Interdisciplinary Educational Experiences for Engineering Students

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Abstract

University level engineering science education, in Canada and elsewhere around the world, is often provided exclusively to a given cohort of engineering students that progress through their collective university educational experiences together. These educational experiences will often consist of little to no interaction with other student cohorts from diverse disciplines and faculties. Engineering students that graduate and enter their longer-term engineering careers may only then be required to work and interact with people of diverse interests, skills and educational backgrounds. As such, traditional engineering educational experiences can fall short in preparing engineering students for their future work environment. This paper reviews an initiative to help address this short-fall through providing an interdisciplinary educational experience that brings together student cohorts from a Media, Art and Performance faculty with software engineering students. The bringing together of diverse student cohorts in a classroom setting requires significant changes to the traditional educational experience of engineering students. These changes include exposing engineering students to different educational experiences, teaching methods and educational content that they would otherwise not experience. In addition, this educational experience also provides participation in building and working on interdisciplinary teams that leverage the unique and diverse skills of its members.

Keywords: Interdisciplinary, Engineering, Education

1. Introduction

The tendency of most post-secondary educational institutions is to focus narrowly on a given area of study. For example, in most post-secondary schools an individual student maybe an “arts” student or an “engineering” student but typically not both.

Post-secondary educational institutions by their very nature guide individual students down separate educational paths and often through very specific programs-of-study.

In Canadian engineering schools program content is often highly prescribed. It normally requires very specific courses and a rigid progression through the engineering degree program. This is primarily due to the educational standards and prescribed content set-out by provincial and national engineering regulators. These regulators require strict compliance by educational institutions in order to maintain accredited engineering programs [1].

Prescribed engineering content will sometimes recognize the need for what has been termed “complementary studies”, but it rarely recognizes the importance of the interdisciplinary nature of successful teams in the workplace. Creating and building systems and products often require teams of people with a highly diverse set of skills and education coming together in the workplace. This is particularly true in software engineering as software products are utilized across all fields of practice and disciplines.

Collaborations between engineers and artists is not new. The successful Experiment in Art and Technology (E.A.T.) group formed in the mid-sixties by a Bell engineer and an Artist offered numerous insights into the benefits of multidisciplinary research teams [2]. These insights have been demonstrated repeatedly since then including various research endeavours involving engineering and art collaborations in research units such as Xerox PARC [3] and others [4].

These types of collaborations are not constrained to research endeavours. The success of several products in the marketplace such as video games [5] and even computing platforms, applications and devices [6] can partially be attributed to collaborations of this kind. It is through these types of collaborations, the innovation, economic potential and cultural shift are now being recognized by both arts and science institutions [7].

2. Methodology

The outcome of an engineering education is intended to prepare students for the workplace. It can be argued that in addition to a technical engineering education, effort should also be put into interdisciplinary experiences as an important aspect in preparing students for the workplace.

To this end, an interdisciplinary elective course at the University of Regina in the Software Systems Engineering program was created and offered. The same course was also offered within the Media, Art and Performance faculty simultaneously. The course had limited enrolment in each faculty to assure that the course offering would include students from both faculties and provide a purposeful mix of students with different skills and educational backgrounds.

There were two instructors in charge of the course, one from each respective faculty. This ensured students were exposed to both arts and engineering content in addition to the teaching and learning styles of each respective faculty. The course focused on “Sound Art” where there is both significant artistic content and technical engineering content. The following is the course description:

This course introduces the artistic practice and engineering design concepts within sound art. It covers a range of sound art practices including avant-garde sound, Musique Concrete, sound and 1960s art movements, electroacoustic music, sound sculpture, radio art, Acoustic Ecology, community-engaged sound art, sound art in performance, and engineering design concepts of new media.

3. Discussion and Results

The course ran once a year in fall over five consecutive years from 2012 until the end of 2016. The total number of students enrolled in the course over those years was 111 students. Approximately one-half of the students were Software Systems Engineering students (53 students) and the remaining students were primarily from the Media, Art and Performance faculty.

Student feedback on the course was gathered from students through a formal course evaluation survey questionnaire at the conclusion of the course. The questionnaire consisted of 15 formal questions on a 5-point Likert scale. Thequestions included topics such as instructor performance, course material, grading, course workload and labs with the option to leave written comments on the back of the questionnaire. 78 of the 111 students completed the survey.

