

COOPERATIVE LEARNING AT A DISTANCE, FOR DESIGN STUDENTS

E. Bohemia and R. Thomson

Keywords: online tutorials, cooperative learning, learning design, industrial design engineering, virtual teamwork, written communication skills

1. Introduction

This paper documents a study of Cooperative Learning achieved within the subject Design Management: Organisational Skills for Designers. The subject has pioneered cross-campus online tutorial delivery within the School of Engineering and Industrial Design at the University of Western Sydney, Australia. Having now been taught in this format for three years, Organisational Skills for Designers is one of the core subjects offered by the School to senior students enrolled in: Industrial Design Engineering (IDE), Industrial Design (ID), Master of Engineering: Industrial Design (MEID), and Design and Technology (D&T) programs.

The paper contrasts the study's findings with the theory of Cooperative Learning proposed by Johnson and Johnson [1998]. The literature indicates that the use of Cooperative Learning practice can greatly enhance learning outcomes for students. Johnson and Johnson [1994] argue that in order to achieve a Cooperative Learning environment which is "...more productive than competitive and individualistic..." environments afford, the following five conditions need to be designed into the learning activities:

- i.) clearly perceived positive interdependence
- ii.) considerable promotive (face-to-face) interaction
- iii.) clearly perceived individual accountability and personal responsibility to achieve the group's goals
- iv.) frequent use of relevant interpersonal and small group skills
- v.) frequent and regular group processing of current functioning to improve the group's future effectiveness.

This paper reports on developments to the subject made in 2003, and documents the learning outcomes which were reported by students and observed by staff. An earlier paper compared initial online developments in the subject to its previous face-to-face delivery [Bohemia and Harman 2001].

In the current study, members of tutorial groups comprised students located at geographically dispersed campuses of the university; this distance decreased opportunities for face-to-face discussion between some members of each group, and increased students' perceptions of the need for online interaction.

2. Subject Implementation

The University of Western Sydney services a vast area of Greater Western Sydney through its six major campuses. The campuses are spread over a geographical area of almost three-quarters of

Sydney, or more than 2000 square kilometres [Contractor 2003a; Contractor 2003b]. During 2000, the University went through a major restructure, and it was decided that, from 2002, the Industrial Design programs would be taught on two campuses: Penrith and Campbelltown. These campuses are about one hour's drive apart. To minimise excessive travel by lecturers between campuses, various possibilities were explored; one of these was the online delivery of some subjects [Bohemia and Harman 2001]. In 2001 the School of Engineering and Industrial Design undertook an initiative to pilot the online delivery of Design Management: Organisational Skills for Designers. An evaluation of the pilot subject by students revealed positive learning outcomes and it was decided to implement the online delivery component of this subject on an ongoing basis [Bohemia and Harman 2001].

Organisational Skills for Designers was developed to address industry needs identified in previous research [e.g. Bohemia 2000; Bohemia 2002; National Design Review Steering Committee et al. 1995]. Key learning outcomes include that students:

- a) Understand manufacturing paradigms and their impact on the product development process and the design process.
- b) Understand the impact of organisational structures, strategies and processes on the design process.
- c) Develop and gain experience of using key skills that will enable them to work successfully with various organisational members in the product development process. These skills include teamwork, decision-making and communication, analysis and problem solving.
- d) Develop and gain experience of using **distance** communication and **virtual** teamwork skills, skills that are becoming increasingly important in new product development.

Of particular interest to this paper are the skills mentioned in points c and d above, that is the development of students' teamwork, communication, decision-making, analysis and problem-solving skills. These skills were developed on a practical level through tutorial activities, all conducted online.

The above outcomes also address a number of Engineering Graduate Attributes [IEAust 1999] such as: the ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams; the capacity to be a leader or manager as well as an effective team member; an awareness of the social and cultural responsibilities of the professional engineer; the ability to effectively communicate (verbally and in writing); an awareness of the need to undertake lifelong learning and the capacity to do so.

3. Description of tutorial structure and tasks

In 2003, 101 students studied this subject; approximately two-thirds were based at Penrith Campus and one-third at Campbelltown Campus. Students attended face-to-face lectures at their home campus, however the tutorials were (all) conducted totally online. Hence students from the two campuses did not automatically meet face-to-face during the semester. The majority of students undertaking the subject had already experienced group based assignment work, however previous group work would have involved extensive face-to-face interaction, and would not have required the use of long distance communication tools.

Tutorial work involved students organising themselves into small groups (3 to 4 members per group) at the start of semester, with the proviso that each group was to comprise membership from the two campuses. Eight small groups together made up one tutorial class of approximately 25 students, which worked together (online) for the duration of the semester. Each small group within a tutorial class chose a seminar paper topic, then developed and presented their seminar paper online in the nominated week of the semester. The other seven small groups within that class provided written feedback online on each seminar paper, doing this within a specified timeframe (the tutor also provided written feedback online). The presenting group then had one week to respond to the feedback received, and to post their response online. This cyclical process of paper presentation, feedback, and response occurred over ten weeks, giving each small group the opportunity to present their own seminar paper and respond to feedback, as well as gaining extensive practice in writing constructive feedback to

others (see Table 1). The seminar papers, feedback and responses remained available online to all groups throughout the semester, providing a continuing resource for students.

