

## Creating online structured academic controversies

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### Abstract

There have been calls within engineering practice and engineering education to develop within engineers a capacity to recognise and accommodate diverse and even competing perspectives within decision-making processes. To satisfy these needs an instructional technique called Structured Academic Controversy was modified for multi-party controversies and for use with internet mediated communication. The activity specifically seeks to promote multiple perspective-taking on a controversial science and technology public issue and to develop conflict management skills, critical thinking and collaborative skills. The technique has been used to explore controversy surrounding genetically modified foods, the provision of telecommunication infrastructure to meet regional needs, the role of e-Libraries and the damming of international rivers. Feedback from student surveys show that there was a high level of student agreement that the activity developed their awareness of the political, social, environmental and scientific dimensions of the issue discussed. There were also high levels of student satisfaction with the activity. However due to the high number of student postings and the threaded nature of the discussion forum some students found it difficult to interact with all the points raised and to sustain dialogue within a thread. These problems with online dialogue have also been found in other studies. The instructional technique described has been effective in allowing students to develop knowledge of contemporary issues and appreciate the impacts of engineering solutions.

### Introduction

Increasingly, social controversy is becoming one of the basic ingredients of technology development<sup>1</sup>. Social debate about technologies used for energy production, transport, biotechnology and lifestyle are widespread. Within these contexts the engineering design process can be complex, multi-dimensional, ill defined and fraught with value judgements. Because no single perspective can fully encompass the whole system or issue at hand, multiple representations of the issues or problems are necessary. Resolving these complex design choices can require many 'actors' who bring different types of knowledge into a forum for extended dialogue. Recognising how to accommodate and even benefit from these diverse and often competing perspectives is a major challenge for the design process and the engineers undertaking the process.

Within engineering education the challenge to prepare students to broaden the basis upon which decision-making can occur is recognised within the generic attributes expected of undergraduate engineers. Recently developed accreditation outcomes required by ABET (Accreditation Board for Engineering and Technology) require that students should have "the broad education to understand the impact of engineering solutions in a global and societal context"<sup>2</sup>. The impacts are defined to include political, economic, religious, environmental,

communication and aesthetic considerations. They also identify as an outcome the need for knowledge of contemporary issues.

Active approaches to teaching and learning that involve a more discursive and collaborative approach to problem solving as well as those which seek to illustrate and accommodate value diversity are needed. One approach is to design teaching and learning activities around the principles which underpin an instructional technique called Structured Academic Controversy<sup>3</sup>. This approach seeks to create engaged co-operative learning through arousing intellectual conflict. Students engage in the controversy by arguing a perspective, then swapping perspectives and then coming to a reasoned judgement on the issue. Through this process students transform knowledge into arguments, critically analyse positions, view issues from different perspectives and synthesize<sup>4</sup>. It has been widely applied including environmental studies<sup>5</sup>, education<sup>6,7</sup> and Science methods classes<sup>8</sup>. It is particularly suited to a constructivist approach to learning where it is believed that individuals construct their conceptions on issues according to the way they focus on, structure and integrate particular aspects of knowledge, attitudes/values and behavioural orientation.

The Structured Academic Controversy technique has traditionally been used in face to face situations where there are two opposing perspectives to an issue. However many controversies which involve engineering and technology are multi-faceted and have many stakeholders. To satisfy these needs the Structured Academic Controversy technique was modified for multi-party controversies and for use with internet mediated communication. It is hoped that the modified technique used in this paper may broaden the application of the constructive controversy to a wider range of educational environments and types of controversies.

## **Teaching Context**

The subject Technology Assessment is a compulsory senior undergraduate engineering subject, which involves students from all engineering sub-disciplines. There are between 150 and 300 students enrolled each semester. It provides an overview of the different approaches to Technology Assessment used in the context of public policy formation, impact evaluation and technology development. It examines public participatory mechanisms, the legal, political, economic, environmental and social frameworks that can be used to assess technology as well as outcome based impact evaluation of large-scale complex engineering systems.

Learning activities within the subject are organised around all students completing the three assessable Tasks. These tasks are;

*Technology Assessment Quizzes Task 1:* The online quizzes comprise 8% of subject assessment and focus on student understanding of approaches to decision-making, technology assessment models, public participation strategies and the causes of conflict.

