Proposal for

Innovative and Creative Undergraduate Teaching

Infusion of Technology and Problem-Based Learning as an Approach to Introductory Engineering

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Summary

The formation of an introduction to engineering technology class has been proposed for the purpose of introducing students to all of the most current technological innovations within the different disciplines of Engineering Technology. This in turn allows the students to determine what field best suits their interest and informs them on how these technological advancements effects their future careers and lives.

Rationale

The recent emphasis on Science, Technology, Engineering, and Math (STEM) education has led educators to review their curriculum in an effort to align with STEM standards. In most cases this is providing incoming freshmen with greater knowledge of STEM concepts and high motivation for STEM related programs. The premise for this proposal is based on creating an introductory class (Introduction to Engineering Technology) for those students entering into the STEM related fields of Engineering Technology and replace the current discipline specific introductory courses, such as MET 1000 or MFET 1150. The introductory class would focus on new technologies for both instruction and problem based learning related to the different disciplines within Engineering Technology.

The students would be introduced to many instructional technologies, which will provide them the tools they need to successfully guide themselves during their academic career. While traditional freshman tend to be better adapted to understanding technologies such as clickers, Canvas, online courses, and flips classroom, the non-traditional students have a steep learning curve when subjected to similar technologies. This proposal attempts to bridge this gap by focusing on implementing several of these technologies. As an introductory course, the students will learn how to use these technologies through new curriculum development and several problem based projects.

Cai and Grebski demonstrated that the retention rates and motivation of incoming engineering students can be greatly increased by the implementation of “fun” projects into the curriculum of introductory engineering courses (Cai & Grebski, 2011). Traditionally introductory courses have focuses on the same “fun“ projects that have been used for decades, such as rubber band powered cars. Many of the incoming students have done similar projects during their high school careers and gone beyond. The transition to college should take the students to the next level. To build on students’ knowledge, three problem based projects involving new emerging technologies in the field of engineering would provide the backbone for the Introduction to Engineering Technology class.

The first of these three projects would replace an outdated design project with the designing and testing of a 3-D printed projectile. The students would be asked to use several technologies such as, CAD modeling, computer simulation, 3-D printing, and pneumatic systems to produce a small projectile for physical testing. The second project would require the students to design and manufacture a hitch plug for going into the receiver of a truck. The students would be exposed to advanced manufacturing technologies such as water jet cutting, CNC subtractive fabrication, and automated assembly. The third project would expose the students to robotic technologies. The students would be required to build and program a robot, integrate sensors, and perform various tasks, culminating in a class competition.

The use of robotics has drastically increased in society from automated work cells to cars that now navigate without a driver. The effects of robotics can be felt in all of the disciplines of Engineering Technology and therefore an introduction to robotics earlier in their academic careers is becoming more crucial for success in a changing career field. The implementation of this robotics technology would not only allow for the students to gain an understanding of how robotics work but would allow for them to solve complex problems through design and programing. The robotics curriculum would be based on the VEX Robotics platform due to several factors. One, using VEX robotics provides a cost effective alternative to the high priced alternate platforms. VEX Robotics classroom competitions are designed to be run over the course of several weeks and allows for a time table compatible with the introduction class. The inclusion of VEX robotics in the curriculum provides a stepping stone for students who are interested in competing in the VEX Robotics Challenge for Universities, to compete with other Universities from around the world.

The benefits of providing such a class to students where they not only learn how to use the technologies that will be used by their professors to facilitate learning but also gain exposure to the latest technology used in their perspective fields is immense. Understanding the instructional technology such as clickers and Canvas will benefit students and professors as these technologies are integrated into more and more classes at Weber State University. The exposure to the latest technology will produces students that will have a better understanding of what discipline within Engineering Technology best suits them, while helping them remain up to date on different technologies and the impact that they have on their career.

Description of the Innovation

The learning objectives of the Introduction to Engineering Technology would be categorized into three groups. The first group would be to understand the new technologies that are present in each of the discipline with in Engineering Technology. And would be as follows:

1. Understand and demonstrate how computer modeling and simulation has drastically changed the way engineers design product.
2. Understand the effect 3-D printing has had on design and how we manufacture product.
3. Understand advance manufacturing processes and how they have changed the way product is produced.
4. Understand how to program robots to perform complex tasks and how the use of robotics is constantly changing the way engineers design to get tasks completed.

