24/7 Lectures as an Exam Review Technique

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ABSTRACT

Assessment of student learning through tests, or examinations, is one of those necessary evils. No one seems to enjoy it, but everyone admits the necessity of it. Reducing student anxiety and frustration is an important activity to obtain a meaningful assessment of their learning. A common way for teachers to help students prepare is with a review session. This paper describes a structured review technique that actively engages every student in a multisensory way, requires little work on the part of the instructor, and is both entertaining and fun. Most important, this paper describes an empirical study that demonstrates the dramatic efficacy of the technique.

Categories and Subject Descriptors

K.3.2 [**Computers and Education**]: Computer and Information Science Education—*Computer science education*

General Terms

Performance, Human factors, Experimentation

Keywords

Pedagogy

1. INTRODUCTION

An ample supply of education research exists indicating the important role feedback plays in student learning. As early as 1923, Jones determined that administering practice tests immediately after lectures led to improved retention of material among students [7]. In his seminal teaching handbook "Teaching Tips", McKeachie suggests a nongraded practice test as a method of reducing student anxiety and improving test performance [11]. Lowman suggests short practice exams that are graded and returned but not recorded [10]. Addison notes in a study of two courses that students who missed one or more post-exam review sessions performed significantly worse on the final than students with no absences [1]. Furthermore, Balch reports that practice exams are more effective than reviewing exams and the increased scores are irrespective of student academic ability [2].

Another form of test preparation is the use of review sessions that are held before tests or finals. Unstructured review sessions in which instructors prepare review material and answer student questions are one option. Unfortunately, instructors find the lack of student participation in such review sessions frustrating [10]. Students often do not prepare questions and some attend only to avoid missing anything – they do not wish to actively participate. Instructors can improve student attendance by using a regular class session, but at the cost of losing class time that could be spent on new material.

Lowman suggests a better review session method is one that is structured. For example, all students answer practice questions, compare responses with other students, and discuss answers provided by the instructor. Another way to structure a review session is to model the activity after popular games or television shows. Kaupins describes variations of "Who Wants to Be a Millionaire", "Family Feud", "Boggle", "Outburst", and "The Amazing Race" that function as exam review sessions [8]. Keck describes a similar strategy based on the "Jeopardy" game show [9]. These types of reviews can be fun and entertaining, properties that can serve to engage student participation. Deeter uses another structured review session in which students help her develop many of the exam questions [3]. Beginning with lists of content, she challenges students to generate questions that would assess their understanding of these concepts. A part of this process includes discussion of the correct answers.

A drawback of these types of review techniques is that the onus for preparation is placed upon the instructor. In addition, these techniques tend to be quite time-consuming to conduct, possibly causing the instructor to decide to hold the session outside of class and risk students being unable or unwilling to participate. In this paper, we discuss the use of a simple review technique based upon the 24/7 Lectures presented in the Ig Nobel Award ceremony. Our 24/7 review technique requires a minimum amount of effort on the part of the instructor, yet engages the student in a multisensory manner. The technique can be structured to take less than a regular session if instructional time is limited. In addition, an analysis of exam results indicates that students, in general, perform better on those questions related to their 24/7 Lecture. We believe that with a little "tweak-

ing" of our 24/7 review technique, student performance will increase even more.

2. 24/7 LECTURES

Improbable Research is an organization focusing on research that makes people laugh and then think. For example, a classic article in the Annals of Improbable Research titled "Does it Rain More Often on Weekends?" uses valid weather data to arrive at an answer to this quirky question. In addition to the magazine, the organization sponsors a website and the annual "Ig Nobel Prizes" awards ceremony. The Ig Nobel Prizes are a frequent topic of a fall episode of NPR's Science Friday. Part of this ceremony is the 24/7 Lectures in which top thinkers explain their subject twice: first is a complete, technical description in 24 seconds, and second is a clear summary that anyone can understand in 7 words.

