

The Effectiveness of Computer-Based “Game Show” Formats in Survey Courses: A Quasi-Experiment

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ABSTRACT

The confluence of computers and integrated projection systems in the classroom has opened new avenues for course content delivery in an active learning format. This paper first discusses the concepts of active learning and play in a pedagogical context. Next, the implementation and subjective results of a generic computer-based game show for delivering course content in introductory survey courses is presented. This paper then describes the employed methodology and statistically tests certain aspects of the course related to the effectiveness of this implementation. The results of this quasi-experiment using five sections of an upper-division MIS (Management Information Systems) survey course spanning three academic terms strongly support the research hypotheses that the game show format increases student learning and improves student perceptions of the overall quality of the course. The implications of this research for educators are discussed. The game show application was developed by the authors and is available for download as freeware.

Keywords: Classroom technology, course content delivery, computer-based, game show, survey course, play, education.

1. INTRODUCTION

In recent years a general call to move from heavy reliance on lecture-based instruction to a richer, more active, technology enhanced learning environment has emerged (Shapiro 1998; Benjamin, et al 1999). Nowhere is this call to action more needed than in introductory survey courses. Collectively these courses occupy a large number of credit hours in the curriculum and often constitute the core. The importance of effective teaching techniques in these courses cannot be underestimated.

Introductory survey courses have characteristics that pose special challenges to the instructor in keeping students interested and engaged. Students often enroll in these courses primarily to satisfy graduation requirements rather than to satisfy an inherent interest in the subject. In addition, these courses are often very vocabulary oriented. Finally, because of the vast amount of information that must be covered in a survey course, breadth is often emphasized over depth.

As computers and integrated projection systems become more common in the classroom, the opportunities for implementing more interactive methods of content delivery are increasing. This paper describes and tests the effectiveness of a computer-based game show format for course content delivery. The contribution of this paper is twofold. First, it provides a useful example of implementing classroom technology to create an active learning environment in introductory survey courses. Second, the effectiveness of this format is tested. Although the use of advanced technology in the classroom is generally considered positive, care must be taken to document the effectiveness of these implementations. It is tempting to place the hurdle to justify the use of classroom technology at the level of “do no harm,” but there are considerable costs associated with acquiring and maintaining classroom technology that should be weighed against the benefits. The importance of careful and appropriate implementation can be demonstrated with an analogy from industry. Many reported failures during the early years of implementing computer technology in industry have been attributed to “automation for automation’s sake” or implementing computer technology simply because it is available. These failures due to inappropriate implementation can cast unjust doubt on the benefits of these computer technologies (Melnik & Narasimhan 1992).

