Comparison of Teaching Systems Analysis and Design Course to Graduate Online Students verses Undergraduate On-campus Students

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Abstract

In this study, the advantages and drawbacks of teaching Systems Engineering courses to online graduate students are explored. The benefits and deficiencies are compared with those of teaching similar course contents to on-campus undergraduate students. For the purpose of this study, the comparison is done based on the ‘System Analysis and Design’ course taught at both undergraduate and graduate levels. The same text book is used at both levels and similar material is covered. At the graduate level, students are expected to do more advanced level projects. At the Polytechnic Institute, graduate students typically have several years of industry experience working as systems engineers or in other similar capacities. It is expected that graduate students will bring a richer experiential knowledge to the classroom. On the other hand, undergraduate students typically have either no systems engineering background or have unrelated industry experience. So the expectations from the undergraduate students are much lower in terms of bringing examples from real world experiences. However it is observed that, because of the online nature of the course, graduate students are often hesitant to share their experiences in discussion based synchronous online classes. Undergraduate students, in a face-to-face environment are observed to be more open to discussions and immediate feedback to the instructor. Graduate students are not shy but their hesitation to actively participate in online classes can be attributed to their un-familiarity with the technology or the hindrances caused by the current state of technology. In this paper, the drawbacks and advantages of both online and on-campus courses are discussed. A few ideas are included that will help bridge the gap between the effectiveness of teaching online and on-campus courses.

Keywords: Graduate, Undergraduate, Systems Analysis and Design

1. Introduction

Traditional undergraduate students are high school graduates with little or often no industry experience in systems engineering. They often do not fully appreciate the value of systems engineering. On the other hand, the graduate students who return to school after a few years of experience in the industry fully understand the value of systems engineering. Graduate students typically have a bachelor’s degree in an engineering discipline. After working in the industry, they realize that to move up the ladder, they need to know more than just the disciplinary knowledge they acquired in their undergraduate curriculum. When these students come back to the classroom, they are typically more motivated than traditional students. They are usually there because of their own well thought out career choice. Graduate students are expected to provide insight and relevant experience related to classroom contents. They usually already have the relevant background experiences necessary for further exploration for research and insightful classroom discussion. Typically, at the undergraduate level, the professor needs to guide students to become better engineers and researchers and to think more critically regarding various issues. At the graduate level, the professor can act like a sounding board for affirmation or guidance. Graduate students have various strengths and needs. Every student has different learning styles. Graduate students are adult learners. Adult learners tend to do well with balancing the school, life and work. Graduate students also have busy schedules including non-academic responsibilities [1].

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Presented at the 5th Polytechnic Summit  
Wentworth Institute of Technology, Boston, Massachusetts, June 5-7, 2013

Online programs is rapidly rising in colleges and universities in the United States. In response to these changes in enrollment demands, many institutions have changed their strategic plans to implement online education. On the other hand, there are misconceptions and myths related to difficulty of online classes, technologies available to support online instruction, and the support and compensation needed for high quality instructors. These misconceptions create challenges for such vision statements. Based on a survey, Kim and Bonk predict that by 2013, the quality of online courses would be identical or superior to traditional instruction. Similarly they predict that the quality of the learning outcomes will be the same or superior [2]. Both students and instructors in an online environment must possess certain characteristics. These include maturity, self-discipline, organizational and management skills, commitment, and assertiveness [3].

A Systems Analysis and Design course is taught during the same semester at both undergraduate and graduate levels. The two classes are independent of each other and meet at separate times. The graduate class is online. Students and instructor ‘meet’ online virtually once a week. The lecture is conducted based around content presentation and discussions. The undergraduate class meets twice on campus. It is one of the first disciplinary courses in systems engineering for both levels. Before taking this course, students take the general foundation courses. In this course they are taught systems engineering concepts for the first time. It is important to conduct this course effectively and establish student interest for their long term retention in systems engineering.

