

Impact of On-line Lectures for an Undergraduate Mechanisms Course

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Abstract

This paper covers an initiative completed by the co-authors of capturing lectures for an undergraduate mechanisms course. In the fall of 2010, all lectures for the core course were presented live to the entire class. However, the first time at the Faculty of the authors' university, they were also recorded and available on-line for individual viewing at the students' convenience. The authors obtained feedback from the students not only throughout the term with informal conversations and assembling comments from the on-line discussion board, but also by carrying out a formal questionnaire at the end of the term. This paper covers the details employed to complete the capture the lectures of the mechanisms course. Also presented are the responses by the students in a number of critical areas, including student attendance, and the reasons and level of viewing of the captured lectures.

Introduction

The Mechanical Engineering program at the authors' university includes a course entitled *Kinematics and Dynamics of Machines* (MIE301), which covers a wide variety of topics of mechanical devices, including linkages, gears, and cams. The content of the lectures in MIE301 includes a combination of delivering notes in real-time, demonstrating mechanical models, showing computer animations and playing of video clips.

The authors developed the *Multimedia Enhanced Electronic Teaching System* (MEETS) to effectively provide presentations in the lectures of MIE301, even when the class size is very large [1]. The signals which are seen and heard during the live lectures may be recorded.

Lecture capture refers to any means by which live lectures are recorded so they may be available at a later time. It can involve the recording of audio and/or video signals of the instructor, and may be extended to the capture of demonstrations of physical systems, video clips and computer animations. The MEETS is ideally suited to be used for lecture capture so that they may be made available on-line for the students soon after the lecture. The students may then review the content from the previous class.

Engineering courses traditionally require rigorous note-taking in the classroom and this often presents a challenge for sometimes missing key points of crucial visual demonstrations. Lecture capture allows flexibility in learning and accommodates the many different learning styles for

engineering students. It allows the students to focus on the presented material knowing that the full content including all demonstration of physical models, will be available for review after the lecture. In addition, should students miss the opportunity to copy important notes or formulas while listening to or watching the instructor the entire lecture, the captured material will be available for review immediately after the lecture.

The ability to for the engineering students to have full knowledge of previous lectures and better understand the content allows the students to be further engaged in subsequent lectures. As one student commented, “I am happy coming to class and want to come to each lecture because I feel prepared for the lecture”

Capture of Lectures for the Mechanisms Course

The MEETS, which was developed by the authors, is shown in Figure 1. It uses two document cameras to project hand written notes, illustrate mechanical drawings as they are created, and demonstrate small mechanical systems. Both of the video signals are recorded using the lecture capture device.

The Easel Paper Dispenser Display Adapter (EPDDA) shown in Figure 1, along with a document camera and video projector, has some similarities to a traditional transparency roll and an overhead projector. However, instead of a transparency roll, the EPDDA incorporates a paper roll, originally produced for a large-format printer, but modified by trimming to a 30 cm width.

Using switch 1 shown in Figure 1, the instructor can select to show images from either a personal computer or from the EPDDA on projection screen 1. Using switch 2, the instructor has control over showing images from the EPDDA/PC or from a room camera, which includes the instructor in the frame of the projected image. Images from document camera 2 are always shown on projection screen 2.

