Enhanced graduate attributes by engaging engineering students in teaching episodes

Fouad Kamel [1] , Margaret Baguley [2] , David Thorpe [1]
[1] Faculty of Engineering & Surveying
[2] Faculty of Education
University of Southern Queensland, Queensland, Australia
Phone : (+61) 7 4631 2503, Fax : (+61) 7 4631 2526 e-mail: kamel@usq.edu.au

***Abstract**: Presentation skills are increasingly becoming essential in the engineering profession. This research addressed the importance of presentation skills for engineering students and presents the results of a peer-assisted learning "student-teaching" episode. The assessment has been carried out through a questionnaire completed during the teaching episode to ascertain the skills required for effective presentation. Initial results indicated students appreciated the opportunity to engage with a student-led session and believed that this approach enhanced relationships amongst themselves and their lecturers.*

Introduction

Increasingly, oral communication is recognized as an essential element of engineering curricula, and is often cited as an important attribute of graduates. Businesses and industries are also recognizing the centrality of communication skills in professional engineering practices. (Kassim & Ali, 2010) suggested that for practicing engineers a majority of time is spent communicating in written or oral form. (Dannels, 2003) prophetically contended that due to the clear connection between engineering departments and industry, oral presentations that simulate the workplace will likely become a critical part of engineering curricula. Due to the competitive nature of engineering activities, industry is demanding not only technically proficient engineers for their companies but also engineers that are prepared to take on leadership positions. To be effective leaders, engineers must possess the 'soft skills' necessary to solve business challenges. (Crumpton-Young et al., 2010) claimed these skills include written and oral communication, self initiative, teamwork abilities, customer relations and decision making.

(Kamel, Baguley, & Thorpe, 2010) examined the initial stages of an investigation, which seeks to ascertain the teaching potential of a group 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.

The aim of this project is to highlight the importance of presentation skills, and subsequently communication skills of engineering students through a peer review process. This opportunity will provide students cohorts with a sense of agency by valuing their contribution in a supportive and collaborative process. The research project allowed students, presenters and the audience, to provide one another with the opportunity to further develop and enhance their presentation skills in a reciprocal and mutually supportive environment. .

Background

Over a decade ago (Shaw, 2001) revealed that although presentation and oral communication are the most widely used skills in human interactions, they were not adequately being taught in many courses other than dedicated speech classes. (Darling & Dannels, 2003) reported during this period engineering

education and industry has requested assistance from communication educators to incorporate speaking and writing within the curriculum of engineering education.

(Schon, 1987) and (Bonwell & Eison, 1991) demonstrated that many strategies which promote *active learning* are comparable to lectures in promoting the mastery of content. However, it has also been shown that active learning is superior to lectures in promoting the development of students' skills in thinking and writing. (Gardner & Moran, 2006) and (Dryden & Vos, 2001) highlighted a significant numbers of individuals have learning styles best served by pedagogical techniques other than lecturing. Therefore, a thoughtful and scholarly approach to skilful teaching requires that faculty become knowledgeable about the many ways strategies promoting active learning have been successfully used across the disciplines. These include active learning pedagogies which can be incorporated into an effective and engaging curriculum such as cooperative learning, debates, drama, role playing and simulation, and peer teaching.

Active learning pedagogies contribute to students' understanding of how to effectively present information and as (Shaw, 1999) noted, presentation is an essential skill in the social sciences. It is important for students to practice and develop their presentation skills in a wide range of content presentations, such as by: topic theme, book chapter, fieldwork, and research project. (Bonwell & Eison, 1991) revealed presenting is itself an exercise in active learning as students develop, organize, and present ideas and materials on an issue.

(Riemer, 2007) and (Jansen, 1998) stated there is ample evidence that graduate engineers lack the required standard of communication skills, particularly when compared to the needs of industry internationally. (Dannels, 2003) and (Darling & Dannels, 2003) argued 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.