2. SYE Undergraduate Students

At the undergraduate level, in the System Analysis and Design course, students learn the techniques for developing, analyzing and portraying design and lifecycle system requirements. Students learn to use tools and techniques including Quality Functional Deployment, requirements management, and enhanced block flow diagram. The class meets twice a week on campus for three contact hours. The lectures cover all aspects and phases of complex system creation. The topics include the analysis and definition of needs and operational requirements, definition of system boundaries and interfaces, identification of constraints and analysis of context, design concept definition and exploration, modeling architectures, technology and engineering development, risk analysis, integration, testing and qualification, production and operation support, trade-off analysis, function allocation, managing complexity, optimization etc. Students get a taste of a variety of systems engineering and related areas. Through this course, they get a preview of what to expect in term of their future courses in the systems engineering curriculum. In this course, student-teacher interaction is heavily emphasized upon. Students are asked to actively participate in the class. One of the assignments for every session is for students to review the latest development in engineering across disciplines and discuss that for first few minutes of the class. Students actively participate in this activity. They bring new and useful knowledge by reviewing non-text book related material. They are encouraged to make connections between the engineering and technological development in the industry and the course topics.

Students learn to represent and model analytically and graphically the functional, physical and operational characteristics of complex systems. They actively communicate their understanding of the role and relationships of the multiple functions needed to design systems. This feedback helps the professor understand the level of student understanding and adjust the class topics accordingly. Through interactive exercises students identify and transform stakeholder needs into specifications and requirements. They understand and apply principles of interface design. They appreciate the decision analysis and associated risks during each phase of system life cycle.

In author’s experience, the undergraduate students interact proactively in the class sessions. They ask good questions, respond to the instructor, and are engaged. Students that are engaged in a classroom tend to perform better in the class. In addition to listening to the professor, they use other faculties of learning. It has been proven that learning by doing helps retain the material. This active student participation may be attributed to the fact that the course is on campus in a face-to-face setting.

3. SYE Graduate Students

The graduate program at Southern Polytechnic State University (SPSU) is designed for working professionals and caters for their needs. All the systems engineering Masters’ level courses are offered online. All the classes are scheduled in the evenings. Working professionals can either go home at the end of the day after their day job or stay back at their workplace and participate in the live synchronous classes. They do not have to drive to campus to attend any of the classes. This opportunity gives them tremendous flexibility. All the classes are archived. If a student misses a class, they can review the entire lecture and the discussion around it any time at their convenience.
The system analysis live class meets once a week. The contents of the class are similar to the contents covered in the undergraduate level with the addition of a few more in-depth and advanced topics. In addition to the live class meetings, students are required to review the online material on their own. Students are required to come prepared for the class to discuss the material. The session is designed for the instructor to give students a general guideline about the subject matter. Students are required to participate by sharing their experiences. Students are also required to prepare presentations for the class. These students are generally more motivated and interested in the curriculum than average undergraduate students. All students listen to the online presentations of their class fellows, ask questions and give feedback. Despite this requirement, it is observed, that majority of the students are hesitant to participate in the online class discussions. These online graduate students tend to limit their interaction with the instructor and other students in the class. This behavior is observed not only in the live classroom sessions but also in the student projects and other group activities. Part of this can be attributed to the fact that the existing online technology inhibits the graduate students from fully participating in the class activities. Students are not as comfortable with participating in a class session with online interface as they in face-to-face sessions. In the author’s experience, while the online courses are becoming popular, a number of potential students have indicated that they would rather not enroll in the program if the program was online. There still seems to be some demand for traditional courses. This lingering demand could be attributed to the students need to interface with the instructor and other students. Online students and the instructor do not receive the immediate feedback from each other.