2. BACKGROUND

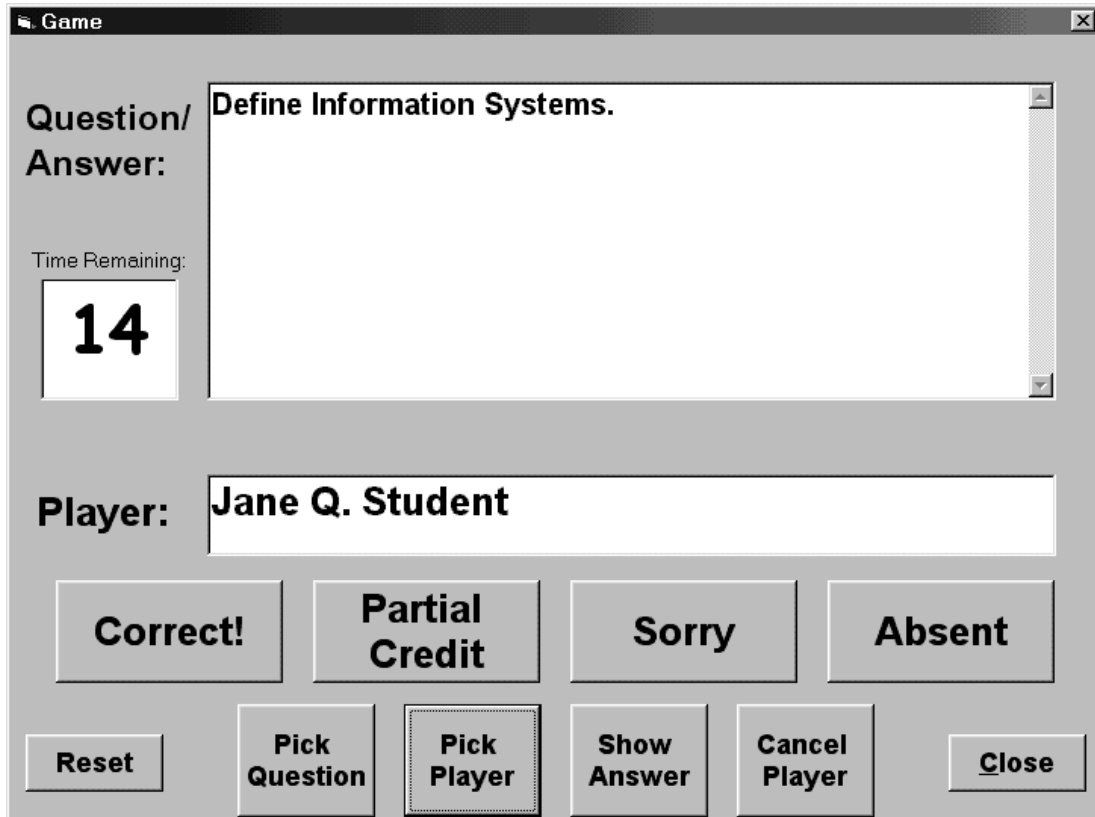
Psychologists, anthropologists, sociobiologists, historians, and educators have thoroughly researched the nature of play and its relationship to learning (Rogers and Sawyer 1988). Play is nearly universal among mammals. Studies show that play stimulates the growth of synapses and through practice enables us to stabilize our learning (Carvey 1977; Wilson 1978). One definition of play is “something that is *fun but purposeful*” (Mann 1996). Because it is fun, play is an intrinsically motivating activity. “Educational” games are fun but purposeful. Games, as a form of play, provide a means of practicing skills with reduced consequences. For example, understanding can be tested and refined without the risk of receiving low marks on an exam. Games can take many forms. This study explores an educational adaptation of the television-based “game show” format.

A review of the pedagogical literature reveals several examples of using game show formats taken mainly from American television to teach particular concepts or as a generic vehicle for course content delivery.

Although many of these shows are widely distributed throughout the international community (*Jeopardy* is available in 43 countries), the details of these games may not be familiar to all. The majority of the game shows discussed in this paper have World Wide Web sites available to those who may want to investigate the details of these show formats.

A popular game show format for general content delivery is *Jeopardy*. This format has been used for geometry, chemistry, and social studies (Saunders 1987; DeChristopher 1991; Fisher 1996). The game show format *To Tell the Truth* has been used in teaching literature and medicine (Brown-Guillory 1988; Hafferty 1990). Wood (1992) uses a game show format similar to *The Price is Right* to teach the concept of probability. Daigle and Doran (1998) use a college bowl format to teach computer history.

Pedagogical research stresses the importance of active learning (Association of American Colleges 1986; Astin 1984; Miller 1988). The major premise of this paper is that games are an effective form of active learning because they engage students in the process of content delivery. Students are active participants in the process, not passive vessels receiving knowledge. The element of fun makes games a powerful form of learning because they are intrinsically motivating. Witness the ubiquitous juxtaposition of “fun” and “learning” in the promotional materials for educational software.



3. THE CLASSROOM GAME SHOW

The concept of television game shows was used as a basis to develop and implement a computer-based learning tool for course content delivery. A discussion of the format, software, implementation, and classroom experiences follows. In addition, the goals of this implementation are used to develop hypotheses to test the effectiveness of this effort.

3.1 Description of Game Show Format

The game show and design of the software (Brandyberry and Pardue 2001) was based on a generic question/answer format. Among current television game shows it is most related to *Jeopardy* but lacks its peculiarities such as phrasing the answers in the form of a question.

To begin, current students, questions and answers are entered into a database via manual entry or by uploading a comma-delimited text file (easily created from a spreadsheet file). During the game, the instructor clicks the “Pick Question” button to randomly select a question from the selected categories (often text chapters) to be covered that session (see Figure 1 – note that the actual program makes extensive use of color to maintain atmosphere). The question is displayed before a student is selected

so that everyone in the class can consider the question.