The lectures are entertaining and informative. As an example, below is the 2006 24/7 Lecture on History by Jill Lepore of Harvard University [12, 6]. (Note that to ensure they finish within the time limit, many lecturers speak very fast resulting in some difficulty in transcription.)

> *History is in an enduring travel to an archive repository or a library, bring in pencil, fill out little (unintelligible); be the chicken scratch of letters, diaries, love notes, speeches, scrapbooks, (unintelligible), unopened mails, stranger and wondrous people you've never met and never will but you probably should could have. Find out everything you can about how they understood why hens lay eggs. Think about it. Think about it some more, and then make up some cock-and-bull story.*
>
> The 7 word summary was, **History is the study of dead people.**

In the fall of 2007, one of the authors just happened to tune into the NPR Science Friday show that presented the Ig Nobel Prizes and realized that the 24/7 Lecture format might be a way to actively involve students in their learning. The following semester the author had students prepare lectures on various sections of textbook chapters and deliver them to the class. The results were disappointing. Upon reflection, it was determined that what makes the 24/7 Lectures humorous and informative is that the audience has a high level of familiarity with the subject matter. However in this particular case, students only read their assigned section and so were not familiar enough with other students' textbook subject material. The thought was then to use the 24/7 Lecture as a review mechanism on course material that all students were previously exposed to during the term. In the spring of 2008, the author retried the 24/7 Lectures this new way with great success. The exam review session was fun, students expressed genuine interest even asking for a second session, and many of the lectures were quite good and useful. After collaborating with the other authors, it was decided to attempt a more rigorous study of the efficacy of the technique.

3. THE EXPERIMENTAL SETUP

The goal of the experiment was to measure the effectiveness of using the 24/7 Lecture as a means to structure an exam review session. Students prepare one or more 24/7 Lectures on various topics related to the course and provide written versions on a class wiki so that all students would be able to use them when studying. In addition, during the exam review session each student delivers orally their own 24/7 Lecture.

Four instructors at two different schools teaching six different courses across all levels of students (freshman through senior) participated. The 24/7 Lecture format introduces constraints on the students. We modified the constraints slightly to investigate any affects. Two instructors used the classic 24/7 format of 24 seconds with a 7 word summary. Students were told they could not be over (a very loud buzzer would sound) or be too far under the 24 second clock. The other instructors used a modified format of 24 words with a 7 word summary. Table 1 shows some of the course parameters.

Some of the instructors assigned review lecture topics and some did not. One class used the technique for a test and the rest for the final exam. Some of the student lectures were deemed "unusable" for the study. This could occur when a student selected a topic that was too easy (e.g., one Data Structures student lectured on sequential search) and thus this lecture was not covered by any exam question. Some students presented a lecture during the review session (so they prepared), but did not post to the wiki and so our ability to map their lecture topic to exam question(s) was impaired.

A short eight question survey was developed to attempt to measure student perceptions about the technique on a 5-point Likert scale. One instructor had student evaluations be optionally completed outside of class and returned, and the others provided a small amount of class time for student evaluations.

4. EXPERIMENT EVALUATION

Three forms of evaluation are presented, an objective measure of student performance, a subjective measure of student perceptions, and a subjective measure of instructor attitudes.

4.1 Student Performance

The objective measurement relates student exam performance to student preparation of a 24/7 Lecture. Exams were graded by the instructors, but in the usual way with no conscious predisposition to lecture topics or exam questions. Exams were generally administered several days after the review session and graded several days after the administration. Later, instructors correlated lecture topics to exam questions. Some lecture topics were not covered by any exam question and some exam questions assessed course material not covered by any student lecture. However, there were 70 instances of student lectures that did map directly to examination question(s).

For each topic, the number of exam points was calculated. Some topics were covered by more than one question. For each student, their score on those questions was computed. All scores are normalized to 100. This results in a table similar to the one shown in Table 2.

