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Influence of Student Ability, Locus of Control, and Type of Instructional Control on Performance and Confidence

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ABSTRACT **This study examined the effects of student ability, locus of control, and type of instructional control on performance and the motivational outcome of confidence. Subjects were randomly assigned to one of two treatments: learner control over the instructional strategy of a computer-based lesson and program control over the instructional strategy of the lesson. Student ability and locus of control were considered as aptitude variables. Upon completion of the lesson, subjects completed a survey designed to measure their confidence and took a posttest to determine if they could identify the concepts presented in the lesson. Results indicated that student ability and locus of control significantly influenced both performance and confidence, whereas type of instructional control did not affect outcomes. Implications for future learner control research are discussed.**

Some learning and instructional theorists have suggested that individuals may benefit from having control over instruction. In describing the factors that influence school learning, Carroll (1963) theorized that students differ in the amount of time required to learn a task (aptitude) and indicated that they should be given enough time for learning (opportunity). Carroll (1963) suggested that one way to provide learning opportunity is to allow students to proceed through instruction at their own rate. Bloom (1976) also indicated that students do not learn at the same rate and suggested learner control over the pace of instruction as a way of helping students to master learning objectives.

Instructional design theorists have advocated learner control in their models. Merrill's (1983) Component Display Theory indicates that learners may have control over content, rate of learning, instructional strategy, or cognitive strategy. Reigeluth and Stein (1983) theorized that the effectiveness, efficiency, and appeal of instruction will increase under conditions of learner control and suggested that informed and motivated students should be given the opportunity to select and sequence instructional content and strategies. Other theorists contend that to motivate students and to help them learn and grow, individuals should have freedom in the classroom and the opportunity to select experiences and materials (Rogers, 1969).

Although theorists have indicated that learners should be given some control over instruction, researchers have attempted to answer whether having control is beneficial to students. Results of learner control studies are inconclusive. Some researchers have suggested that the "mere illusion of control" significantly improves motivation and performance (Perlmuter & Monty, 1977), whereas others have concluded that "there is little support from the research literature that offering students control will lead to increased learning" (Carrier, 1984, p. 17). Authors have argued that additional research is required to determine which types of students will benefit from having control and to decide what kinds of control are beneficial to learners (Carrier, 1984; Snow, 1980). Others have suggested that the effects of learner control on motivational variables have not been extensively studied (Hannafin, 1984).

In addition to these areas of concern, another gap exists in the learner-control literature. Scholars have not systematically examined the effects of both affective and cognitive learner characteristics on motivation and performance when learners are given control over instruc-

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tion. Researchers have examined the effects of learner control on each of these dependent variables. Motivation and performance have not been studied together in a systematic manner, however, with respect to both cognitive and affective independent variables.

Several learner control studies have examined the relationship between performance and the cognitive characteristic of student ability. There is evidence that performance in learner-controlled settings is influenced by student ability. Researchers have reported that low-ability students achieve more objectives under conditions of external control (Gallegos, 1968), whereas high-ability students succeed most often during control over instruction (Campbell, 1964; Snow, 1980). Other learner-control researchers have reported a positive relationship between student ability and performance, regardless of whether subjects were given control over instruction (Carrier, Davidson, & Williams, 1985).

Although a relationship between student ability and performance has been found in learner control research, only a few studies have examined the relationship between ability and motivational outcomes when students are given control. Campbell (1964) reported that low-ability students preferred externally controlled instruction, whereas high-ability students preferred learner-controlled instruction. Research conducted by Snow (1980) also suggested a relationship between student ability and preference toward instruction that provides learners with control. In contrast, Judd, Bunderson, and Bessent (1970) found that student attitudes were not affected when subjects were allowed to control instruction.

Several studies have examined the influence of affective student characteristics on performance in learner-control settings. Evidence exists that the affective variable of locus of control influences the performance of students who are given control over instruction. Researchers have reported that subjects with an internal locus of control perform better, when given control over instruction, than do those with an external locus of control (Allen, Giat, & Cherney, 1974; Daniels & Stevens, 1976; Parent, Forward, Center, and Mohling, 1975; Peterson, 1979; Sandler, Reese, Spencer, & Harpin, 1983). Some researchers also have reported that externals perform better under conditions of more structure (Daniels & Stevens, 1976; Parent et al., 1975; Sandler et al., 1983).

