Effects of Using an Instructional Game on Motivation and Performance

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ABSTRACT **Although many educators theorize that instructional games are effective for providing students with motivating practice, research on instructional gaming is inconclusive. The purpose of this study was to determine the effect on motivation and performance of using an instructional game. The effect of using a supplemental reading on motivation and performance was also examined. We randomly assigned 75 undergraduates to one of two treatments after they had attended a lecture on the information-processing model of learning. The subjects in one treatment group used an instructional board game to practice the material presented in the lecture, while those in the other group practiced using a traditional worksheet. Results indicated that using the instructional game significantly affected the four motivational components of attention, relevance, confidence, and satisfaction. The instructional game did not influence performance. The results also suggested that the subjects who reported completion of a supplemental reading had significantly better performance and confidence than did the subjects who reported that they had not completed the reading. Implications for the design of practice are discussed.**

Providing students with an opportunity to practice newly acquired skills and knowledge is an important component in designing an instructional strategy. Although many instructional design theories include recommendations for designing practice activities, Salisbury, Richards, and Klein (1986) have emphasized that most of the theories fail to address how to design practice that is motivational.

Some educators have theorized that instructional games are effective for providing motivating practice of newly acquired skills and information. They have argued that instructional games are motivational because they generate enthusiasm, excitement, and enjoyment, and because they require students to be actively involved in learning (Coleman, 1968; Ernest, 1986; Rakes & Kutzman, 1982; Wesson, Wilson, & Mandlebaum, 1988). Other scholars have theorized that instructional games decrease student motivation. Those authors have suggested that the motivational aspects of instructional games are limited to those who win, and that losing an instructional game produces a failure syndrome and reduces self-esteem (Allington & Strange, 1977; Andrews & Thorpe, 1977).

Whereas theorists have argued about the motivational aspects of instructional games, researchers have investigated the effect of using games on student motivation. Some researchers have reported that the use of instructional gaming increases student interests, satisfaction, and continuing motivation (DeVries & Edwards, 1973; Sleet, 1985; Straus, 1986). In addition, investigators have reported that instructional games influence school attendance. Allen and Main (1976) found that including instructional gaming in a mathematics curriculum helped to reduce the rate of absenteeism of students in inner-city schools. Studies by Raia (1966) and Boseman and Schellenberger (1974) indicated that including games in a college business course has a positive affect on course attendance but not on expressed interest and satisfaction. Others have reported that playing a game does not influence student satisfaction or attitude toward school (DeVries & Slavin, 1978).

In addition to the possible motivational benefits of games, many educators have theorized that games are effective for increasing student performance. They have argued that instructional games make practice more effective because students become active participants in the learning process (Ernest, 1986; Rakes & Kutzman, 1982; Wesson et al., 1988). Others have suggested that games foster incorrect responding and inefficiently use instructional time; also, the rate of practice in a game cannot compare with that of a flashcard drill or reading a connected text (Allington & Strange, 1977; Andrews & Thorpe, 1977).

Researchers have attempted to answer whether instructional games are an effective method for learning. Some

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investigators have reported that instructional games are effective for assisting students to acquire, practice, and transfer mathematical concepts and problem-solving abilities (Bright, 1980; Bright, Harvey, & Wheeler, 1979; DeVries & Slavin, 1978; Dienes, 1962; Rogers & Miller, 1984). Others have reported that using an instructional game to practice mathematics skills assists slow learners but not more able students (Friedlander, 1977). Research on the use of instructional games in college business courses has produced inconclusive or nonsignificant findings in many studies (Boseman & Schellenberger, 1974; Greenlaw & Wyman, 1973; Raia, 1966), whereas instructional games have positively influenced learning in actual business training settings (Jacobs & Baum, 1987; Pierfy, 1977). Even advocates of instructional gaming are unsure whether games teach intellectual content and skills (Boocock, 1968).

There are several explanations for the inconsistent findings from research concerning the effect of instructional games on motivation and learning. A few authors (Reiser & Gerlach, 1977; Remus, 1981; Stone, 1982) have suggested that much of the research on instructional gaming has been conducted using flawed experimental designs and methods. Another explanation is that many studies on instructional gaming have not investigated the integration of games in an instructional system. Gaming advocates have suggested that games should be used with other instructional methods such as lecture and textbooks (Clayton & Rosenbloom, 1968). A third explanation is that researchers examining the effect of instructional gaming on motivation have not adequately defined and operationalized the variable of motivation. After an extensive review of instructional gaming, Wolfe (1985) indicated, "No rigorous research has examined a game's motivational power, [or] what types of students are motivated by games" (p. 279).

