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Assessment of How Engaging in Teaching May Enhance the Learning Journey of Engineering Students

Fouad Kamel[1], Margaret Baguley[2], David Thorpe[1]
1. Faculty of Engineering & Surveying
2. Faculty of Education
University of Southern Queensland
Toowoomba, Australia
E-mail: kamel@usq.edu.au

Abstract—This paper examined the initial stages of a research project which seeks to evaluate the teaching potential of engineering students in the higher education setting. The analysis was conducted independently by three academics from engineering and education based on an initial neophyte teaching performance of engineering students. The academics utilised both discipline specific and pedagogical expertise in order to compare and contrast their findings and in the process were able to identify areas in which they perceived the student demonstrated lack of discipline knowledge and presentation skills during their teaching episode. The results of this pilot study provided important information in relation to enhancing the teaching and presentation skills of future engineers; determining how to provide opportunities for engineering students to learn these skills within an already crowded curriculum; and devising ways to integrate pedagogical skills within authentic assessment tasks, including the possibility of peer review.

Keywords- ***Engineering, Education, Peer assisted learning, Presentation skills, Communication skills***

I. INTRODUCTION

The process of applying acquired knowledge is a well known and effective mode for improved, accelerated, well founded and authentic learning [1]. Teachers seek to convey information to others in a competent and convincing manner, yet simultaneously provide the learner with opportunities to seek further information and practice what they have learned in a new context. [2]. The process of peer review, which is often used in teaching, provides the presenter with insights into how they are disseminating knowledge and insights into what aspects of their presentation are effective and which require further work, and provides an authentic teaching experience. For the reviewer it provides greater agency in the learning process and opportunities to develop their skills in assessment.

This research examined the initial stages of an investigation, which seeks to ascertain the teaching potential of engineering students in the higher education setting. During the preliminary stage an engineering student group was assigned a teaching episode to present to peers in the classroom context. The goals and quality of the delivered information to achieve a learning task was assessed. Concurrently, the feedback of the peer audience and how they achieved the learning outcomes will be discussed. This initial analysis of the teaching episode was conducted independently by three academics from the faculties of engineering and education based on an initial neophyte teaching performance of engineering students.

The aim of this project is to enhance the evaluative and communication skills of engineering students through a peer review process. This opportunity will provide both cohorts of students with a sense of agency by valuing their contribution in a supportive and collaborative process. The innovative nature of this research project allowed students, presenters and the audience, to provide one another with the opportunity to enhance their presentation and evaluative skills through a reciprocal and mutually supportive arrangement. Peer assisted learning has been shown to have positive effects on academic performance and attitude. [3]

II. BACKGROUND

Traditionally engineers, throughout more than two centuries history of technological and economic growth and development have been judged as being inherently deficient public speakers, and frail negotiators [4] . This can be traced back to engineering education curricula which predominately focused on scientific and technical knowledge at the expense of communication skills such as negotiation and presentation [5, 6]. Consequently, as a group engineers became increasingly isolated, inflexible thinkers and unilateral presenters with intractable self-esteem [7]. Finally and most importantly, on the environmental impact front, engineers were accused of causing increasing amounts of environmental damage resulting in serious ecological instability, degradation and green house gas emissions [8]. Recently, engineering education curricula has transformed traditional ways of thinking and included important issues such as sustainability to educate engineers about these issues. This paper proposes that including communication skills may also enhance the important skills engineers are required to have resulting in greater impact on areas such as the environment.

Engineer's roles usually require the ability to express and convey knowledge to others such as clients, colleagues or superiors in a convincing, engaging, competent and

professional manner. Learning from peers is an important aspect in students' cognitive development, an element that fits well in the University of Southern Queensland [9] graduate skills, which are Discipline Expertise, Professionalism, Global Citizenship, Scholarship and Life-long Learning [9],[10]. The proposed approach enables engineering students to appreciate the value of pedagogical expertise in being able to organise, present and communicate complex information to an audience of peers and academics in order to prepare them for their future careers. We predict that involvement in such teaching strategies would improve preparation and consequently the quality of learning outcomes [11] .

III. OBJECTIVES

The objectives of this research are: 1) To provide an opportunity for engineering students to internalise and disseminate complex engineering subject matter more effectively by teaching designated sections of course material to their peers; 2) To provide an opportunity for students to enhance their evaluation skills through peer reviewing selected engineering students teaching episodes; 3) To increase the presentation and communication skills of engineering students by providing support through written feedback from their peers and teaching staff; 4) To enhance the professional competencies and graduate attributes of engineering students in the areas of communication, presentation, collaboration and evaluation so that they can effectively undertake leadership roles in their chosen careers and 5) To enhance the teaching inter-faculty collaboration between engineering and education academics by utilising available expertise and providing opportunities to conduct research on the pedagogical value of this project.