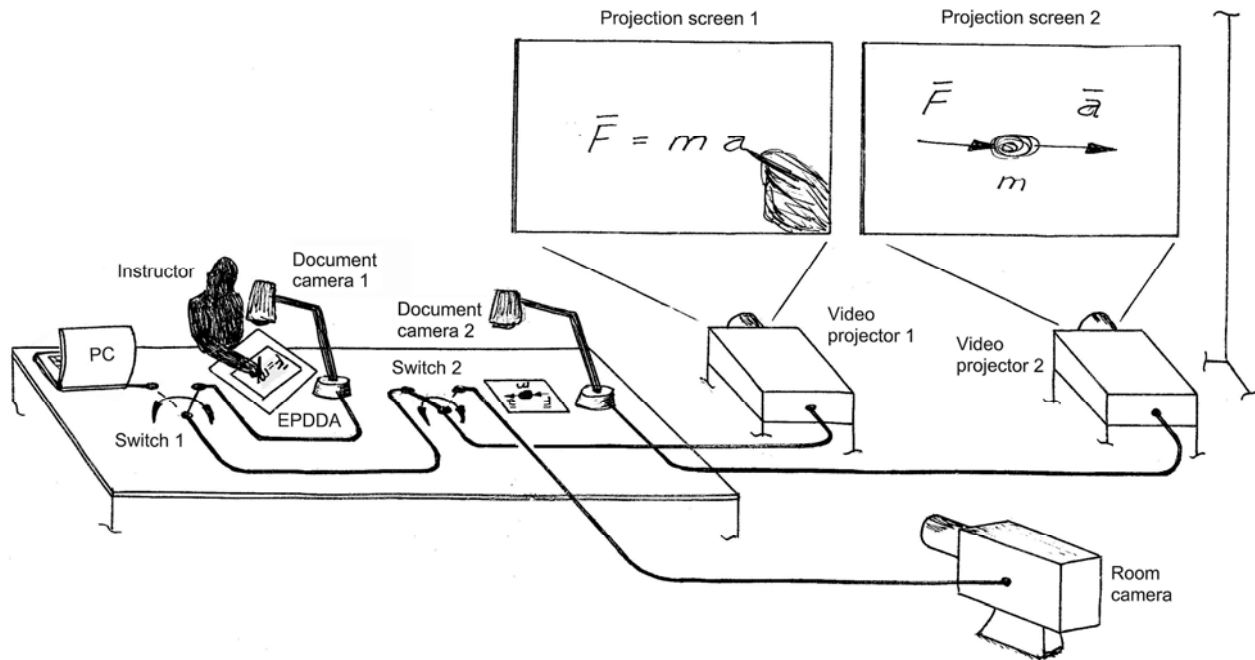


Figure 1: The MEETS

The MEETS has the following advantages over traditional chalkboards and whiteboards:

- (i) There is no need to periodically erase material.
- (ii) It is possible to review previously presented material (i.e., go backward).
- (iii) Projected images can be much larger and more suitable for large classes.
- (iv) Other media, such as video, may be incorporated to support presentations, and there is no need to employ separate equipment.
- (v) One can more easily overlay annotations on prepared images.
- (vi) The instructor may remain facing the students, allowing more effective presentations without the instructor having to turn away for writing.
- (vii) It is not essential for the instructor to remain front and centre in the classroom. Students may concentrate on the material being presented on the projection screen, while the lecturer is off to one side.

Prior to lectures, files of illustrations to be covered are posted on the course management system (Blackboard) website. The students are required to print hard copies and bring them to the lectures.

The instructor generally employed the following steps for covering an example:

- (i) Demonstrate either a physical mechanical system using document camera 1 or an animated motion using the PC (display on video projector 1).
- (ii) Show an illustration of the system printed on a page of letter sized paper (display with document camera 1).

- (iii) Annotate the image with the related information, such as the pertinent components and dimensions (display with document camera 1). The students copy the material onto their own copies of the pages.
- (iv) Move the page from (ii) and (iii) to document camera 2 (display with video projector 2)
- (v) Write out the related notes and equations on the EPDDA (display with document camera 1).

When the MEETS is employed, the students are active participants rather than passive observers during lectures. They are required to copy the material which the instructor hand writes on the EPDDA. The students leave lectures with annotated and scaled diagrams, which are particularly important for graphical analyses.

