Introducing Emerging Engineering Materials to Lower-Level Engineering Technology Students

Introduction:

Teaching lower-level engineering students about new materials is a daunting task for educators for several reasons: educators may not be familiar with emerging materials, many of the staple material science textbooks do not include emerging engineering materials, engaging students in new materials can be difficult, there are a multitude of new materials being developed and creating assignments pertaining to emerging materials may be problematic.

This paper presents how a Current Topic Presentation was implemented into a Manufacturing and Materials course that has overcome the aforementioned issues. The assignment requires students to research a new material in journal publications or recent materials-related magazines, and then prepare and deliver a presentation. Student performance is assessed by their speaking ability, relevance of topic/material, quality of their presentation, the student's interpretation of the topic, submission of hardcopy items and their response to questions. Students are provided the guidelines for the assignment, the presentation format, and the grade sheet the educator uses for their presentation. The assignment helps to develop their oral presentations skills. Also, the assignment may help achieve ABET requirements. All of these issues are discussed in this paper in addition to student feedback about the assignment.

Teaching does not cause learning in the direct way that is often assumed[1]. In higher education, in particular, much of a student's learning takes place in private, through the effort to make sense of new ideas[1]. This assignment allows the student to take ownership of learning about a new material and the responsibility to properly describe it to their peers.

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Background

Teaching freshman or sophomores about emerging engineering materials may be challenging. Covering the basic engineering materials usually occupies the entire semester. Also, faculty that teach engineering materials are quite capable and are familiar with emerging materials but not familiar enough to introduce them into a lecture and many material science textbooks do not yet have information about emergant materials since the state of the industry is constantly evolving. Previously, assignments were given to students to either write a paper or give an oral presentation of a new material, which had its merits, but there was something lacking from the assignment. What was lacking was that the students were not always interested in the material assigned to them which resulted in a poor paper or presentation. Student-led discussions/presentations take advantage of a social dimension that creates strong sutdent motivation[2]. These issues were overcome by giving students the freedom to pick their own topic.

Assignment

The goals of this assignment included the following:

- To give students an opportunity to learn about an emerging material used currently in industry or that is in the research stage.
- To enhance the oral communication skills of the student.

Each student works independently to deliver a 4-6 minute oral presentation. Scheduling presentations may be a challenge if class sizes are larger than 25 students. Students give their presentations at the end of class. Occasionally, multiple presentations are given on a scheduled day at the end of the semester if a class was cancelled or if there are 30 students enrolled during that semester.

Students are expected to research newspaper, magazine or journal articles. Newspaper and magazine articles are to be no older than 3 months. Journal articles (e.g. ASTM, ASME, SAE, ASEE, etc…) are to be no older than 1 year old. The journal or article is to be from a reputable source and not from an internet article unless it is from an online version of newspaper,

magazine or journal articles. The materials are not to be a duplicate of what they may have previously learned in another course.

Students must create an MS PowerPoint presentation which includes the following slides:

- Title Slide (course name and number, school name, article title, reference source, semester and their name).
- Introduction Slide (summary of the article and their presentation)
- Next several slides are to discuss the material they researched. Students are encouraged to include photos, tables, graphs and bullet lists relevant to the topic.
- A slide used to illustrate their interpretation of the article. Discuss your thoughts of the article which may be positive or negative.
- A slide proving the article came from a valid reference source as previously mentioned. Just showing a web address will probably result in a major loss of points.
- Last slide should say "Thank you for time, any questions."

The order of the presenters is shown on the course website. The order of the presentations is randomly generated. If the student is not prepared, their presentation will not be allowed to be rescheduled; therefore, the student will receive a zero on the assignment. Assignments begin the second week of the semester to ensure all students are allowed the opportunity to present.

Students are required to present the instructor with the following at the time of their presentation:

- The grade sheet that is available to the student on the course website for printing
- A copy of their presentation slides (multiple slides per page)
- A hardcopy of the article

All three items are to be stapled together, in the order listed above, with one staple in the upper, left-hand corner. Students are also required to save a copy of their MS PowerPoint presentation on a flash drive so that it may be displayed with the computer in the classroom.