The relationship between locus of control and motivational outcomes also has been examined in a few learner-control studies. Researchers have indicated that locus of control is associated with motivation when students are given control over instruction. Keller, Goldman, and Sutterer (1978) reported that locus of control was more highly correlated with the attitudes than with the study habits of subjects who were allowed to control instruction. Reiser (1980) found that internals procrastinate less than externals when they can control instruction. Internals have expressed greater satisfaction with learner-controlled instruction, whereas externals have reported greater satisfaction with instructional environments that are controlled by a teacher (Peterson, 1979; Ryback & Sanders, 1980). Finally, externality has positively correlated with state-anxiety in learner-controlled settings (Allen, Giat, & Cherney, 1974).

Whereas learner-control studies were conducted to investigate the separate effects of cognitive and affective characteristics on performance and motivation, researchers have done little work to examine the complex relationships among these variables. We examined the influence of cognitive and affective student characteristics and type of instructional control on both performance and the motivational outcome of confidence. The purpose of the study was to examine the effects of student ability, locus of control, and type of control over instruction on performance and confidence. We attempted to answer the following questions: What effects do type of control over instructional strategy, student ability, and locus of control have on performance? What effects do these variables have on the motivational outcome of confidence? What is the relationship among student ability, locus of control, performance, and confidence, regardless of whether learners are allowed to have control over instructional strategy?

Method

Subjects

Subjects in this study were 75 seventh-grade students enrolled at the developmental research school operated by Florida State University. Students at this school are selected to be representative of Florida's school-aged population with regard to academic ability, sex, race, and socioeconomic factors.

Materials

The materials used in this study included a measure of student ability, a measure of locus of control, two computer-based lessons, a 15-item posttest, and a measure of the motivational outcome of student confidence.

Student ability measure. We used Form I, Level 6–9, from the Henmon Nelson Tests of Mental Ability to measure student ability. Scores on this test were obtained for all subjects in the study from school records. The Henmon Nelson is considered to be a valid measure of mental ability because it employs items concerning word knowledge, verbal analogies, verbal classification, sentence completion, numerical problem solving, number series, pictorial analogies, and pictorial classification. Odd-even reliability coefficients for Form I, Level 6–9, have been estimated at .89. A mean of 100 and a standard deviation of 15 is the norm. Scores for the current group ranged from 87 to 135, with a mean of 107.9 and a standard deviation of 13.10.

Locus of control measure. We used the Intellectual Achievement Responsibility (IAR) questionnaire, developed by Crandall, Katkovsky, and Crandall (1965), to measure student beliefs in internal versus external control over academic responsibility. A low score on the IAR indicates that the subject believes success and failure in school is attributed to factors outside of his or her own control (luck, task difficulty, other persons). A high score suggests that the subject attributes success and failure to his or her ability or effort. The test-retest reliability of the IAR has been estimated at .69 (Crandall et al., 1965). For sixth graders, the established mean on the IAR is 25.84, the standard deviation is 4.14, and the range is 21. For eighth graders, the established mean is 26.11, the standard deviation is 3.77, and the range is 21 (Crandall et al., 1965). Scores for seventh-grade students in the current study varied from 9 to 32, with a mean of 23.22 and a standard deviation of 5.07.

Instructional program. Two computer-based lessons developed by Carrier and her associates were used (Carrier, Davidson, Higson, & Williams, 1984; Carrier et al., 1985; Carrier & Williams, 1988). Both lessons teach four defined concepts in advertising—bandwagon, testimonial, transfer, and uniqueness. According to Carrier et al. (1984), the definition for each concept was based on an assessment of its critical attributes, and an instance pool for each concept was generated. Each instance pool was tested with a group of 35 sixth graders to test difficulty level and to eliminate confusing instances.

One lesson allowed for learner control over the instructional strategy, whereas the other externally controlled the instructional strategy. In the learner-control condition, students were presented with the definition of a concept, one example, and one practice item with knowledge of correct results feedback. Students in this group had the options of viewing a paraphrased definition, three additional expository instances, three additional practice items, and analytic feedback that explained why an answer was correct. Students in this condition were not told that they would have control over the lesson. In the program-controlled condition, students were presented with the entire lesson in a fixed sequence. In this condition, students viewed a definition of each concept, a paraphrased definition, four examples, and four practice items with both knowledge of results and analytic feedback. Students in both conditions viewed copies of actual advertisements as instances of each concept and had control over the pace of instruction.

Posttest. We used a 15-item, multiple-choice test to measure the degree to which subjects learned each defined concept presented in the lesson. Each item presented an example of an advertisement, and students were asked to identify the type of advertising technique that was used. The internal consistency reliability of this posttest was .80. A pilot test of this instrument, conducted with three sixth graders prior to the experiment, indicated that the test was at the appropriate reading level.

