.

Carrier, C., & Williams, M. (1988). A test of one learner-control strategy with students of differing levels of task persistence. *American Educational Research Journal, 25*(2), 285–306.

Carroll, J. B. (1963). A model of school learning. *Teachers College Board, 64*, 723–733.

Duchastel, P. (1986). Intelligent computer assisted instruction systems: The nature of learner control. *Journal of Educational Computing Research, 2*(3), 379–393.

Garhart, C., & Hannafin, M. (1986). The accuracy of cognitive monitoring during computer based instruction. *Journal of Computer Based Instruction, 13*(3), 88–93.

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

Hicken, S., Sullivan, H., & Klein, J. (1992). Learner control modes and incentive variations in computer-assisted instruction. *Educational Technology, Research and Development, 40*(4), 15–26.

Hintze, H., Mohr, H., & Wenzel, A. (1988). Students' attitudes towards control methods in computer-assisted instruction. *Journal of Computer Assisted Learning, 4*(1), 3–10.

Kinzie, M., & Sullivan, H. (1989). Continuing motivation, learner control and CAI. *Educational Technology, Research and Development, 37*(2), 5–14.

Klein, J. (1988). *The effects of student ability, locus of control, and type of instructional control on motivation and performance.* Unpublished Doctoral Dissertation, Florida State University, Tallahassee, FL.

Lepper, M., & Chabay, R. (1985). Intrinsic motivation and instruction: Conflicting views on the role of motivational processes in computer-based education. *Educational Psychologist, 20*(4), 217–230.

Merrill, M. D. (1983). Component Display Theory. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status* (pp. 279–333). Hillsdale, NJ: Lawrence Erlbaum.

Milheim, W., & Martin, B. (1991). Theoretical bases for the use of learner control: Three different perspectives. *Journal of Computer Based Instruction, 18*(3), 99–105.

Morrison, G., Ross, S., & Baldwin, W. (1992). Learner control of context and instructional support in learning elementary school mathematics. *Educational Technology Research and Development, 40*(1), 5–13.

Oliver, T., & Shapiro, F. (1993). Self-efficacy and computers. *Journal of Computer-Based Instruction, 20*(3), 81–85.

Pintrich, P., & De Groot, E. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40.

Reigeluth, C., & Stein, F. (1983). The elaboration theory of instruction. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status* (pp. 335–382). Hillsdale, NJ: Lawrence Erlbaum.

Salomon, G. (1983). The differential investment of mental effort in learning from different sources. *Educational Psychologist, 18*, 42–50.

Schunk, D. (1985). Self-efficacy and school learning. *Psychology in the Schools, 22*, 208–223.

Schunk, D. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist, 25*(1), 71–86.

Tennyson R., & Park, O. (1984). Computer-based adaptive instructional systems: A review of empirically based models. *Machine-Mediated Learning, 1*, 129–153.

Tennyson, R., Park, O., & Christensen, D. (1985). Adaptive control of learning time and content sequence in concept learning using computer-based instruction. *Journal of Educational Psychology, 77*(4), 481–491.

Williams, M. (1993a). A comprehensive review of learner-control: The role of learner characteristics. In M. R. Simonson (Ed.), *Proceedings of Annual Conference of the Association for Educational Communications and Technology* (pp. 1083–1114). New Orleans, LA: Association for Educational Communications and Technology.

Williams, M. (1993b). *Interactions among attributional style, attributional feedback, and learner-controlled CBI.* Paper presented at the Annual Meeting of the American Educational Research Association, Atlanta, GA. (ERIC Document Reproduction Service No. ED 363 271)

Yang, Y.C. (1991). *The effects of self-regulatory skills and type of instructional control on learning from CBI.* Unpublished Doctoral Dissertation, Florida State University, Tallahassee, FL.

Zimmerman, B. (1989). Models of self-regulated learning and academic achievement. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theory, research, and practice* (pp. 1–25). New York: Springer.

Zimmerman, B. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25* (1), 3–17.

Zimmerman, B., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23* (4) 614–628.

Zimmerman, B., & Martinez-Pons, M. (1988). Construct validation of a strategy model of student self-regulated learning. *Journal of Educational Psychology, 80* 284–290.