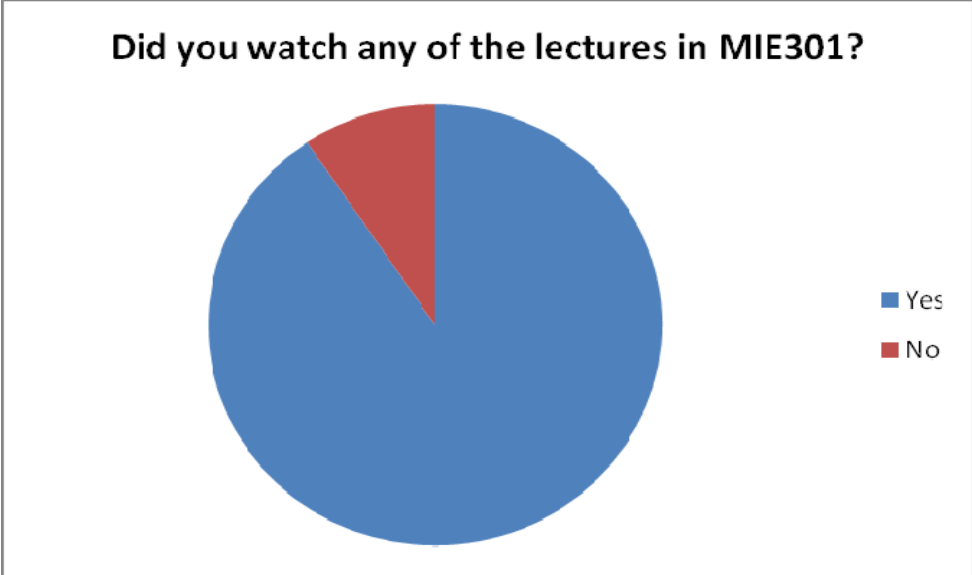
In the fall of 2010, all lectures for the MIE301 course were presented in one section to the entire class of a group of nearly 200 students. The lectures were captured live in the classroom using the MEETS and then put on-line for the students to either listen to the ones they had missed or review those parts which they had trouble understanding. This was the first undergraduate course in the Faculty of Applied Science and Engineering, University of Toronto to have all lectures captured in a term.

Throughout the course, the authors obtained feedback from the students from the on-line discussion board, numerous personal interviews conducted between lectures, and a formalized questionnaire near the end of the course. Their feedback was collected to be used to improve future lectures. All feedback was consolidated at the end of the course and is presented below.

It was hypothesized that online captured lectures supplemented with live lectures for an undergraduate course with a high degree of mathematical content and complex mechanical engineering concepts, would help students enhance core competencies for success in undergraduate engineering. The selection of the lecture capture system for MIE301 involved significant review to ensure the captured content would allow the student audience to enhance the live lectures with “on demand” excellent visual and audio quality, synchronized multimedia course content.

The initial analysis of the student survey data was to learn about the impact of lecture capture on student learning and engagement. To fully understand the effect of the online lecture capture content, it was necessary to determine if the students watched the recorded lectures, how many they watched, and learn about their viewing patterns.

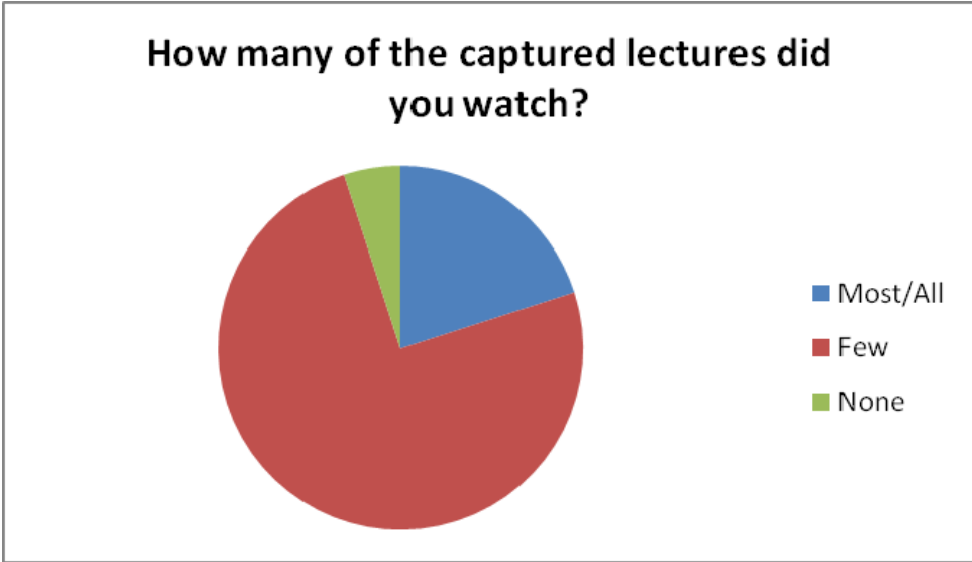
Although the viewing of the online captured lectures was completely optional and was not suggested during the course as a method to supplement the class lectures, the data revealed that a very high percentage did watch the captured lectures. Figure 2 shows that 95% students responded “Yes” when asked if they had watched any of the course content online.



