AC 2010-2060: MARKETING-BASED PRESENTATIONS IN COMPUTER ARCHITECTURE

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Marketing-Based Presentations in Computer Architecture

Abstract

A key component of engineering education is helping students understand how the information of a given class is applied to the current technology and applications of that field. In addition, it is also critical for students to understand the broader impacts of a product during the design, manufacturing, and useful life stages as well as how the materials are disposed of, recycled, or re-used afterwards. One method of helping students achieve this insight is through the use of marketing-based presentations in which groups of students present competing technologies.

This paper will describe such presentations that encourage students to explore both the technical details of a product as well as the economic, environmental, and societal impacts in order to convince a group of their peers that the application is commercially and ethically viable. Survey results were taken from three different classes using a 9-value Likert scale. The current research will explain the pedagogical basis for using competition in such presentations and a discussion of trade-offs, observations of how to implement such presentations at different student levels, and their impact on student motivation.

1. Introduction

It is the role of every engineering degree-granting institution to make sure their students have a solid background in the core topics of their specific field as well as engineering in general. As engineers, they must then be able to integrate this knowledge in order to utilize a more holistic view[4] when designing products and systems. Such a view must incorporate many aspects of human impact, including the issues of economical, environmental, and social sustainability[1 (p. 2), 6, 9]. Furthermore, students must not only understand such concepts, but also be able to effectively communicate such findings to their peers and other members of the public with widely varying backgrounds[1, 10].

There are two general (not necessarily mutually exclusive) approaches to achieving such outcomes. The first method is to require students to take courses outside of their major that fulfill such requirements. The second approach, meanwhile, is to integrate such learning in the context of the technical information of classes in *their own* major. By doing so, students might also be more likely to assimilate such practices when they enter the work force. This paper describes such integration via presentations in which the students are required to market a product both in terms of its technical specifications and also the broader ethical questions of the use and production of the product and/or its applications.

The remainder of the paper is organized as follows: Section 2 first explains the layout of the presentations and the pedagogical basis for their use. Section 3 next describes the survey that was utilized to determine the perceptions of the presentations. Section 4 then depicts the results of

this survey for the current senior-level class and also as compared with previous implementations in lower-level classes, including observations about similarities and differences as well as their impact on student motivation. A discussion then follows about the trade-offs of implementing the presentations. Section 5 describes possible improvements for subsequent classes as well as potential future research about the use of such presentations. Lastly, Section 6 concludes with a summary of the paper and its contributions.

2. Presentation Overview and Pedagogical Basis

The primary goals of the presentations were for the students to develop communication skills by presenting a product that dealt with the computer architecture topics discussed in class and to explore the broader issues of economic, social, and environmental sustainability in terms of the design of such products and/or the business practices of the companies that make them. Furthermore, they were to do so in the context of marketing their product. For the presentation, students were first split into groups of three or four students. Each *group* was then paired with another group and the two teams were required to choose competing technologies in a given computer area (e.g. microcontrollers: one group presented the PIC32 while the other presented the ARM7, processors: Intel Core2 Quad 9400 versus AMD Phenom x4, gaming systems: PS3 versus Xbox, etc.). Their peers then served as potential customers to whom the groups presented.

The paired groups then presented during successive class periods, alternating which group presented first. In the first session, the groups informed potential customers (the remainder of the class) about the technical superiority of each product and short-term financial aspects. During this session, the groups were required to address the following questions in their presentations (where questions in parentheses were suggestions about how to answer the primary question):

- What is the application or what applications could the system be used for?
- What is unique about your computer system's design?
- What is the architecture of the system? What are the benefits of the structure?
- What type of characteristics does the system/application have? (Processing power, throughput, etc.? Size and/or type of memory? Types of peripherals/interfacing?)

In the second session, the focus was placed on the long-term research goals within the technology and the broader societal and environmental impacts. The questions to be addressed for this latter session were as follows:

- What companies are involved with the manufacturing and sale of the application? (Names? Locations? Outsourcing? Trade secret issues?)
- How sustainable is the design?
  - Environmentally? (Power consumption? Re-usability? "Cradle-to-Grave" considerations?)
  - Economically? (Product marketability? Cost of production? Relevance in 2 years?)
  - Socially? (Application benefits for society? Short/long-term positives, negatives?)
- What are the limitations of the application and how are these being addressed through research?