Our purpose in this article is to describe the results of a study conducted to determine the effects on student motivation and performance of using an instructional game as practice. Because the study was designed to integrate the game into an instructional system, we also attempted to determine how using a supplemental reading affects student motivation and performance. Motivation was defined using the ARCS model of motivation (Keller, 1987a). The model suggests that motivation in an instructional setting consists of four conditions: attention, relevance, confidence, and satisfaction. According to Keller (1987a), all four conditions must be met for students to become and remain motivated. We hypothesized that students using an instructional game to practice newly acquired information would indicate that the method enhanced their attention, relevance, confidence, and satisfaction. We also believed that students who reported that they had completed a supplemental reading would perform better on a posttest than would those who reported that they did not complete the reading.

Method

Subjects

Our subjects were 75 undergraduate education majors enrolled in a required course in educational psychology at a large southwestern university. Although students in this class were required to participate in one research study during the semester, participation in this particular study was not mandatory.

Materials

Materials used in this study were an instructional game and a worksheet (both designed to provide practice of information and concepts presented in a lecture), the textbook *Essentials of Learning for Instruction* by Gagne & Driscoll (1988), the Instructional Materials Motivation Scale (Keller, 1987b), and a measure of performance.

The term *game* has various meanings, and several characteristics are important to understand the construct of game. In general, most games include a model or representation of reality, a set of rules that describe how to proceed, a specified outcome, and a group of players who act individually or collectively as a team (Atkinson, 1977; Coleman, 1968; Fletcher, 1971; Shubik, 1975, 1989). Games usually require active participation by players and can include elements of competition and cooperation (Orbach, 1979; Shubik, 1989). Games used for instructional purposes should be based on specific educational objectives and provide immediate feedback to participants (Atkinson, 1977; Jacobs & Baum, 1987; Orbach, 1979).

The instructional game used in this study included the elements listed above. We developed the game to provide students with practice on objectives from a unit on the information-processing model of learning. The instructional game consisted of a board that graphically represented the information-processing model, a direction card that explained the rules of the game, and a set of 25 game cards. Each game card had a practice question about the information-processing model of learning on the front and feedback with knowledge of correct results on the back. The rules were developed to encourage cooperation, competition, and active participation. The rules specified that team members should discuss each question among themselves before providing an answer. Teams were also told that they would be playing against another team.

We also developed the worksheet to provide subjects with practice on the information-processing model of learning. The worksheet was four pages in length and included the same 25 questions that appeared on the game cards. After subjects completed a set of five questions, the worksheet instructed subjects to turn to the last page for feedback.

We used the Instructional Materials Motivation Scale (IMMS) developed by Keller (1987b), to measure student perception of the motivational characteristics of the instructional materials. The IMMS includes four subscales to measure the degree to which subjects believe that a set of instructional materials address the motivational components of attention, relevance, confidence, and satisfaction. Keller reported that Cronbach's alpha reliability of the instrument is .89 for attention, .81 for relevance, .90 for confidence, .92 for satisfaction, and .96 for overall motivation.

A 15-item constructed response posttest was used to measure student performance. We developed the items on this posttest to determine subject mastery of the information-processing model. The Kuder-Richardson internal consistency reliability of this measure was .77.

Procedures

All of the subjects attended a 50-min lecture on the information-processing model of learning and were told afterward to read chapter 2 in the textbook, *Essentials of Learning for Instruction*, by Gagne & Driscoll (1988). Two days later, the subjects were randomly assigned to one of two treatment groups. The subjects in both groups were given 30 min to practice the information presented in the lecture and assigned reading by using either the instructional game or the worksheet.

One group of subjects used the instructional game to practice the information-processing model. Those subjects were randomly placed in groups of 8 to 10 and formed into two teams of players. Each group received the game materials described above, and the experimenter read the game rules aloud. Subjects in this group played the game for 30 min. The other group of subjects used the worksheet to practice the same items. The latter group worked individually for 30 min to complete the worksheet. The subjects were told to review incorrect items if time permitted.