Setting and participants

This pilot project took place in an Australian university as part of a first year engineering course which focuses on technology sustainability and society. The ENG2002 Technology, Sustainability and Society course commenced at the University of Southern Queensland in 2000 following a major review of the Bachelor of Engineering program and the Bachelor of Engineering Technology program. The review was part of the preparation for accreditation in 2001 by Engineers Australia. It is taken by all degree level students in the Faculty of Engineering and Surveying, normally in the second year of their study program. Depending on the program and the student's enrolment pattern, it may also be taken in the first or third year of the study program. Over time, the course has tended to reflect an increased sustainability component, which maintained the original concept of the responsibility of the professional to society.

Objectives

The objectives of this research are to: 1) Provide an opportunity for engineering students to learn, internalise and disseminate complex engineering subject matter more effectively by teaching designated sections of course material to their peers; 2) Provide an opportunity for engineering students to enhance their evaluation skills through peer reviewing selected engineering students teaching episodes; 3) Increase the presentation and communication skills of engineering students by providing support through written feedback from their peers and teaching staff; 4) 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) Enhance inter-faculty collaboration between engineering and education academics by utilising available expertise and providing opportunities to conduct research which focuses on the pedagogical approach and value of this project.

Methodology

This initial analysis of the teaching episode was conducted independently by three academics from the faculties of engineering and education based on an initial teaching performance of engineering students. Engineering students were given assigned teaching episodes in order to demonstrate their existing communication skills and to provide an opportunity to develop these further. This evaluation focussed on the following four aspects: 1) How students who have engaged in the teaching episode and the peer reviewers have gauged their effectiveness and value to their professional practice; 2) How the student organized the material for presentation to the group; 3) The types of skills the student used in both the preparation for and delivery of their teaching episode, and; 4) The effectiveness of this active learning strategy.

This project aimed to achieve the following two parallel goals in the engineering education curriculum: 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.

In this pilot project, 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 responded to the same questionnaire, using multi-aspect Likert-scale.

This paper concentrates on the student evaluation of this teaching episode. It does not evaluate the way the students approached their task or the skills they developed. These areas will be the subject of future research.

Control/regulations

- The teaching test-group was of a limited number, e.g. two of volunteer students;
- Assessment of this exercise was carried out through an anonymous questionnaire;
- Students were not identified in the data collected and university ethics clearance was sought and approved;
- A lecturer supervised the class during the exercise in order to ensure the environment was conducive for teaching and learning;
- A lecturer monitored class discussions;
- A lecturer guided discussions and intervened when necessary to ensure the discussion remained relevant;
- Completion of the anonymous questionnaire was voluntary.
- Feedback to staff and students was provided immediately after the completion of the exercise;

Pedagogical Significance

This active learning strategy, also known as micro-teaching, connected students with each other in a learning community confirming results reported by (Shaw, 2001). They became active participants and also evaluators in the learning process. The presenters had to actively interrogate the subject matter and present it in an effective yet engaging way. This removed the aspect of passive learning which can occur when students are listening to a lecturer. The responsibility of providing the information and in the process further developing presentation skills, in addition to being able to ascertain whether fellow students understood the concepts under discussion was upon the student presenter. Peer learning took place during the student presentations which in some ways incorporated existing classroom standards but also allowed scope for individual interpretation of the material in the presentation format. The peer reviewers learned engineering concepts from a fellow student which may have provided reassuring familiarity, but also enabled comparisons to be made between the lecturing style of the student and that of a more practised presenter. This strategy also revealed to the lecturers how the students comprehended the subject matter and whether they were making connections to previous concepts

within the course. A micro-teaching exercise is a valuable tool to help students develop communication, critical-thinking, and problem-solving skills. (Popovich & Katz, 2009) emphasized the approach helps increase student learning, helps students to ‘‘think on their feet’’ and be reflective. Importantly it provides an opportunity for students to analyze their own and fellow classmates’ presentation methods and develops their skill in the provision of constructive feedback through peer assessment.