*Structured Controversy Activity (32%) Task 2:* This activity comprises 32% of the assessment for the subject and requires students to actively participate in either an online roleplay-simulation<sup>9</sup> or a Structured Controversy Forum. To accommodate the large student numbers and the varied interests of students, there are multiple Forums run concurrently. Students either self select or are allocated to one of these Forums. The issues explored within the Forum have focused on controversial public issues related to science and technology. These have included genetically modified foods, the provision of telecommunication infrastructure

to meet regional needs, privatisation of telecommunication providers, the role of e-Libraries and the damming of international rivers. The Forum activity specifically seeks to promote multiple perspective-taking on a controversial science and technology public issue and develop conflict management skills, critical thinking and collaborative skills

*Technology Integration Report (60%) Task 3:* In this component of the subject, students address issues surrounding the integration of Technology into a particular business or socio-political context. They produce a report which seeks to address the adoption, consultation or evaluation of a technology product, project, plan, policy or programme. The available report types are an Impact Evaluation report, a Stakeholder Engagement Report, Product-Service Evaluation report and an Innovation Evaluation report.

### **Structure of the Structured Controversy Forum**

The focus of this paper is design and evaluation of the Structured Controversy Forum which occurs with Task 2. Each of the Forums comprises between 30-50 students who represented 10-14 personae (stakeholders). The Forums are structured around 3 stages.

*Position Preparation (Stage 1):* During this stage the students research the issue and their assigned persona (stakeholder). There are 3 or 4 students who share a persona. Each personae is a real stakeholder that the students can research using various media sources, articles and websites. The topic for dialogue within each Forum is defined by specific terms of reference. Each Persona must post an initial statement describing the responsibilities, general viewpoints and/or value statements of the persona they are representing. This stage occurs over 12 days and prepares students for the online stage of the Forum. Each student is assigned a login name which adds to the perceived authenticity of postings to the discussion board and allows student anonymity.

*Advocating Positions (Stage 2):* This stage involves persona posting messages to a threaded discussion board. The postings include submissions relating to the persona's perspective or position on an issue as well as responses to the postings of other personae. A threaded discussion results from these postings as students attempt to persuade other personae of their views and positions. These Forums have been designed to simulate public inquiries although the public nature of the message posting systems allows all students to view multiple perspectives about the topic being discussed. This stage is highly interactive with each Forum having between 320 and 560 postings over a 7 day period.

*Debriefing and Reflection (Stage 3):* During this stage participants identify what they have learned as a consequence of participating in the activity. The debrief of each Forum occurs in a face to face mode over a 3 hour time period. It is a structured post hoc method involving guided recall, reflection and analysis of the experience involving three phases<sup>10</sup>. This involves a systematic reflection and analysis of the experience followed by an intensification and personalisation of the experiences by the participants. Finally participants generalise their experiences and discuss the application and implications of the experience. The final reflective process occurs over 12 days as students write up their report on the activity. In this report they are required to present arguments which both support and refute those made by their persona. This stage requires the students to step outside of the position they had in the Forum and consider other perspectives.

### Example of the design of the Telecommunications Forum (Forum C)

Telecommunications infrastructure and service provisions to regional, rural and remote Australia is an issue that has increasingly become a public and controversial issue. Recent statements about the possibility of privatizing Telstra which would result in a \$40 Billion sell-off have increased the need to address issues surrounding regional telecommunications in Australia.

The terms of reference for the Telecommunications Forum were;

- i) Whether existing and proposed telecommunication infrastructure and services are expected to meet the development needs of regional Australia in an equitable way with metropolitan Australia
- ii) Which issues should be given priority if existing levels are not equitable
- iii) Whether it is appropriate to privatize Telstra at this time.

The personae to be represented in the Forum were chosen to encourage interaction on a number of broadly based but often inter-related issues. These are detailed in Table 1.

**Table 1 Personae in the Telecommunications Forum**

Persona	Possible issues for discussion	Stakeholder (Persona login)
1	Link between communication infrastructure & regional development	National Farmers Federation (NFF)
2	Link between social benefit, Telstra jobs & ownership	Communications, Electrical and Plumbing Union (CEPU)
3	Link between Indigenous development and infrastructure	Aboriginal and Torres Strait Islander Commission (ATSIC)
4	Link between current initiatives & telecommunication needs	Department of Communications, Information Technology and the Arts. (DCITA)
5	Link between ownership & Liberal policy on government ownership	Liberal (LIB)
6	Link between ownership & Labor policy on government ownership	Labor (LABOR)
7	Link between ownership & service provision	Telstra (TELSTRA)
8	Link between ownership & national interest	Institute of Public Affairs (IPA)
9	Link between service provision & regulatory framework	The Australian Competition and Consumer Commission (ACCC)
10	Link between regulatory controls and ownership	Competitive Carriers' Coalition (CCC)
11	Link between regulatory controls and ownership	Optus
12	Link between business practices & justice	Cyber Justice (CYJUST)
13	Link between uses & infrastructure	Consumers' Telecommunications Network (CTN)
14	Link between uses & infrastructure	Australian Telecommunications Users Group (ATUG)

## Assessing student learning for the Structured Controversy Forum

The assessment tasks associated with the Structured Controversy Forum were clearly structured around the teaching and learning objectives of the activity. The assessment includes measures of the performance of the participants while they were undertaking the activity, and measures of their learning from the activity.

