COMPUTERS IN TEACHING

Using Interactive Computer Technology to Enhance Learning

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We assessed the effects of using LearnStar™, an interactive, computer-based teaching tool, as an in-class exam review method. Students with higher LearnStar review scores had higher grades. Furthermore, students' satisfaction ratings indicated that LearnStar reviews were more enjoyable and conducive to participation than traditional reviews. However, students who reviewed using LearnStar did not have significantly higher exam scores or course grades compared to students who had traditional reviews. Future research directions include measuring different aspects of students' engagement in courses and examining the effects of using tools such as LearnStar for other in-class activities such as brief quizzes or polls.

Maintaining students' interest as well as engaging them in the classroom are two challenges faced by instructors. For example, if students are not interested in the course material, they are less likely to come to class (Galichon & Friedman, 1985). Furthermore, activities that increase active participation have improved students' performance (Narayan, Heward, Gardner, Courson, & Omness, 1990), and students report greater enjoyment of classes using active learning techniques (e.g., Middlecamp, 2003; Zaremba & Dunn, 2004; Zehr, 2004).

Instructors have used many techniques to increase students' interest and participation in the classroom. For example, Boniecki and Moore (2003) increased students' participation by using a token economy, whereas Butler, Phillmann, and Smart (2001) used short writing exercises followed by discussion to increase students' active learning in a lecture setting. Recently, another area of interest has been the use of computer-based techniques to increase participation, interest, and learning outcomes. Technology-assisted instruction tends to be associated with increased student motivation, enjoyment, learning, and development (Forsyth & Archer, 1997); however, learning outcomes are not always superior in technologically assisted classes (DeBord, Aruguete, & Muhlig, 2004). Thus, although computer-assisted instruction appears to be associated with positive outcomes in general, the research in this area is inconclusive. Furthermore, the specific tools and techniques used vary widely, and the effect of any one tool cannot be generalized across studies.

Our study assessed the effects of LearnStar™, a computer-based, interactive trivia-style game, on students' reactions and performance in two different undergraduate psychology courses (General Psychology and Abnormal Psychology). Our goal was to increase student achievement and satisfaction with these courses. We hypothesized that using LearnStar would achieve these goals by increasing students' level of interest, participation, and class performance.

Method

Participants

Three hundred seventy-seven undergraduate students from six introductory psychology and two abnormal psychology classes participated. The number of students in the introductory psychology sections ranged from 48 to 51 (149 total in LearnStar classes; 148 total in traditional classes), with the majority (70% to 80%) being freshmen. Both abnormal psychology sections had 40 students, the majority of whom were at or above junior level (75% in the LearnStar class; 87% in the traditional class). The majority of students in both courses were women (60.6% women and 39.4% men in introductory classes; 72.5% women and 27.5% men in abnormal classes). Scheduling constraints (e.g., moving the LearnStar keypads from one classroom to the next) determined which classes received LearnStar; thus, complete random selection was not possible.

Measures

Four exam scores and final semester grades were measures of class performance. In classes using LearnStar, students received a review score during each of the four review sessions based on the accuracy and speed of their responses to the questions. At the end of the semester, all students completed a five-item questionnaire assessing how beneficial they found the review sessions. The students responded to each statement on a 6-point Likert-type scale (*strongly disagree, disagree, somewhat disagree, somewhat agree, agree, strongly agree*). This

forced-choice response format prevented students from choosing a neutral answer.

Procedure

Each class participated in a review session the class period before each exam. All sections had four review sessions. In half of the classes (three introductory psychology classes and one abnormal psychology class), the instructor led the class in a review session using LearnStar. At the beginning of these reviews, each student received a keypad and a code name to maintain confidentiality. The instructor displayed multiple-choice review questions on a large screen located in the front of the classroom, and students used their keypads to submit their answers. After a set amount of time, the correct answer appeared on the screen along with the number of people who had answered the question correctly. Students who answered correctly received points toward their LearnStar review score, with faster responses resulting in more points, whereas students who answered incorrectly lost points. In the traditional review classes, instructors used a standard review format covering the same topics as in the LearnStar classes but not necessarily asking the same questions or using a question-and-answer format.

Classes were standardized as much as possible across conditions. Each introductory psychology instructor taught one LearnStar and one traditional course, using the same lecture notes and textbook for both sections. Two instructors cotaught the abnormal psychology classes, with one instructor teaching both classes during the first half of the semester and the other instructor teaching both classes during the second half; the instructors used the same textbook and lecture notes for both classes. In addition, the class meeting times were counterbalanced as much as possible across conditions.

Results

Comparison of Exam Scores and Final Grades

We used a two-way ANOVA, with instructor and type of review as independent variables, to compare students' final grades. The level of statistical significance was .05 for all analyses. LearnStar students' final grades were not significantly different from regular-review students' grades, $F(1, 361) = 0.99$, $p = .32$, nor was there a significant Review Type $\times$ Instructor interaction, $F(3, 361) = 0.37$, $p = .77$. In addition, the LearnStar students' mean exam scores did not differ significantly from the traditional review students' scores, $F(1, 369) = .69$, $p = .41$, nor did the Review Type $\times$ Instructor interaction have a significant effect on these scores, $F(3, 369) = 1.03$, $p = .38$.

