Teaching Tip

It's All Fun and Games ... Until Students Learn

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ABSTRACT

Faculty are often frustrated by student preparedness (or lack thereof) for exams and review sessions. This may be partially attributed to passive involvement during lectures and the failure of students to discuss and reflect on topics as they are introduced. Active learning refers to techniques that move students beyond listening to lectures to activities (in and out of the classroom) that engage students in topics (e.g., discussion, reflection). The purpose of this teaching tip is to describe the use of games as active learning techniques to encourage students to review materials over the life of a course and engage them in review sessions. Through a study conducted in two different information systems courses, we provide evidence of effectiveness including impact on exam performance and feedback from students derived from a questionnaire.

Keywords: Teaching method, Effective instruction, Active learning, Games

1. INTRODUCTION

As educators (and former students ourselves), we can probably agree that there is a relationship between student procrastination and poor exam performance. Too often, students put off preparation until the day(s) immediately preceding an exam. Although many faculty conduct review sessions, students often enter such sessions expecting that a whole course can be revisited in one class period. Because the timing of such review sessions typically does not coincide with student review habits, students are often ill-prepared to ask questions. As a result, the value of the session often falls short, leading to frustration on the part of both the instructor and the students.

What if there was a technique that would encourage students to review materials over the life of a course, or a technique that would actively engage students in a review session? Active learning refers to techniques that move students beyond listening to lectures to activities (in and out of the classroom) that engage students in topics (e.g., discussion, reflection) (Meyers and Jones, 1993). While a number of active learning techniques exist, our interest lies in the use of games – specifically crossword puzzles and a Jeopardy-like game – as part of homework assignments and for review sessions. Games can complement traditional methods of learning and increase student involvement, motivation, and interest in the material and allow instructors to creatively reinforce topics (Lewis et al., 1989).

2. BACKGROUND

Developing skills and knowledge in the field of information systems (IS) is difficult due to rapidly changing content, the amount of material that needs to be covered to establish foundation knowledge, the complex interrelationships among and between concepts, and the seemingly endless list

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of acronyms in the field (Downing, 2002; Gill and Hu, 1999; Silver et al., 1995).

A particular challenge facing IS faculty is how to efficiently convey concepts via lecture, but at the same time, effectively engage students in course content. The complexity of topics strongly suggests that students must be actively engaged in digesting concepts, rather than passively taking lecture notes and reviewing them in the days immediately preceding an exam. Moreover, as faculty, we have most likely experienced review sessions wherein students are ill-prepared to ask questions and the session degrades into a poor attempt to revisit multiple weeks of lecture in one period. Past research suggests that active learning techniques can engage students and positively enhance performance (Purao, 1998; Spruell and Le Blance, 1992; Zack, 1995). In the following sections, we describe how to incorporate two games as active learning techniques into IS courses in order to encourage students to prepare for and actively participate in reviewing course material. We discuss the impacts of the games on learning and performance.
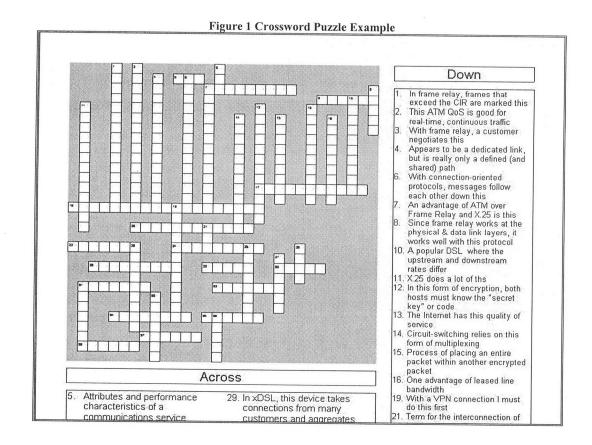
3. THE TEACHING TECHNIQUES