The performance of students during the Forum comprised 37% of the mark for the activity. Ensuring all students contributed was important to ensuring that a full range of perspectives on the issue was raised during the Forum. The capacity to log individual student access to the Forum and the use of online peer assessment system<sup>11</sup> for students within a persona allowed for a high level of individual accountability within each persona. The performance of students during the Forums was assessed based on the quality, quantity and frequency of submissions.

The quality of the postings in the Forums was peer assessed by all students in the Forum with validation of the final ranking by teaching staff. The criteria for assessment of quality of student postings were;

- Showed respect and understanding of other personae views while still challenging them
- Were persuasive
- Increased Forum participants understanding about the issue
- Were clear and concise

The purpose of measuring the quantity and frequency of the postings was to encourage an extended debate through the activity. The teaching staff assessed the postings using the following measures and methods;

- Frequency of access to the Forum (assessed using student login data)
- Number of postings accessed in Forum (assessed using student login data)
- Number of posting submitted by persona (calculated from discussion board)

For each performance criteria a mark was given within range of 0-100. The final performance score was then weighted according to the following formula;

Final score for persona=  $0.5 * (\text{posting quality}) + 0.15 * (\text{access quantity}) + 0.2 * (\text{posting quantity}) + 0.15 * (\text{access frequency})$

Student learning from the activity was also assessed through an individual report completed as part of the debriefing and reflection stage. The report comprises 63% of the assessment for the Forum activity. The report has four sections; persona description, persona position, issue representation and persona analysis. Within the section on persona position, students are required to identify three points which support and three points which challenge the position advocated by their persona. Students are also encouraged to identify multiple perspectives on the controversy by synthesizing and then representing the arguments made in the Forum in the section on issue representation. In the section on persona analysis they reflect on the nature and inherent complexity of the issue discussed and in particular on the factors (e.g. technical, legal, institutional, commercial political, social and environmental) impacting acceptance of the position advocated by their persona within the Forum. The assessment of the issue representation and persona analysis sections of the report were analysed using SOLO<sup>12</sup>, a hierarchical approach to assessment that focuses on the structural complexity of responses. Responses range from pre-structural (containing irrelevant information) and uni-

structural (showing understanding of one or a few basic aspects) through higher levels which provide evidence of understanding by integrating and structuring relevant concepts to multi-structural responses which generalise beyond the information given to yield higher order principles.

## Evaluation

The effectiveness of the Forum was evaluated based on student responses to the teaching activity and their perceptions of the learning that resulted. The data used in this evaluation is based on the three concurrent Forums (A, B, C) which occurred between August and September 2003. Student responses were captured using an online student survey. In the survey, items 2, 3, 4 and 6 used a 5 point Likert scale ranging from strongly disagree (1) through disagree, neutral, agree to strongly agree (5). Item 8 used a 7 point Likert scale ranging from very poor (1) through poor, not quite satisfactory, satisfactory, good, very good to excellent (7). The level of student agreement to a survey item was derived from the percentage of students who responded that the activity was rated as agree or strongly agree (Items 2, 3, 4, 6) or satisfactory to excellent (Item 8). Completion of the survey was voluntary with a response rate of between 70 to 80% across the Forums. A summary of the results is presented in Table 2.

**Table 2: Student responses to achievement of learning outcome**

Item No.	Survey Item	Forum A mean Likert	Forum B mean Likert	ForumC mean Likert
2	The online forum developed my ability to see a science and technological issues from multiple perspectives	3.6	3.6	3.7
3	The online forum developed my ability to seek and utilise knowledge from a range of sources	3.5	3.3	3.7
4	Task 2 developed my awareness of the political, social, environmental, economic and scientific dimensions of the issue discussed	3.9	4.0	3.9
6	The online forum and debriefing developed my critical thinking skills	3.6	3.7	3.6
8	All things considered, how would you rate the online forum and debrief	4.5	4.7	4.8
	Number of Responses (n)	31	25	45

Items 2, 3, 4, 6 used a 5 point Likert scale

Item 8 used a 7 point Likert scale

Feedback from student survey shows that there was a high level of student agreement that the activity developed their ability to take multiple perspectives on the issue (3.6-3.7 and 71-78% agreement) and awareness of the political, social, environmental and scientific dimensions of the issue discussed (3.9-4.0 and 76 to 90% agreement). There was lower levels of agreement that the Forum developed some information literacy skills in seeking out and utilising knowledge from different sources (3.3-3.7 and 52-75% agreement) and critical thinking skills (3.6-3.7 and 58-67% agreement). In written feedback about the activity a number of students identified that the threaded structure of the discourse within the discussion board and the large number of postings did not lead to conditions suited to high levels of closure or consensus building. The limitations of asynchronous computer mediated communication and threaded discussion boards in providing support for convergent process (e.g. synthesizing and summarising) have been recognised in other studies<sup>13</sup>.

