AC 2011-1120: ETHICAL AND SOCIETAL IMPLICATIONS OF INTERNET-BASED ENGINEERING EDUCATION: FACULTY AND STUDENT PERSPECTIVES

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Ethical and Societal Implications of Internet Based Engineering Education: Faculty and Student Perspectives

Introduction

Internet-based engineering education has been in existence since the early 1990s in several forms. Through internet-based learning students are able to pace themselves, interact with instructors and other classmates, and participate in live feedback sessions. Internet-based learning also bears in mind students with various learning styles and physical disabilities. There are many positive implications of internet-based learning such as a means to interactively present and disseminate curricula through coursework management tools such as Blackboard. It also promotes collaboration and continuing education for full time employees, i.e. "learning anywhere, anytime."[1] Students are encouraged to expand their knowledge of the material being taught through media, images, animation and streaming audio/video.

Internet-based engineering education is an accepted practice throughout the United States and abroad. There are interesting ethical and societal implications the authors would like to address. Are students who take courses via internet-based learning technologies more prone to cheating and plagiarism than those in traditional learning environments? Do students feel they are gaining the required knowledge in their courses and laboratory sessions to become successful engineers? Do their expectations of what will be asked of them on homework and exams reflect what is seen in industry? Are instructors of internet based learning courses satisfied with the quality of work being submitted by their students?

This paper will discuss the opinions of undergraduate students, graduate students, and faculty members regarding the ethical and societal implications of internet-based engineering education. By discussing ethical implications, we seek to understand how learning engineering by way of internet-based tools affects the engineering students' best interest. By discussing societal implications, we seek to understand how learning engineering by way of internet-based tools affects society and the engineering community as a whole. Specifically, the authors seek to understand if internet-based engineering education affects the quality of engineers being produced in society. Focus group studies and electronic surveys were used to capture the opinions of undergraduate and graduate engineering students, and engineering faculty members. The responses from these surveys were compiled and discussed in this paper.

Background

What was once thought of as an "educational experiment"[6] to encourage student participation and promote the use of new technology is now a common practice in universities and colleges around the world. As early as the 1990s, teaching and learning with the internet has: increased student enthusiasm; provided an avenue for efficient data exchange; encouraged collaborative, student-led learning; promoted the discussion of course topics before, during, and after class; and offered a variety of learning

environments[5, 6]. In its initial stages, internet-based learning was offered through e-mail lists, bulletin boards, and basic web sites[6]. In some instances, those students receiving web instruction performed higher than those receiving traditional classroom instruction[6]. Notwithstanding, students viewed traditional educational approaches as important components to learning engineering successfully[5].

Internet-based engineering education has evolved from discussion boards and electronic homework submissions. Courses are now being offered via webcasts, podcasts (non-streamed webcasts offered via download through web syndication), and satellite broadcasts. These courses reach a larger student body and provide convenience and self-paced distance education[4]. The range of possible interactions for internet-based courses encompasses web syllabi, asynchronous (student-centered) discussions, video conferencing, and simulated and real-time control[4]. Internet-based courses can be partially or fully offered online; thus, a range of interactions is necessary.

Implications of Internet Based Learning

Various options for teaching and learning with the accessibility of the internet exist. What effect does internet-based engineering education have on student learning? Does the type of web format affect a students' comprehension of the material? A study conducted at the University of Florida on the effectiveness of web formats on student learning showed no significant differences between constructivist learning (learners are active in acquiring their knowledge) and objectivist learning (reduces the learner to a passive role)[2]. In other words, the format of internet-based learning may not affect a technical students' comprehension of the information being taught.

What then can we say about the ethical and societal implications of internet-based engineering education? The success of an internet-based learning experience depends on community, pedagogy (style of instruction), interaction, and feedback[9]. From a student's perspective, although internet-based learning can be effective and rewarding, separating students taking the same course "hinders the development of interactions and the formation of a community of learners."[9] From an instructor's perspective, implementing traditional pedagogical approaches provide students with familiar learning environments, allowing them to feel comfortable, although electronic delivery of lectures and course material requires greater preparation[9].

In general, faculty are satisfied with internet-based learning, and students are successful learning online[1]. Incidentally, the quality of engineers being produced by way of internet-based learning can be improved through collaboration between institutions and industry[1].

In terms of students' expectations of what they should be able to produce on homework and exams, if instructors provide clear definitions of course objectives and expected outcomes, students should be able to meet those objectives regardless of their learning environment[3].