Upon completion of the practice activity, all the subjects completed the Instructional Materials Motivation Scale and then took the posttest. The subjects also were asked if they had attended the lecture on the information-processing model and if they had completed the assigned reading from the textbook. Completion of the activities took approximately 15 min.

Results

Motivation

We used a multivariate analysis of variance (MANOVA) to test for an overall difference between groups on the motivation scales. Stevens (1986) indicated that MANOVA should be used when several dependent variables are correlated and share a common conceptual meaning. An alpha level of .05 was set for the MANOVA tests. The analyses were followed by univariate analyses on each of the four IMMS subscales. To account for the possibility of inflated statistical error, we set the alpha at .0125 for the univariate analyses, using the Bonferroni method (Stevens, 1986). To determine the size of the treatment effect for each variable, we calculated effect-size estimates expressed as a function of the overall standard deviation (Cohen, 1969).

Results indicated that using the instructional game to practice information had a significant effect on motivation. A significant MANOVA effect, $F(4, 64) = 6.57$, $p < .001$, was found for the treatment on the motivation measures. Univariate analyses revealed that subjects who played the game rated this method of practice as motivational in the four areas of attention, $F(1, 67) = 21.91$, $p < .001$; relevance, $F(1, 67) = 15.05$, $p < .001$; confidence, $F(1, 67) = 16.80$, $p < .001$; and satisfaction, $F(1, 67) = 24.71$, $p < .001$. Effect-size estimates for each motivation variable were .61 for attention, .91 for relevance, 1.01 for confidence, and 1.23 for satisfaction. Cohen (1969) indicated that an effect size of .80 should be considered large for most statistical tests in psychological research. Table 1 includes a summary of means and standard deviations on each motivation subscale for the game and the nongame groups.

Results also suggested that subject self-report about completion of the reading assignment was significantly related to motivation. A significant MANOVA effect $F(4, 64) = 2.94$, $p < .05$, was found for this variable on the motivation measures. Follow-up univariate analyses revealed that the motivational area of consideration was sig-

Table 1.—Means and Standard Deviations on Attention (A), Relevance (R), Confidence (C), Satisfaction (S), and Performance (P) Measures, by Treatment Group

Group	A	R	C	S	P
Game (n = 37)	4.22 (0.58)	3.71 (0.58)	4.06 (0.57)	3.88 (0.86)	10.49 (3.20)
Nongame (n = 38)	3.77 (0.89)	3.13 (0.69)	3.31 (0.90)	2.72 (1.02)	9.39 (3.60)

Note. Maximum scores = 5.00 for A, R, C, S and 15.00 for P.

nificantly related to completion of reading assignment, $F(1, 67) = 6.52$, $p < .0125$. Attention, relevance, and satisfaction were not significantly related to self-reported completion of reading assignment. In addition, a test of the interaction between self-reported completion of reading assignment and the treatment was not statistically significant, $F(4, 64) = 0.97$, $p > .05$.

Performance

We measured performance using a 15-item constructed response posttest. Analysis of variance (ANOVA) was used to test for differences between groups on the performance measure. An alpha level of .05 was set for all statistical tests.

Analysis of the posttest data revealed that self-reported completion of assigned reading was significantly related to performance, $F(2, 71) = 14.87$, $p < .001$. Subjects who indicated that they had read the assigned text ($n = 40$) performed significantly better on the posttest than those who indicated that they did not complete the reading ($n = 35$). The mean performance score of subjects who reported reading the text was 11.25 ($SD = 3.07$), whereas the mean performance score for those who reported that they did not read the text was 8.45 ($SD = 3.22$).

No statistically significant difference was found on the performance measure when the treatment groups were compared. The mean performance score for subjects using the game was 10.49 ($SD = 3.20$), and the mean performance score for those in the nongame group was 9.39 ($SD = 3.61$). In addition, a test of the interaction between the treatment and self-reported completion of reading assignment was not statistically significant, $F(2, 71) = 0.14$, $p > .05$.