Confidence measure. The dependent variable of confidence was measured using subscale C of the Instructional Materials Motivation Scale (IMMS) (Keller, 1987). This subscale measures a student's confidence after using a set of instructional materials. The internal consistency reliability estimates of this instrument (Form 3) was .77 when used by subjects in the current study.

Procedure

After permission to conduct the study was granted, we searched school records to obtain student-ability scores for each subject. All subjects were given the IAR questionnaire to measure their beliefs in internal versus external control over academic responsibility (Crandall et al., 1965). This measure was given to subjects in their English classes several days prior to receiving the treatment.

Subjects were randomly assigned to one of the two treatment conditions. One half of the subjects completed the learner-controlled lesson, and the other one half completed the program-controlled lesson. To receive the treatment, we brought subjects in groups of 14 to an Apple computer lab for 1 hour on 3 consecutive days. Seven subjects using the learner-controlled lesson and 7 using the program-controlled lesson were represented in each group.

On the 1st day, we told the subjects that they would be using a computer lesson to learn about some ideas used in advertising. On each day, subjects were asked to work through the lesson until they were finished and to raise their hands to indicate when they were done. At the end of the lesson on the 3rd day, all the subjects completed the confidence measure and then took the posttest. A formative evaluation of these procedures was conducted prior to the actual study. No problems were found at that time, and none occurred during the study.

Results

We used a linear regression model that employed a hierarchical approach to analyze the results from the posttest and the confidence measure. Inspection of the residual scatterplots generated for each dependent measure did not indicate any violations of the assumptions required for multiple regression. Data from 68 subjects were included in the analyses because scores for 7 subjects were unavailable on one or more of the measures. All statistical tests were conducted using an alpha level of .05. With alpha set at .05 and a sample size of 68, we determined that the power for determining moderate effects was .80.

In addition to multiple regression analysis, we conducted the multivariate technique of canonical analysis. Canonical analysis was used to determine the relationship of student ability, locus of control, performance, and confidence, regardless of treatment condition. For this analysis, posttest performance and confidence scores were designated as the set of dependent variables, and student ability and locus of control were designated as the set of independent variables.

Performance

We measured performance by the number of correct responses on the 15-item multiple-choice test. Results of the regression analysis indicated that student ability significantly increased the amount of posttest variance explained by the regression model. The increase in posttest variance accounted for by the variable of student ability was approximately 42% and was statistically significant, $F(7, 59) = 46.87$, $p < .0001$. Results also indicated that locus of control significantly increased the amount of posttest variance explained by the regression model. The increase in posttest variance due to the variable of locus of control was approximately 5% and was statistically significant $F(7, 59) = 5.49$, $p = .022$. The increase in posttest variance accounted for by the treatment variable was not statistically significant, $F(7, 59) < 1.0$. In addition, tests of all possible interactions were not statistically significant. Table 1 includes a summary of results for the regression model in which the dependent variable of posttest was regressed on the independent variables of ability, locus of control, and treatment.

Using standardized coefficients to determine the effects of each independent variable while controlling for the other (Pedhazur, 1982), one can conclude that posttest performance is expected to increase by 0.61 standard deviations when student ability increases by one standard deviation, controlling for locus of control. Posttest performance is expected to increase by 0.22 standard deviations when locus of control increases by one standard deviation, controlling for student ability. Comparison of these coefficients indicates that the effect of student ability on posttest scores appears to be stronger than the effect of locus of control.

Whereas the regression analysis discussed above accounted for the continuous nature of the independent variables of ability and locus of control, we included a summary of descriptive statistics for posttest by levels of student ability, locus of control, and treatment groups for interpretive purposes.

Table 1.—Summary of Multiple Regression Analysis for Posttest Results

Variable	R^2	R^2 increase	F	p
Ability	.419	.419	46.87	.000*
Locus	.465	.046	5.49	.022*
Treatment	.465	.000	.06	.801

*Significant at the .05 level.

As seen in Table 2, higher ability students (i.e., Henmon-Nelson scores of one standard deviation above the sample mean) performed better on the posttest than average-ability students, who in turn, performed better than lower ability students (i.e., Henmon-Nelson scores of one standard deviation below the sample mean). Students with an internal locus of control (i.e., IAR scores of one standard deviation above the sample mean) performed better on the posttest than those with an external locus of control (i.e., IAR scores of one standard deviation below the sample mean). Table 2 also indicates that there was no effect for treatment. Subjects in the learner-control group performed about the same on the posttest as those in the program-control group.