When the “Pick Player” button is clicked, a student is randomly selected. The randomizing process weights the probability of a student being selected according to the number of questions they have previously been asked. This results in the situation where a student who has received fewer questions has a greater chance of receiving the next question but all students have some chance of selection. If the selected student is absent, this is recorded by clicking the absent button and another student is selected. The student then attempts to answer the question before time expires. The instructor then displays the answer and determines if the student’s answer is correct, partially correct, or incorrect. The judgement is recorded in the database, and the next question is displayed.

In order to add to the feeling of “play,” a light-hearted atmosphere is maintained. Although the instructor is central to this, certain features of the software help maintain the atmosphere. For instance, when the

“Correct!”, “Partial Correct”, incorrect (“Sorry”), or “Absent” buttons are clicked, the program randomly plays sound files selected for each button. These could be as simple as buzzer and chime sounds but the use of sound clips from popular television shows and movies are especially effective.

The software allows substantial customization. In addition to changing students and questions, the instructor can change between multiple courses, course sections, and texts. Different categories or chapters may be selected with multiple selections simultaneously used in one session. Questions can be asked sequentially by question number or in a random fashion. This allows for a structured format where topics are introduced in a logical sequence or a randomized review format. The score values for correct, partially correct, incorrect, and absent can be modified as can the time allowed for each response. Sound files to be played for certain actions can be added simply by storing them in a specified file folder.

3.2 Implementation and Classroom Experiences

Certain aspects of the implementation of this format in the classroom do not involve the software and is at the instructor’s discretion. For instance, may the students consult their books or notes? For the MIS survey course used for the pilot implementation of this format, it was decided that students were permitted to consult only handwritten notes of their own creation. The text, printed lecture notes, photocopies of notes, and other related materials were not permitted. In addition, the instructor may decide to include “mini-lectures” or discussions between questions. A question often introduces a topic but doesn’t fully explain it. Where this occurred, the instructor provided additional information before the next question was asked. Questions were both definitional and conceptual and could be answered in a sentence or two in an open-ended format. Multiple-choice and other objective formats were not used but would be simple to implement with the software.

The instructor’s subjective assessment of this implementation is entirely positive. The students appeared to be very engaged in the process and most appeared to be entertained. In addition, it was also a greatly improved experience for the instructor, both from an entertainment perspective and from the satisfaction derived from seeing students enjoying the learning process. This assessment is supported by dramatically increased attendance and in student comments on course evaluations. Attendance was undoubtedly partially stimulated by the use of extra credit points to reward the top performers (being absent when your name comes up equated to an

incorrect response). However, the entertainment aspect of the format was also perceived to be a major influence. The comments on course evaluations (objective course evaluation results are analyzed in a later section) were very positive. Of students who choose to make optional comments concerning the game show format, all but one was positive. Most comments were related to the format being a fun alternative to traditional activities and that the game show aided them in motivating themselves to keep up with the assigned material.

3.3 Hypotheses

In addition to describing the game show format and its implementation, an objective of this research was to measure and test its effectiveness. The goals of the implementation were to improve the level of student learning and to improve the students’ perception of the course. These goals were used to determine the effectiveness of the implementation. The measurement of student learning was operationalized as student performance on exams and the measurement of students’ perceptions was operationalized as the results of course evaluations. It is important to note that the concept of “learning” is complex and exam scores provide a limited measure of this. This resulted in the formulation of two hypotheses.

H1: Treatment group will display greater learning than control group

H2: Treatment group will have a more positive perception of the course than control group

The next section describes the methodology used to test these hypotheses. This is followed by a discussion of the data analysis and results.

