



## Are we prepared to bridge the gap?

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I have a Ph.D. in Computer Science, M.Sc. in Engineering, and B.Sc. in Electrical Engineering. Currently I serve as a chair of department of computer science, information and media systems and Professor of Computer Science and am intimately involved with program development and streamlining of existing programs to align them towards the future demands of academia. I am currently the Program Lead for BS in Electrical and Computer Engineering and BSc in Information Systems and have also served as the co-Lead for MSc Computer Science and Program Lead for MSc in Database Administration programs. My association with ABET (Accreditation Board of Engineering and Technology) US dates back to 2001, as a certified program evaluator for BSc in Computer Science and BSc in Information Systems. At present, I am also serving as the Commissioner for the Computer Accreditation Commission (CAC). Ongoing assessment of academic programs is a personal interest of mine, and I am involved on an ongoing basis at the departmental, school and university levels. Previously, I have taught in different countries for over 23 years. I have been privileged to be part of the DESY Group (Deutsches Elektronen Synchrotron), Hamburg Germany, as a research fellow, and worked with an MIT group, led by a Nobel laureate.

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### **ABSTRACT**

*Today our academic institutions are expected to turn out high caliber graduates who can smoothly transition into jobs in industry at large quickly and effectively thus increasing the ability of technology companies to innovate and be more competitive in the global markets. The objective of this research is to help educational organizations achieve these goals by better preparing new graduates to be more competitive and successful in meeting the challenges of the technological future and brave new world. This paper will also examine some of the ways this can be achieved.*

### **INTRODUCTION**

It is hoped that work presented here will broaden and deepen awareness among faculty members and administrators of the educational institutions and that it will motivate more educators to participate in and support this global understanding of this issue. This paper will also help in further growing the body of knowledge about educating our future generations by initiating a more active, interdisciplinary, and international collaborations among educators, education researchers and curriculum designers. Faculty in the engineering programs have shown increased interest in reading the education literature, attending education conferences and teaching workshops and a few have attempted to use various teaching approaches in their classes [18]. There are number of factors for higher interest in improved and effective teaching in engineering programs. Today our academic institutions are expected to turn out high caliber graduates who can smoothly transition into jobs in industry, at large, quickly and effectively thus increasing the ability of technology companies to innovate and be more competitive in the global market. The mechanisms to meet these expectations are however complex, and not always easy to achieve. Some of the known factors for this situation are, geographical location, stature of the educational establishment and the delivery mode used. Another key contributing factor has been to examine how specifically an institution prioritizes one set of subject matters over any other so as to make new graduates more technologically attractive to their constituents (Perspective employers) at the same time use technology and course delivery that is attractive to students. To encourage and hold the interest of students, much effort has gone into research and development of innovative methods of teaching. So in an effort to increase student enrollment as well as produce high quality graduates according to institution's mission both faculty and administration are always trying to attempt different approaches to design attractive curriculum as well as to try appealing modes of delivery of course material to help students learn and gain knowledge more effectively. We always try to address most of these issues by paying attention to the delivery mode, keeping in mind different options that students appreciate, some feel more comfortable with face-to-face format while others prefer online mode of delivery. This paper examines some of the delivery modes used to achieve these objectives especially by our institute.

### **GLOBAL IMPACT**

For over two centuries, the competencies that engineers have been expected to gain from engineering education have been associated with countries [17]. Increased mobility in the

workplace is generating pressure to expand competencies beyond countries. A key indicator of changing expectations is found in efforts by engineering education organizations to extend themselves beyond country boundaries. The U.S. Education Department's National Center for Education Statistics reports a drop of .2% in college enrollment for fall of 2011, first decline in the last 15 years as reported by [19]. On the other hand many others academic institutes are also on the receiving side of the economic crunch in the form of limited budgets and scarcity of federal and other funding. Among other things, these limitations has caused hiring of the fewer full time faculty members and relying more on the hiring of the part time or adjunct faculty to teach, the number of classes that are to be offered to meet student demand [19]. Students and graduate in these days move from country to country seeking employment or going for higher degree. The mass movement forces academic institute to globalize or internationalize their curriculum for various programs. Academic globalization would mean that the graduates are equipped with competencies applicable in today's world where national borders no longer hamper the flow of employment, technologies and products from one country to another. On the other hand it is also the ability of academic communities to attract as well as integrate brainpower of any nationality seamlessly. The rationales for this globalization are somewhat similar for developed or developing countries. Authors in [1] present four kinds of rationales not only for academic institutions of higher education, but also for national governments, international bodies, and the private sector. These rationales are valid if these entities want to be actively involved in international educational activities, and can be stated as academic, cultural, political and economic. However, this academic globalization will have its impact on education as well as on the providers. These can be categorized as follows [1]

- Cooperation: Memorandum of Understanding (MOU) among academic institutes for mutual recognition of credits. Development of a common systems or sharing their functionality.
- Convergence: Global synchronization of the educational structures among different institutes.
- Competition: Struggle among institution for enticing motivated and qualified students.

