

# ONLINE COURSES: A Threat to the Class Room Oriented Engineering Education?

Rajarajan Subramanian, Lecturer, Civil Engineering, Pennsylvania State University at Harrisburg, Email: [rus30@psu.edu](mailto:rus30@psu.edu), Grady F. Mathews IV, Lecturer, Civil Engineering, Pennsylvania State University at Harrisburg, Email: [gfm5121@psu.edu](mailto:gfm5121@psu.edu)

## Abstract

The main goal of any instructional system is to promote learning. Educators therefore, should inherently or unambiguously know the concepts of learning and students' learning process before they develop any scholarship materials. Recently it has been recognized that the online courses are gaining foothold as the medium of education at college level.

The quality of education is gauged by numerous factors including the design of the course and the delivery methods. The online education is widespread at the post-graduate degree level. Most of the top Universities in the United States offer Bachelor's and Master's degree through online courses.

The humanities courses that are included in the Engineering curriculum can be taken through online. However, some Engineering courses cannot be taught online especially the laboratory oriented courses. This paper explores the pros and cons of the online education for engineering courses that are taught at college level.

## Introduction

All over the globe, the World Wide Web is changing the way we conduct ourselves, the way we do things, and allowing us to do things we could not do before. It is transforming the way we access information, enabling networks of interest and communities of practice to flourish across physical distance with an immediacy and breadth that were impossible less than a generation ago. There is informed speculation that it is changing the way in which today's younger generation learn and communicate, and the way they construct, not just their social networks, but their identities as social beings<sup>1</sup>.

What is online learning? Learning a course where most or all of the content is delivered online. Typically almost have no face-to-face meetings. An online course is defined as one in which at least 80 percent of the course content is delivered online. Face-to-face instruction includes courses in which zero to 29 percent of the content is delivered online; this category includes both traditional and web facilitated courses. The remaining alternative, blended (or hybrid) instruction, has between 30 and 80 percent of the course content delivered online. Following the year of commercialization of internet as World Wide Web, the online education was started by

few Universities. Commercial use restrictions were lifted in 1995 for internet. Online education has been in existence for the past 15 years catering to the needs of most of the educational areas. Increasingly, the internet is used for various types of online learning for various different courses.

For the educator of innovations, the improvement in the quality of education and the learning experience, it is imperative that an education system is to be created such that it sets its goals and ambitions high enough to fulfill the need for adaptation to its technological, political, social and cultural environment. The arrival of worldwide communications networks and powerful computer technologies has redefined the concept of distance learning and the delivery of engineering course content.

Online learning is recognized as the use of any of the new technologies or applications in the service of learning or learner support. It is important because online learning can make a significant difference as to how students learn, how quickly they master a skill, how easy it is to study; and, equally important, how much they enjoy learning. Such a complex set of technologies will make different kinds of impact on the learning experience<sup>2</sup>.

Learning experience at a distance, as provided through correspondence courses and video media, has been largely complemented by online education as the world's networking capabilities have become pervasive. Studying engineering online has become possible in recent years but is not yet widespread throughout all engineering education disciplines. While online education may be primarily about offering to distance learners anywhere and at any time, it may well play a remarkable role in bringing together the work of colleges and universities across the United States. Social presence (i.e., the social connectivity among learners, between learners and instructors) is a key factor which defines the success of online education<sup>3</sup>.

But unfortunately, engineering courses such as that are in need of laboratories, team works, construction site visits, field personnel's technical presentations cannot be offered through online medium. The physical interactions that are needed in the laboratories and construction sites cannot be offered by the online courses. Such collaborations of educational institutions with industry and Government are necessary for Civil Engineering program's success. Undergraduate Engineering students love to have hands-on experience for the most of the courses in their Course curriculum. The instructors who teach courses that are complemented by laboratories receive high grade of student evaluations. This paper will ascertain the benefits and pitfalls of using online medium for Civil and Construction Engineering education. This paper will also explore the possibility of blending the online tools with the class room setting mode to teach Civil Engineering courses.

## **Current status of Online Courses**

Over 6.1 million students were taking at least one online course during the fall 2010 term; an increase of 560,000 students over the number reported in the previous year. The number of students taking at least one online course was increased by over 1 million to a new total of 7.1 million as per 2013 data. There were 412,000 more online students in fall 2012 than in fall 2011, for a new total of 7.1 million students taking at least one online course. This year-to-year change represents the smallest numeric increase in the past five years. The growth rate of 6.1 percent in students taking at least one online course also represents the lowest percentage increase since these reports began tracking online enrollments.

There is widespread agreement that higher fuel costs will lead to more students selecting online courses. Institutions that offer programs to serve working adults are the most positive about the potential for overall enrollment growth being driven by rising unemployment. Both chief academic officers and online teaching faculty said that flexibility in meeting the needs of students was the most important motivation for teaching online. Public institutions continue to be the most likely to believe that online education is critical to their long-term strategy. Approximately one-third of baccalaureate institutions consider online to be critical, a rate about half that of other institutional types such as associate degree institutions.