Yes	95 %
No	10 %

Figure 2

Analysing this further, the students were asked to quantify the amount of lectures they watched. The data reveal (Figure 3) that 75% preferred to watch some of the lectures, and 20% watched most or all of the lectures.



Most/All	20 %
Few	75 %
None	5%

Figure 3

In addition, a survey question that asked about how much of a particular recorded lecture the students preferred to watch, revealed information about the student viewing pattern. It is interesting to observe that 35% of the students watched the entire lecture and, 65% selected only the parts necessary for review (Figure 4).

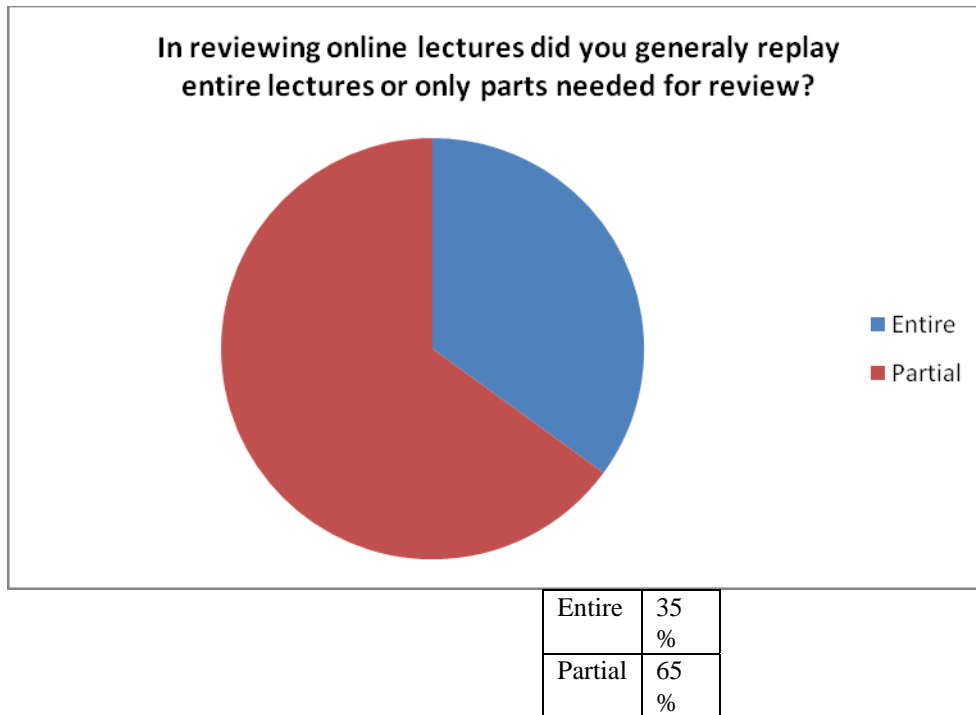


Figure 4

The data analysis confirms the student feedback received throughout the term during course office hours and on the online discussion board for the course website. The students in MIE301 commented that the online lectures were excellent supplements to the live lectures. The students were appreciative of the flexibility and confirmed the captured lectures were predominantly used to review parts of the live lecture that were particularly difficult to understand the first time. The students complimented on the indexed navigation of the lecture capture system that allowed the student to on-demand easily skip to the any specific part in the lecture.