3.1 Crossword Puzzles for Homework

The first technique is the use of crossword puzzles as an out-of-class homework assignment. Relatively easy for an instructor to create (e.g., Crossword Construction Kit™ http://www.crosswordkit.com), the objective of the crossword puzzle is for students to complete it by answering questions related to course materials (in our case: telecommunications or database). While students may believe they are simply seeking answers to the puzzle, they are in fact actively reviewing course material. Specifically, the search for answers forces students back into lecture material delivered over several class periods. Similar to a typical crossword puzzle, students are presented with two columns of questions (down and across). Each question is numbered and corresponds to the number found in the puzzle. If the student cannot answer the clue, letters from previously answered questions may aid the student in correctly identifying the concept. Figure 1 presents an example of a telecommunications-related puzzle that we have used.

Although crossword puzzles can be completed individually, we have found that students typically work in groups to complete the puzzles, often leading to broader and deeper discussions of course topics. Puzzles can be assigned before or after course topics are covered. When assigned ahead of time, a puzzle helps provide a sense of direction for students as they can simultaneously work on a puzzle as new material is presented. Recently, we have also experimented with student teams developing their own crossword puzzles using concepts not included in the instructor-created puzzle. These puzzles are posted to electronic Web-repositories for use by other students.

Figure 1 Crossword Puzzle Example

Down

1. In frame relay, frames that exceed the CIR are marked this
2. This ATM QoS is good for real-time, continuous traffic
3. With frame relay, a customer negotiates this
4. Appears to be a dedicated link, but is really only a defined (and shared) path
6. With connection-oriented protocols, messages follow each other down this
7. An advantage of ATM over Frame Relay and X.25 is this
8. Since frame relay works at the physical & data link layers, it works well with this protocol
10. A popular DSL where the upstream and downstream rates differ
11. X.25 does a lot of ths
12. In this form of encryption, both hosts must know the "secret key" or code
13. The Internet has this quality of service
14. Circuit-switching relies on this form of multiplexing
15. Process of placing an entire packet within another encrypted packet
16. One advantage of leased line bandwidth
19. With a VPN connection I must do this first
21. Term for the interconnection of

Across

5. Attributes and performance characteristics of a communications service

29. In xDSL, this device takes connections from many customers and aggregates

In the end, crossword puzzles provide an innovative, unique, and fun opportunity for students to assess their own level of learning by identifying concepts not yet mastered (Baily et al., 1999). The inability to answer a question highlights areas of concern that can be addressed through further in-class discussion and/or student study. In addition, as a homework assignment, the crossword provides valuable insight to the instructor regarding the effectiveness of topic presentation. This insight can be used to alter future teaching methods and/or address currently problematic topics.

3.2 Jeopardy for Review Session
The second technique is the use of a Web-based Jeopardy game during designated, in-class, review sessions. Figure 2 illustrates the Jeopardy game deployed in a telecommunications class.
While not typically as comprehensive as crossword puzzles, due to class time limits and the number of possible questions, the Jeopardy game engages students in a fun and competitive fashion during the session. Again relatively easy to implement, the instructor identifies categories and answers (increasing in difficulty) to be addressed in the review. Our html-based game and instructions for course adaptation are available from the authors. We have specifically designed it to support the active learning process, e.g., it allows the instructor to embed links to relevant lectures. The game also has a hidden "double Jeopardy" answer as well as a "final Jeopardy" answer.
During the session, the game is implemented by dividing the class into two teams (A and B) with one student

identified as the score-keeper. The instructor flips a coin to determine which team begins the game, e.g., Team A. The instructor calls on the first student on Team A who makes a selection – e.g., in Figure 1, *"Mobile Voice for 200"*. The instructor clicks on the link which then reveals the answer. If the student can successfully provide the question, the Team receives the points and retains control of the board. The instructor then moves to the second student on that Team. If the student cannot provide the question, the instructor turns to the first student on Team B, who is provided the opportunity to ask the question. If correct, Team B is awarded the points and Team B now has control. The next student on Team B continues with another selection.