Equally important are the issues of cyber ethics and plagiarism. Plagiarism occurs often in the online classroom by way of using other's opinions or theories, borrowing statistics or illustrative material, and submitting projects using others' material without acknowledgment[8]. To this end, it is the instructor's responsibility to help students understand the importance of academic integrity[8].

This discourse provided a background to shape an understanding of the ethical and societal implications of internet-based engineering education as summarized through current literature. Moving forward, the authors summarize the thoughts and opinions of current undergraduate students, graduate students and faculty members in Mechanical, Civil, Electrical, Chemical, and Environmental Engineering. The opinions were collected at a medium sized technological institution to compare respondents' sentiments. The authors posit the results of the survey and group study will be similar to current research studies.

Method and Results

To study the opinion of students and faculty members on internet based learning, ten questions were posed to 20 students and 5 faculty members. These questions were aimed at understanding the ethical and societal implications of internet based learning in engineering education. The answers from the surveys and focus group discussions are summarized below.

Q1. What single word comes to mind when you hear the phrase "internet based learning"?

Figure 1 presents a word cloud of the responses received. Words including new, technology, computer and webinar were popular among faculty, while students mentioned words including easy, informal, Google, interactive, freedom, dedication, opportunity, infinite, advancement and convenient. Negative words such as unreliable, boring, disconnected, stupid, unacquainted, distance and cheating were also mentioned.
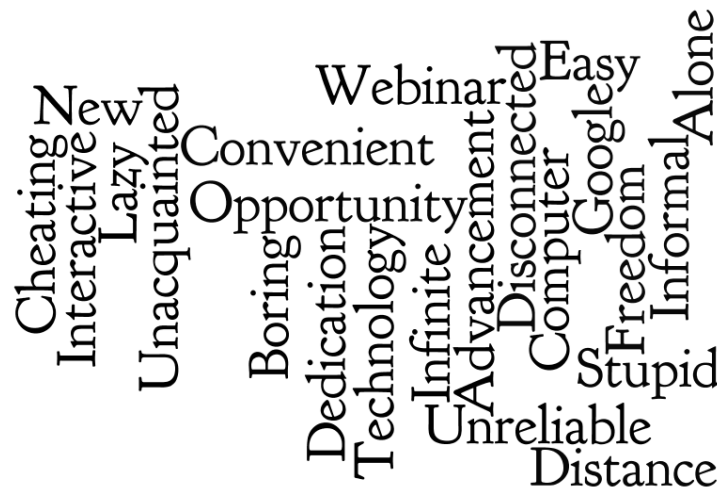

Figure 1: Word cloud of survey responses

Q2. What courses do you feel internet based learning is most effective?

Responses were similar across the board with respect to undergraduate students, graduate students and faculty members. Fundamental and introductory level classes, ones that involve memorization of facts and a great deal of reading, and those that do not rely on real time responses, such as English, History, Foreign Languages, IT, Business and software tutorials would be effective through internet based learning. Math based courses and those courses involving lab work and dialogue may not be as effective as they could be if taught in a traditional classroom setting.

Q3. What is your definition of plagiarism? Is it possible to plagiarize through internet based learning? How?

Both students and faculty were well aware of the definition of plagiarism and common copyright laws. They generally believed that it would be easier to plagiarize by submitting assignments through the internet rather than in an actual classroom setting because information on the internet is easy to access and open to the public.

One of the faculty maintained, "cutting and pasting is very common, and it is easy for students to forget their references."

When submitting assignments through the internet it is easy for a student to work in a group even when they are not allowed, to submit quizzes and homework multiple times until they receive full credit, or to submit an answer someone else has come up with without the instructor knowing.

Q4. Does internet based learning (ex., submitting homework and exams on-line) make it easy for you to cheat?

Nearly all of the students answered yes to this question. A summary of the reason for their response is as follows:

> When you do not see your teacher or classmates in person, it is easier not to be accountable because most of the time grading is also done automatically. There are less ways for the instructor to notice something suspicious.

Faculty seemed to have a different opinion. They believed that with internet based learning there is always a record of all of students' work, which makes it more difficult to cheat. There were also some who figured students who want to cheat, will cheat, no matter what the situation is.

Generally, respondents felt the answer to this question depends on the situation. Internet based learning takes place in a mildly controlled environment, and cheating is easier during exams.

In summary, each group agreed that it is easier to cheat in an internet based course, although cheating in traditional classroom settings is possible, too.

Q5. What expectations do faculty set with respect to internet based learning?

