Engagement of Millennial Students Using Web-based Screen Movies to Replace Traditional Lecture in Lecture/Lab Courses

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Abstract - **An emerging literature focuses on differences in learning style between the so-called millennial generation and preceding generations of students. Concurrently, engineering educators have developed a number of intuitions about millennial students, most with the common theme of lowered tolerance for lecture settings. Two current threads addressing the "lower attention span problem" are (a) approaches under the rubric active learning and (b) technology developments such as web-enabled screen movies and pod-casts. The second thread is often aimed at a technology "fix." Experience shows that any technology fix is of itself minimal value. Specifically, our research question is the following: In traditional lecture/laboratory courses what is the effect of replacing lecture sessions with web-based, voice-over slide presentations punctuated with full screen demonstrations and interactive quizzes? We report results from a side-by-side study that replaces lecture with screen movies for three of ten lab sections in a high enrollment, computer tools and problem solving course. Results generally indicate no significant difference between the treatments for learning outcomes, attitudes towards engineering, and attitudes towards the screen movies. Student survey data indicates very favorable attitudes towards the screen movies in general. The results are encouraging given the early state of screen movie development.**

Index Terms - millennial student, web-enabled voice-over movies, active learning, hybrid course, alternative models for high enrollment classes.

INTRODUCTION

An increasing number of academics share common perceptions about the so-called millennial students - students who are matriculating to universities in the early years of the twenty-first century. These perceptions encompass a large range of anecdotal observations; many focus on differences between millennials and former generations in their learning styles and on differences in effective means of supporting learning of the millennials. Definitive studies demonstrating these putative differences are lacking in the literature, but discussion of the millennials is growing across a broad range of disciplines; e.g., [1-3].

A point that is commonly mentioned by faculty is that the millennials have little patience with standard linear textbooks, or by extension, with linear text put up on the web as PDF. Experience with and immersion in multimedia experiences, usually web-based, are often thought to be the reason for this attitude towards the linear presentation of textbooks. Whatever the reason, there is a need to reexamine knowledge-delivery methods with the goal to better meet the needs of millennial students. We do not seek a "tech fix."

Our first goal is to leverage current technology capabilities while starting from the position that we will embed active learning in our applications of current technology.

Our second goal is to determine the initial viability of the hybrid class model in which lecture is replaced by screen movies and lab or recitation continues as a live activity.

Our second goal is motivated as follows. It is often pointed out among engineering educators that "we know what the problem is - all we have to do is fix it." The problem pointed to is the large lecture format of many of our first and second year classes. The way to fix the problem is quite simply to do away with those high enrollment courses, replacing them with classrooms having 20-30 students and a seasoned and interactive faculty person. The "problem" and the "fix" are independent of discussion of millennial students. In a perfect world, classes of fewer than 20 students would be the norm at all levels. In the current economic climate that perfect world will not be attainable in most institutions. Developments to help make a high enrollment course more engaged or active include the one-minute paper [4], personal response systems [5], cooperative learning methods in general [6], and a number of others. But the large lecture format remains.

For a technical course that has lecture *and* a small group meeting (recitation or lab), we see an alternative model: a well crafted and executed set of content screen movies *and* the standard small group meetings. This second model is essentially a hybrid class model: part on line, and part live. But there is a twist. Typically it is difficult determine in a principled way what part of a hybrid class should be online and what part should be live. In our setting, the online portion of the course is precisely the course part least palatable for millennial students - the portion that is traditionally a large lecture. In our model, the live part of the hybrid course remains the small group meeting.

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BACKGROUND

Our research compliments the body of literature on web-based delivery of course material. Although a very large literature exists regarding computer-based learning in general, and web-based delivery in particular, there is very little work on the type of environment in which our work is carried out: web-based delivery of screen movies replacing the lecture component of a lecture-laboratory, high enrollment course. For example, Willett [7] and Rivera, McAlister and Rice [8] have conducted studies by artificially partitioning of a course into live and web-based elements. This is in contrast to our setting in which a natural course decomposition is available around lecture as one component and laboratory meetings as a second component. Likewise, many studies have focused on the use of hybrid course models in delivering part of a course to non-traditional, older learners; e.g., Koohang and Durante [9]. Again, this is different than our target of early, high enrollment, lecture/laboratory classes.