After each pair presented, time was allotted for questions, discussion, and rebuttal between the teams.

After the set of presentations, students were assessed according to a grading matrix that was given to them when the presentations were assigned. The grading was based on whether the group:

- Stayed within the allotted time-frame,
- Answered the topical questions,
- Adequately researched and cited the information that they used (including technical references), and

In addition, students' public speaking skills were scored based on if:

- Eye contact was made with the *whole* audience,
- Voice was easy to hear, but not too loud; words were enunciated,
- Positive body language and gestures were displayed,
- Transitions between slides and between presenters were smooth, and
- There was a minimal use of non-word slurs (e.g. "uh", "um")

As in the previous presentations[11, 12], students obtained approval for their selected topic and were required to send a list of references to the instructor in advance of the presentation. Implementing this enables an instructor to familiarize him/herself with the information, make any needed corrections in the content portrayed in class, and determine appropriate questions for each of the groups to spur discussion.

After each set of presentations, students were required to provide feedback about their peers, including at least one strength and one weakness of the presentation. To ensure anonymity, this feedback was sent to the instructor who then forwarded the information to the presenters after stripping out any personal identification information. Since students in the audience were only familiar with the topics covered in class, this peer assessment was primarily limited to the visual and oral portrayal of the information (i.e. students rarely commented on if the technical content was correct).

The pedagogical foundation for such presentations has been primarily explained in "Encouraging Sustainable Practices via Student Presentations"[12] with the basis for several modifications having been described in "Inherently Adaptable Education through Student Presentations"[11]. One of the primary methods of student motivation in the presentation is the utilization of student choice. It has been shown that there is a high correlation between student choice and the students' self-efficacy and motivation to learn[2, 13]. In addition, changes have been made to the original presentations to incorporate a marketing style format to better mimic a real-life situation, the importance of which has been explained by Bhagat[3]. Lastly, research has shown the usefulness of both cooperation and competition in learning environments[7]. The presentations combined both as students must work cooperatively with their own team, but competitively against another team (although the grading is not based on the result of this competition).

3. Student Survey

After the completion of all the presentations, students were required to fill out a survey with a series of 13 questions (as well as an opportunity to express opinions about the presentations and/or possible ways to improve them). Each of the questions was a Likert item[8], for which the students were directed to state the level to which they agreed with the statement. Values ranged from 1 ("Strongly Disagree") to 9 ("Strongly Agree") in increments of one. The questions with their abbreviations for the results were as follows:

*Because of the presentations, …

1. *I have a clearer idea of where the course information is applied in current technology and/or commercial products. (App)
2. *I am now better prepared to research a technical topic. (Rsch)
3. *I am now better prepared to present technical information to my peers. (Pres)
4. *I now have a more complete view of the entire process of engineering a product than I did before the class. (EngP)
5. The presentations inspired me to (continue to) pursue an engineering degree. (EngD)
6. The presentations motivated me to study more (beyond the preparation for the presentation). (Stdy)
7. The feedback I received from my peers after the presentation was useful. (Prfd)
8. The feedback I received from my instructor after the presentation was useful. (Ifd)
9. Overall, the presentations were a beneficial component of the course. (Wrth)
10. Having competing technologies made the presentations more interesting. (CTInt)
11. Having both groups present on both days was beneficial *as a presenter*. (CTPres)
12. Having both groups present on both days was beneficial *as a member of the audience*. (CTAud)
13. *I feel better prepared to be involved in the marketing of a product. (Mrkt)

The first 9 of these questions were the same as those given in previous lower-level classes. The primary reason for the inclusion and wording of these questions was to ensure uniformity when comparing the responses of the different classes which had been collected in previous semesters[5].

4. Survey Results and Comparison Between Classes

The results of the survey for the senior-level computer architecture course can be found in Figures 1 and 2. It is important to note that for this class, all 29 students that participated in the presentations also participated in the survey. Figure 1 depicts the arithmetic average of the class in response to the 13 previously described statements. The students agreed with each of the statements, but to varying degrees. The two statements with the lowest agreement rates were that the presentations inspired the students to study more (5.86) and that the presentations better prepared them to research a given topic (5.97). The two statements with the highest agreement raters were that the instructor feedback was helpful (7.34) and that the competitive nature of the presentations made them more interesting (7.1).