Faculty members mentioned that they do not set any different expectations from students in a traditional classroom setting, but in an internet based course, they assume that students can use technology and that they have enough discipline to keep up with the class.

Students had interesting answers to this question. It seems that they believe faculty do not know much about internet based learning, and they believe students are cheating all the time, so they have minimal expectations from students.

Q6. What are some examples of safe and easy to use internet based learning tools? What types of features do these tools offer?

Blackboard, Echo360 and Connect pro, problem solving calculators, spell check and online dictionaries were some of the examples mentioned. Respondents feel these tools are great for sharing class material (documents, lecture slides and notes, web links, etc.). They make it easy for faculty to provide information for students, and students can easily submit their exams and homework anywhere, anytime.

Q7. How do you think students perform who take classes on-line (via watching lectures on the web or recorded videos) compared to students who are physically in the classroom?

In general, respondents felt those who attend classes in a traditional classroom setting perform better than those who take classes online because: students do not have the discipline needed for following online class instruction; in online learning environments students do not use as many senses as they use in a traditional classroom setting, thus they do not learn as much; attention is divided while students listen to an online lecture; and more importantly students learn through their interactions with faculty and their fellow students. They may not have these opportunities through internet based learning.

It is also worth noting that this comparison (internet based learning vs. traditional classroom setting) may be biased. When answering this question many mentioned that the class subject is important (factual or hands-on techniques), the size of the class is important, each person learns differently (some need to sit in a class, while others just need a book in hand) and that online learning makes it easier for students to cheat and get higher grades compared to students in a traditional classroom setting. Comparing only grades is not conclusive. Students and faculty tend to believe that even if both groups earn the same grades, long term retention is going to be higher in the students who sit in a classroom and interact with others.

Q8. Does internet based learning help foster strong peer-to-peer relationships and collaboration?

In general, students and faculty were neutral on this subject. They all agreed that relationships depend the individual, and that it is always easier to make friends in person.

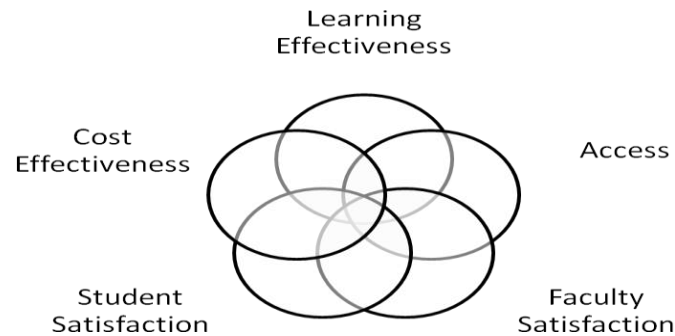*Q9. Does the quality of internet based learning depict the 5 pillars shown?*

Figure 2: The five pillars of online learning[1].

Access: The general consensus was that internet based learning provides easy access to knowledge.

Faculty Satisfaction: Faculty satisfaction seems less. Most instructors enjoy teaching because it involves one-on-one interaction with students. This is minimal when teaching internet based courses.

Student Satisfaction: Students enjoy internet based learning because they can work from the comfort of their homes at their leisure. This type of learning environment specifically appeals to working students.

Cost Effectiveness: Internet based learning is definitely viewed as being more cost effective than attending college courses.

Learning Effectiveness: Based on the course being taught and individual student learning, effectiveness may vary, but the fact that students can watch a lecture multiple times may increase their learning effectiveness.

Q10. Is internet based learning affecting the quality of engineers being produced in society?

It is not surprising to find that everyone participating in our study believed engineers need hands-on experience and to work in teams to learn the analytical skills needed to become successful engineers. Engineers also need social skills to be successful. Face-to-

face interaction in the classroom provides these skills, while internet based learning lacks these factors.

Conclusions and Future Considerations

Internet-based learning is definitely a growing option for engineering educators and students. It is a subjective debatable option in which the implications for the university environment and its interaction between the students and faculty are taken into account. Along with this interaction, the ethical and society implications it has on the university community is of great interest. This paper aimed to address these implications by summarizing the responses of those directly involved in internet based learning, engineering undergraduate and graduate students as well as engineering faculty members. The authors realize these findings may depend on the tenure of the faculty being surveyed, type of institution under consideration, and caliber of engineering students (i.e. are they responsible? Self-disciplined?)