Predicting Exam Scores and Final Grades

We tested LearnStar review scores for their ability to predict class performance. First, we predicted each exam score using a hierarchical regression model with instructor entered as the first predictor (to account for variance due to different grading standards) and the LearnStar review score entered as the second predictor. The overall model was significant for each exam (Exam 1: $R^2 = .52$, $p < .001$; Exam 2: $R^2 = .29$, $p < .001$; Exam 3: $R^2 = .29$, $p < .001$; Exam 4: $R^2 = .17$, $p < .001$). In all analyses except Exam 4, the LearnStar review scores predicted a significant proportion of the variance in their respective exam scores over and above the effects of instructor differences (Exam 1: $pr^2 = .37$, $p < .001$; Exam 2: $pr^2 = .32$, $p < .001$; Exam 3: $pr^2 = .25$, $p = .001$; Exam 4: $pr^2 = .15$, *ns*). Furthermore, we predicted final grades from LearnStar review scores. The overall model was significant, indicating that the optimal linear combination of all four LearnStar review scores accounted for a significant portion of the variance in final grades, $R^2 = .18$, $p = .014$.

Satisfaction Analysis

See Table 1 for means, standard deviations, significance levels, and effect sizes for all analyses discussed in this section. The mean satisfaction score, created by averaging ratings on

Table 1. Mean Ratings on Satisfaction Statements

	LearnStar™		Traditional			
Statement	*M*	SD	M	SD	$F(1, 254)$	η_p^2
1. Compared to reviews in other classes, I participated more during these reviews.	5.03	1.17	4.03	1.38	39.25**	.13
2. Compared to reviews in other classes, LearnStar [or the instructor] made reviews more interesting.	5.15	1.23	4.48	1.17	19.76**	.07
3. Overall, I enjoyed LearnStar [or the instructor's reviews].	5.04	1.23	4.60	1.12	9.02*	.03
4. I found LearnStar [or the instructor's feedback] beneficial for reviews.	4.80	1.24	4.80	1.02	< 0.01	—
5. The review helped me prepare for exams.	4.53	1.35	4.45	1.31	0.27	—
Mean satisfaction score	4.91	1.13	4.47	1.02	10.69*	.04

Note. Possible range of scores was from 1 (*strongly disagree*) to 6 (*strongly agree*).
*$p < .005$. **$p < .001$.

the five statements assessing how beneficial students found the reviews, was significantly higher for the students participating in the LearnStar reviews compared to those participating in the traditional reviews. However, the difference in these mean scores was small (less than half of a point), and the partial eta-squared statistic indicated that this effect was negligible (explaining less than 5% of the variance). Further examination of the individual statements revealed that students who reviewed using LearnStar gave significantly higher ratings to three of the five statements addressing interest, participation, and overall enjoyment of the reviews, although effect sizes again indicated that review type explained less than 15% of the variance in responses to each of these questions.

Discussion

Instructors are often faced with the challenge of inducing student interest in course material. Furthermore, instructors must find ways to maintain this interest. Our study examined the use of LearnStar, an interactive computer technology tool, to increase interest and achievement in the classroom. Our results suggest that students in the LearnStar classes did not achieve significantly different final grades or exam scores compared to students in the traditional-review classes. Thus, using this type of tool for exam review may not be an effective way to improve student performance.

Regression analyses indicated that students who performed better during LearnStar reviews also performed better on exams and in the class as a whole. Thus, performance on LearnStar reviews predicted student performance. However, we were unable to compare this predictive ability to the predictive ability of traditional reviews, as the traditional reviews did not yield scores assessing knowledge of the topics covered. Furthermore, the amount of variance in final grades accounted for by LearnStar review scores, although significant, was small (18%), indicating that knowledge of review topics was a relatively minor predictor of final grades. Nonetheless, the review scores' predictive ability, especially their ability to predict exam scores, could give instructors valuable information, such as allowing them to gauge student knowledge of topic areas and helping them determine which areas need more discussion.

Although the LearnStar reviews did not appear to improve student performance, student evaluations showed that students preferred this type of interactive tool when reviewing for exams. Specifically, students in the LearnStar reviews reported finding the reviews to be more beneficial than those students participating in the traditional reviews. Compared to previous classes students had taken at the university, students in the LearnStar review classes reported that they found the reviews more interesting, participated more in class during the reviews, and enjoyed the reviews more overall. However, the low effect sizes for these results indicate that the type of review was not the most important contributor to student satisfaction.

These results may have been influenced by several uncontrolled variables. One such variable may have been class attendance. Specifically, some students attended class only on exam days and did not participate in the reviews. Thus, they did not benefit from either type of review. Future studies might attempt to control for attendance to assess better the effects of a tool such as LearnStar. Another area for research is the potential use of such technology for in-class activities other than reviews. As yet, few researchers have examined possibilities in this area. Instructors or researchers could use LearnStar or a similar tool to increase engagement during lectures, such as by using it to give brief quizzes on the information being covered or to conduct opinion polls on controversial topics.

In summary, LearnStar scores predicted class performance, and its use was associated with small increases in student satisfaction with and participation in reviews. However, using LearnStar did not improve students' grades. These results suggest that although computer-based learning aids may increase student participation, they may not be an effective way to improve academic performance.

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Notes

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4. Information on LearnStar™ can be obtained at www.LearnStar.com or via e-mail at sales@LearnStar.com.
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