

Debate Activity as an Effective Interactive Learning Approach for Civil Engineering Students

Introduction

Conducting critical review and being a critical thinker are two major competencies expected from engineering students after graduation from university. Despite the emphasis on the above skills as the obtained graduate attributes, industry has expressed concerns about inability of students to integrate teamwork, communication, and oral presentation skills with critical thinking (investigators' industry network and previously reported by Roy & Macchiette, 2005 and Scott, 2009). Application of eLearning combined with face-to-face activities (conveniently labeled "blended learning") in the university education can give opportunities for small group discussions and collaboration, the possibility of creating extended learning communities, and access to specialists who are otherwise difficult to bring in to the university. According to Biggs (1999) and Prosser & Trigwell (1999), student factors and teaching/environmental factors are the key items significantly influencing the university students learning outcomes. As highlighted by Biggs (1999), what matters most is the nature of the students' activity: what they do, what and how they think when working. Student activity is directly related to learning outcomes. Other factors such as the approach to teaching or the learning resources provided have only indirect relationships (Biggs, 1999; Goodyear, 2002).

Past research (e.g. Dickson, 2004; Vo and Morris 2006) shows that transforming students from passive learners to active learners improves their learning experience and assist them to obtain the desirable skills much faster. Lectures and step by step problem solving in university classrooms are mainly dominated by the passive learning strategy, thus implementing active learning strategies, such as discussions, role playing, case studies, and debate can be adopted. Although traditional teaching techniques such as lectures and classroom quizzes and exams help students to obtain the technical knowledge and assess themselves, the use of debates in engineering subjects can effectively facilitate critical thinking as well as oral presentation. Vo and Morris (2006) used debate to supplement the traditional lecture by engaging the learner allowing the teachers to create an environment that helps students move away from just receiving knowledge into an atmosphere of active participation. Additionally, as highlighted by Dickson (2004), debating contemporary issues in the classroom can be an invaluable tool for encouraging critical thinking.

An in-class debate has its own place in pedagogical methods allowing participating students to critically analyse a controversial topic while practicing other academic competencies such as writing, investigating arguments, gathering information through research and public speaking to name but a few (Scott, 2009). It is a public nature of the debate format that motivates participating students to perform well. Likewise, these debate participants would further acquire the time managing and organising skills, and teach themselves to collaborate efficiently with their partners. As suggested by Walker and Warhust (2000), the debates in the classroom have been effective in developing critical thinking by letting students to connect while learning subject knowledge. Evidently, the statistical report given by Walker and Warhust (2000) has revealed that 82% of students believed that they understood the subject matter, and 85% stated that they gained valuable experiences through the debate activity.

Nevertheless, many Civil Engineering subjects and projects still require students to follow the existing national and international standards and procedures step by step for design and

construction purposes. Thus these subjects do not give students the opportunity to build their critical thinking and communication skills by being active learners and not being only the recipients of the knowledge (passive learners). In this project, the research team shares the experience for providing alternative learning activity (in-class debate) in a core Civil Engineering subject named Soil Behaviour replacing parts of traditional tutorial classes and the assignment based assessment.

Methodology

After consultation with many industry partners and senior civil and geotechnical engineers, the research team introduced “In-Class Debate”, which is an active and flipped learning method for undergraduate students. It is believed that Civil Engineering students in their second and third year have acquired the fundamental knowledge (e.g. fundamental engineering and communication subjects) and skills which are the basic requirements to form a logical technical argument after research. Each semester eight to ten different debate topics including the title/question, key challenges, and a few initial references to start have been distributed in the tutorial classes. Students have been encouraged to form their groups and prepare their arguments in the group and the subject coordinator and tutors have been organising debate sessions in the tutorial classes as well as some of the lecture classes. The new collaborative theatres and collaborative spaces available at the university have been facilitating the required collaborative group work for planning and presenting the debates (see Figure 1). This has been a new learning activity in Civil Engineering with the express purpose of developing students’ oral communication skills, and developing the kinds of professional presentation skills students would require in the workplace. Students learn how to research and prepare material for a debate on an infrastructure/socio-political issue. In addition, each debate group has been mentored by senior engineering students (PhD students). This learning experience has contributed to implementation of new strategies to systematically improve skills, knowledge and behaviour of our civil engineering students to operate effectively in a changing global environment.