There are very few studies reported that parallel our research focus. The closest of which we are aware is a study by Utts et al [10]. In this study, Utts and her colleagues examine the learning and attitudinal outcomes for a side by side comparison of an elementary statistics lecture/recitation class compared to the same class but configured as a lecture only class with substantial course material delivered on the web. That is, the experimental manipulation by Utts et. al. was to drop the recitation part of the class and replace it with web delivered material. For our study, we dropped the lecture component and replaced it with web delivered material.

PROJECT ENVIRONMENT

Our target class for this study is CSE 131: "Problem Solving with Computer Tools." CSE 131 is a high enrollment (200 students per term), early engineering course focused mostly on problem solving with MATLAB. At the time of this study CSE 131 was a required course for all undergraduate engineering majors except for electrical engineering and computer science students. CSE 131 is a lecture/lab course in which students meet once per week in a large lecture setting, and twice a week in hands-on laboratory (22 students per lab). Lecture periods and lab periods are all eighty minutes long. Demographics of students entering CSE 131 are highly variable and present a challenging course environment for faculty.

In Fall 2008, there were ten lab sections of CSE 131 and one lecture section. Each lab section had between 15 and 22 students enrolled. Each lab section was staffed with two teaching assistants - making the student:staff ratio 11:1 at worst.

Seven of the ten lab sections were conducted in the "traditional" manner: students went to lecture meeting once per week and to their assigned lab section twice per week. A faculty person well experienced for this class conducted lecture, in which active learning methods and techniques were the norm. In particular personal response system (PRS) units were used extensively.

Concurrently, three lab sections were designed "no lecture" sections: students were not required to attend lecture at all, but had the traditional two lab meetings per week. In lieu of lecture, students were presented with screen movies that delivered the same content as lecture.

The screen movies were developed and produced by the same faculty person who delivered the live lectures. The screen movies were not "talking head" movies; i.e., not a taped lecture put up on the web. Rather, they were "instructor talk" over Power Point or screen demonstrations. An informal description of our approach is that we design the screen movie experience to give a student the feel of 1:1/faculty:student sessions.

The screen movies included embedded quizzes that students took, and that were used to effectively build user-tailored paths through the screen movie content. Student quiz answers could be used to direct the student to a different part of the screen movie.

Students in the lecture/lab sections had available the same screen movies that students in screen movie/lab section were required to watch. In most weeks of the course, these students were not required to watch the screen movies. In two weeks of the course, lecture was not held and the lecture/lab students were required to use the week's screen movies.

Students in the screen movie/lab sections were not required to go to lecture, and almost uniformly, none did.

All students self selected for either a traditional lecture/lab section or for a screen movie/lab section. Current IRB regulations at Michigan State make it quite hard to obtain approval for random assignment studies.

RESEARCH QUESTIONS OF THIS STUDY

There are four research questions we targeted in the current study:

1. Is there any statistically significant difference in learning outcomes between the lecture/lab sections and the screen movie/lab sections of the course?
2. Is there any statistically significant difference in attitudes towards engineering between the lecture/lab sections and the screen movie/lab sections of the course?
3. Is there any statistically significant difference in attitudes towards the screen movies between the lecture/lab sections and the screen movie/lab sections of the course?
4. What is the attitude of students in both the lecture/lab and in the screen movie/lab sections towards the screen movies?

DATA COLLECTION AND RESULTS

As a preliminary, because students were not randomly assigned to either a lecture/lab section or a screen movie/lab section we needed to determine if there was some selection effect. For example, one might suggest that students who were more "self starting" might prefer to be in a screen movie/lab section. We would also expect "self starting" students to be in general higher performing students.

