E-Technologies in Interdisciplinary Education: Engineering and Business Perspectives

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Abstract

In this paper, we consider the use of e-tools in engineering and business programs. In both, this use is increasing rapidly, partly to serve the large body of non-traditional students and partly to exploit the benefits of the information technology advances and keep their curriculum modern. In this evolving educational domain, it is important to understand the needs and constraints posed by the unique characteristics of business and engineering programs. This would benefit the developmental efforts in e-tools to support these programs and also contribute to the discussion on how best to use these new tools to aid student learning.

I. Introduction

The rapid technological advances of the last few decades fueled by the phenomenal growth of the information technology (IT) industry, has led to an increased relevancy and value of graduate degrees in industry. Recognizing the need and opportunity to serve a large number of working professionals, engineering colleges have begun offering graduate (MS) degrees by distance learning. Business schools have traditionally focused on Executive Education programs. But, over the last five years, on-line MBA programs have been developed by many institutions. Finally, since the early 1990s, acknowledging the industryís need for graduates with both engineering and business skills, several interdisciplinary degree programs have been developed (e.g., MITís Leaders for Manufacturing, Northwesternís 3M program, the Program in Manufacturing at University of Michigan, AIM at Stanford). Distance versions of interdisciplinary programs are also available now (e.g., University of Michiganís PIMís Master of Engineering degree is offered by distance to employees of several companies including General Motors, United Technologies, Ford).

The explosion of on-line and distance learning and teaching activities both in educational and corporate settings, and the continued growth potential, is well documented [1]. As detailed in Taghaboni-Dutta and Velthouse [2] this growth can be attributed to: continuing advances in information technology; the corporationsí need to maintain a competitive workforce in the globalized economy; and the non-traditional studentís desire to eliminate the skill gap with traditional college students.

Thus, the market for e-learning is likely to continue to grow. Consequently, it is important for us to be effective users of e-tools in engineering and business education. In the following, we first make brief remarks on the uses of IT in the business and engineering pedagogy, as well as the current boundary conditions impacting both domains. Then we consider the commonalities and differences in business and engineering education and how each impacts or is impacted by e-technologies. We conclude with some closing remarks.

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II. Uses of IT in e-Learning and Teaching

Over the past 50 years, information technology has changed the world we live in and impacted almost every aspect of our lives. In the e-learning and teaching domain in engineering and business, the focus on the use of IT can be categorized into the following: connecting people, creating content, and connecting people and content.

Todayís engineers are expected to work globally ó collaborating with team members located in various countries with diverse languages and business cultures to engineer products and services that insure the companyís competitiveness in the global economy. As detailed in Dutta et al. [3], exploiting IT to connect students in three continents a new course addressed this specific issue. IT did not just enhance this course; it was the tool that ensured the courseís global character by creating a virtual classroom for the ìliveî lectures and allowing the students to work in global teams. Infrastructure and cost issues notwithstanding, similar uses of IT are on the rise.

The use of IT in creating content is the most common task for faculty in engineering and business. Web pages are becoming routine for every class and CD-ROMS accompany many new texts. On-line and digital versions of textbooks, journals, etc., are also increasing rapidly. However, in the e-learning domain, content creation is supposed to be much more than putting course materials (lecture slides, assignments, solutions, etc.) on

the course Web site or a CD-ROM. The use of e-tools must necessarily be with a view towards compensating for the lack of faculty/student interaction. Creation of an intuitive, stimulating and collaborative environment is the goal.

Finally, IT connects people to content. By eliminating the need to be in the classroom at scheduled time, it affords the needed flexibility for non-traditional and traditional students alike. A course offered by distance learning offers the same flexibility to on-campus students as it does to off-campus students. The issues here include connection bandwidth, speed and reliability as well as some on the server side.

In the current economy, professional schools like business and engineering share similar boundary conditions, as listed below.

1) *Globalization:* Its impact of is felt in both business and engineering schools, and global programs are on the rise. Many are focusing on global reach, i.e., offering their course and degree programs globally. Many others are also focusing on global enrichment of their on-campus programs via novel courses and study abroad modules. In both cases, the increased use of e-tools will help.

2) *Industry Partnership:* Interfaces with industry: Increased interaction with industry has significant benefits for business and engineering programs. The development of distance and on-line programs can be viewed as much as a requirement for maintaining industry partnerships as an opportunity for increasing program enrollment.

3) *Lifelong Learning:* In this information and knowledge age, the growth of non-traditional students is bound to increase. Life-long learning will be a way of life. Age, distance and other conventional barriers to life-long education and enrichment are beginning to disintegrate. E-technology uses based non-degree programs for future leisure learners, who are well versed in the everyday use of IT, are likely to increase significantly.

III. Business and Engineering Education Environments: Similarities and Differences

These teaching environments in these professional disciplines have several similarities and also some differences. We consider them in turn and remark on how each impacts or is impacted by e-technologies. Note that our comments below apply more to (product/process/system) design, development and manufacturing areas of engineering as opposed to traditional areas (such as fluid mechanics or controls). However, the Accreditation Board for Engineering and Technology (ABET) has emphasized the importance of design (open-ended problems in real world setting) in all branches of engineering education.