(Matveev & Milter, 2010) reported such pedagogical strategies are instrumental in developing analytical and presentation skills, effective teamwork, reflective learning, and the application of knowledge and skills in future learning. Another benefit is a potential increase in social interaction with other students, staff and faculty as stated by (Reinhart, 2010). (Shaw, 2001) reported that team presentations help students grasp information as they organise and prepare to present new material to their peers. They also enable students to learn from one another and sharpen interpersonal communication skills as they interact with team members and other classmates as affirmed by (Eisen, 1998). (Dunne & Bennett, 1990) argue teams not only provide a powerful context for learning, but also have a strong behavioural and cognitive impact on learning outcomes. The importance of teamwork cannot be underestimated, particularly in an increasingly interconnected world.

Analysis and Results

The assessment of the micro-teaching episode gauged the level of satisfaction of participating students in comparison to their evaluation of conventional lectures. The assessment elements used are described below and the statistical results can be found in Table 1.

Assessment elements and results:

1. The amount of acquired specific knowledge gained through the test-teaching episode increased contrasted to the effort committed to conventional lectures: 45% of students were in varying agreement, 30% disagreed and 25% were undecided.
2. The teaching episode enhanced the depth of information gained through the opportunity given for discussion among peers: 45% of students were in varying agreement, 20% disagreed and 35% were undecided.
3. The amount of knowledge acquired was more rooted compared to conventional lectures because students, covering the topic, needed to discuss and explore more: 40% of students agreed, 25% disagreed and 35% were undecided.
4. This exercise improved the relationship amongst the student-group: 60% of students were in varying agreement, only 5% disagreed and 35% were undecided.
5. The exercise had a positive impact on their relations to peers: 60% of students were in varying agreement, only 5% expressed disagreement and 35% were undecided.
6. The exercise had improved relationships with the lecturers of this subject: 60% of students were in varying agreement, 10% disagreed, while 30% were undecided.
7. This approach was more time consuming compared to conventional lectures: 25% of students agreed, 50% disagreed, while 25% were undecided.
8. This exercise unnecessarily put students in challenging situations: 15% of students agreed, 65% disagreed, while 20% were undecided.

Discussion

The results support the claim that active learning strategies are powerful tools for developing previously de-emphasised aspects required for contemporary engineers, particularly in relation to teamwork and presentation skills. This finding is in line with past research on learning and the effectiveness of student presentations in the learning of new material by (Eisen, 1998) and (Shaw, 2001).

It is important to note that this was a small focussed activity and the results are not generalisable given the number of participants. However, a number of interesting insights are evident in the data that was

collected. Overall, the micro-teaching episode was not viewed negatively by the students, although the novelty of the exercise may have contributed partly to this. The presenters who volunteered for the

Table 1 Assessment of research outcomes stated by teaching and audience students in % - total number of participating students 20.

Assessment element	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1	15	30	25	20	10
2	15	30	35	10	10
3	0	40	35	20	5
4	35	25	35	5	0
5	25	35	35	5	0
6	30	30	30	5	5
7	15	10	25	30	20
8	0	15	20	20	45

teaching role were both quite confident both in terms of personal attributes and their familiarity with the material. It appears that social skills were further enhanced in relation to further strengthening relationships amongst peers and lecturers. Further insights were also gained by the students into what may seem an effortless weekly presentation by lecturers when students who are less experienced take on this role. However, due to the material being re-interpreted by peers, there was a noticeable empathy and rapport with the student presenters by the audience who visibly become more attentive and sought to ask questions to help 'move' the presentation along. Students also appeared to be more comfortable to ask questions which they may not have asked the lecturer in a similar setting.

Conclusions

In the context of this study, presentation was an activity where students not only presented engineering knowledge but also negotiated what information was relevant for presentation, how to structure that information, which audiences would be appropriate for that information, and how presenters' engaged with the audience. The exercise demonstrated how the teaching and learning of micro-teaching sessions had implications beyond the boundaries of delivery.

Thus the apparently novel combination of individual student presentations covering syllabus material in lieu of the lecturer, and the inclusion of multi-aspect Likert-scale peer assessment marks in the final informal grading, was found to be a useful and constructive approach. The results support the claim that the approach assisted in developing students confidence in self-learning and in their value judgement by (MacAlpine, 1999).

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 they were able to comprehend the information more easily through the peer approach and also gained important insights to presentation skills through the opportunity to either present or peer-review a micro-teaching session.

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