The percent of higher education institutions that currently have a Massive Open Online Courses (MOOC) increased from 2.6 percent to 5.0 percent over the past year. The majority of institutions (53 percent) report they are still undecided about MOOCs, while under one-third (33 percent) say they have no plans for a MOOC. Only 23 percent of academic leaders believe that MOOCs represent a sustainable method for offering online courses, down from 28 percent in 2012.

Engineering is the only discipline area where online representation is much lower than for other areas. Public institutions have the highest penetration rates for all disciplines other than engineering. Associate degree's institutions have a wide lead in online penetration for psychology, social sciences, and liberal arts. As far as training needs are concerned, only six percent of institutions with online offerings report that they have no training or mentoring programs for their online teaching faculty. The most common training approaches for online faculty are internally run training courses (72 percent) and informal mentoring (58 percent). Smaller institutions are more likely to look outside the institution for their training than are larger institutions.

When asked why their institutions have implemented online courses and programs, academic leaders have consistently told that online education provides greater flexibility -- sometimes for the institution or the faculty member, but primarily for the student. Not surprisingly, online instruction is seen as having much better scheduling flexibility for students. Over 90 percent of all academic leaders rate the scheduling flexibility of online as “superior” or “somewhat superior” to that for face-to-face instruction. Online education is possible only because of the technology changes that have impacted all areas of contemporary life. High-speed networks, nearly ubiquitous computing availability, and software to support teaching and learning have combined to provide the foundation on which online learning has grown<sup>4</sup>.

However, the recent report says the opinion that online instruction is inferior has jumped from 56 to 72 percent in one year from 2012 to 2013. Likewise, the proportion thinking that learning outcomes for online courses are superior dropped from 8.5 to only 2.3 percent over this same period. The most recent results provide further support for this view, with a smaller increase in the absolute number of additional online students and the lowest ever growth percentage. The evidence continues to mount that a plateau for online enrollments may be approaching, but there is no evidence that it has yet arrived. Baccalaureate institutions continue to hold the most negative views toward online education, and are the largest proportion of institutions with no online offerings<sup>5</sup>.

### **Exploration of tools for online education**

In this section of the paper, the tools that are used for the delivery of online lessons are explored. It is important how students communicate with the instructor and their peers that help in learning the course in depth. The following tools are generally used for the online delivery of courses as well as for communication purposes.

- Laptop or desktop computer with the required software
- High resolution video and still cameras
- Internet (preferably high-speed internet)
- Presentation software
- Course Management Software (CMS)
- Course Communication software (may be part of CMS)
- Graphic software
- Video Capture and Edit software
- Software for preparation of reports and spreadsheet software
- Pdf file editing software
- Audio visual streaming software
- Manuals or study guides for the software applications that we intend to use.

For each of the software application (tool) that is mentioned above, lots of products are available in the market. The tools can be chosen depending on the price, the course requirements, instructor's choice and the capabilities so that the requirements of that course can be met. Unless the required tools are able to be used effectively, it is hard to conduct lessons online

### **Online course development for Civil Engineering**

Online course development for Civil Engineering can be traced back to late nineties. Most of the online degrees in Civil Engineering are offered at Master's level program. There are very few Universities and Colleges that are offering Civil Engineering full time online 100% complete. University of North Dakota is offering 100% complete online degree in Civil Engineering. The duration for the completion of degree is about 6 years and the laboratory classes are conducted during summer in a condensed manner squeezed into a week or two<sup>6</sup>. However, by conducting laboratory oriented courses online, the effective teaching cannot be delivered.

For example, the Civil and Construction Engineering Materials Laboratory uses the following syllabus:

1. Course Aggregates Gradation
2. Fine Aggregates Gradation
3. Specific Gravity, Unit weight and Natural Moisture Content of Course and Fine Aggregates
4. Making fresh concrete that features determining the fresh concrete properties that include the air content, slump, unit weight and temperature.
5. Breaking concrete cylinders for determining 7 day and 28 day Compressive strengths
6. Making Masonry Mortar cubes.
7. Breaking the mortar cubes and determining the 28 day compressive strength.
8. Asphalt binder viscosity determination test
9. Asphalt Mixture compaction and determination of Bulk Specific Gravity test
10. Determination of Maximum Theoretical Specific Gravity of Asphalt Mixture.
11. Determination of moisture susceptibility test on asphalt mixtures.

These laboratory experiments need to be preceded by the lessons featuring the theory of those tests with appropriate concepts explanation. If this order of experiments is not able to be followed after appropriate lectures featuring the concepts behind those experiments, the teaching is not going to be effective. Also, some experiments can be conducted after 28 days of waiting so that the required strength parameters can be determined for concrete materials as per test specifications and design codes.

Construction Methods and Materials course needs lots of construction site visits. When a building is installed it needs to follow a certain procedure. Starting from excavation, proceeding

with the different steps such as foundations, walls, roof, windows, doors and finishing, the construction engineering is to be taught using lecture presentation along with site visits to show how really it looks like. Perhaps, showing the pictures and videos in the class room setting could reinforce lectures to a little extent.