Discussion

The major purpose of this study was to determine the effect of using an instructional game on student motivation and performance. The results of the study suggest that using an instructional game as a method of delivering practice did enhance the motivation of students in the four areas of attention, relevance, confidence, and satisfaction. However, the results show that using the instructional game to practice information did not contribute to enhanced performance when compared with a traditional method of practice. There are several possible explanations for the results found in this study.

In keeping with established ideas of the characteristics of a game, we used a game board that provided students with a visual representation of the information-processing model of learning and required players to be active participants. Keller (1987a) indicated that visual representations and active participation are two strategies that can increase student attention in an instructional setting. Furthermore, use of the game may have contributed to the results found for attention, because of a novelty effect. Some researchers have reported that student motivation and interest fluctuate and decrease as the novelty effect of a game wears off (Dill, 1961; Greenlaw & Wyman, 1973), whereas others have reported that interest tends to persist over time in gaming settings (Dill & Doppelt, 1963). Although novelty may be a reason for increased attention in this study, instructional designers who are concerned with providing motivating practice to students should consider that explanation as positive. Motivation and attention can be increased when variability and novelty are used in the classroom (Brophy, 1987; Keller, 1983).

The results found in this study for the motivational factor of relevance are consistent with the theories proposed by gaming advocates. Both Abt (1968) and Rogers and Miller (1984) argued that students will not question the relevance of educational content when it is presented via an instructional game. In addition, instruction can be made relevant to students by designing materials that are responsive to their needs (Keller, 1983). Orbach (1979) indicated that games are excellent methods to motivate students with a high need for achievement, because a game can include an element of competition. Orbach (1979) also theorized that games can motivate students with a high need for affiliation when the game requires interaction among individuals and teams. The instructional game used in this study included a moderate level of competition and required students to interact cooperatively through the team approach.

The instructional game used in this study also provided circumstances for student-directed learning. As a motivational strategy, researchers have linked student-centered learning with increased confidence (Keller & Dodge, 1982). The finding that the game increased student confidence is consistent with theorists who have suggested that games can influence student efficacy (Abt, 1968) and with researchers who reported that students rate the task of gaming as less difficult than other instructional techniques (DeVries & Edwards, 1973).

The positive finding for satisfaction is also consistent with theory and research. Some scholars have indicated that instructional games contribute to motivation because they provide intrinsic reward and enjoyment (Coleman, 1968; Ernest, 1986; Rakes & Kutzman, 1982). Researchers have reported that instructional games lead to increases in student satisfaction (DeVries & Edwards, 1973; Strauss, 1986). The results of this study support theorists and researchers who have suggested that students enjoy the gaming approach in instruction.

Although our results did suggest that the instructional game had an effect on student motivation, the game used in this study did not have a significant impact on student performance. However, subjects who reported completing an assigned reading performed significantly better

and had more confidence about their performance than those who reported that they did not complete the reading. The results may have occurred because of the nature of the reading. Even though all the students were provided with necessary concepts and information in a lecture, the textbook, *Essentials of Learning for Instruction* (Gagne & Driscoll, 1988), provided readers with practice and feedback in addition to supplementing the lecture. The additional practice and feedback more than likely influenced both the performance and confidence of those who completed the assigned reading.

The findings of this study have some implications for the design of practice. Although many instructional design theorists have indicated that students should be provided with an opportunity to practice newly acquired skills and knowledge, most fail to address how to design practice that is motivational (Salisbury, Richards, & Klein, 1985). The results of this study suggest that instructional designers can provide students with a motivating practice alternative that is as effective as more traditional methods of practice by including a game into instruction. Although using the game to practice did not have an effect on immediate performance in this short-term study, motivating practice alternatives can possibly influence long-term performance because of increased student contact with materials that they find motivational. Future research should investigate the impact of gaming on long-term performance.

The current study also suggests that instructional designers should include reading assignments that provide additional practice in their instruction. The use of those types of readings will not only increase student performance, but also will lead to increases in student confidence about that performance.

As in our study, future research should integrate instructional games into a system to determine if the method has an impact on educational outcomes. Besides using a game as practice, research could be conducted to examine the effect of using a game to present other instructional events, such as stimulating recall of prior knowledge or as a review of learning. Researchers of instructional gaming should continue to investigate the effect of using a game on student motivation and should be specific in their operational definition of motivation. Implementation of our suggestions will assist us in determining how to design practice that is both effective and motivational.

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