Redefining Engineering Education Methods Using New Technologies

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I. Introduction

As our global community increases its utilization of new technologies in the distribution and acquisition of knowledge and information, new paradigms in engineering and technology education emerge. Engineering education's traditional standards, methods and educational models must be reassessed in order to proactively address future needs in the training of engineers and technologists.

A successful engineering education model must include and initiate new and diverse methods in order to effectively determine and address the current and forthcoming needs in the training of engineers and technologists.

Learning complex subject matter, often times, begins with failure and frustration. With a plethora of information, in diverse and varied locations, covering a rich abundance of concepts, and changing constantly, a conventional content-oriented education model has proven to be ineffectual.

Diversification in several areas including course content, multimedia learning environments, team teaching and application of industry resources all play a critical role in the successful advancement in engineering education [1].

At the University of Central Florida new approaches in engineering and technology education are currently being redefined and implemented. The changes being made in various aspects of engineering education including course content and curriculum, multimedia learning environments, teaching methods, classroom and laboratory setup.

II. Course Content and Curriculum

Traditionally, curriculums for various engineering disciplines focused on that independent discipline with little to no reference to other engineering disciplines. Course content helped to define and maintain this disciplinary focus and isolation.

Cross utilization of multiple engineering disciplines should be incorporated into each discipline-specific engineering education curriculum as it lends itself to more holistic knowledge base to best fuel creative thinking and cross-application.

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The key objective is to insure that students leave their respective engineering program not only with a firm grasp of their chosen discipline, but also with the ability to collaborate effectively with those from various backgrounds on multi-disciplined projects.

III. Multimedia Learning Environment

An educational environment rich in varied learning methods provide students with a diverse means of receiving and applying knowledge and information resulting in a more engaging and interactive educational setting.

It has become common knowledge among educators that various learning methods affect the retention rates of the learner. The following data [2] notes that student retention progressively increases as their sensory involvement increases.

Learning Method	Retention by Learner
What they Read	10%
What they Hear	26%
What they See	30%
What they See and Hear	50%
What they Say	70%
What they Say As They Do Something	90%

Cooperative learning strategies move students through the range of learning methods, from the top to the bottom thus increasing their retention of learning [3].

A Multimedia-rich learning environment including distance learning, computer hardware and software, Internet, videos and virtual reality can all play a significant role in creating wide-ranging opportunities to receive instruction and information. This variety in which content matter is delivered enriches the overall instructional soundness of its course material as it addresses the diverse ways in which individuals best absorb and retain information.

Ideally, students should be introduced to the broad benefits of learning in a multimedia environment early on in their university experience. In this way, not only do students take with them an understanding of their subject matter but also an understanding of the various modes and methods that information can be accessed, received and delivered. This can greatly assist engineering graduates in work settings as they are tasked with finding and communicating solutions to real world problems.

IV. Teaching Methods

The utilization of team teaching methods and case study focus in an engineering classroom have proven to be effective in providing students with an interesting and diverse approach to the understanding and application of engineering principles.

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Effective teaching must be assessment centered. This is not to say an abundance of testing but an abundance of appropriate feedback. The emphasis should be on process and hence the students' progress rather than the final grade achieved.

Our studio calculus classroom for engineering students incorporated engineering professors from various disciplines and a professor from Mathematics department hence, offering a range of perspectives and considerations as problems were presented and solved. Factors, issues and concerns varied from each professor as they brought emphasis from their respective disciplines to consideration. This rich diversity in perspective greatly enhanced the analytical processes necessary for problem solving [1].

The use of case studies in the curriculum also proved an effective tool in enhancing problem solving strategies. Students need "opportunities to link the theoretical constructs developed in the classroom with the practical application in the workforce" [4]. Perhaps the greatest advantage for using cases in an engineering classroom is that students must focus on the applications in the workforce by solving real world problems.

There are numerous advantages for integrating cases into an engineering curriculum. These can be generalized in four main categories: 1) cases provide students with a link to the real world; 2) cases develop students' critical thinking and problem solving skills; 3) cases develop students' communication skills; and, 4) cases involve students in a cooperative learning activity [5].

V. Physical Learning Environment

Integrating new and varied technologies early on in the students' academic experience, both in the course curriculum and in the physical learning environment, helps to maximize proficiency and application in various aspects of their education.

Practical application best sets the stage for theoretical learning. If students are immediately provided with context to better understand and experience the theories at hand, then retention will be greater.

To maximize the classroom's ability to deliver instruction, the engineering learning environment should be designed in a way to effectively support available technologies such as computer hardware and software, Internet, audiovisual, etc. Our experience at the University of Central Florida has proven to be very effective [1]. With the classroom hardware being set up in a way that the instructor could easily monitor all student systems, immediate feedback could be provided in order to confirm and/or clarify subject matter at hand.

Laboratory assignments help to clarify and reinforce course content matter presented in both the textbook and in the classroom. Laboratory experiments should bridge the wide gap between complex theories and real-life situations [6].

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The design of the laboratory itself can greatly enhance the learning potential of those that use it. An efficient laboratory experiment should [7]:

- clearly relate to textbook materials,
- relate to real life situations,
- challenge students' ability to design and test, and
- encourage the student to analyze the design and draw conclusions.

Along with an effective design, a laboratory that emphases a multi-disciplinary team approach to problem solving best reflects current industry practices.

VI. Conclusion

At the University of Central Florida the new approaches in engineering and technology education being implemented are bringing light to the importance of addressing the needs of human ecology within an academic environment.

Examining the relationships between students and their university's physical and social environment emphasizes the need to examine and reassess various aspects of engineering education including course content and curriculum, multimedia learning environments, teaching methods and classroom and laboratory setup.

Cross utilization of multiple engineering disciplines, an educational environment rich in varied learning methods and the integration of new and varied technologies early on in the students' academic experience all support problem solving approaches currently found in industry practices.

The aim of these innovative approaches to teaching engineering is to increase a students' ability to quickly adjust into the real world of work and be a productive member of an engineering team.

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