

Teaching Engineering Using Today's Communication Technology

Abstract

Innovative teaching and learning strategies have been adopted by some of the School of Engineering faculty members at Western Illinois University. Extensive use of recording software (Debut Software) in mechanical and electrical engineering classes facilitates students being able to replay lectures outside of class at their convenience. In addition to the Debut program, Smart Podium equipment and Smart Note software was used, this combination of equipment and software establish a complete innovative teaching system. The recorded lectures are privately uploaded on YouTube and the campus course management system (Desire to Learn, D2L) where students then have unlimited and easy access to all course materials. The access for all the lecture videos is not limited to any time period, and can also be used indefinitely by the engineering students as they progress in their engineering program. The effectiveness of using these advanced teaching tools was determined by analyzing the number of hits to the lecture links on YouTube and D2L. The impact of these new innovative teaching and learning strategies on the level of education and the retention of engineering students at WIU University was found to be extremely positive and encouraging. Student feedback was obtained using WIU University's Student Course evaluation and ABET Outcomes evaluation results. After introducing this innovative teaching system, the positive engineering student response has helped motivate the faculty members to constantly evaluate student and class performance and when necessary rectify their teaching methods and course content. The affordability and ease of implementing this teaching system are also discussed.

Introduction

Educating engineers has been a challenging topic for ages, and it has been a changing process through the years. Similar to other educational domains, teaching engineering has progressed tremendously with civilizations, and it will always be a target of improvement. Engineering teachers have always looked for ways of improvements to optimize the way they present their engineering topics and they have used all available technological tools to do so. Every generation has different perspectives and expectations of how they want to be taught, and we as educators have to focus on finding ways to meet their expectations and optimize our ways of communicating with them so we can be successful in delivering our messages to them. Teaching the fundamental concepts and theories should never be compromised when teaching engineering. However, the methods adapted to present lectures and the way we communicate with our students should always be variable and changeable to meet the expectations of each generation. The daily use of advanced technology by our present engineering students is forcing us as a higher educational institution to implement new innovative teaching methods with extensive use of technology. The engineering department in Western Illinois University has started a new undergraduate general engineering program three years ago in the new campus in the Quad Cities. This program has been a success story in the community because of the fast growth of the

number of the students and also because of the advanced innovative teaching methods that most of the engineering professors are using to enhance the way of teaching engineering. The word of mouth and great feedback that the students are spreading out there has made the WIU engineering program attractive to many students in the Quad cities and surrounding areas. This paper explains these advanced learning system that is adopted by the engineering faculty and its effect on improving the level of education of the engineering students. This learning system basically consists of two main advanced communicating tools that helped our students to have unlimited access for class lectures and other materials. The first tool is using smart Podium equipment and Smart Note software. This software allows the instructor to solve problems and write notes on his screen which is also projected on the classroom screen so that the students can clearly see all the work. Moreover the smart notes files for each class session is also saved and uploaded on Desire to learn so that the students can always have the ability to review all in class work done by their professor. In addition to using the smart note software, a recording software 'Debut' is also used to record all lectures. These recorded lectures are also privately uploaded on Desire to learn and on YouTube so that students can have unlimited access for those videos. The use of these educational tools has enhanced the exposure of the students for all lectures and class materials. It also created a constant and permanent communication link between the student and the instructor.

Communication optimization

Optimizing student – instructor communication facilitates tremendously the student learning process, and it allows the student to focus more on learning the engineering concepts by minimizing the time required to obtain them. Creating a complete integrated educational system that enhances the communication process was one of the main aims for the engineering faculty at Western Illinois University. The desirable system will allow the students to have unlimited access for their instructor lectures and in class work, and also saves the instructor a valuable time which can be used to deliver more examples and solve more problems in class. As it was discussed before this innovative teaching system uses the smart note and Debut recording software to save and record all class lectures and work. The key of success of any project is establishing a good communication between the parties involved in the project. This is true for education applications. Besides the in class and off class communication between the student and the instructor, it is desirable to establish a constant and permanent link of communication between them. Using the present computer technology allows such communication. The use of smart notes and the recording software has established this constant link of communication between the engineering faculty and their students. A student can review the lectures and the class notes, and replay the lecture videos as many times as he desires. The use of these advanced tools should not be a replacement for the class attendance of the student. This will work best as an additional exposure of the lectures and class notes for the students.

The use of advanced technology in higher education

No generation is more at ease with online, collaborative technologies than today's young people—"digital natives", who have grown up in an immersive computing environment. Where a notebook and pen may have formed the tool kit of prior generations, today's students come to class armed with smart phones, laptops and iPods ¹. This era of pervasive technology has significant implications for higher education. Technology allows students to become much more engaged in constructing their own knowledge and cognitive studies show that ability is key to learning success.