[2] States that Romania follows a framework for the development of its academic institutions. Thus, allowing universities for individualizing their curriculum. However, although progress is achieved in the these changes do not reflect all the changes that are taking place in the area of specific subjects as well as of the interdisciplinary domains. A solution to bridge this gap could be the recommendation made to the faculty to ensure that a curriculum that is designed and used should be mainly an interdisciplinary one, or the one focusing on new domains [4]. As part of the academic globalization effort, the European Commission has prepared a document that, as a recommendation propose a set of new set of basic skills to meet the new challenging demands of society and economy [3]. These basic skills are as follows:

- Helping workers as well enterprises adapt to changing circumstances in the global economy.
- Through better education and proper training systems improve skills.
- Improved partnerships between employers and non-governmental organizations.

## **CHANGES IN THE CURRICULUM**

The ABET of USA accreditation board realized the lack of some of the essential skills among the graduates, such as, professional awareness, low levels of communication and teamwork skills. ABET therefore now proposes improvement for the knowledge, skills and professional values for the graduating students. In addition, analysis of the industry studies, together with the review of the ABET accreditation criteria and study of engineering education reveals that the industry employers and the students are looking for significant changes to the current philosophy and delivery of engineering education [5]. These issues can be summarized as follows:

1. Engineering curricula does not provide sufficient integration of engineering science and technical topics to industrial practices.
2. Programs at times do not provide sufficient design experiences to students.
3. Graduates lack communication skills as well as teamwork experience.
4. Programs should address developing more awareness amongst students of the social, environmental, economic and legal issues.
5. Faculty in academic institutes generally lack industrial experience, hence are not able to adequately relate theory to practice or provide design experiences.
6. The existing teaching and learning strategies are outdated and require to be more student-centered.

The solutions generally proposed to overcome most of these issues point to a fundamental redesign of the curriculum in engineering programs.

## **ISSUES WITH THE CHANGES**

In the traditional teaching environment the faculty lectures and gives well-defined single-discipline take home assignment, and the students listen, take notes, and submit assignment individually. Alternative pedagogical techniques have repeatedly been shown to be more effective and much more likely to achieve the objectives. The superiority of the alternative methods at achieving desired both cognitive and affective educational outcomes has been demonstrated in many of empirical research studies [18]. In addition there may be considerable number of faculty that are still not aware of alternative teaching approaches and methods, on the other hand many of those who know these techniques may still choose not to utilize any of them into the classes that they teach. This behavior can be attributed to many likely reasons other than the unavoidable known human resistance to change. On the other side, although the change may be opposed by many faculty members but it is encouraging knowing that there is also a view that some of these changes are very beneficial for the graduating students. In addition, at the same time industry have been applying growing pressure on academic institutes to pay more attention to the quality of their programs, and growing competition for engineering programs has provided further motivation for the change. The new ABET criteria for program accreditation is also emphasizing changes in the curriculum accordingly. Moreover, major support for educational restructuring has come from the National Science Foundation (NSF) Division of Undergraduate Education and the NSF-sponsored Engineering Education Coalitions. It is because of all of these recommended changes that initiated the development of a large number of innovative programs, teaching methods and materials.

## **OUR APPROACH**

National University (NU), an independent, nonprofit institution of higher education, has dedicated itself to providing educational opportunities to a diverse population of working adult learners since 1971. The School of Engineering, Technology and Media (SETM) at National University (NU) was established in July 2002, and has attracted a current student body of over 1300 whose profile generally mirrors that of the university itself. NU, the second largest private non-profit university in California, has over 23,000 mainly non-traditional students: students whose average age is over 30. The university also boasts of a large population of students from traditionally underrepresented groups, such as women and minorities. Typically, most of these students, whether at the undergraduate or graduate level, are re-entering an academic environment after having been out in the working world for some time. SETM offers nine undergraduate and eight graduate degree programs with several specializations. Over 90% of these programs are offered both in the online and on-ground modes. SETM has over 10 years of experience in online education. The push from industry, ABET, NSF and personal beliefs regarding the importance of education in the academic institution have led increasing numbers of university administrators and faculty to question the viability of the traditional way of teaching in engineering program. However, at the same time many of the faculty members are not sure of what are the alternative to the traditional methods. On the other hand those who know the alternate methods to teach require a full-time commitment that will leave them with insufficient time to pursue their research. In the following section we list how we addressed one of the factors that contributed to the changes in the curriculum, namely the course delivery mode.