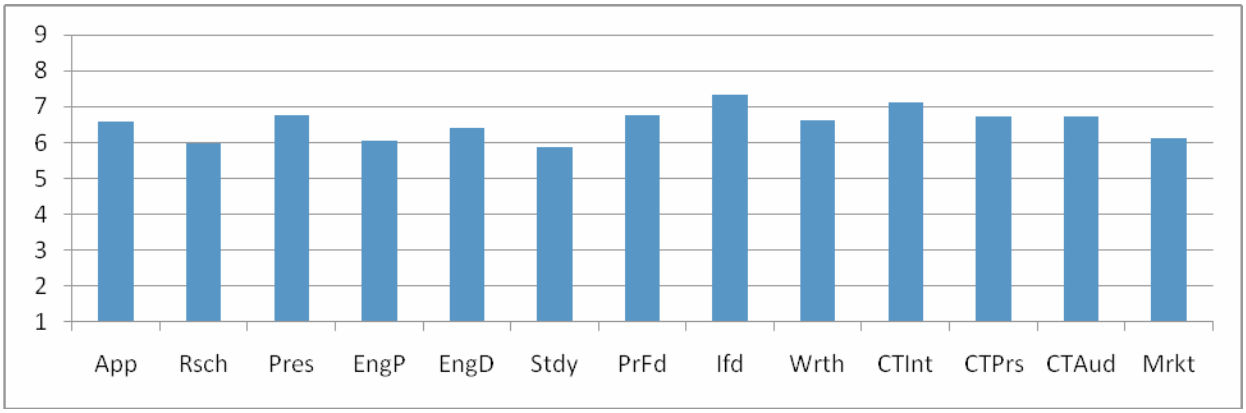

Figure 1: Mean of Student Results for Computer Architecture Course

Student perception was also analyzed according to consensus in terms of the standard deviation as shown in Figure 2. As can be seen, students were most in agreement (with each other) about the presentations helping them to better understand where the information was applied (1) and that the instructor feedback was useful (1.29). There was the smallest consensus in terms of whether the presentations inspired them to continue pursuing an engineering degree (1.94) or if they were a beneficial part of the class (1.95)

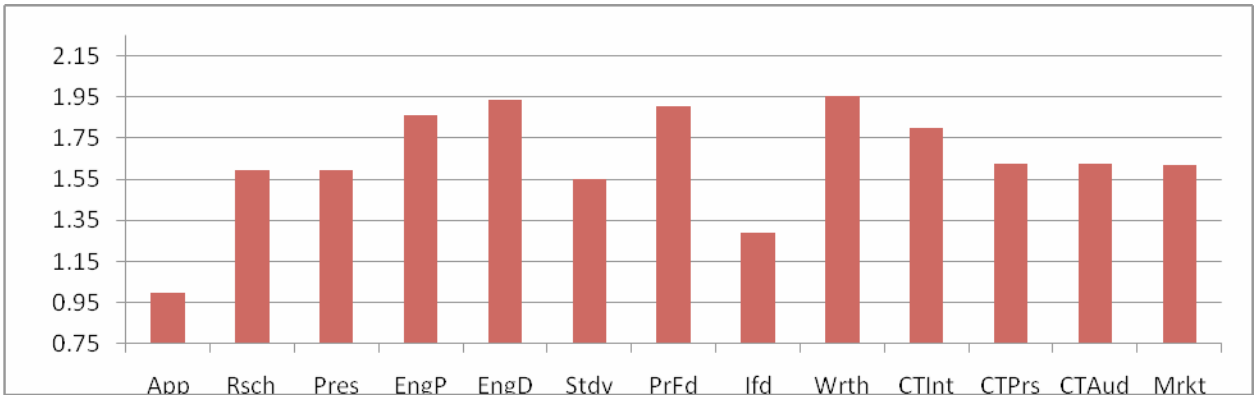

Figure 2: Standard Deviation of Student Responses for Computer Architecture Course

As previously mentioned, the same initial 9 statements were also given to students that had completed similar presentations in freshman and sophomore-level courses in the 2008-2009 academic year. The results of the mean and standard deviation are shown in comparison to the upper-level course in Figures 3 and 4, respectively.