As a metric for the level of performance expected of students, we obtained the beginning-of-term grade point average (GPA) of all students. Grouping all students in the seven lecture/lab sections into one group, and all students in the three screen movie/lab sections into another group, we compared the GPAs for the two groupings. Based on a T-test, we found no statistical difference between the two groups. We conclude that although students self selected into the lab sections, there was no a priori expected performance difference between the students in the lecture/lab sections and the students in the screen movie/lab sections.

The metrics we used for **learning outcomes** were direct: the course points earned in each of all categories of graded work in the course, plus the total of all categories (out of 100 possible term points). Students in all sections got comparable work assignments/tests. There were six relevant categories of graded work: (a) the final examination, (b) the midterms, (c) in-lab quizzes taken in the first half the term, (d) in-lab quizzes taken in the second half the term, (e) EXCEL/WORD assignments, and (e) sum of a-e - total term points. All graded work was over MATLAB topics except for category *e*. Category *c* consisted of short quizzes at the end of lab sections, taken individually. Category *d* also consisted of short quizzes at the end of lab sessions, and also taken individually. However, in the second part of the term, students worked in study teams. The *d* category quizzes included a grading component for each student based on how well the other students in his group performed. The grading metric was 75% based on the individuals score, and 25% based on the average of his teammates score.

Comparing results between the lecture/lab sections and the screen movie/lab sections, there was no statistical difference in results based on a T-test comparison with significance at the 0.05 level for all grading categories.

To assess **student attitudes towards engineering** in the two types of sections, we used the Pittsburgh survey [11] as modified by Malik [12]. The survey instrument was administered to students in both sections in the second week of the term, and in the fifteenth week of the term. Shifts in attitudes were measured. And the difference between the lecture/lab sections and the screen movie/lab sections was tested. After some adjustment in the psychometric groupings of test items in the Pittsburgh survey (which will be described in a forth coming paper), it was found that there was no statistical difference in the attitude shifts between the two groups, save one factor. A matched T-test revealed that the screen movie/lab sections produced students whose attitude towards studying alone was enhanced over the course of the semester as compared with their counterparts in the traditional lecture/lab sections.

To assess **student attitudes towards the screen movies**, we developed a short survey that was administered in the fifteenth week of the semester. This survey served two roles in our work. First, we used results of the surveys to compare student attitudes towards the screen movies in the lecture/lab sections versus student attitudes towards the screen movies in the screen movie/lab sections. Recalling that students in the traditional lecture/lab sections experienced one week in which they were required to use the screen movies, and also recalling that they could use the screen movies optionally whenever they wanted to, we used the comparison across the two treatments to probe for any push back from the screen movie/lab students at being "forced" to watch the screen movies and at the same time being "deprived" of a live lecture.

Comparison of survey results showed no significant difference on any "attitude about screen movie" question between the traditional lecture/lab sections and the screen movie/lab sections. The point will also be discussed below.

The second role of the "student attitudes toward screen movies" survey was simply to get a reading of how our students in both sections were experiencing the screen movies, and in particular their attitudes about screen movies in comparison with standard lecture classes. While space will not permit a full exposition of the results, the graphs below are representative of a strongly positive set of attitudes towards screen movies as a content delivery mechanism in a hybrid class.

Figure 1 below shows the most basic of attitudes towards the screen movies – do the students believe the screen movies are a valuable alternative to standard lecture. The histogram shows data for both the traditional lecture/lab sections (marked "lecture" in the graph) and the screen movie/lab sections (marked "screen movie" in the graph). The take away message from Figure 1 is that around 80% of students have favorable attitudes towards screen movies compared to standard lecture and that around 40% of students have very favorable attitudes.

Figure 2 below shows responses to a survey question trying to get to the same concept (what do the students feel about the screen movies compared to standard lecture) but doing so from the opposite direction – do the student feel that the screen movies hindered their learning (implication: the lecture would have been less hindering). Again overwhelmingly, students registered attitudes that indicated satisfaction with the screen movies.