Confidence

The motivational outcome of confidence was measured using subscale C of the IMMS (Keller, 1987). Results of the regression analysis indicated that locus of control significantly increased the amount of confidence variance explained by the regression model. The increase in confidence variance accounted for by the variable of locus of control was approximately 6.7% and was statistically significant, $F(7, 59) = 4.84$, $p = .031$. Results also indicated that student ability significantly increased the amount of confidence variance explained by the model. The increase in confidence variance accounted for by the variable of student ability was approximately 27% and was statistically significant, $F(7, 59) = 26.78$, $p < .0001$. Although subjects in the learner-control group expressed slightly more confidence than did those in the program-control group, the increase in confidence variance accounted for by the treatment was trivial (1.9%) and was not statistically significant, $F(7, 59) < 2.0$. Tests of all possible interactions also were not statistically significant. Table 3 includes a summary of results for the regression model in which the dependent variable of confidence was regressed on the independent variables of locus of control, student ability, and treatment.

Using the standardized coefficients to determine the effects of each independent variable while controlling for the other, one can conclude that confidence is expected to increase by 0.80 standard deviations when student ability increases by one standard deviation, controlling for locus of control. We expect confidence to increase by 0.14 standard deviations when locus of control increases by one standard deviation, controlling for student ability. Comparison of these coefficients indicates that the effect of student ability on confidence appears to be stronger than the effect of locus of control.

Table 2.—Means and Standard Deviations of Posttest and Confidence by Student Ability, Locus of Control, and Treatment Groups

		Posttest		Confidence	
	n	Mean	*SD*	Mean	*SD*
Student ability					
High	11	12.62	1.12	37.77	4.55
Average	44	10.26	2.79	33.28	5.97
Low	13	7.00	3.95	28.18	5.34
Locus of control					
Internal	19	11.79	1.87	36.47	6.22
Midrange	36	9.81	3.42	32.36	6.45
External	13	9.08	3.55	30.46	4.37
Treatment group					
Learner control	35	10.24	3.18	33.79	6.16
Program control	33	10.12	3.31	32.53	6.67

Note. Minimum/maximum scores: posttest (0, 15); confidence (1, 45).

Table 3.—Summary of Multiple Regression Analysis for Confidence Results

Variable	R^2	R^2 increase	F	p
Locus	.066	.066	4.84	.031*
Ability	.333	.266	26.78	.000*
Treatment	.352	.019	1.97	.165

*Significant at the .05 level.

Whereas the regression analaysis for confidence scores accounted for the continuous nature of the independent variables of locus of control and student ability, Table 2 includes, for descriptive purposes, a summary of descriptive statistics for confidence by levels of student ability, locus of control, and treatment groups. As seen in Table 2, higher ability students (i.e., Henmon-Nelson scores of one standard deviation above the sample mean) expressed greater confidence after using the computer-based lessons than did average-ability students, who in turn expressed greater confidence than lower ability students (i.e., Henmon-Nelson scores of one standard deviation below the sample mean). Table 2 also indicates that students with an internal locus of control (i.e., IAR scores of one standard deviation above the sample mean) expressed the greatest amount of confidence after using the computer-based lessons, whereas those with an external locus of control (i.e., IAR scores of one standard deviation below the sample mean) expressed the least amount of confidence.

Canonical Analysis

To determine the relationship of student ability, locus of control, performance, and confidence regardless of treatment condition, we conducted a canonical analysis. Canonical analysis is used to form a linear combination of the independent variables and a linear combination of the dependent variables under study. Canonical analysis provides the maximum correlation between the two canonical variates and maximizes the explained variance of the variables in each set (Pedhazer, 1982). For the canonical analysis described below, student ability and locus of control were designated as the set of independent variables, and posttest performance and confidence scores were designated as the set of dependent variables.

Results of the canonical analysis suggested a significant canonical relationship between the linear combination of student ability and locus of control and the linear combination of posttest performance and confidence, (Wilks's lambda = .538, $F(4, 130) = 11.83$, $p < .0001$). The linear combination of student ability and locus of control accounted for approximately 27% of the variance in the linear combination of posttest and confidence scores.

A summary of the correlations between the original variables and the canonical variates is given in Table 4. Results indicated that the independent variable of student ability had the strongest relationship with the linear combination of performance and confidence (r = .96), whereas the correlation of locus of control and the linear combination of the dependent variables was of less magnitude (r = .48). Furthermore, the relationships between posttest performance and the linear combination of student ability and locus of control (r = .92), and between confidence and the linear combination of the independent variables (r = .84), was strong. All of these relationships can be considered as meaningful, using r = .30 as a cutoff (Pedhazer, 1982).