A. Similarities

1) *Case-study and Discussions:* Business schools routinely employ case-study format teaching. Discussions and situation analysis are an integral part of the class. In engineering, this aspect is of increasing importance and all design courses now have a significant amount of open-ended and unstructured problems often involving case study and discussions. This poses unique challenges in the design of e-learning environments. There are examples (known to the authors) where faculty have resisted the creation of distance versions of courses that have a significant discussions component. While progress has been made, work remains for designing e-learning environments to capture/create a discussion environment for the e-learner.

2) *Teamwork and Collaboration:* In many engineering courses, as in business courses, teamwork and collaboration is routine. There are also courses that team up engineering and business student to work on projects. But, if team members are not co-located, as would be in the e-learning domain or in global corporations, collaborative work can be a challenge. While much progress has been made and several commercial (e.g., E-viz, Alibre, Placeware, Praja) and university efforts (e.g., Coursetools and MEonline at University of Michigan) have led to effective collaboration environments, much remains to be done as the needs and work cultures are made explicit.

In e-learning environments, both issues above are impacted significantly by course design and content creation. Faculty members, in addition to content, have to create a learning community that enables and enhances peer-to-peer interaction, collaboration and creativity. Often times successful methods from traditional classroom environments do not transcend. Distance students miss out on the classroom synergy. While the best lecture and content organization will not prevent this, it is possible to create and support a collegial atmosphere. Some guidelines include [2]: design the course to promote interaction; conduct a chat room during the first week of class or arrange for a face-to-face session; individualize the learning experience; provide timely and meaningful feedback; and provide structure, allow flexibility yet retain control.

B. Differences

1) *Laboratory experiments:* In many engineering courses (e.g., manufacturing, thermo-fluids, control) experiments are an integral part of the course. Experimental set-up, data gathering and analysis are as much a part of the learning as are the lectures. This is almost never the case in business courses. If data gathering is required for financial markets, economic indicators, etc., they can be obtained from the Internet; in this way IT has positively enhanced research/education in business. Efforts are under way to provide

this capability to engineering e-learners. Virtual environments/experiments are being developed, but this effort is still in its infancy.

2) *Heavy Duty Computing:* Many engineering analysis courses (such as finite elements, fluids, etc.) are computationally intensive. Homework problems require access to large computer codes and long compute times. Business courses do not have such requirements. E-learning students in this area are not adversely affected since most codes can be run remotely. Self help and other program operation guidelines can be effectively designed for the e-learners.

3) *Contemporary topics:* Business courses are more focused on contemporary issues and topics as compared to engineering. The Internet positively impacts such courses by making information (such as from the *Wall Street Journal*, economic forecasts, market surveys, etc.) available readily. An informed group of students (having read the *Wall Street Journal* on the Web) can significantly impact and enhance the classroom discussions in a corporate finance course. Engineering education is rarely affected by such contemporary information.

4) *Communication:* In many business courses (and few engineering courses) the need for effective verbal communication is paramount. The in-class presentation is often the best chance to convey the significance of the results of the marketing project. The speakers use their personality to make the topic content exciting and memorable. The availability of classroom non-verbal cues (i.e., student interest, confusion, and boredom) can be effectively used to focus or change emphasis on portions of the presentation. The interactivity of a face-to-face encounter goes a long way in making an ordinary presentation seem rather interesting. Current technology allows for e-learners to send in their pre-recorded presentations on CD/Video. This area still needs further development to close the gap between in-classroom and distant presentations.

IV. Conclusion

E-technologies have enabled e-learning to fill a critical need in society today. However, despite the best technology, it is still the teacherís responsibility to develop the learning community, to provide structured content and to give meaningful feedback. While some of the techniques needed for these tasks in e-learning are adaptations from the traditional approach, it is incumbent upon us to recognize and accept that the e-learning environment is indeed a very different one. New methods will have to be devised for a new generation of students. This is our responsibility.

William Brody, president of Johns Hopkins University, said it eloquently:

ìMany people believe that, in the future, everything done in schools today using blackboards and chalk, pen and paper will still be done, only on computers instead. They could not be more mistaken. We are faced with something new and profoundly different. In the next several decades, we will need to use IT to advance the science of education, to make learning more efficient, more effective, more universalÖ. We will need to create entirely new paradigms of learning.î

References

[1] Bonk, C.J. and C. Essex (2001), ìStating the State of E-learning: Surveys in College and Corporate Training Settings,î *Proceedings of 17th Annual Conference on Distance Teaching and Learning*, pp. 61-66, August 8-10, Madison, Wisconsin.

[2] Taghaboni-Dutta, F. and B. Velthouse (2002), ìTeaching in An e-Classroom: How To Be An Effective Teacher to E-Learners,î *Proceedings of 2002-World Conference on E-Learning*, October 15-19, Montreal, Canada.

[3] Dutta, D., Efsthathiou, J. and Kim, J. (2002), ìGlobal Product Development: Using Global Resources Effectively for a Novel Course,î *Proceedings of E-Technologies in Engineering Education Conference*, August 12-16, Davos, Switzerland.

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