Online degree programs and distance learning have gained a firm foothold in universities around the world. What was once considered a niche channel for the delivery of educational content has rapidly become mainstream, creating wider access to education, new markets for content and expanded revenue opportunities for academic institutions. Most of college professors and students say that the technological change occurring in our midst will alter the perception of the college campus from a one-dimensional (physical) concept to a multi-dimensional (physical and online) one.

New technologies are also affecting other areas of campus administration. Social-networking tools are helping to build connections with alumni and support career service activities. E-marketing campaigns expand the reach and success of recruiting and fundraising efforts, and drive down the cost of direct-mail campaigns. And automated, self-service programs reduce administrative requirements, streamline course registration and enhance academic life.

Although university participants view these changes as having a largely positive impact, many institutions struggle with the twin challenges of rising information technology (IT) costs and the need to avoid technological obsolescence. In addition, insufficient resources, a lack of adequate instructional design staff and other technological support issues can also impede the adoption of new technologies. Consequently, the affordability of using these technologies should also be discussed and analyzed in our study. Despite these challenges, most believe that technology will become ever more interwoven into the fabric of academic life.

Media and video in particular, are in a period of profound transition, rivaling any we have ever seen. Causes are various, but three stand out. First, technology has rendered many of the processes of media creation, distribution, and consumption faster and less costly than ever before². Second, public expectations about the availability of media have grown to the point that many people consume and freely exchange media property—including private, copyrighted property—each day in the course of their personal and professional lives. Third, new companies, enterprises, and initiatives regularly exert game-changing influence in film and electronic media. YouTube, by posting 13 hours of video every minute, is one such player; Wikipedia, about to make video available in its entries online via the open-source codec Ogg, will be another ³.

Unlike other educational domains, teaching engineering online by using all media and classroom technologies is a challenging task because of the nature of the engineering education. That is why it is scarce to find a higher education institution that offers an online engineering degree presently. The engineering faculty at WIU have studied and analyzed these challenges of using the online and video technologies in their classrooms, and they have come up with an innovative learning system that has combined the traditional engineering educational methods with the new online system that uses today's technologies

Affordability

As it was mentioned in the previous section, the use of new technologies in classroom can be costly, and require additional resources. With the financial hardship that most of universities are facing, it is difficult to allocate additional resources to implement these new technologies in classrooms⁴. For example, in most universities recording a lecture using a codex classroom requires an expensive recording system and one or two technicians depending if you are broadcasting you lecture online to be presented in other locations. This can be extremely expensive if the engineering department decides to record and broadcast all their classes' lectures online. To avoid using additional and unaffordable costs, the WIU engineering faculty has implemented an affordable yet effective innovative learning system by using extensively recording software (Debut Software) in most engineering classes. The recorded lectures videos allow students to replay lectures outside of class at their convenience. In addition to the Debut program, Smart Podium equipment and Smart Note software was used, this combination of equipment and software establish a complete innovative teaching system. The recorded lectures are privately uploaded on YouTube and the campus course management system (Desire to Learn, D2L) where students then have unlimited and easy access to all course materials. The cost of the recording program (Debut) is \$150.00 for five users, and the Smart Podium equipment and Smart Note software are already available in most of the classes. There is no need to hire any technician to administer the recording process. The professor will start the recording program (Debut) at the beginning of each class and will terminate the recording at the end of the class. Debut will record the instructor screen for the whole class period, and then export a video file to a preselected directory; the professor can then privately upload the lecture video to desire to learn or YouTube. Moreover, the in-class notes can be saved as PDF files and also uploaded to desire to learn. The time required to upload a lecture video to You Tube is about six to seven minutes. Moreover, uploading the lecture notes to Desire to learn should not take more than a minute or two. As an instructor, spending these extra minutes in uploading the recorded lectures and the in-class notes can be extremely rewarding especially in measuring the performance of the class.

System Implementation

The previous section has showed the affordability as well as the easy mechanism of implementing this innovative learning system. Most of the classrooms in the WIU engineering building have Smart Podium equipment and Smart Note software. The only additional software

that is needed to be installed is the recording software (Debut). Installing the recording software should not take more than five minutes to be complete. Once it is installed, the instructor can use it immediately by starting the program, and clicking on the recording button. After completing the class session, the instructor can terminate the recording and the recorded lecture file will be exported to a preselected directory. The lecture video file can be renamed and privately uploaded to You Tube immediately so that students will have an immediate access to the lecture video. Moreover, the lecture notes can be saved as PDF file and uploaded to Desire to Learn. Having both lecture video and the lecture notes immediately available online for each class will tremendously enhance the students' performance in the class. The impact of the use of this innovative system on the student outcome will be analyzed in the following section, and will show some existing data and some student's evaluations feedback. The aim of this learning system is to optimize the exposure of the students for all lecture materials with a very affordable and simple method.

