Educating Energy Engineers Using the Flipped Classroom
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Introduction
The flipped classroom experience has students prepare for class by watching the lecture before the scheduled meeting time thereby opening class time to be an interactive experience where students can participate in a dynamic classroom, engage in hands-on experiments or computer simulation based problems and explore other in-depth concepts.

This project is focused on undergraduate students with interests in the energy service industry

Objectives
To train students with hands on experimentation, use of technical journals and papers to develop modules and educational videos on the topic of energy acquisition and production technologies

Modules developed from the course will be available for use in UTEP Engineering Summer Camps, Teacher Development and In-Service, and K-12 Outreach Programs.

The project would like to determine if 1) student learning can be enhanced using this type of methodology, and 2) if continued use of videos can enhance future class learning experiences

Learning Activities and Materials
• Many materials created so far using this method have been online lectures posted onto YouTube. These lectures are either recordings of PowerPoint presentations, recordings of lectures, or recordings of the computer screen as I use a particular software.
• Since these materials were watched outside class time it has resulted in many other small projects students have developed (see below)
• These can then be used as starting points for future classes
• I have not developed materials related to the area of energy – I am looking for ideas on how to improve the content delivery and enhance student learning

Execution
• I plan to approach the new course I develop differently:
  • First I plan to create an elective based course and I will admit students to my class on an individual basis (evaluate GPA, major and level) – 30 expected
  • Next I plan to train these students using materials I have developed in other classes including online lectures on: combustion and propulsion systems and computational modeling.
  • I also plan to have these students practice using hands-on exercises in the various labs available to them
  • Using these trainings I would like to develop scientifically sound educational videos on energy and combustion
  • Finally the students will use these videos and lectures during a K-12 recruitment activity. A end of presentation feedback form will be given to students to get feedback on their impressions.

Developmental History of Innovation
I have used the flipped classroom in some of my other undergraduate classes with positive feedback. Implementing this method allowed me to undertake projects like: design building and testing of a CO2 powered racecar, design and sizing of a magnetic pump that will be used on a lunar base as part of a project with NASA Glenn, and the use of computer software for the prediction of temperatures on the outer surface of space shuttle reentry in the atmosphere.

I have materials such as PowerPoints and other instructional videos already posted on YouTube. I plan to use YouTube as the primary interface that students can use to watch the created videos.

I believe this program will enhance student learning, provide a training and support system for participants, and ultimately lead to better trained engineers by their graduation

Major Issues to Resolve
(What you hope to learn at FOEE)
• I hope to learn about several aspects of how I can improve these methods that I am implementing. I need suggestions on assessment and feedback on my pedagogical approach.
• I would also like to hear how some others have overcome some other types of problems including:
  • Logistical Issues:
    • Students not owning a laptop or other technology (cannot afford) making it difficult for students to watch lecture
    • Heavily technology based courses need lots of power outlets and broad internet access points! How have some others dealt with this?
  • Student/Faculty Issues and questions:
    • Ideas to get more students to watch videos on a consistent basis (not quizzes).
    • Requires a lot of work on faculty end – does this have a viable future?

Discussion
Overall, my proposed project looks to provide students with a scientific understanding of combustion and energy conversion processes and a working knowledge of this subject through hands-on experiences in a laboratory environment.

To accomplish this I am preparing to:
• Establish and train a group of energy conscious engineers devoted to both education and cutting edge research activities
• Educate K-12 level students about energy engineering and combustion using the developed educational materials, student developed educational videos, and existing infrastructure at UTEP.

I hope that I can receive some valuable feedback from the FOEE conference and make this project into a more robust educational model that benefits students.

Some other ideas or studies that can be learned from implementation of this project include:
• Is student learning enhanced if they participate in making their own videos as opposed to having instructor made videos?
• Is this an effective pedagogical approach – what is the role of the instructor if student learning is taking place almost independent from instructor?
• What is the future of the flipped classroom?

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