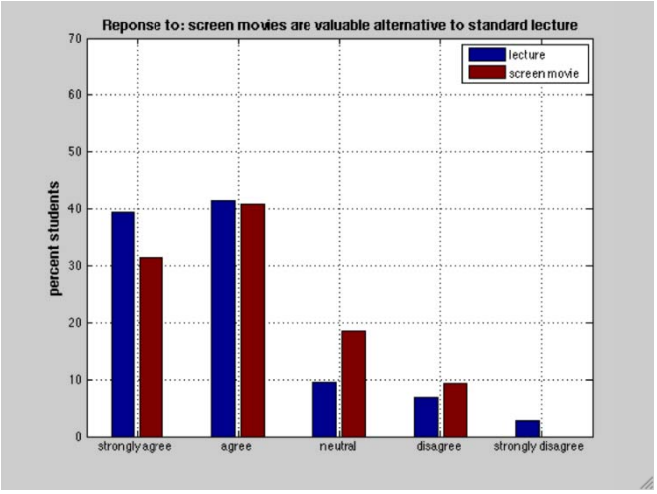

FIGURE 1
Response to "screen movies are valuable alternative to standard lecture"

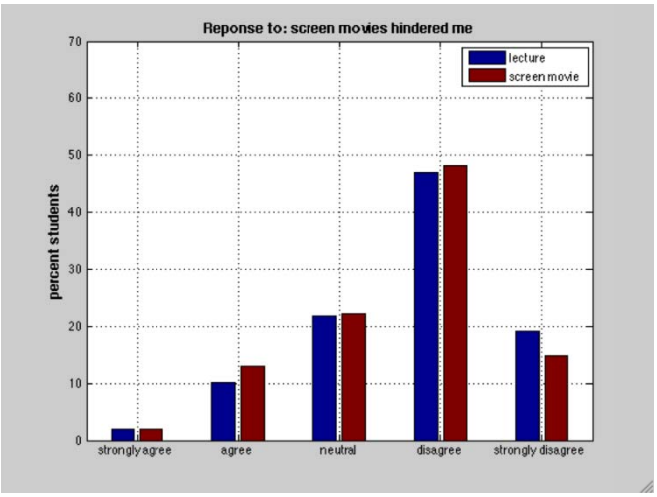

FIGURE 2
Response to "screen movies hindered me"

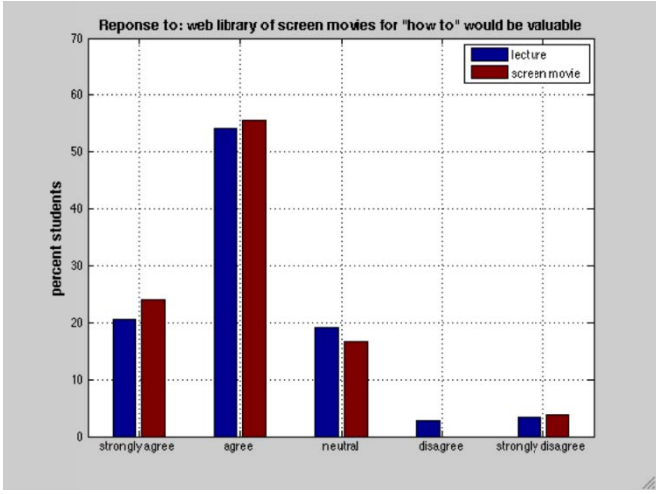

FIGURE 3
Response to "web library of screen movies would be valuable"