Fig. 1 New Collaborative Learning Space at the University of Technology Sydney (UTS) used by students to prepare for the debate

The defined debate topics have been directly or indirectly related to some of the lectures which has allowed the research team to monitor the students’ improvement in that specific part as well as the whole subject. The instructors have introduced sufficient resources for research helping to support both opposing viewpoints, and the online subject website has been used for this purpose.

This active learning activity has been running in class and students have been advised to form their groups and prepare their arguments in the group and there has been debate sessions in the tutorial classes as well as some of the lecture classes. The debate topics have been controversial, to persuade students to evaluate not only their own points of view, but other possible viewpoints as well. Sample debate topics adopted are as follows:

- Should Australia Invest on Extraction of Coal Seam Gas From the Ground (CSG)?
- Is Shale Gas Viable Solution to Solve Energy Problem in Australia?
- Shall We Construct More Large Dams in Australia?
- Should We Build Airports Closer to Sea or Inland?
- Does Australia Need to Invest on High Speed Rail?
- Should Australia Invest More on Rail Transport or Road Transport?
- Does New South Wales Need More Investment on Bridges or Tunnels?

In the first round of debate, each group member talks 1.5 min presenting the supporting facts and argument. We go back and forth between groups till all 4 members give their prepared talk (1 from one side of the argument then 1 from the other side of argument and back and forth). Thus in 12 min all group members had a chance to present their argument. In the second round, again each group member has a chance to present further argument and possibly try to respond to some the comments made by the other group or present more facts and evidence. Again, we will go back and forth between groups till all 4 members present their responses. After each debate, each panel member is given 2 min to give short comments about the debate. There have been two assessments in the grand final debate session; one done by panel of distinguished judges and another people's choice. On the basis of the presented arguments, bonus mark up to 10% (considered as an optional part of the assessment) were offered to the participants. Alternatively, incentives such as certificate of participation or success, book vouchers and cinema tickets were also offered for encouraging the students to deliver higher quality arguments. A ballot was hold among 5 members of the panel of judges to select the best presented discussion. Criteria of assessment and selecting the best side of the argument have been as follows:

- Presenting argument logically supported by facts and evidence
- Professional presentation of argument
- Extent of literature review conducted and understanding of the topic.
- Consideration of technical, social, environmental and political aspects in the argument
- How properly the group could respond to the arguments of the other group

Results and Discussion

Research students possess many skills that make them great mentors, such as their technical expertise, critical thinking and ability to review available information, to synthesise and present the outcome. PhD students can also act like a reviewer or a person who can steer the group work so that quality of arguments would be brought to a new high level. PhD students who worked with debate groups were advised to stress the importance of team work. Team arguments need to be strong and fully backed by reliable data. Arguments need

to be sorted into groups of arguments, which was then assigned to each responsible member. They should be also able to assess and respond to any possible opponents' arguments. Initially, a few groups were weak at communication skills; hence to make sure everything goes smoothly, mentors asked participating students to report back to the mentors frequently. The other challenge was to work with those who initially lack motivations and enthusiasm. One way to get through this was to set them high, but realistic, expectations. Mentors and the subject coordinator taught students how to relate what they debate with practical real life examples, as well as with students' own experience. It was evident that successful groups were those who took the ownership of what they were doing.

On average 40% of students participate in this optional activity each semester (total number on subject enrolment varies between 170 and 210 per semester). The debate training sessions were organised for participating students and a professional trainer from the Institute for Interactive Media & Learning (IML) provided several debating skills supported with hints and examples. Discussions such as how participants would define terms clearly, brainstorm ideas and arguments in a short period of time, or provide evidence and ethical data to support arguments etc. were highlighted. In the training sessions, importance of maintaining coherence and eloquence throughout the speech and some strategies to achieve this ability were discussed. Based on students' feedback, one of the most useful tips was to start off the speech in an academic manner by using some popular debate phrases (e.g., I agree/disagree with..., in addition to your comments...), and these phrases could handsomely link arguments together and engage the audience. While managing an engaging explanation, the trainer was able to exude sense of humour throughout the training sessions and participants could successfully gain some presentation skills from the training session. The tips given in the training session could help the students to structure their speech logically and deliver sufficient information within the time constraint. Some participants further developed their eloquence and confidence in front of the crowd. Furthermore, as emphasised by the panel of judges most of participants were able to show eye contact with the audience while giving a speech.