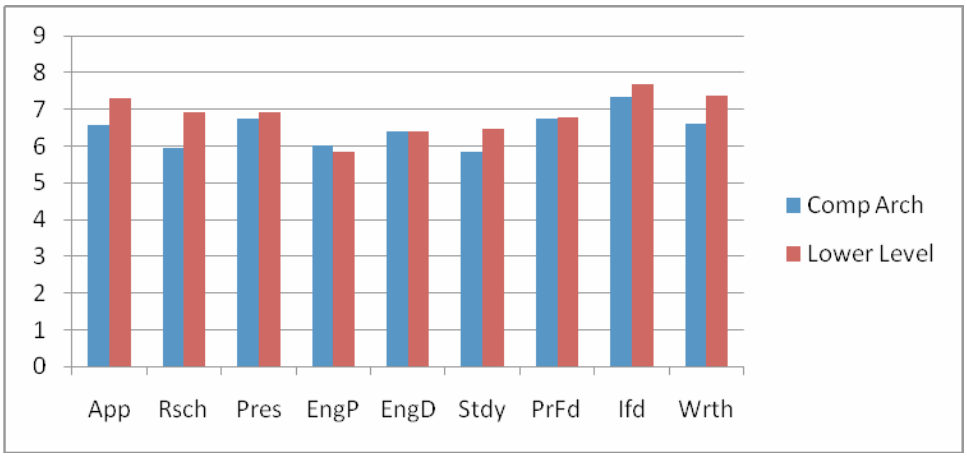

Figure 3: Comparison of Mean of Reponses with Lower-Level Courses

The only statement for which there was *not* a greater mean value for the lower-level course (for which the lower-level course students agreed *less* with the statement) as compared to the upper-level course was that the students had a better understanding of the entire engineering process. For all other statement, the lower-level course students did agree more with each statement. Such agreement might arise due to the fact that students in the lower level courses have significantly less exposure to viewing how engineering is applied in technology, experience with researching topics and presenting them to their peers, etc.

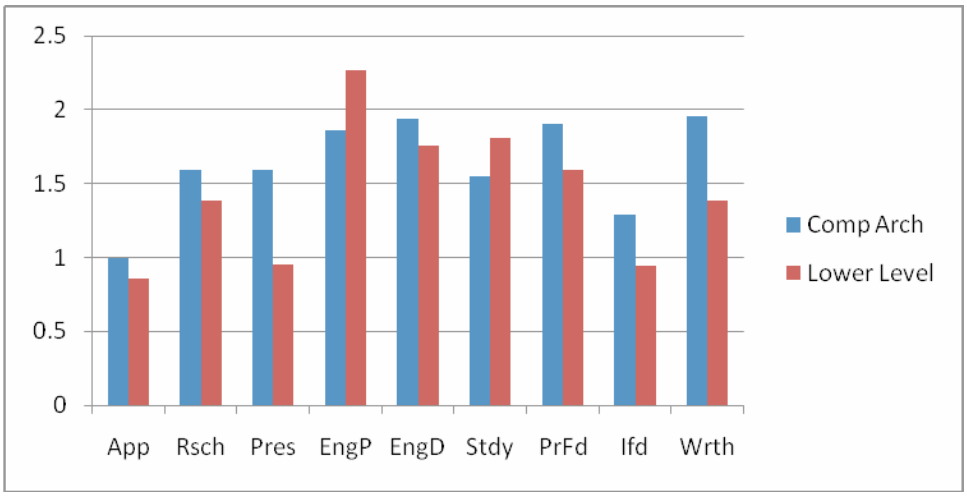

Figure 4: Comparison of Standard Deviation of Reponses with Lower-Level Courses

The consensus data shown in Figure 4, meanwhile, has more variation. The three statements for which there was the greatest difference between the upper and lower-level courses were that:

- The students felt better prepared to present information to their peers because of the presentations (the lower-level course students were more in agreement possibly due to the relative newness of such presentations as compared with their upper-level peers);
- The instructor feedback was helpful;
- The students had a better understanding of the entire engineering process (there was a smaller consensus in the lower-level courses due to the fact that some students strongly agreed while others were neutral or slightly disagreed).