The asterisks denote that the student prepared a lecture topic; thus, student 2 prepared a 24/7 Lecture on AVL trees. Generally, half of a class will score above the average and half below. Thus, we hope that students consistently score

Table 1: Some experimental parameters

Course	# Students	# Usable Lectures	24/7 Format
Machine Organization	17	11	24 seconds, 7 words
Data Structures	27	31	24 seconds, 7 words
CS2	20	9	24 words, 7 words
Operating Systems	13	7	24 words, 7 words
CS1	13	7	24 words, 7 words
Graphics	10	5	24 words, 7 words
Totals	100	70	

Table 2: Sample data collection

Student	Heaps	AVL trees	Iterators
1	62	*100	50
2	71	*33	75
3	76	*78	*63
4	95	100	*88
5	*95	78	100
...	...	...	...
N	100	100	*100
Averages	67	51	72

above the average on questions that they specifically reviewed through their 24/7 Lecture. In Table 2, we can see that students 1 and 3 did score above the class average on the AVL trees questions; however, student 2 scored below the average. Only student 5 delivered a lecture on heaps, scoring above the average.

Across all 6 courses we have 70 instances of correlated topics and questions (i.e., asterisk entries). In these cases, 71% of the time students scored at or above the class average on topics on which they had prepared a 24/7 Lecture. Breaking out the differences in the lecture formats results in 67% for the classic 24/7 format and 79% for the modified format in which student lectures consisted of exactly 24 words. Thus, having students prepare a 24/7 Lecture does indeed seem to improve student exam performance.

We expect that very good students would be scoring above the average anyway and likely contributed usable lectures. We wanted to consider the results by eliminating this "upward pulling" effect. We examined the data again focusing on only those students whose overall examination score placed into the lowest third of the course. These students are generally scoring below the average. Yet, for those questions that these students prepared a 24/7 Lecture, they scored above the entire class average 59% of the time. Breaking out the differences in the lecture formats results in 57% for the classic 24/7 format and 63% for the modified format. This indicates that the 24/7 Lecture exam review technique is indeed helping those students who need the most help.

The next question to consider is the effect 24/7 Lectures have on other students. That is, does student A's 24/7 Lecture help student B and student C do better too? To answer this question the data was examined comparing student performance on all the questions covered by any student's 24/7 Lecture to student performance on the exam as a whole. We found that 54% of the students scored higher than their overall exam grade on those questions that were covered by some 24/7 Lecture. In addition, the average score (normalized out of 100 points) was 2 points higher on that portion of the exam that related to the 24/7 Lectures than the av-

erage score of the entire exam. This is a mild indicator that even just hearing another student's review lecture can be beneficial.

4.2 Student Perceptions

Students were asked to complete a survey to gauge their perceptions of the 24/7 Lecture exam review technique. Responses were received from 84 students with results shown in Figure 1. We surveyed students after the review session and before administration of the final exam.

Questions 2 and 3 indicate that students do not feel overwhelmed by the activities required on their part for this review technique. Questions 4 and 5 reveal that most students agree or strongly agree that the technique is beneficial to them. Question 1 shows that about a third of students are uncomfortable presenting in front of class; however, when asked in question 7 about presenting their 24/7 Lecture only about 20% expressed an uncomfortableness. Thus, for a number of students the fun aspect of the activity won out over their normal predisposed fears. Generally, most students found the review technique an experience worthwhile enough to recommend to others. There were, however, a small group of students that were not satisfied with the experience as indicated by several survey results in which students consistently selected the more negative response.

4.3 Instructor Attitudes

The instructors believe that the 24/7 Lectures were an effective review technique for their students. Given that the results were not substantially different for the two forms of lectures we used, we believe that the real learning is occurring for three reasons. First, the format demands a repeated engagement with the material. In the case of the classic 24 second format, students must develop their initial lecture and then practice delivering it. Likely they will need to make some adjustments – it might be a little too long or a little too short. They must then return to the writing and practice again. In the case of the modified 24 word format, they would likely need to rephrase wordings several times to end up with 24 words. It is interesting that it does not seem to matter what the constraint actually is so much as there is some constraint that forces this repeated engagement. The second reason we believe it was successful is the multisensory nature of the experience. Students are engaging with the material visually by seeing their own writing, tactilely by doing the writing, and aurally by hearing themselves speak. Finally, the 24/7 Lecture is an application of the pedagogical pattern "Explain It Yourself" based upon the insight that individuals understand concepts better when they can explain them in their own words [4].