Students enrolled in the Soil Behaviour subject and more specifically the students who have been involved in this activity were asked to participate in a survey and give the lecturers (investigators) some feedback about the implemented active learning model through debates. Samples from anonymous online Students' Feedback Surveys about application of debate activity helping with student learning experience are presented below:

"Throughout the soil behaviour subject, debating was the most exciting activity. This activity not only motivated me to do research to understand more about my debate topic, but it also helps me to combine all the knowledge that I have learnt from all the previous subjects. In addition, doing research for my debate topic with my team helps me update my knowledge and understand different aspects when building a project in the civil engineering area. That will definitely be a good preparation for me before I come out the work field". Survey 105567, 48330-SPR-U-S-LEC1-01.

"I like the idea of debating. It is such a new and interesting activity. Instead of doing normal/ original report research, debate is much more fun and it is also great to listen to other student's points of view about the current engineering issues. My friends and me absolutely like it", Survey 105567, 48330-SPR-U-S-LEC1-01.

Debate and discussion boards were setup on Facebook as well as UTSONline (using Blackboard Learn). As mentioned earlier, eight to ten debate topics will be available and

debate boards were setup for each topic and students could choose their preferred topic and join either side of the debate. Different sides of the debate can comment on each other's arguments for or against. In other words, students will form two perspectives of pros and cons, and express their opinion and contradict each others' arguments. Instructors will monitor the debate discussions and if necessary introduce some new references to be considered. As mentioned earlier, each debate group was coached by PhD students helping the debating students to refine their arguments and guide them through to find reliable sources to support their arguments.

All the members of distinguished panel of judges including senior academics, engineers and strategists from both university and civil engineering firms involved in design and construction of infrastructure were invited to give comments to participating students. In addition, each group received the written comments and feedback of panel judges about their group performance and aspects to improve. Those constructive comments were well-received by students. Some highlights of students' feedback about the comments from the distinguished panel of judges are as follows:

"The feedback that our group has received from the panel of judges, lecturer and our tutor are very useful. It helps our group to _understand clearly the tasks that we have to do _perform better teamwork _present ourselves in a professional way and _improve our arguments to perfection", Survey 105567, 48330-SPR-U-S-LEC1-01.

"It was a very good experience to participate in the debate as I was able to further my thinking about the complex issues involving transport. It was great to listen to the response from the judges was constructive", Interview undergraduate student R.G. who participated in the debate Activity in Autumn 2015.

Members of panel of judges particularly those involved in strategic planning and design and construction of infrastructure were interviewed to receive their feedback on different aspects of this activity. Following are the highlights of comments made by them:

"I believe the debate activity adopted in Soil Behaviour Subject at UTS fosters teamwork and leadership, encourages critical thinking, research and communication skills of Civil Engineering students. In addition, the adopted in class debates help spontaneity and "thinking on your feet" and develop persuasion skills. Obviously, the "competitive" framework of a debate adds an element of individual urgency while at the same time the friendly/nurturing environment makes it non-threatening and enabling". Written Feedback received from a Member of Distinguished Panel of Judges, Executive Manager, Research and Innovation Office (RIO).

In the next step, a statistical analysis has been undertaken based on the performance of the students in Soil Behaviour subject as summarised in Figs 2 and 3.