The discussion above for the MIE301 survey data confirms many of the pedagogical reasons presented in the academic literature on lecture capture, in particular the works of Gosper et al. [2] and KOnisky et al. [3], which state that students choose to attend lectures and then listen to the same online lecture to supplement their learning by:

- revising for exams
- revisiting complex ideas and concepts
- working at their own pace and place of convenience

- picking up on things that they missed in class
- going back and take comprehensive notes after the lecture so they can concentrate on what is happening in the lecture
- checking what was said before approaching their lecturer for clarification of issues, ideas or misunderstandings

This same paper presents findings on the interesting observation that even with the reliable availability of online lecture captured content, classroom attendance is still popular with students because they:

- find lectures motivating
- value contact with lecturers and peers

The results from our survey confirm this finding on attendance. The MIE301 students were asked if having the lectures available online affected their attendance for the live lectures (Figure 5), and a very high majority of almost 90% responded that it did not.

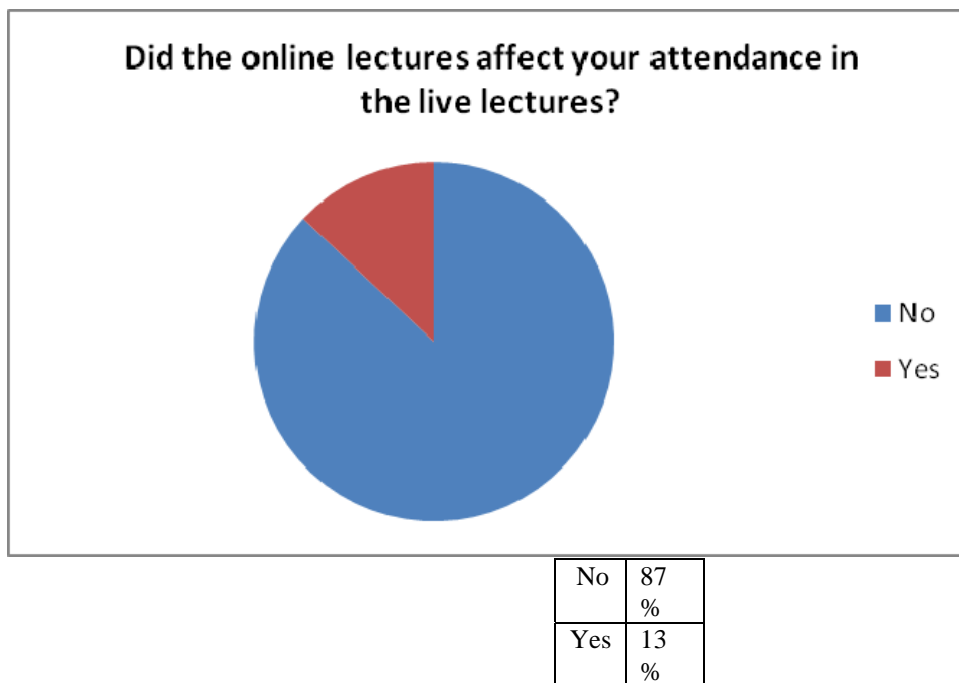


Figure 5

In addition to the results from the questionnaire, the following feedback was obtained from the students through the course website:

- “Just wanted to say how much I appreciate the effort that goes into capturing the lectures and posting them online. They're a great resource and are very helpful for review before exams and tests.”
- “I really like how the lectures were recorded. I usually don't get everything in class 'cause I'm too busy copying things down. I can always go back to the recordings to catch the notes I missed in class and clarify the key concepts.”
- “The new way of recording the lectures is amazing, it helps me a lot as I can always go back to it as a referral if something needs clarification.”
- “The recorded lectures are excellent for reviewing certain sections that were not understood at the time during class. I also like how all the videos have the topic covered in the title so it's easier to go back the specific section needed.”

Conclusions

Because of the favorable feedback, the authors will continue using the MEETS and capture lectures.

References

- [1] Cleghorn, W.L. and Dhariwal, H. “Pedagogical Impact of the Multimedia Enhanced Electronic Teaching System (MEETS) on the Delivery of Engineering Courses”, *Third International Symposium for Engineering Education*, July 1-2, 2010, Cork, Ireland.
- [2] Gosper, Green, McNeil, Phillips, Preston & Woo, 2008, “The Impact of Web-Based Lecture Technologies on Current and Future Practices in Learning and Teaching”, 2008.
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Biographies

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