Importantly, if neither Team is able to provide the correct question (both lose points), it is opened to the class as a whole (with no points awarded). This step allows the instructor to expound on a topic that is generally problematic before proceeding with the game. After the discussion, if both teams were wrong, play reverts back to the next person on Team A. The game continues until the whole board is completed (or the class session nears an end) at which point both Teams play "final Jeopardy". Here, we allow each Team to select 1 individual as their representative. The final Jeopardy category is revealed and the amount of points to be "bet" is collected. Then, the final answer is revealed, with the two representatives recording their questions in written form. We allow teams to "bet" the larger of their total points or 1000, just to keep things interesting.

Figure 2 Example of Jeopardy Game

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In this interactive review session, the Jeopardy game allows an instructor to assess the current level of student knowledge, clarify problem areas, and reinforce critical information (Rotter 2004). Importantly, the game helps individual students to highlight areas in which they require more attention in exam preparation. Depending on class size (we have played with 25 to 45 students) and the incidence of incorrect responses, students typically get at least 2 turns on the board. The game generally takes about 45 to 60 minutes to play, depending on how much expanded discussion is warranted. Following the review session, students are provided with the game's URL link (and correct responses) so they can "play" the game again as they test their knowledge during exam preparation. Also, as shown in Figure 1, we provide a reference to specific weeks or lectures to assist students in targeting their review efforts.

4. THE STUDY

We hope the descriptions offered in the previous section illustrate how easy both techniques are to implement and that they offer a fun way to actively engage students (individually and in groups) in IS topics. Perhaps of greater importance, is that we have found that both techniques positively impact exam performance and are well received by students as learning techniques. The development and integration of the Jeopardy game and crossword puzzles into our IS courses has evolved over the last eight years, with lessons learned and modifications in use occurring over several semesters. Evidence of success was anecdotal, e.g., positive student comments on end-of-semester course evaluations, and supported by the fact that our approach has been adopted by colleagues not only in IS, but also other disciplines (e.g., Medical Sciences, Kinesiology) on our campus. Moreover, one of the authors of this article was invited to present these techniques at a university-wide teaching exposition, garnering inquiries and further adoption. Given this, we set forth to validate the benefits of the two techniques by formally examining exam performance and student questionnaire data.

4.1 Study Settings and Design
We evaluated the impact of the games on final exam performance in two courses: (1) a graduate telecommunications course (with 40 students), and (2) an undergraduate database course (with 37 students). The first course was S517 Wireless Systems, a telecommunications course offered in fall 2003 to MBA and MS graduate students. S517 focuses on the foundation concepts necessary to gain an understanding of the industry, cellular and mobile data networks, and m-business. The second course was S307 Data Management, offered in fall 2003 to undergraduate business students, in particular IS majors. S307 focuses on the foundation knowledge necessary for students to design, develop, and implement a relational database.

To assess effectiveness, the instructors followed the same procedures for game inclusion. Specifically, a crossword puzzle was assigned for homework approximately two weeks before the final exam. Jeopardy was played during the last class period (review session), one week before the exam. After the respective final exams, the authors administered a brief anonymous questionnaire to all students. The survey items were derived from the learning self-assessment items used by Alavi et al. (2002). The items included in the questionnaire are offered in the Appendix.

4.2 Results
With regard to exam performance, we coded the final exam questions for both courses to indicate which ones had been addressed in the crossword puzzle, Jeopardy game, or in both. For each student we identified the proportion of questions answered correctly in each of the three categories. Finally, for each course, we regressed these variables against student exam performance. The results are shown in Table 1 for both the graduate-level telecommunications course and the undergraduate-level database course. Our results provide evidence of the effectiveness of both games, albeit in varying fashions.