In addition to considering student perception of the learning that resulted as a consequence of participating in Forums, student responses to the Forum as a learning activity were also examined. Most students (4.5-4.8, 84-92% agreement) rated the activity as satisfactory to excellent.

## Conclusions

The modified Structured Academic Controversy technique used in this paper has been effective for addressing multi-party controversies and allowing for online interaction. The technique appears to effectively support divergent thinking and the development of alternative perspectives. The threaded discourse in the online interaction phase was found by some students to limit convergent thinking and consensus building on the issue. The design of the activity has attempted to account for limitations in the threaded nature of online discourse through using face to face debriefing and a written assessment task to develop convergent thinking (e.g. synthesizing and summarising) by the technique. Within the activity further educational development work will focus around giving students more control over shaping the topics for discussion within the Forum. Another area for further work is trying to address information overload and lack of structure within the online discussion. Adjusting the number of participants within a Forum and limiting the number of postings within a Forum are options. However it is important that this does not restrict student engagement with the activity and the diversity of views expressed within the Forum.

## References

- <sup>1</sup> Todt, O. The Role of Controversy in Engineering Design, *Futures*, 29(2), 177-190, 1997
- <sup>2</sup> Besterfield-Sacre M., Shuman, L.J., Wolfe, H., Atman, C.J., McGourty, J., Miller, R.L., Olds, B.M. and Rogers, G.M. "Defining the Outcomes: A Framework for EC-2000", *IEEE Transactions on Education*, 23(2), 100-110, 2000
- <sup>3</sup> Johnson, D. W., Johnson, R. and Smith, K.. Academic controversy: Enriching college instruction through intellectual conflict. ASHE-ERIC Higher Education Report Volume 25, No.3. Washington, D.C.: The George Washington University, Graduate School of Education and Human Development, 1997
- <sup>4</sup> Johnson, D. W., Johnson, R. and Smith, K. Constructive controversy: The educative power of intellectual conflict. *Change*, 32(1), 28-37, 2000.
- <sup>5</sup> Ballantyne, R. and Bain, J. Enhancing environmental conceptions: an evaluation of structured controversy learning units, *Studies in Higher Education*, 20(3): 293-303. 1995
- <sup>6</sup> Townsend, J. K. and Fitzgerald, J. The use of structured controversy as the instructional format for capability in tertiary teaching and learning. *Different Approaches: Theory and Practice in Higher Education*. Proceedings HERDSA Conference 1996. Perth, Western Australia, 8-12 July. <http://www.herdsa.org.au/confs/1996/townsend.html>
- <sup>7</sup> D'Eon, M., Reeder, B, Lemire, E., Proctor, P. and Leis, A. Structured Controversy in the Medical School Classroom, CAME Workshop, Toronto, May 2001, [http://www.came-acem.ca/pdf/SC\\_Handout.pdf](http://www.came-acem.ca/pdf/SC_Handout.pdf)
- <sup>8</sup> Monhardt, R.M. and Monhardt, L.C. The Use of Academic Controversy in Elementary Science Methods Classes, *Bulletin of Science, Technology & Society*, 20(6), 445-451, 2000
- <sup>9</sup> McLaughlan, R.G., Kirkpatrick, D., Hirsch, P. and Maier, H. R. Using online roleplay/simulations for creating learning experiences, *CAL-laborate*, v7, 23-25, 2001 <http://science.uniserve.edu.au/pubs/callab/vol7/mclaugh.html>
- <sup>10</sup> Lederman, L.C. Debriefing: Towards a Systematic Assessment of Theory and Practice, *Simulation & Gaming*, 23(2):145-160, 1992

- <sup>11</sup> Freeman, M. and McKenzie, J. Aligning peer assessment with peer learning for large classes: the case for an online self and peer assessment system, *In Peer learning in Higher education: Learning from and with each other*, edited by D. Boud, , R. Cohen, and J. Sampson (London: Kogan Page), 156-169, 2001
- <sup>12</sup> Biggs, J.B. and Collis, K.F. *Evaluating the quality of learning: The SOLO taxonomy*, (New York: Academic Press), 1982
- <sup>13</sup> Hewitt, J. Beyond Threaded Discussion, *International Journal of Educational Telecommunications*, 7(3), 207-221, 2001

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