The 24/7 Lecture review technique requires very low ef-

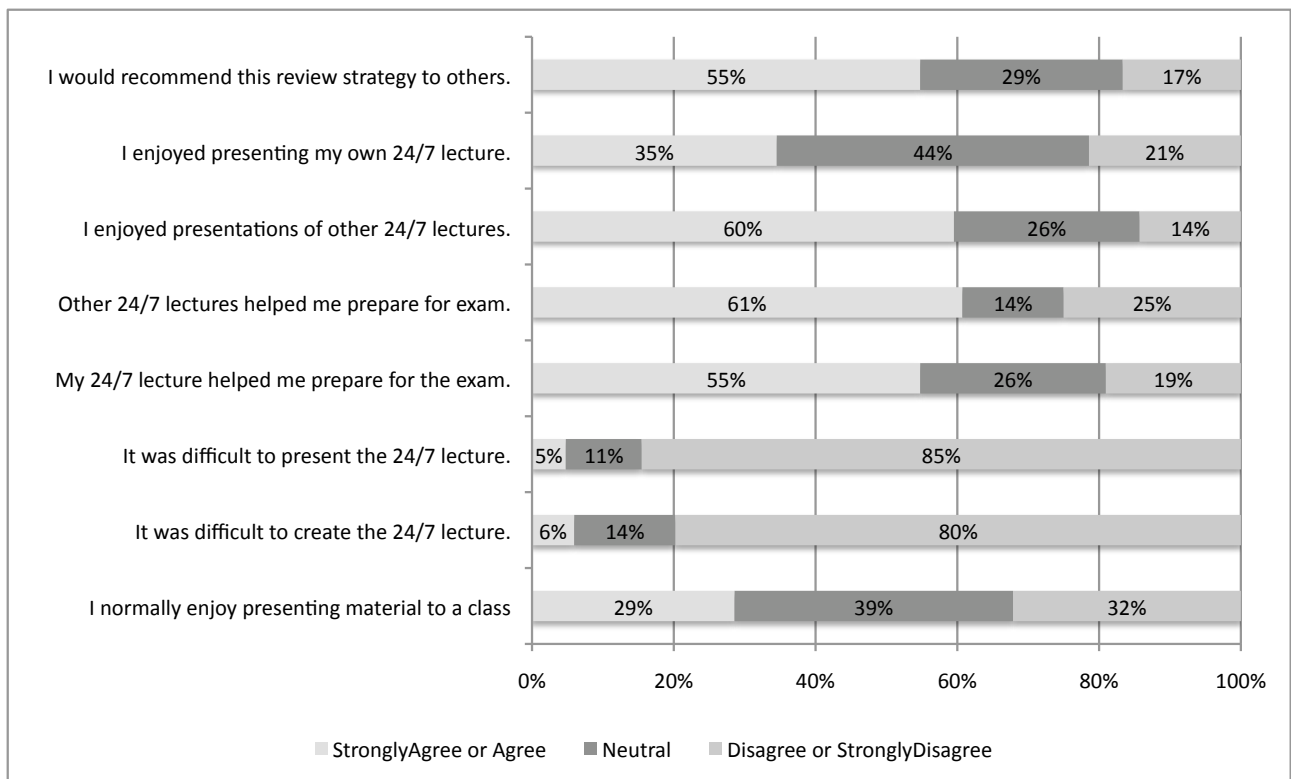| | StronglyAgree or Agree | Neutral | Disagree or StronglyDisagree |

Figure 1: Student perception survey results

fort on the part of the instructor. Some instructors chose to come up with categories of questions, but these are more-or-less aligned with course goals and objectives and is thus not a difficult task. Some of the instructors spent some effort to keep the review wiki page formatted nicely and sensibly (some students just cut/paste their wiki lecture entry anywhere!).