4. METHODOLOGY

This study used a quasi-experimental design. A self-critical use of this design is recommended where the experiment is conducted in the field and “randomized treatments are not possible” (Campbell & Russo 1999, p. 81). Although great care was taken to isolate the treatment effect, it must be recognized that in the classroom numerous subtle factors can influence outcomes. Because actual classes were used, students self-selected into one group or the other through normal registration procedures and were not randomly assigned. To reduce any effects of this potential source of sample bias, students were not informed of the treatment prior to or during registration. This information was not disclosed until the first day of class in the context of the syllabus. A total of five course sections of an upper-division MIS survey

course spanning three academic terms (to minimize any effects of the non-random selection process) were included in the study. Because the MIS field changes so rapidly, the course content and materials could not be held constant for more than three terms. One approach to controlling possible sample bias is to compare the sample grade point average (GPA) mean for each group to the population GPA mean. Because of privacy issues, this information was not available for the subjects and the control could not be implemented. However, the instructors perceived no reason to suspect that the groups were not academically representative of the population. Additionally, it is believed that the variety of scheduled course offerings further reduced any possible effects of the non-random selection process.

4.1 Subjects

The subjects in this study were undergraduate, business students who had enrolled in the upper-division MIS survey course at a regional campus of a state university. The course is required of all business students.

4.2 Experimental Design

This experiment involved two instructors (both at the Assistant Professor rank with substantial experience teaching the course) and five course sections spanning three consecutive academic terms. Course sections were divided into three control groups and two treatment groups. To minimize effects due to differences in teaching style, both instructors used a common set of course materials including the same texts, lecture notes (PowerPoint slides), syllabus, supplementary materials, and exams. The only difference was the addition of a description of the game show in the treatment group syllabus.

4.3 Dependent Variables

The dependent variables were student scores on three standardized multiple-choice exams and student responses on standardized course evaluation forms. The objective format of the exams eliminated grading bias. Students were not informed that identical exams were used across sections and care was taken to maintain a secure exam environment. There was no overlap between the exact game show questions and the exam questions. The course evaluation instrument was developed at the University level to measure students' overall perceptions of a course, course content, instruction methods, and the instructor.

5. DATA ANALYSIS AND RESULTS

In general, we expected the treatment group to display significantly greater learning and have a significantly more positive perception of the course than the control

group. Hypothesis 1 was tested using a one-tailed t-test and a factorial Type III sum of squares test. Hypothesis 2 was tested using a one-tailed t-test. The following section describes the data analysis and summarizes the results.

5.1 Student Learning

Arithmetic means were calculated for exam scores by treatment group and instructor (see Table 1). The means reveal that the treatment group consistently scored higher than the control group on all three exams (5.9%, 4.5%, and 4.7% respectively). Before examining the statistical significance of the increase, the effect of instructor bias was tested. A simple t-test conducted on the three exam scores between instructors for the control groups showed no significant difference (minimum $P > t = 0.6610$).

The significance of the treatment effect was tested in two ways, a one-tailed t-test between groups and a factorial Type III sum of squares test. The results of the t-tests (shown in Table 2) confirm that the treatment group scored significantly higher than the control group on all three exams.

To further test the possible influence of instructor bias, a factorial design was employed and an F-statistic computed for instructor treatment. A Type III sum of squares test, $SS(\text{Game Show} \mid \text{Instructor})$, is appropriate since it measures the "extra" effect of the treatment with the instructor effect accounted for (Montgomery 1997, p. 164). The results of these tests are shown in Table 3 and confirm that there are significant differences on the test scores attributable to the game show treatment with the instructor treatment controlled for. In addition, it is confirmed that the instructor did not significantly affect exam scores.

5.2 Student Perceptions of the Course

To measure the change in student perception due to the treatment effect, the difference between the item means on end-of-term course evaluations for the treatment and control groups were computed for the instructor who was involved with both treatment and control groups. All 26 items reflected a nominal positive change, 17 were statistically significant (see Table 4). The Likert scale questions employed are actually ordinal measures. However, it is common and has been shown to be fairly robust to treat these as interval in analysis (Emory & Cooper 1991, p. 222). Therefore, this approach is taken so that means and t-tests may be employed and the clarity of the results maintained. The results strongly support the hypothesis that the treatment groups had a more positive perception of the course than the control group. Although not all questions address issues logically linked to the game show format, the increase

seen in all areas can be attributed to an overall improved perception of the course. Questions that dealt primarily with classroom delivery universally displayed strong positive change. Most encouragingly, the questions

Table 1. Exam scores for treatment and control groups.