Table 1 Regression Results
Telecommunications Course

	R-Square	Standardized Beta
Model	.545	
Crossword		.493 *
Jeopardy		.016
Both		.460 *

* p < .001

Database Course

	R-Square	Standardized Beta
Model	.768	
Crossword		.307 *
Jeopardy		.682 *
Both		.043

* p < .001

In the telecommunications course, exam questions related to concepts covered in the crossword puzzle and in both games were positively related to performance, whereas the Jeopardy game in and of itself did not directly affect performance, i.e., it only contributed when a concept was also emphasized via the crossword puzzle. Conversely, in the database course concepts addressed in both games individually influenced performance. Thus overall, our empirical results provide evidence that one or both techniques can contribute to student learning. The efficacy of the games themselves to particular IS courses may be influenced by a number of things such as the nature of the course topics themselves, how uniquely or repetitively concepts are covered in the two games, as well as the number of questions covered in any given crossword puzzle. In the end, the true value of both games is the active involvement by students in the learning process.

Table 2 presents the questionnaire results. We found no significant differences between the graduate and

undergraduate courses. Thus, Table 2 reflects composite results from both courses.

Table 2 Questionnaire Results

Technique	Mean[1]	Std. Deviation
Crossword	4.112	.874
Jeopardy	4.311	.816

[1] Average of 5 survey items

With a "5" indicating "strongly agree" with statements regarding the positive benefits of the crossword and jeopardy game, the results strongly indicate that the students perceived value in both games. Prior to analyzing these results, we conducted a confirmatory factor analysis. Confirmatory factor analysis of the items supports the notion that there are two distinct constructs being assessed. Item loadings were all greater than .65 within construct and cross loadings were all less than .30. Overall, students perceived that both games helped increase understanding, the learning of factual material, and the identification of issues central to both courses. Moreover, both games were perceived as a fun way to engage in learning and topic review. It is important for us to emphasize that both games complement lectures. Both techniques, albeit in different ways, facilitate reflection and discussion among students and/or between students and the instructor. Interestingly, there was no significant difference across the courses or the games.

Overall, our results indicate that the use of games is beneficial, both in terms of exam performance and student perceptions of learning and the learning experience. It is likely that students assess the games positively because they are different from traditional classroom techniques, yet familiar.

The differences with respect to exam performance, while promising, also raise questions. Ultimately, we have evidence that the use of games, in this case crossword puzzles and a Jeopardy-like game, is associated with positive performance on exam questions that are directly related to material covered in the games. Yet, why there were differences in the relative impact of the games across the classes? One explanation could be the differences in the student make-up of the classes; the telecommunications class was entirely graduate students, while the database class was entirely undergraduate students. These differences in age, maturity, and work experience may have contributed to the differences in the relative importance of the games. Another possibility for the differences is the type of material covered in each course. Concepts and facts are most easily conveyed via the crossword puzzle. Jeopardy, while very good at reinforcing conceptual knowledge, does allow for some application (through the use of visuals, etc.). More research is needed to understand the nuances associated with different types of games. For now, it is reasonable to say that the evidence suggests they have a positive effect.

5. CONCLUSION

More often than not, student learning depends primarily on what the students do, both in and out of the classroom. The challenge is to select pedagogical techniques through which students can be actively engaged in mastering concepts (Bonwell and Sutherland, 1996). Games are becoming an increasingly popular tool used to encourage student involvement with course material. Clearly, the choice of strategies is affected by a number of considerations: the nature of course content, class size, teaching skills and preferences, and the abilities of the students. However, we believe that strategies such as the use of games, like those offered here, can promote active involvement in learning, increase student satisfaction with the learning process, and enhance performance. And, most importantly, these techniques are applicable in a wide variety of contexts.

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Appendix 1
Questionnaire Instrument

Students were asked to answer the following questions on a 5-point Likert scales scored 1 for "strongly disagree" and 5 for "strongly agree".

Items –
Crossword:
1. The crossword puzzle increased my understanding of basic concepts.
2. The crossword puzzle helped me learn factual material.
3. The crossword puzzle helped me identify issues central to the course.
4. Working on the crossword puzzle was a fun way to review class materials.
5. Completing the crossword puzzle helped me prepare for the final exam.

Jeopardy
1. Jeopardy increased my understanding of basic concepts.
2. Jeopardy helped me learn factual material.
3. Jeopardy helped me identify issues central to the course.
4. Playing jeopardy was a fun way to review class material.
5. Playing jeopardy helped me prepare for the final exam.

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