The second group of learning objectives for the course would be learning objectives for the use of instruction technology and would be as follows:

1. Understand how the Turning Technologies clickers work and how to use them to interact during class.
2. Understand how to navigate and use the Canvas system at Weber State University
3. Know the difference between face to face, online, and flipped classes.

The final learning objective for the course would focus on the different discipline within Engineering Technology. The students should be able to determine the difference between the Mechanical, Manufacturing, Design, and Electronic disciplines within the Engineering Technology department.

The main goal of the project is to retain and motivate engineering technology students, while reducing the time taken to graduate with a four year BS degree. A baseline would be generated for retention my major and time taken to graduate for assessing the effect of the course. Students from the class will be able to use the various instructional technologies used at Weber State University. The students should also have a greater knowledge of the new technologies being used in their field of interest. Finally, students should be able to determine which field of study best suits them in Engineering Technology and the amount of time lost due to changing majors will be reduced.

Preliminary Evidence

The formation of a single introductory course for an entire department or college is not new. Several universities such as Purdue University and Utah State University have developed and run introductory courses that would expose the student body to the various disciplines with great success. The implementation of such a course at Weber State University should result in a similar outcome. Two of the curriculum projects were piloted during the Fall 2013 semester in MET 1000, Introduction to Mechanical Engineering Technology. The projects were received well by the students and students' excitement and interest levels remained high during the projects. From the previous experiences the project has a high probability of being very successful.

Implementation

The new curriculum would be developed over the summer of 2014 and the Introduction to Engineering Technology would be implemented in Fall of 2014 as a replacement for MET 1000 for Mechanical Engineering Technology Students and MFET 1150 for Manufacturing Technology Students. The course would also be open for the Electronic Engineering Technology and Design Engineering Technology students. The course would also be offered each semester. The direct impact of the class on students would affect all of the incoming students into the Engineering Technology Department. This also simplifies many of the students courses of study since most of the current introductory courses are offered only once per academic year, causing prerequisite conflicts. The implementation of the new curriculum would allow the incoming students to expand their knowledge base by being exposed to new technologies that build on the skills that they have previously acquired rather than redo the same projects that they did during their time in high school. The new course also benefits the incoming students and those curious about Engineering Technology with an overview and hands on experience

with each of the disciplines taught in the department, allowing the student to have a clear picture of what degree is best suited to their interests.

Detailed Assessment Plan

To assess the success of the project several assessment strategies will be used. The first method that will be used to assess the students is the use of a portfolio which will be in the form of a lab note book. The lab note books can be collected periodically to assess the students understanding of the topics. Another method for accessing the students understanding will be through the use of individual and co-authored reports summarizing each of the three projects. Students will be given the opportunity to demonstrate their understanding of the topic both individually and as a group through writing. The final method for assessing the project would be to survey the students before and after taking the course to measure the leaning objectives.

Sustainability

The project will be self-sustaining after the initial funding from the proposal. The premise of the proposal is to create an Introduction to Engineering Technology, which would replace the other introductory course scattered in Engineering Technology. The program would be supported by the department with instructors to teach the course and lab fees to supplement the initial proposal funding. The course would be based on the three problem based projects that would use equal portions of the semester. This allows for multiple sections of the course to be taught without the need to purchase additional materials. The three projects can be taught simultaneously and then rotated throughout the semester allowing for three sections of the course to be taught in one semester.

Budget

VEX Robotic Swept Away Classroom Bundle (1@ $4,999.99)	$4,999.99
VEX Robotics Classroom and Competition Super Kit (2@ $999.99)	$1999.98
Pneumatic Launcher	$325.00
Rapid Prototyper Materials (2@ $230.00)	$460.00
Half Month Summer Stipend	$2500.00
Total	$10,284.97

To ensure the success of the project, funding is necessary to acquire the necessary equipment and time to produce the new curriculum. The robotic equipment can be obtained from VEX Robotics and is crucial for introducing students to robotic technologies through hands on activities. Without the robotics packages that curriculum would be left incomplete. During the piloting of the projectile design project a launcher was barrowed and additional funding would be required to purchase a permanent launcher for the class. The sections of the course that expose the students to the concept of rapid prototyping or 3-D printing requires consumables for the system and is necessary to demonstrate the technology and allow

students to build their designs. The summer stipend is requested to compensate the time needed to put the project together and make sure it will be successful.

References

Cai, S., & Grebski, W. (2011). Improving Retention through Implementation of "Toy Fun" Projects into Fundamental Engineering Classes. *Proceedings of The 2011 IAJC-ASEE International Conference.*