	Control	Treatment
Instructor 1	Exam 1: 74.4%; n = 102 Exam 2: 76.5%; n = 99 Exam 3: 70.0%; n = 102	
Instructor 2	Exam 1: 75.1%; n = 50 Exam 2: 76.1%; n = 50 Exam 3: 69.2%; n = 49	Exam 1: 80.5%; n = 55 Exam 2: 80.9%; n = 55 Exam 3: 74.4%; n = 55

Table 2: T-test results for differences on exam scores. ^a

	Treatment Mean	Control Mean	Treatment Sample Size	Control Sample Size	T-value	P>T
Exam 1	80.45	74.62	55	152	4.2303	0.0000
Exam 2	80.92	76.39	55	149	2.6906	0.0039
Exam 3	74.44	69.73	55	151	2.8638	0.0023

^a α is set at 0.05 for all tests in this study

Table 3. Factorial analysis results (Type III SS) for differences on exam scores. ^a

		F-value	P>F
Exam 1	Game Show Treatment	9.87	0.0019
	Instructor Treatment	0.19	0.6639
Exam 2	Game Show Treatment	5.32	0.0221
	Instructor Treatment	0.06	0.8142
Exam 3	Game Show Treatment	6.51	0.0114
	Instructor Treatment	0.19	0.6633

^a The F-statistic, analogous to a two-tailed t-test in the hypothesis tested, is less powerful than the one-tailed t-test in Table 2. The resulting p-values are expected to be approximately twice the p-values found in the t-tests above without any effect from the instructor treatment.

Table 4. Significant results ($\alpha = 0.05$) for tests for changes in mean evaluation scores.

Question	Treatment Mean – Control Mean	T-Value
1 The instructor presented challenging and stimulating material	0.43	1.78
2 The instructor inspired interest in the subject	0.76	2.72
3 The instructor displayed enthusiasm in teaching the subject	0.94	3.69
4 The instructor motivated me to do my best work	0.55	2.10
5 The instructor used examples and illustrations effectively	0.54	1.80
6 The instructor explained what is expected of students	0.48	1.80
7 The instructor was an effective speaker	0.61	2.04
8 The instructor maintained an atmosphere in the class that encouraged learning	0.44	1.72
9 The instructor made clear how my work was to be evaluated	0.52	1.82
10 The instructor gave helpful feedback on my performance	0.58	2.24
11 The instructor provided students with the opportunity to answer questions	0.61	2.07
12 The material was summarized in a manner that helped me learn	0.50	1.71
13 The instructor encouraged students to participate in class discussions and/or activities	1.15	4.03
14 The work assigned to be completed outside of class contributed to my	0.61	2.06

	understanding of the subject matter		
15	The course as a whole was good	0.72	2.83
16	Overall, the instructor presented the subject effectively	0.82	3.41
17	Overall, I learned a lot in this course	0.92	3.64

addressing the overall perception of the effectiveness of the course and instructor all showed significant positive changes (e.g. questions 15, 16, 17).

The results of the data analysis show that the treatment group (game show format) scored higher on all three exams and evaluated the course more positively than the control group. These results support the hypotheses of greater learning and more positive course perceptions in the treatment group.

6. LIMITATIONS

As with any empirical study, there are limits to the degree results can be generalized to a broader population. This study examined only one game show format in only one MIS introductory survey course. To generalize to all game show formats and introductory survey courses, a cross-format, cross-disciplinary study would be needed. Although exams are among the most common methods used to evaluate the level of learning demonstrated by a student, they are an imperfect and incomplete measure of learning. The higher exam scores achieved by the students exposed to the game show format certainly support the inference that these students learned more, however, a more exhaustive study including a detailed analysis of all aspects of learning would be necessary to make a definitive statement. Finally, the quasi-experimental format did not permit a blind study from the perspective of the instructors. Further, only one instructor used the treatment in class. These design limitations are moderated by there being a strong career-oriented motivation on the part of the instructors to have any class (treatment or control) show positive results in both student outcomes and course evaluations.

7. CONCLUSION

The findings of this study support the hypotheses that students who participate in a game show format will perform significantly better on exams and will have a more positive perception of the course. This suggests that active learning in the form of well-structured purposeful computer-based games can be an effective vehicle for the delivery of survey course content. One implication of this study is the observation that the increase of computing technology in the classroom provides the more technically capable educators an opportunity to add to the tools available to their

profession by developing and making available applications unlikely to be developed by commercial enterprises.

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