Discussion

Although many learning and instructional theories include the idea that individuals may benefit from having learner control, these theories differ in terms of what types of control should be given to students (Bloom, 1976; Carroll, 1963; Merrill, 1983; Reigeluth & Stein, 1983; Rogers, 1969). In this study, subjects were given control over the instructional strategy of a computer-based lesson while controlling for many other features that could be varied in terms of learner versus external control (e.g., pace, sequence, objectives). Despite psychological studies that demonstrate positive effects for personal control (Perlmuter & Monty, 1977), there was no such effect in this study. The lack of effect, however, helps to delimit the degree to which specific aspects of learner control can be isolated and expected to be influential.

Allowing learners to control the instructional strategy of a lesson may not be beneficial. Theorists suggest that the effectiveness, efficiency, and appeal of instruction will increase when informed and motivated students are given the opportunity to select and sequence instructional strategies (Merrill, 1983; Reigeluth & Stein, 1983). In this study, informed and motivated students performed better and exhibited more confidence under conditions of both learner and program control.

Also, the effort to isolate a specific feature of learner control may have resulted in treatments in which there were too many similarities in the overall degree of learner control. The amount of control given to students in the learner-control group may not have been adequate to give them the perception that they had control. Perlmuter and Monty (1977) have indicated that control will enhance motivation and performance when students have the perception of control. Subjects were not given any directions to inform them that they would have control over the instruction because it was expected, as in "real world" situations, that the actual control features would influence perception. In similar studies and in actual instructional settings, students may benefit by being overtly informed of their degrees of control to help build positive expectations toward lesson control. In the present study, it is equally possible that students in the program-control group felt perceived control, because they had control over pace.

The findings of this study lend support to theorists who have suggested that student ability strongly influences motivation and performance in instructional settings (Bloom, 1976; Carroll, 1963; Keller, 1983; Snow, 1977). The relationship between student ability and performance found in this study is consistent with established findings; student ability accounted for approximately 42% of explained variance in posttest scores. In addition, we found that student ability supported the less frequently observed positive relationship to motivation. Ability accounted for about 27% of explained variance in confidence scores. Results of the canonical analysis also provided evidence that student ability is highly related to performance and motivation. Student ability had a strong relationship with the linear combination of the dependent measures.

The affective variable of locus of control, which was used to represent an aspect of motivation, also had a positive relationship with performance and confidence. Regression analysis indicated that locus of control accounted for approximately 5% of the variance in posttest performance and about 6.7% of the variance in confidence scores. The canonical analysis indicated that locus of control and the linear combination of performance and confidence were positively related. These findings provide support for the assumption that the motivation to learn, including expectancies for control, makes a difference in performance and motivation (Keller, 1979, 1983). Social learning theorists (Phares, 1976; Rotter, 1966) suggested that locus of control will influence student performance in unfamiliar environments. Subjects may have viewed the task used in the present study as unfamiliar, thus the relationship between locus of control and performance. In addition, the positive relationship between locus of control and confidence supports attribution theorists who contend that locus is related to affective outcomes (Weiner, 1979, 1980, 1985).

The findings of this study have some implications for researchers of learner-control questions. Future research into learner control should attempt to determine student perceptions toward their feelings of control over instruction and should investigate the relationship between these perceptions and motivation and performance in actual instructional settings. Future studies also should continue to delineate specific aspects of control, using them individually and in combination, to determine the critical features of control that influence performance and motivation. The effects of instructions should be investigated. In both real world and in studies of expectations, people are sometimes told what to expect in regard to personal control. The effects of these instructions in conjunction with actual variations in learner control should be studied.

Future research concerning control over instructional strategy should be conducted using a learning task other than intellectual skills. This type of control may be beneficial for other kinds of learning outcomes. The relation-

Table 4.—Correlation Between Original Variables and Canonical Variates

Variable	Correlation
Independent	
Student ability	.96
Locus of control	.48
Dependent	
Posttest	.92
Confidence	.84

ships among learning outcome, type of instructional control, performance, and motivation have not been adequately explored.

Instead of allowing students to have control over all instructional strategy options, future research could allow students to control only certain options to determine the impact of this type of control. Control over the strategy components of practice and feedback may enhance motivation and performance more than control over information presentation.

Finally, future learner-control studies should continue to investigate the impact of individual differences and type of instructional control on motivational outcomes. Individual differences such as age, sex, motives, and needs may have a relationship to educational outcomes in learner-controlled environments. Motivational outcomes such as attention, relevance, and persistence also might be related to individual difference and type of control in future learner-control research.

As we did in this study, researchers of future learner-control questions must continue to be careful to describe the type of control that students are given, the characteristics of students given control, and the kind of learning outcome desired. Implementation of these suggestions will assist researchers in determining the benefits of learner control over instruction.

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