In engineering studies on internet based learning, research has shown that there was not much difference in the quality of education whether a student participates in an active (in class) or passive (video streamed) environment[2]. The format of the information taught is not considered an integral factor in internet based learning technology. Therefore, this leaves the responsibility on the individual student to be disciplined and keep up with the organization of their internet based course. Moreover, as the format may not be a factor, perhaps the actual content of what is being taught may be something to consider when considering internet based learning's effectiveness.

The general overview from the focus group studies and surveys about internet based learning in engineering education was that students were satisfied with the flexibility and general cost of this instruction. Faculty felt it was less satisfying than in-class instruction. Nonetheless, both groups feel the accessibility is paramount. It is also agreeable among the groups that this type of learning is more suitable for introductory or lower level courses than those of more technical and laboratory background. Also, classes that require more writing (e.g. English or History) and computer based (e.g. Programming or Information Technology) seem suitable for internet based learning.

The effectiveness of internet based learning is an important topic with respect to its social implication on the university community. The general synopsis of the learning effectiveness of internet based learning is that it depends on the student taking the course. It was regarded that those in a traditional classroom setting perform better than those watching a streaming internet video. Consider also if the student repeatedly reviewed material readily accessible on the internet that may not be otherwise available for those taking in-class instruction. They have an obvious advantage as repeatedly watching lectures may improve long-term memory with respect to the information being taught in the lecture. Additionally, internet based learning was questionable in its effect on fostering peer-to-peer relationships.

In considering words that come to mind when hearing the phrase "internet based learning" it is no surprise that there are varied reactions. This helps us understand the ethical implications of internet based learning. When considering this form of learning technology, most students felt it allows an easier way to cheat and plagiarize as there is no in-class proctor or monitor. Notwithstanding, this technology provides creative ways to inspect typed work and easily identify plagiarized assignments.

It was also mentioned that it is the faculty's responsibility to implement academic integrity policies and expectations; furthermore, faculty feel that their expectations are not any less than those of in-class instruction. It was reported that faculty who have taught internet based courses also assume their students will be able to discipline themselves in the internet based learning environment and can effectively use the technology. To the contrary, most students surveyed feel that there are not many expectations instilled on the students in internet based education. It seems there needs to be clear objectives and standards of internet based learning education to avoid misunderstandings and misinterpretations.

As we posited, the results of the survey and group study are similar to current research studies. A long term concern is the quality of engineers that are produced through internet based engineering education. Both faculty and students feel that engineering students need hands on experiences and personal interactions. In industry social skills are needed for interaction in the field. As technology continues to advance, internet based learning is likely to grow among campuses. As long as safe and interactive tools are implemented, a welcoming internet based environment may drive the future of internet based engineering education.

Future work requires the creation and validation of an assessment that can be used to determine the effectiveness of internet based engineering education compared with the traditional classroom setting. Factors to be addressed in this assessment include but are not limited to duration of class sessions, class structure/format, and student enrollment statistics (i.e. ACT score, class rank).

References

1. Bourne, J., Harris, D., Mayadas, F. Online Engineering Education: Learning Anywhere, Anytime. Journal of Engineering Education, Vol. 94, No. 1, pp. 131-146, January 2005.
2. Donnelly, A., Hargis, J. Engineering Education and the Internet: A Study of the Effectiveness of Web Formats on Student Learning. Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition.
3. Krishnamurthi, M. Experiences In Teaching Engineering Courses Through the Internet. American Society for Engineering Education IL/IN Sectional Conference. April 2005.
4. Krishnamurthi, M. Enhancing Student-Teacher Interaction in Internet-Based Courses. Proceedings of the 2000 American Society for Engineering Education Annual Conference & Exposition.
5. Paterson, K. Student Perceptions of Internet-Based Learning Tools in Environmental Engineering Education. Journal of Engineering Education, Vol. 88, No. 3, pp. 295-304, July 1999.

6. Starrett, S. A Beginner's Approach to Teaching with the Internet. Proceedings of the 1996 American Society for Engineering Education Annual Conference & Exposition.

7. Wallace, D., Mutooni, P. A Comparative Evaluation of World Wide Web-Based and Classroom Teaching. Journal of Engineering Education, Vol. 86, No. 3, pp. 131-146, July 1997.

8. Whittington, J., Colwell, J. Should a Cyberethics Class Be Required? Plagiarism and Online Learning. Proceedings of the 2009 American Society for Engineering Education Annual Conference & Exposition.

9. Williamson, C., Bernhard, J., Chamberlin, K. Perspectives on an Internet-Based Synchronous Distance Learning Experience. Journal of Engineering Education, Vol. 89, No. 1, pp. 131-146, January 2000.