IV. METHODOLOGY

Engineering students are given assigned teaching episodes in order to demonstrate their existing communication skills and enhances these. This evaluation targeted the following criteria: 1) To ascertain how students who have engaged in teaching and those who have viewed the teaching episodes have gauged their effectiveness and value to their professional practice; 2) How the student organized themselves to present the material to the group; 3) The types of skills they may have gained both in preparation for and delivery of their teaching episode; 4) The effectiveness of their learning when the role of student and teacher was reversed.

The *assessment* used a *questionnaire* to evaluate the *tested* teaching method. Completing the anonymous questionnaire was voluntary. The main content of the questionnaire targeted the amount of acquired knowledge, engagement of students to the subject topic and to the rest of the classroom participants, and engagement of students in relation to their responsibility to society and the environment.

A. *Control/Regulations*

- The teaching test-group was of a limited number, e.g. four, of volunteer students.
- Assessment of this exercise was carried out through an anonymous questionnaire.
- Students shall not be identified in the data collected.
- A lecturer was supervising the class during the exercise in order to ensure the environment is conducive for teaching and learning.
- A lecturer was monitoring class discussions.
- A lecturer was guiding discussions and intervening when necessary to ensure discussions remain relevant.
- Completion of the anonymous questionnaire was voluntary.
- Feedback to staff and students was provided immediately after the completion of the exercise.
- The students were informed via the information sheet that their participation is voluntary and that they may withdraw from the exercise at any time without any stigma or repercussions.

In this first trial, 20 engineering students participated in the exercise. Two of the students volunteered to be presenters and 18 students volunteered to undertake the responsibility of peer reviewing the teaching episodes presented. In this preliminary evaluation student presenters and their peers answered the same questionnaire which contained the following questions:

- I gained through the preparation of this test lecture more specific knowledge than in usual lectures.
- Because I needed to present this lecture to other class mates I have learned the topic more thoroughly.
- The knowledge I have acquired is more rooted and more durable than what I gain through usual lectures because I understood it through my own search and efforts.
- This methodology improved my relations to other students in the teaching team.
- This methodology improved my relationship with other class mates.
- This methodology improved my relationships to the lecturers of this subject.
- This methodology is for me more time consuming than usual teaching methods.
- This methodology put me in unnecessarily challenging situations I am not used to in usual teaching methods.

Despite the fact, the presenting group had invested more time and effort in preparing the topic for a satisfactory presentation, the peer audience were receiving the information provided and also evaluating the teaching episode. The questionnaire therefore also functioned as an evaluative tool for both the presenters and the peer reviewers in relation to how they perceived this process.

B. *Analysis and results*

The assessment gauged the level of satisfaction of participating students achieved through the teaching episode in comparison to conventional lectures:

- 45% of students were in varying agreement the amount of acquired specific knowledge gained through the test-teaching episode increased contrasted to the effort committed and to conventional lectures; 30% disagreed and 25% were unsure, Fig. 1.
- 45% of students were in varying agreement the teaching episode has enhanced the depth of information gained through the opportunity given for

discussion among peers; while 20% of students disagreed, 35% were unsure, Fig. 2.

- 40% of students agreed the amount of knowledge acquired was more rooted compared to conventional lectures because students, covering the topic, needed to discuss and explore more; while 25% disagreed, 35% were unsure, Fig. 3.
- 60% of students were in varying agreement the exercise had improved their relations to the teaching student-group, while only 5% disagreed, 35% were unsure, Fig. 4.
- 60% of students were in varying agreement the exercise had a positive impact on their relations to peers, only 5% expressed disagreement, 35% were unsure, Fig. 5.
- 60% of students were in varying agreement the exercise had improved their relations to the lecturers of this subject, 10% disagreed, while 30% were unsure, Fig. 6.
- 25% of students considered the approach more time consuming compared to conventional lectures; 50% disagreed, while 25% were unsure, Fig. 7.
- 15% of students agreed this exercise put them unnecessarily in challenging situations; 65% disagreed, while 20% were unsure, Fig. 8.