4. Teaching Online Versus Teaching On-campus

Several advantages of online instruction have been studied and reported [3]. Online environment provides the opportunity to the working professionals and mature students to bring their knowledge back to the classroom. The instructor can leverage that knowledge to add value to the class. Often times, the graduate students are the top 15% of their undergraduate class. They are mature and bring value to the class. It is the responsibility of the instructor to exploit that knowledge so everyone can seek benefit from it. Flexibility of schedule is of significant importance to graduate students and working professionals. The online environment also provides the same flexibility to the instructor. The instructor can teach from their residence or while traveling. Although it is hard to develop an online course, but once developed, it is highly reusable. A number of modules in an online course can be re-used. This includes the reuse of archived lectures. The voice-over lectures are helpful for qualitative and quantitative material. One of the greatest advantages of online classroom is the ability to simultaneously teach large number of students all over the world. Students do not have to commute or travel to go to school. They could seek admission in the universities of their choice anywhere around the world and take classes without having to step out of the comfort of their home. This helps universities and programs to reach out to students in remote area who might otherwise not be able to get quality education and in this particular case, systems engineering education. There are still limited numbers of institutions that offer systems engineering degrees. The online capability helps reduce the cost of education. Students do not have to pay to live on or near campus. The commute cost is eliminated. The online class is also green. It requires fewer or no papers. The white or blackboard is not used. In long run, that also helps reduce the cost of education. There are a number of other advantages of online instruction identified in the literature [3].

While there are lots of advantages of online teaching, there are still some drawbacks or limitations that need to be considered. Preparing for an online course may take significant amount of time and effort from the instructor compared to an on-campus class. Delivering an online lecture also presents a set of challenges. The instructor cannot write on the board or walk around in the room. The instructor is usually stuck in the chair looking at a computer screen. That decreases the dynamism that some instructors enjoy in a classroom environment. There is also a lot of administrative work required from the instructor in an online class. This includes uploading, and downloading lectures, archiving lectures, keyboard activities, and other secretarial work. Grading homework and assignments also poses certain challenges. The instructor cannot mark on the student’s work unless if they are using a touch sensitive screen. The other alternative is to print the student work, mark it, and then scan it back for student review. This also causes lots of extra work and time commitment from the instructor. Some instructors argue that the personality buildup process is missing in an online classroom environment. Students do not get a chance to meet with other students, faculty, and colleagues in person. The inter-personal and communication skills may not develop or may not be at par in an online environment when compared to traditional on-campus classes. The general perception of the online programs in the industry is still not as favorable as the traditional on-campus programs. Engineers are process / algorithm based learners. They do not learn well with bullet-points in a slideshow. A typical traditional engineering class will show the process or evolution of a theory or a mathematical concept. This becomes second nature to
engineering students after years of learning and practice. Unfortunately that process is hard to mimic in an online class. Another challenge in an online class is proctoring exams for students. Usually special arrangements have to be made to proctor the closed book exams. The alternative is to make open book exams, which could be yet another challenge for the students and the instructor alike.

One of the biggest drawbacks that the author feels exists in an online classroom environment is the lack of face-to-face interaction between the instructor and students. When an instructor teaches an on-campus course, they can get a direct and immediate feedback from students by looking into their eyes. That immediate feedback is not available in an online environment. There are ways to improve the student-teacher and student-student interaction but the interaction is not close to what one can expect when all participants are physically present in the same room. Due to the lack or absence of this interaction, team-work is hard to accomplish. Since students do not get a chance to meet with each other in person, they are more reluctant to interact with each other and work in groups. Students often do not want to interact with groups online especially if they have not met them in person. They are also hesitant to discuss the course material or assignments online with each other. This hinders the student’s ability to present their work in groups. In the author’s experience, most students prefer on-campus classroom environment for presentations – despite knowing that everyone can see them. When asked to present online, they are often either reluctant or do not perform as well as they would otherwise. This may have to do with the ‘fear of unknown.’ This also makes the environment more formal than an on-campus class.