Each student cohort's background knowledge varied widely. It was considered important for the instructors to strike the correct balance of lecture content such that both arts and engineering students could grasp and understand the content of the lectures. For example, the technical knowledge had to be presented in a more fundamental way for arts students then would be required for engineering students.

Similarly, the arts knowledge presented to the engineering students had to include fundamental art concepts that they may not have been exposed to anywhere previously. The intended effect is that each cohort would learn more from the other faculty's instructor while still learning new things from both instructors.

The instructor communicated well and explain[sic] concepts clearly.
Average: 4.28 Variance: 0.50 SD: 0.70

The result of the survey question above demonstrates that the students did not seem to have trouble understanding the content and a reasonable balance was struck for both cohorts. The student comments also included similar evidence such as:

"Great prof. Made understanding for Fine Arts students easy."

There is an inherent difference between teaching styles of any two instructors, but teaching style difference is generally more exaggerated between instructors from different faculties. The difference in teaching style between instructors in this course was intentional in order to expose students to different styles of teaching and learning.

The instructor used class time and visual aids effectively.
Average: 4.26 Variance: 0.62 SD: 0.79

The result above tends to demonstrate that each cohort was willing to accept the significant differences in teaching/learning styles between instructors. For example, for the technical content, it was expected that students write notes and work-out technical details with the instructor whereas the artistic content was delivered through lecture slides and instructor-led discussion of the relevant concepts/topics.

"I found the combination to be quite different. Craig's lectures were really different from Rebecca's."

An anecdotal observation was that the engineering students seemed less likely to participate in classroom discussion on subjective artistic topics. This leads to the question of student buy-in of the course, its content (technical and artistic) and whether it was considered a worthwhile experience.

The instructor displayed enthusiasm and energy and presented material in an interesting way.
Average: 4.42 Variance: 0.59 SD: 0.77

Putting aside the instructor portion of the above question, the result indirectly suggests that students may have at least found the material interesting. The below comments further demonstrates student sentiment about the course content and the learning experience.

"I enjoyed the interactions and practicality of the lectures"

"Great course. It was a really nice change of pace from the usual Software classes"

However, despite these positive indications of student buy-in, not all of the students felt the course provided educational value.

"The offering of this course, even as an elective is wasteful. No useful concepts or information can be learned from this course."

As this course was a significant change in both content and learning methodology for engineering students, it is not surprising that there would be some students that did not recognize value in this interdisciplinary educational experience.

The course included numerous assignments, smaller projects and an open-ended larger final sound art project which was required for completion of the course.

Another interesting anecdotal observation was that several engineering students had trouble with the open-ended nature of creating an artistic project. In several cases, the engineering students just wanted to be told what to do. This is not a complete surprise since normally for an open-ended engineering problem, the problem is known up-front.

When confronted with creating absolutely anything they wanted without being given any particular direction, some of the engineering students experienced frustration deciding where to begin and what to do.

The students were also exposed to the element of "play" as a learning experience.

In this case, it meant giving students free class time to simply play around with the software and/or hardware provided to them in order to gain some unrestrained experience with it.

Labs were instructive and relevant.
Average: 4.12 Variance: 0.86 SD: 0.93

The in-course labs were designed with the element of play in mind. These labs did not include any specific tasks but rather only some overall instruction on how to use the software and/or hardware and students were expected to play with them with little to no supervision. Once again it was observed that the engineering students

experienced some frustration with not having specific directions on what to do with the resources and time provided.

4. Conclusion

The result of an engineering education is meant to prepare engineering students for entry into the workforce. Often, engineered products, systems and services are created by a diverse team of individuals with differing skills and educational backgrounds. As such, it is incumbent upon engineering schools to provide educational experiences that are widely diverse in teaching and learning experiences. This includes teaching and learning experiences from other disciplines as well as interaction with students outside of their engineering student cohort in order to better prepare them for their professional lives after graduation.

To this end, this paper reviews a course initiative where students from an engineering faculty and an arts faculty were put together in the same classroom to provide an interdisciplinary educational experience. The students were exposed to teaching and learning styles from each respective faculty and encouraged to work with each other on assignments and projects in an interdisciplinary way. The educational experience was generally well received by students and provides experiential benefits that a typical engineering course cannot provide.

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