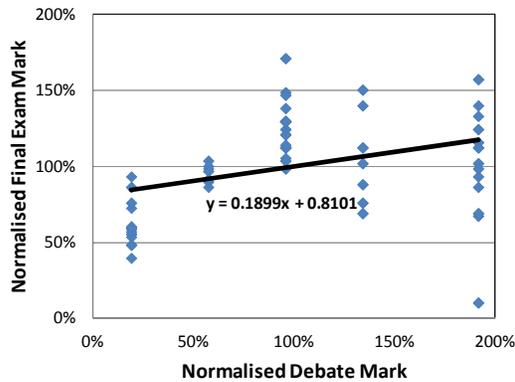


Fig. 2 Statistical Analysis Results for Soil Behaviour Subject Autumn 2015

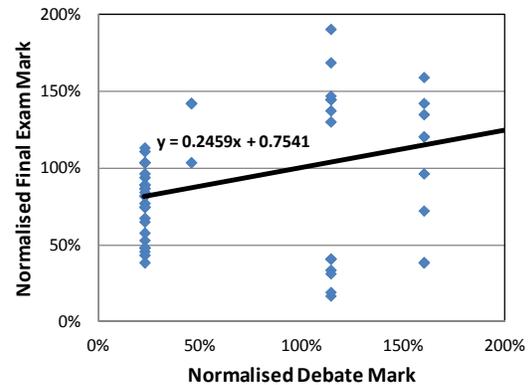


Fig. 3 Statistical Analysis Results for Soil Behaviour Subject Spring 2014

As shown in Figs. 2 and 3, students with better performance in debate activity have performed better in the final exam, which is totally independent assessment task. Clearly, the averaged final exam mark of students actively participated in the activity and presented a better debate has been higher than that of other students. The feedback received from students show that the debate activity had encouraged students to do research and they were motivated to learn more about soil behaviour. It should be noted that better students were strongly motivated to succeed, thus overall they performed much better in both debate and the exam.

Considering the new campus development and innovative teaching/learning spaces available, and in line with the new teaching and learning initiatives at the University of Technology Sydney (UTS), by including In-Class Debates, research team could reengineer their approaches to teaching and learning to use new spaces and classroom facilities. Availability of new collaborative theatres and collaborative learning spaces could facilitate the required collaborative group work for planning and presenting the debates. Using online discussion boards and online subject website, students could access the digital sources available and prepare their arguments prior to coming to classes to be engaged in active and collaborative discussion while being mentored. Introducing the in-class debates are considered as flipped learning aligned.

The following outcomes will contribute to implementation of new combined eLearning and in-class strategies to improve skills and knowledge civil engineering students need in the workplace, in line with the university's strategic plan and model of learning as well as faculty's graduate attributes:

- Providing a proper opportunity for students to know and understand their peers better for further teamwork activities
- Engaging students in active learning through online and in-class 'activities'.
- Encouraging students to support and listen to each other for clarifying ideas and showing interest in respecting peers contributions
- Developing specific skills such as analysing, synthesising and evaluating supported arguments in students using debate as a learning tool
- Strengthening students' teamwork skills through delegation involvement, sharing tasks, interacting and communicating effectively

- Encouraging students to develop critical thinking, active listening, researching, problem solving, reasoning, questioning, and communicating skills through the debate process
- Inspiring students and staff to adopt active learning and interactive teaching, respectively
- Familiarising Civil Engineering students with debatable/challenging topics in Geotechnical discipline
- Sharpening students' ability to quantify issues from various perspectives
- Providing a vibrant learning environment for students to be active participants

This research can be further developed by monitoring students' performance in other university subjects needing team work, communication skills, and critical review and research skills to further evaluate effectiveness of the adopted debate activity. In addition, graduates can be interviewed after joining industry to assess how the debate activity has helped them to be successful in the workplace, while further feedback from the employers would be beneficial.

Conclusions

The research team has attempted to improve the learning experience of Civil Engineering students by introducing debate activities in engineering subjects. This could encourage the students to be active learners (against passive learner or lecture receivers) and we consider this process as an activity (what students actually do) and not a task (the work prescribed by the teacher). In this project, a main stream civil engineering subject, namely Soil Behaviour has been targeted. Feedback received from the students has indicated that the developed in-class debate activity has been effective in improving communication and critical-thinking skills of students. Availability of new collaborative theatres and collaborative learning spaces could add great advantages to enhancing the efficiency of collaborative group work, in terms of planning and preparation for the debates. In addition, available online discussion boards and online subject website would provide flexibility for students to access digital resources and prepare their arguments.

The professional training sessions, on the other hand, could equip participants with important tips to improve the argument presentation skills while were trained to overcome the panic and fear of making mistakes during the speech. International students, whose English is not their first language, were particularly encouraged to attend the training sessions helping them to obtain profound presentation skills not only for Soil Behaviour debate but also for their future career.

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