5. Bridging the Gap

Some of the challenges of teaching online that existed several years ago are now being addressed and resolved with the advent of technology. Students and faculty are also becoming more technology savvy. The biggest gap that remains today is the difficulty of interaction and immediate feedback in an online course. There is a need for technology where all the students, while staying off-campus can independently access the live class sessions. The technology needs to provide means for the students and the faculty to interact with each other seamlessly. For the instructors, the feedback needs to occur immediately. This feedback needs to include both the verbal and visual forms of communication. Without the audio and visual communication, there is no way for the instructor to verify whether a given student is continuing to participate in the class or has walked away from the computer [4, 5]. Similarly students need to feel comfortable with asking questions and interacting in the online classroom. They should have the flexibility to ask questions, carry out discussions and interact with the faculty and other students just like they do in an on-campus classroom. The solution may lie is a combination of high bandwidth ubiquitous internet connections, high resolution motion sensitive cameras, high speed personal and school computers and servers integrated with high fidelity learning management system and virtual online classroom platform. One thing to keep in mind is that all this technology may make the entire online environment complex.

Online learning could be improved by training students to self-regulate their learning, having better measure of student readiness, better evaluation of student achievement, and better course management system to track student engagement. It is likely that graduate students who have years of combined industry experience could bring valuable systems engineering knowledge to the classroom environment. This knowledge could benefit all the participating students. This knowledge should not be lost because of the online presence of the course. The primary reason this does not happen is because of the difficulty of online communication. The current online infrastructure creates a barrier for several graduate students and keeps them from actively participating in classes. If the highlighted drawbacks are eliminated, then all the advantages of online classes could be retained and all the advantages of on-campus classes could be fully utilized.

Conclusions

In this paper, an on-campus face-to-face undergraduate systems engineering class is compared with an online graduate systems engineering class. It is observed that the undergraduate students, who although have little or no experience in systems engineering participate actively in the class. Active class participation and engagement is directly linked with better learning and retention. On the other hand, the graduate students take a similar course in an online setting. These students usually do not participate proactively in the class sessions, because of which they often miss out on the opportunity to learn from each other. There are several advantages of online classes. The lack of graduate student class participation can be attributed to the technology barrier. Amongst other reasons, current technology does not allow students to actively engage in classroom discussions without disrupting the flow. It is
Presented at the 5th Polytechnic Summit  
Wentworth Institute of Technology, Boston, Massachusetts, June 5-7, 2013

expected that if technology can remove the verbal and visual conversational gap between students and faculty, and amongst students, then the online graduate classes could become as effective as on-campus classes. More students would be interested in taking online courses. The classes will become richer because the material covered by the faculty will be augmented by student experiences from the industry.

Acknowledgements

The author would like to acknowledge all the undergraduate and graduate system analysis and design students who participated in the on-campus and online classes.

References

While many on-campus students are offered the option to take some of their course load online, there are often requirements for these students to be on campus at a pre-determined date and time to attend class. An online degree, however, removes the need to go to campus, and ensures that you will always have the flexibility of studying online while pursuing the degree program you are in. UCF Online undergraduate students save $33.09 per credit hour. UCF Online graduate students save $42.33 per credit hour. Many online courses are blended with online degree students and in-person degree students. This structure helps to ensure that you receive the same quality education regardless of how you choose your degree experience.

C. Undergraduate Courses for Graduate Credits

Graduate students can enroll up to 12 credits of undergraduate courses and use them toward their graduate degrees, providing those are 300 or 400 level courses and are relevant to their areas of study. Students should discuss the relevance of those courses with their advisors prior to registering. All upper-level undergraduate courses must be pre-approved by the Graduate Program Director. Such courses must be preceded with a Â«GÂ» prefix during registration to obtain graduate credit. Advanced students may submit the Reduced Credit/Course Load Form to the Graduate Program Director for approval. Advanced students may be allowed to register for as few as 1 credit per.

4. Some students don't want to go on with their education. When they leave school they will look for a job. Other students are thinking about colleges. They are each writing letters to three or four different colleges, and sending in forms. Colleges accept only those students who have done well in high school. They want to meet these students before they decide to accept them.

Other students choose large universities because they teach lots of different subjects. Some choose small religious colleges. There are differences between colleges and the type of study programs they have. For example, many four-year Â«Liberal ArtsÂ» colleges are small and teach only the most important subjects for a general education. State universities are large.