The instructors are excited about continuing to use the review activity with perhaps a few slight modifications (see the next subsection). In addition to the fun of the activity and improved exam scores, students are provided with an opportunity to improve public speaking skills. As the students indicated in the survey, they do not generally feel comfortable speaking in front of a class. Yet, it has long been recognized that strong communication skills are crucial for CS majors [5]. Small, well-structured opportunities for public speaking, like this review technique, can be an important part of this skill development.

Some of the lectures were not of a high quality, but many of these students would probably be minimally engaged in any review activity. Yet, overall, we were impressed with the lectures. The first sample below is taken from the set of 24/7 Lectures created for a *Data Structures* class. The second lecture is taken from the sest created for *Assembly Language and Machine Organization.*

> *An AVL tree is a balanced binary tree because it keeps the entries balanced around the root. To keep the balance the tree performs a rotate left or rotate right depending on where the new node was placed. These can come as a single rotate or a double rotate. A double rotate is just a combina-*

tion of both single rotates, just in a specific order. Double rotates are caused by inner grandchildren, while single rotates are outer grandchildren.
Summary (referencing the movie The Karate Kid):
A rotate right looks like wax on.

> *With the n-thpe if it is given 2.9 Volts than it's gate link will be closed, but if the n-type is given 0 Volts then it's gate will be open. The p-type is the exact opposite. So basically for an inverter if the input is a 1 then n-type will cause the output to be a 0, but if the input is a 0 then the n-type can't run the power out and the p-type will cause the output to be a 1.*
Summary: **n is zero so p is hero.**

4.4 What might we try different?

We are excited by the success of the technique and intend on using it again in the fall 2009 term. Based on our experiences, here are a few ways we could "tweak" the approach.

Letting students choose their own 24/7 Lecture topic can be a weakness. There were definitely a number of lectures submitted that were on subject matter not deemed all that important by the instructor. For example, in the Data Structures course, the unit on Big-Oh complexity analysis begins with a simple O(n) sequential search to lay the groundwork. This is followed by the more interesting and important binary search and the various sorting algorithms. However, one student chose sequential search as their lecture topic. To address this, we will likely provide students with a list of review topics to ensure a decrease in lectures on topics that are not covered by questions on the exam.

Delivery of an individual 24/7 Lecture takes very little time so the technique could be incorporated into class sessions other than an exam review session. It might be beneficial for students to consistently be developing 24/7 Lectures during the term. Periodically, the instructor could use 5 minutes of class time for randomly selected students to deliver their lectures. By the time of the final exam review session, students would have developed a portfolio of course 24/7 Lectures. A final exam review session might not even be needed, since it essentially has been distributed throughout the course. However, a fun review session could involve voting for the most clever lectures of the year and reprising those during the review session.

As was described previously, we attempted a modified format that used 24 words rather than 24 seconds. Interestingly, the results are not that different between the formats. We believe the key to the improved student learning that is occurring with both formats is the presence of the constraint (24 words or 24 seconds). So, modifying the constraint in various ways could still serve the purpose of increased student learning. One idea is to provide a third level. Allow a student to write an "unlimited" lecture (or provide a high cap of 250 words for instance). Then require them to also provide a version of the same lecture that is pared down to say 50 words. Lastly, require a third version that is pared down to the seven word summary. This approach teaches valuable skills including abstraction and stepwise refinement.

5. CONCLUSIONS

This paper presented a review technique based upon the entertaining 24/7 Lectures presented at the Ig Nobel Award ceremony. An analysis of the exam results indicated that 71% of the time students scored at or above the class average on exam problems related to their 24/7 Lecture. 54% of the students scored better on those portions of the exam related to the 24/7 Lectures presented by the class than they scored on the exam overall. In addition, the average student score for students on the portion of the exam related to the 24/7 Lectures was 2 points higher than the average score on the exams overall. The technique requires little effort on the part of the instructor yet engages students in a fun and multisensory way.

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