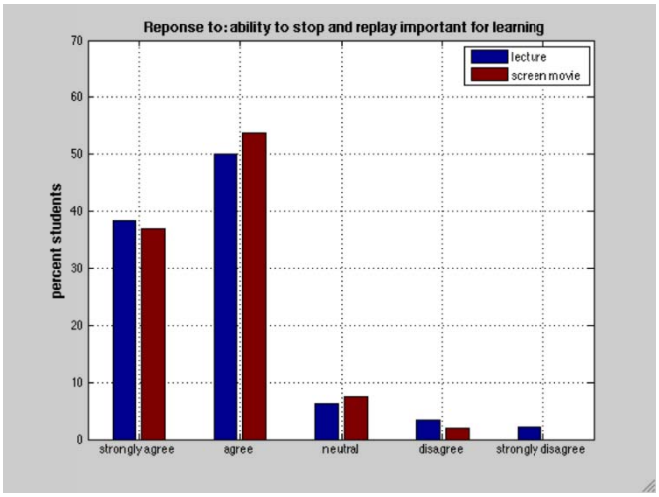

FIGURE 4
Response to "ability to stop and replay important for learning"

Figure 3 above shows results on a question that looks beyond the current study but still speaks to the utility that students see for content delivery by web-based screen movies. The results in Figure 3 are for a question asking students if they feel that a web-based archive of screen movies on tool use would be of value. The specific context of this question is MATLAB tool use. 70-75% of students had favorable responses to this question, indicating students see continuing value in the web-based screen movies.

Figure 4 above shows results from a probe on features of web-based screen movies. The goal was to test one feature that is often mentioned as being important in student perceptions of such movies: ability to stop and rewind. Our results support the commonly held view that the stop/rewind option is very important for students; around 90% of our students report this is either important or very important.

ANALYSIS AND DISCUSSION

Our results from the (modified) Pittsburgh attitude survey revealed one puzzling result: students in the screen movie sections valued more highly working alone (as opposed to within groups) at the end of the term than at the beginning. This result is logical; the students in the screen movie treatment were required to work on their own to watch the screen movies. On the other hand, a key goal in engineering is for students to become effective members of work teams.

On reflection, this result does not point to a problem with using screen movies. Students come to a group work setting best if they are prepared to take part in the work of the group. In fact, successful participation in group work requires that the participants each do their own part before the group meets. Although conjecture now, it would seem to be logical that students who are motivated to work well on

their own will also work well in group setting when the opportunity arises. CSE 131 does not exercise strong elements of group work. More study is needed to explore this interaction between attitudes about working alone and ability to work in a group setting.

As we noted earlier in this report, a somewhat parallel study to work reported here is the work by Utts et. al. [10]. Utts worked in a context of an introductory, high enrollment statistics class that was organized as a lecture/recitation class. In a side-by-side study, she removed the lecture component of the class and replaced it with web-based delivery of course material. Compared to the traditional class, Utts found that learning outcomes were not statistically different across the two treatments. She found however that student attitudes towards the course were significantly worse for the experimental treatment. These results cannot be compared directly to ours because we do not report here on the attitudes towards the *course*. But we do report on attitudes towards the web delivered component of the course: attitudes towards screen movies. We believe the results that Utts found are just opposite of what we find. We also find it quite reasonable that the opposite polarity is present. Utts removed the recitation – the part of the class in which students had maximal individual attention/interaction. We removed the lecture section.

Our experience with voice-over screen movies with embedded full motion demonstrations and interactive quizzes has demonstrated that (a) replacing lecture in lecture/lab courses such as our test bed (high enrollment, first or second year course, oriented at technical issue) does no harm to learning outcomes, and, somewhat paradoxically, shows some mild promise for producing better learning outcomes for group oriented activity.

By definition, our class population is made up of millennial students. We view our results as setting the stage for better understanding of the linkage between millennials and instructional methods that better serve this current population in our institutions.

Our screen movies are currently primitive in terms of what they can be. We believe eventually screen movie use in lieu of lecture in high enrollment, lecture/lab courses may provide a practical missing link in helping our millennial students feel they are in a small environment (small class) when in reality they are in a high enrollment class.

ACKNOWLEDGMENTS

We gratefully acknowledge the generous support of the MathWorks to Prof. Sticklen to integrate computational tools vertically through our engineering curricula. We also thank Bill Sherman, Steve Cronin, and Tim Plumer of Adobe for very valuable help in developing the infrastructure to efficiently create the library of voice-over screen movies that this work utilized.

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