As a recent National Science Foundation (NSF) report notes, the pool of engineering graduates that supplies the engineering workforce is predicted to remain flat for the foreseeable future, even as the need for more engineers increases. Increasing the availability of online degrees in engineering and science can increase the number of qualified workers in the labor pool in these fields. Yet, even with the need for growth, adopting the methods of quality online learning has been slow to take hold in engineering education.

### **Advantages and Disadvantages of online learning**

#### Advantages:

- Travel is not required to go to attend class.
- Online lessons are usually recorded and available 24 hours a day for use.
- If you miss a class, you can always watch the video of the recorded version later.
- Online media allows for distance education.
- Ability to link resources in many formats.
- Resources can be made available from any location at any time.
- Potential for expanding access to part-time students, working class students and professionals.
- Students can receive quick feedback on their classwork that includes tests and quizzes.

#### Disadvantages:

- Obtaining access to appropriate computer equipment.
- Poor quality graphics, images, charts and video clips.
- The necessary infrastructure must be available and affordable.
- Information can vary in quality and accuracy.
- Limited interaction and guidance from course instructor(s).
- Students can feel isolated.
- Online assessments can be limited to objective questions.
- Can be difficult to authenticate students' work.
- Computer marked assessments tend to be knowledge based and does not measure in-depth learning.

- Laboratory courses that require significant physical interaction with materials and equipment cannot be simulated through online modulus.
- Construction site visits cannot be simulated.
- Interactions and experiences with guests such as industry professionals are difficult to facilitate through online media.
- Online degrees discourage social gatherings, face-to-face meetings, and typical campus activities and college life.

### **Blending of online teaching tools with class room lectures**

Blending class room lectures with online delivery tools can help with effective teaching. Blended courses can be achieved by using online tools such as recorded lectures in a classroom setting. For example, the Construction Project Management courses can be taught effectively by utilizing online software such as bidding, scheduling and Construction Management software.

Class lectures can be recorded and uploaded on course pages. Also instead of homeworks, classroom work can be given to students so that they can work under the direct supervision of an instructor. This enables the students to ask questions and get into discussions. Also, communication can happen through internet via email, social media and internet video chatrooms.

For the purpose of communication, lots of software is available for use including “Blackboard Classroom” that helps in interactions among students with video chats. Sometimes students feel that they do not know when to post a new item thread for discussion and debate. There needs to be a clear cut direction in using the software to take advantage of the tools available for the online learning process.

### **Conclusions and Recommendations**

Online education works for some courses that are text oriented and do not require any intense interaction with students and instructors or laboratory facilities. The Civil Engineering and Construction Management programs have several courses that require either a) significant physical interactions with student peers and instructors, and/or b) hands on access to laboratory facilities. Some of these courses are Civil & Construction Materials, Strength of Materials, Construction Methods, Construction Project Management, Soil Mechanics, Hydraulics, Fluid Mechanics, Plane Surveying, Chemistry and Physics need laboratories to teach effectively.

Laboratory sessions should be taught in conjunction with corresponding classroom lessons so students can relate course materials to real world applications. For the courses studied in this paper, it can be seen that the disadvantages of using online courses in Civil Engineering outweigh any advantages. Often times, students should work in a team climate to achieve success in various projects that they may have to undertake in the real world. As online education advances, it is a concern that technology will overtake face-to-face education style.

Is online education a threat to the class room style of education delivery? Time can only answer this question. However, we cannot ignore the fact that the internet can be used to the advantage of both the instructor and students. Therefore the blending of the class room lectures with online tools for delivering the education to students will be very beneficial in effective teaching.

## **Bibliography**

1. Heather Fry, Steve Ketteridge, Stephanie Marshall, "A Handbook for Teaching and Learning in Higher Education" 3<sup>rd</sup> Edition, 2009.
2. Laurillard Diana, "E-Learning in Higher Education", "From Changing Higher Education", Edited by Paul Ashwin Routledge Falmer, forthcoming, June 16, 2004.  
[http://www.immagic.com/eLibrary/ARCHIVES/GENERAL/U\\_LONDON/L040616L.pdf](http://www.immagic.com/eLibrary/ARCHIVES/GENERAL/U_LONDON/L040616L.pdf)
3. Bourne, John; Harris, Dale; and Mayadas, Frank, "Online Engineering Education: Learning Anywhere, Anytime", 2005. Paper 1. [http://digitalcommons.olin.edu/facpub\\_2005/1](http://digitalcommons.olin.edu/facpub_2005/1)
4. Elaine Allen, I., Jeff Seaman, "Going the Distance Online Education in the United States", 2011, Online book available at the website <http://www.onlinelearningsurvey.com/reports/goingthedistance.pdf>
5. I. Elaine Allen and Jeff Seaman Grade Change "Tracking Online Education in the United States", Babson Survey Research Group January 2014.
6. University of North Dakota website, "Online Civil Engineering Degree", <http://und.edu/academics/extended-learning/online-distance/degrees/civil-engineering> accessed on March 2<sup>nd</sup> 2016.