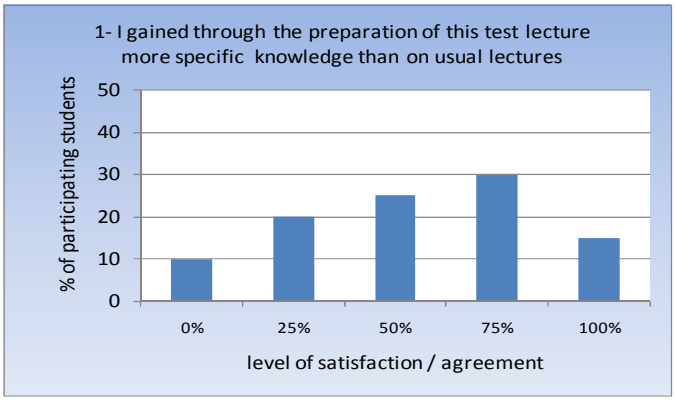

Figure 1: Element 1: Amount of acquired specific knowledge.

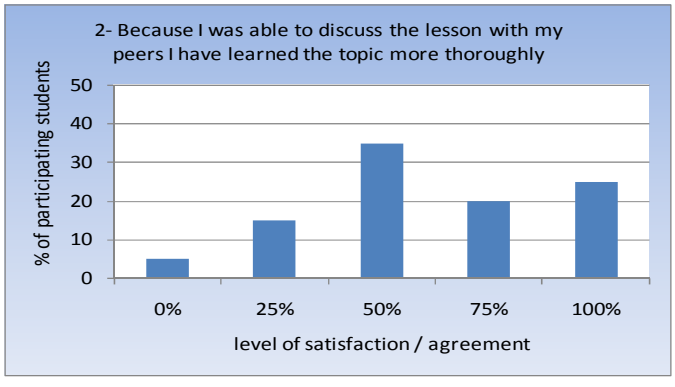

Figure 2: Element 2: Depth of acquired knowledge.

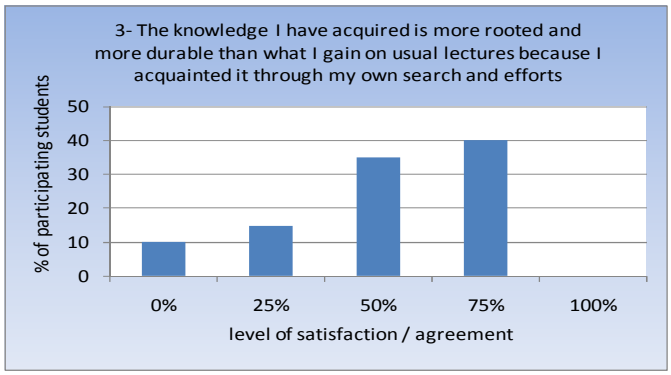

Figure 3: Element 3: Quality of acquired knowledge.

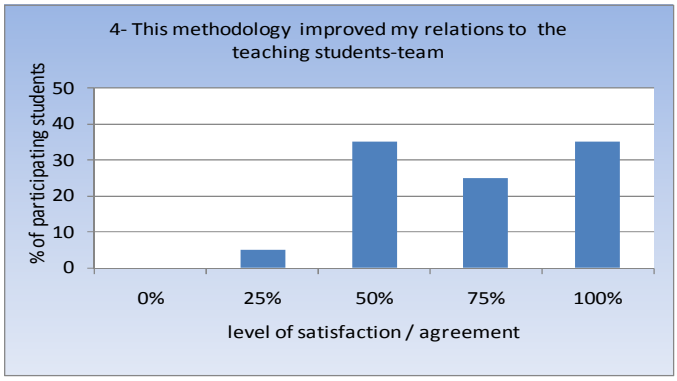

Figure 4: Element 4: Rapport to student teaching-group.

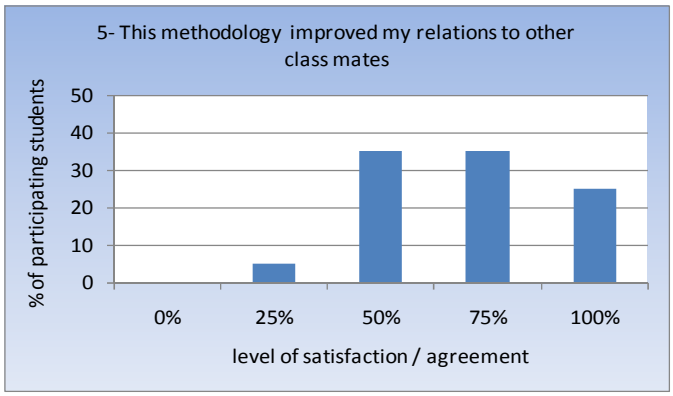

Figure 5: Element 5: Rapport to other class mates.