Innovative teaching outcomes evaluations

The feedback of the students was obtained by multiple methods. The first method by communicating directly to the students in class and asking them how often they are replaying the lectures videos and accessing the lectures notes. The second method is to have them write letters explaining their experiences with the use of the innovative technology in class. The third method is to read the students comments when they evaluate their classes at the end of the semester. All student evaluations comments are all read and analyzed so that professors can always look for ways to enhance this system to make it better and more efficient for his students. The last method is to count the number of hits for each lecture video link, and also to check the average replay time for each lecture video. Since these recorded lecture videos are privately uploaded to You Tube, the students are the only people that can access the lecture links. The instructor can simply estimate the exposure of the students to his lecture by seeing the number of hits on his lecture links. Moreover, this can be a measure of the instructor performance in each lecture. For example, if one of the lecture links gets a lot of hits, the instructor should assume that the materials discussed in this lecture is somehow difficult and was not fully covered, and he should consider refocusing on these materials in incoming classes. If used efficiently, this innovative learning system can be an iterative method of teaching. Table 1 shows data that reflects the average number of hits and average replay time of the video lectures for different WIU engineering courses for the two years. Moreover Table 1 presents the percentage of students who replayed the video lectures. This in turn is very useful in engineering education. Although this learning system can be used as an online teaching tool for strictly online classes, the WIU faculty has only used it as an additional teaching resource for students in engineering classes to optimize the educational process. Since most of the students are attending classes regularly, we do not expect a lot of hits on the lectures links. However, if fifteen to twenty percent of the students replay the lecture videos, this should be satisfactory for the instructor. Some students need to be

more exposed to class lectures and material than others, and the use of this innovative learning system will satisfy the needs of these students, and allow them to perform better in class.

Table1: Analysis for students' use and exposure of the recorded lecture videos for various WIU engineering classes

Courses	Course Description	Semester/Year	Number of Students	Number of lectures	Average number of hits per lecture	Average time spent per hit (minutes)	Percentage of students that replay lecture videos (%)
ENGR 105	Engineering Graphics	Fall/2012	23	32	5.1	34	23
ENGR 300	Thermodynamics	Fall/2012	14	33	2.9	27	21
ENGR 300	Thermodynamics	Fall/2013	27	33	6.3	24	23
ENGR 310	Fluid Mechanics	Spring/2013	18	32	3.7	21	20
ENGR 411	Heat Transfer	Spring/2013	3	33	0.45	42	15
ENGR 410	Thermo- Fluids	Fall/2012	5	33	0.87	45	17
ENGR410	Thermo- Fluids	Fall/2012	2	33	0.32	37	16
ENGR 481	Finite Element Method	Spring/2013	3	32	0.42	48	14
ENGR 212	Dynamics	Fall/2013	19	33	3.8	29	20
Total (Average)			13	32.67	2.65	34.11	18.78

Conclusion

As educators, it is always desirable to enhance the way we conduct our classes and deliver our messages to students. The aim of the WIU engineering department was essentially to optimize our teaching methods to fit the needs of this generation of students, while keeping the cost of using innovative technologies low. To do so, we have come up with a simple low cost innovative teaching system that combines both Debut recording and Smart Note software to record lecture videos and export lecture notes as PDF files so that they can be uploaded on You Tube and Desire to learn. The WIU engineering students have taken advantage of this learning system, and have shown positive feedback. Moreover, the monitoring of the number of hits and the replay time of the lecture video links has demonstrated that students have used this system efficiently. Moreover, professors have benefited from this innovative teaching system by constantly measuring their teaching performance with monitoring their lecture video links and reading students evaluations comments. The system is affordable yet effective, and can definitely be developed and optimized with future affordable technologies. Moreover, this system can also be used as a fully teaching tool for online classes in the future if needed. The new innovative system has been used in WIU for almost two years, and the outcome has been very positive. Moreover, evaluation of this learning system needs to be performed for incoming years with the increase of the number of the engineering students at WIU.

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Bibliography

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Dr. Zbeeb's research devotes itself to the theoretical and computational modeling of thermo fluid and energy systems. His interests span both low and high speed fluid mechanics, multiphase flows, hydrodynamic and acoustic instabilities, engine internal flow fields, vorticity dynamics, combustion, alternative fuels and CFD. His research activities since 2008 have materialized in over fifteen publications in first-rate journals, book chapters, and conference proceedings. His work on flow modeling for two after-bodies trapped vortex combustion has led to the establishment for new design correlations for the TVC technology. Dr. Zbeeb has also

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