A similar assignment is given the following year in a material science course. Students are able to present in lab the final week of the semester so no lecture time is lost. Course topics include

metals and alloys, heat treat, thermoplastics and thermosets, elastomers, composites and ceramics (i.e. the four basic families of materials). Students have the freedom to chose a new material within the four basic families of materials. Examples include conjugated polymers, biodegradable polymers, starch-based polymers, reinforced polymers, advanced ceramics, metals and alloys, composites etc. Students may also focus their research on a specific industry and present a "state of the art" focus on new materials used in that industry. Examples of student presentations include: new materials used in the semiconductor industry, new composites and ceramics used in bearing design, advancements in fishing line, advancements in building construction (composite wood), advancements in tire design, bullet proof vests, armored cars, bicycles, snowboards, plastics used in children's toys, etc.

Grading

The presentation is worth 100 points. The criteria for grading include the following:

- Relevance (whether it is in fact an emerging material) …. 20 points
- Quality of the presentation …. 30 points
- Thoroughness of the presentation …. 10 points
- Thoughts and their interpretation of the article …. 10 points
- Properly referring to the article …. 10 points
- Submit a hardcopy of the article and slides to their instructor …. 20 points

Also, students are required to ask relevant questions to their fellow presenters. If students do not ask two questions throughout the semester to different presenters then their presentation grade is lowered by 20%.

Student Feedback

Students were surveyed to gain insight on their thoughts about the project. All 24 students from the previous semester completed the survey. The following shows the survey questions and the students' responses:

1. Q: The project was interesting?

Student Response: Likert Scale 6.3/7.0

2. Q: The level of complexity of the assignment was adequate for this course?
   Student Response: Likert Scale 6.1/7.0
3. Q: The forensic project's educational value was high (i.e. you learned a lot)?
   Student Response: Likert Scale 6.4/7.0
4. Q: You feel that this assignment should be included in this course for future students?
   Student Response: Likert Scale 6.3/7.0
5. Q: What changes would you make to the assignment?
   Summary of student responses: Most often stated was that there should not be any changes. Other suggestions included allowing less recent articles to be presented and try to minimize the overlap of similar materials that were presented.
6. Q: You enjoyed the challenge of the assignment?
   Student Response: Likert Scale 6.0/7.0
7. Q: Comment on whether you think the assignment will help you in the future?
8. Summary of student responses: Most often stated was it helped them develop their presentation skills. One student commented that they have entrepreneurial goals and plan to use the information gained from the assignment to help them with their business.
9. Q: Comment on the assignment (i.e. level of adequacy, interesting, informative, etc...).
   Summary of student responses: Most often stated was it was interesting and helped them develop their research skills.
10. Q: Did you get the grade you thought you were going to receive?
    Student Response: Likert Scale 7.0/7.0
11. Q: If you did not get the grade you thought you were going to get on the assignment, why do you think you didn't?
    Summary of student responses: Students overwhelmingly stated that the assignment was appropriately graded. Not one student felt the grading was not adequate or inappropriate.

Conclusion:

Based on the work performed by the students and the student feedback, the assignment was

found to be very appropriate and rewarding for the students. From a teacher's perspective, the presentations are much more enjoyable as well. Students are much more engaged with the assignment and with each other. Students are more interested because the subject is their choice and perform better as a result. Many pertinent and insightful questions are asked during the question portion of the student's presentations. The teacher does not have to intercede unless the student misinterprets information in the article which occurs less frequently than expected. Teacher's comments are included on the grade sheet which provide feedback for developing a student's presentation ability. Grading time is reduced because it is easier to grade the presentation than the paper, and students appreciate receiving their grade on the assignment quicker.

Another benefit of this assignment is its ability to satisfy the Accreditation Board For Engineering and Technology (ABET) student outcomes[3]. The following ABET student outcomes could be satisfied with this project:

g. An ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;

k. a commitment to quality, timeliness, and continuous improvement.

The only negative to the assignment is that it consumes nearly 10 mintues of each 50 minute lecture (not an issue for the subsequent materials course since given in lab). Other out of class assignments were developed to compensate for the lecture time lost due to the assignment.

This assignment has been expanded to include manufacturing methods as well, giving students the option of reporting on a new material or new manufacturing method. This type of assignment may be used for a multitude of educational purposes and objectives.

Bibliography

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