### **Accelerated Format**

The global market for graduate these days is very dynamic, changing job opportunities every month if not every week. In addition graduates also want to finish their studies as quickly as possible and are also on the move seeking employment. The economic globalization means that graduates are equipped with all the required skills that are universal and also meet the expectations of perspective students, to graduate as early as possible and with least amount of debt. We at our institute use accelerated pace for teaching and learning. This faster pace helps students to graduate in much shorter time and join the workforce sooner than later. Our quarter system lasts for 4 weeks with 10 class sessions, each for 4 hours and 30 minutes.

### **Delivery Modes**

Following sections briefly explain various delivery modes that we use for our programs.

#### **1. Online Mode of Course Delivery**

Online education is no more considered as one of the new trends, since it has been one of the modes of instructions in various forms as early as 1900. In its early years it was obvious that interest and improvement in online education will keep on growing in the 21<sup>st</sup> century because of the various trends in social community and economic [6]. The popularity of online education has provoked even, in the last few years, some big name as well as other universities to start offering online courses if not a complete program in addition to more traditional face-to-face format.

Online education can be considered as a win-win scenario because it can help administrative issue by avoiding cancelling classes with low enrollment. On the other hand online offerings can be attractive for off campus and nontraditional students. The great benefit of online education is for working students, adult learners and returning students who are seeking improvement in their qualification for perspective promotion or better employment. Immediate feedback is not possible; therefore both student and the instructor for a particular course have to adjust to the time gap in their communications, because of the inherent asynchronous nature of the online environment. Another issue with the online degree programs is their acceptance or recognition in general by the employers, since many organizations still do not consider online degrees at par with the onsite degree. Students taking online courses and/program need to have some basic computer literacy and knowledge of internet use to be able to get most out of their online courses. They also need to consider what type of learner they are since online education needs additional self-discipline, motivation and commitment from their side.

## **2. WebClass Approach**

One of the formats used for teaching courses at our school is called WebClass. To overcome some of the limitations of online programs we introduced WebClass format for some of our classes. This format is quite similar to face-to-face teaching with the difference that students and teacher are connected through the web. A WebClass, uses a synchronous approach utilizing a live interaction among students and teacher as opposed to a traditional online class. The primary Learning Management System used by National University for teaching and WebClass is called eCollege developed by Spectrum Pacific Learning (SPL). In a WebClass, just like any typical onsite or face-to-face class session, students need to attend the entire class session at a prearranged time and day of the week. This mode of teaching is a good compromise between a well-tested and longtime established mode of teaching called face-to-face (F2F) teaching and now becoming popular and gaining strength day by day approach called online teaching. This relatively new format encompasses all the benefits of face-to-face class and all the advantages of an online class, since student are not required to be physically present at any one compass. In order to make full use of the potential presented by this mode the instructor needs to play the role that is analogous to a guide on the side. In order to achieve a better teaching and effective learning atmosphere the students also need to be advised to take a more proactive and responsible role while taking a class in this mode.

## **3. Hybrid Class Approach**

Generally speaking the enrollment in engineering programs is on the decline for the last few years [6]. In order to produce the high quality graduates from engineering programs faculty and administration of the academic institutes try to meet the variety of student demands of having variety of options for their classes. For example, some students would like to be in face-to-face class rather than in online class whereas another group of students with full time employment and other commitments would prefer to take online class since it can easily fit into their schedule. Thus making it very difficult for institutions to make a decision on the mode of class offering that for them would not have negative financial impact. To combine WebClass and online class formats is a good compromise and real solution to varying student demands. To encourage and hold the interest of students, much effort has gone into research and development

of innovative methods of teaching. The institutions like ours, classes do get cancelled because of low Students-In-Class (SIC), so in order to ensure high enrollment we would like to use the methodology for teaching a class that will satisfy the needs and preferences of all students. A combination of face-to-face approach with WebClass approach is offered as a Hybrid class. The faculty teaching hybrid class mixes online feature with webclass and then have split the total class meeting time with half of the time and other half in the online format. The faculty needs to juggle his/her efforts and class time within different modes. All the course material; lecture slides, quizzes, exams, assignment solutions and lab exercises need to be organized and delivered accordingly.

## CONCLUSION

The idea behind writing this paper is many folds; to share our experience and approach with other engineering faculty and to attempt to bring and broaden the awareness among the higher education management as well as engineering faculty members. We share variety of approaches that we used to prepare and field graduate at a faster pace. It is also hoped that this paper will encourage engineering education researcher as well as other stake holders to take this to the next level.

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