It is important to note that the participation rate for the survey in each of those courses was significantly lower than that of the upper-level course (the combined number of students that participated was 13 as compared to the 29 in the single upper-level course). Possible reasons for the low participation rate are that the survey was not a class requirement and that it was distributed after the end of the semester. Due to this fact, as well as the relatively small sample sizes and lack of a control group, these results should not be viewed as broadly generalizable, but rather used as a starting point for further research.

For the lower-level courses, the marketing-based approach was not used. Experience in using such presentations indicated that this extra time and effort was not necessary (although it might still be beneficial) in the lower-level courses. This was due to the fact that for a number of students, this is the first time that they had to research a real-world application on their own and determine how it was engineered using some of the information discussed in the course (as opposed to reading about more general applications in a textbook or being told by an instructor, for example). As was seen in the survey results, for the lower-level courses there was more of a newness or a "wow" factor to research and presenting technology as it relates to class information. This then correlated with greater agreement about the presentations' value to the course and motivation to study the course information. However, given the different motivation of the marketing-based approach, the presentations still kept students' interest for the upper-level course as well.

The primary trade-offs for implementing such presentations are time and effort versus having more well-rounded and motivated students. Using the marketing approach necessitated further work on the instructor's part to ensure that the competing technologies were similar enough (e.g. that the comparisons were apples to apples as opposed to oranges). In addition, the presentations in general do consume more class time and as well as instructor preparation time for the first time they are implemented. For subsequent courses, however, there is little difference in the preparation time on the instructor's part since the extra time helping the students is offset by the fact that the students present during the lecture period. The benefits of using such presentations include the students' increased awareness of non-technical and broader issues, improved "soft skills," and ability to perform research and examine the limitations of a product or implementation as well as an increase in motivation.

5. Improvements and Future Research

There are several improvements that will be implemented in future classes. The first of these is to help students better prepare for presenting in a given time frame. For many, this was the first timed presentation that they had given. To better prepare students for this, instructors can provide students with pointers ahead of time (such as rehearsing the presentation, knowing what they are specifically asked to present on and avoiding tangents, etc.). In addition, for lower-level students especially, some sort of visual warning could be given during the presentation to indicate that they are getting close to the end of their allotted time.

Another important improvement based on student comments is to change the class structure for that day. Specifically, the presentations should all be adjacent to each other during the class

periods or (more preferably if possible) the instructor should try to cover material in class related to the presentations. Usually the presentations were done at the beginning of the class period followed by unrelated class information that the students then sometimes had trouble focusing on. Lastly, since the presentations were split up over multiple days, one other possible change would be to give feedback after the first day and then grade the students only on the second day in terms of their public speaking skills.

Future research in this area would be necessary to achieve more generalizable and objective conclusions. While the presentations are worthwhile in terms of furthering students "soft" skills of research and communication and helping them make connections between the core topics covered in class and the products to which the theory is applied, it is hard to track student learning because they are not tested on most of the material that is presented. Furthermore, there was a large discrepancy between the upper-level course participation (all students) and lower level courses (~20%). If the participation was the same, then a more detailed statistical analysis of results with multiple semesters of data could be used to determine more precise (generalizable) relationships. Lastly, since the presentations employ marketing techniques and look at social, environmental, and economic sustainability issues, it would be interesting to include business majors as part of the teams if possible and/or consult other students/faculty with backgrounds in environmental and social issues. The effects of such inclusions could then also be analyzed.

6. Summary

Helping students understand broader, non-technical issues, providing opportunities for them to develop "soft" skills such as researching and presenting information, and facilitating making connections between class information and current technology are crucial to student success. This paper has described marketing-based presentations that are designed to do just that. Student perceptions of the presentations were also summarized in terms of levels of agreement and class consensus. Based on these results, for the given courses the presentations did indeed meet these goals and also provided important opportunities to increase student motivation.

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