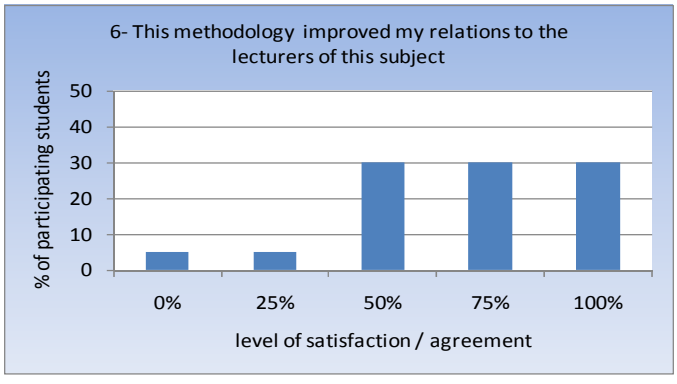

Figure 6: Element 6: Rapport to in-charge lecturers.

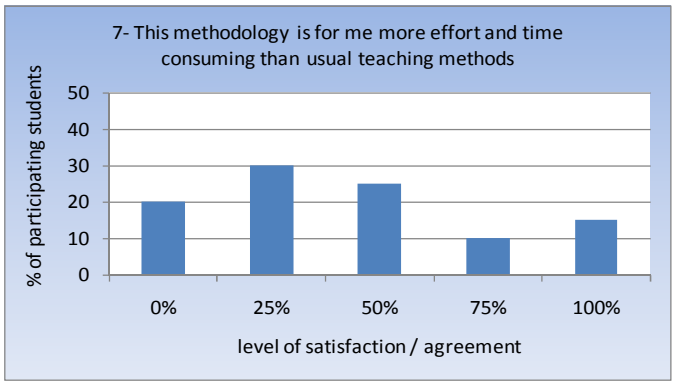

Figure 7: Element 7: Extra effort and time demand.

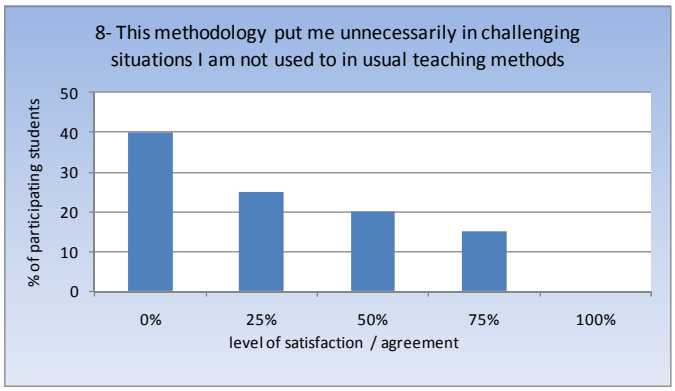

Figure 8: Element 8: Deliberate unconventional challenge.

V. DISCUSSION

The trial revealed, in this first attempt, 45% of students believe they have learned more through this approach than other methods, while only 25% disagreed. In addition, 45% of students agreed that the amount of knowledge acquired was more durable than usual methods because students, in order to learn about, teach and understand the topic needed to discuss and explore more. Regarding improved social interrelation/interactions between student-student and student-staff, the study reveals 60% of students agreed this had been achieved. Interestingly, 25% of students indicated this approach was more time consuming than conventional methods. Those who found this approach put them in unnecessarily challenging situations were 15% of students.

This approach appears to have facilitated a more relaxed learning environment and greater ownership by the student of their learning. In addition, the lecturer is seen to value the input of the students and also becomes a learner in the process. In relation to social attributes the approach facilitates improved student-student and student-lecturer interrelationships so that students are gaining more from the teaching-learning process. The approach could be considered as a training/introductory preparation for professional life, where there is an expectation that group members will learn from and support one another. Ultimately, the approach offers engineering students the opportunity to enhance their public presentation skills in a preparation for a successful professional life.

VI. SIGNIFICANCE

This project aimed to achieve the following two parallel goals in engineering education. 1) To enhance learning of increasingly sophisticated knowledge in short periods of time by reinforcing, reflecting and examining what students are learning from their peers and 2) To improve the skills and attributes of students to enhance their roles as good public presenters, negotiators and effective leaders.

VII. CONCLUSIONS

The results and discussion revealed this approach had positive impacts on students and on their learning experience to variable extents. Students expressed satisfaction about the amount of information gained and the opportunity given for discussion among peers and with teaching staff. The participants considered that the information gained is more authentic and that the exercise improved the student-student and student-staff relationships.

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