Table 1. Schematic presentation of online activities

Time		Activities			
Cycle	Week	Face-to-face	Online		
		Lectures	Seminar Papers, due Tuesday 9am	Feedback, due Friday 9am	Reflection, due Friday 9am
C1	W4 C1	Lecture on W4 Topic C1			
C2	W5 C2	W5 Topic C2	Seminar Paper is presented by the Seminar Group on W4 Topic C1	Feedback is provided on Seminar Group Paper on W4 Topic from 7 groups and the tutor C1	
C3	W6 C3	Lecture on W6 Topic C3	Seminar Paper on W5 Topic C2	Feedback on W5 Topic from 7 groups + tutor C2	Seminar Summary (response to feedback) on W4 Topic C1
C4	W7 C4	W7 C4	Seminar Paper on W6 Topic C3	Feedback on W6 Topic from 7 groups + tutor C3	Seminar Summary on W5 Topic C2
C5	W8 C5	W8 C5	Seminar Paper W7 C4	Feedback on W7 C4	Seminar Summary W6 C3
C6	W9 C6	W9 C6	Seminar Paper W8 C5	Feedback on W8 C5	Seminar Summary W7 C4
C7	W10 C7	W10 C7	Seminar Paper W9 C6	Feedback on W9 C6	Seminar Summary W8 C5 C6
C8	W11 C8	W11 C8	Seminar Paper W10 C7	Feedback on W10 C7	Seminar Summary W9 C6
	W12		Seminar Paper W11 C8	Feedback on W11 C8	Seminar Summary W10 C7
	W13				Seminar Summary W11 C8

This tutorial structure and task design implements Johnson and Johnson's five elements of Cooperative Learning, with the notable exception of the promotive interaction which in contrast to the Johnsons' recommendation, occurred primarily in the online environment. In explanation, we map the tutorial structure and tasks against Johnson and Johnson's five elements of a successful and productive cooperative learning environment:

1. Clearly perceived positive interdependence. Positive interdependence involves students perceiving that their own learning outcomes are linked with those of their group mates and that the best results (learning and marks) will be achieved by each member contributing to processes. In this subject, group members working constructively together could gain up to 45% of the total mark for the subject (24% for the seminar paper and seminar paper summary, and 21% for seminar response participation which consisted of 7 weeks' participation, each worth 3%). Discussions leading up to written contributions, as well as the actual contributions, were visible online both to group members and to the lecturer.

2. Considerable promotive (face-to-face) interaction. Johnson and Johnson define promotive interaction as individuals encouraging and facilitating each other's efforts to achieve, complete tasks, and produce in order to reach the group's goals [1994]. They stress that promotive interaction occurs face-to-face. In this subject, the structure of the tutorial required students to interact regularly with their group mates, since each group was required to write feedback on that week's seminar paper. However, in order to develop their group response, students interacted with group members in the online environment, rather than face-to-face as proposed by Johnsons. Survey results show that students found the workgroup's online discussion room and 'coffee room' (an unmoderated discussion forum where members could talk about topics of their choice) a very useful resource for regularly completing their group work.
3. Clearly perceived individual accountability and personal responsibility to achieve the group's goals. Individual accountability exists where students' contributions to the group are identified, and the group receives feedback on their contribution. Further, the group holds individual members responsible for contributing to the group's success. In this subject, each group member's contribution to writing their seminar paper, and to discussing and providing feedback to other groups was 'captured' online (and named), hence each person's contribution was visible both to group members and to the lecturer. Group papers and responses also listed the participating members (i.e. members not listed missed out on that week's assignment mark).
4. Frequent use of relevant interpersonal and small group skills. Students need to learn the interpersonal skills that will enable them to work effectively in small groups. Appropriate interpersonal skills include getting to know each other, developing trust, communicating accurately and unambiguously, accepting and supporting each other, and resolving conflict constructively. Students also need to practise these interpersonal skills frequently in order to gain some mastery of them. In this subject, students were introduced to interpersonal and small group skills through lectures focusing on issues such as group dynamics theory, cross-functional team structures, interpersonal communication models, and group decision-making techniques. Online tutorial tasks required students to put these ideas into practice as well as drawing on their own experiences of having been team members (in other situations), and to do this on a weekly basis throughout the semester. Students' engagement with the weekly tasks was rewarded by giving marks (3% per week for participation). Online coffee rooms, where students were not monitored, promoted interpersonal communication.
5. Frequent and regular group processing of current functioning to improve the group's future effectiveness. Johnson and Johnson state that "effective group work is influenced by whether or not groups reflect (i.e. process) how well they are functioning", and that "the purpose of group processing is to clarify and improve the effectiveness of the members in contributing to the collaborative efforts to achieve the group's goals" [Johnson and Johnson, 1994]. In this subject, students were introduced to models of effective group functioning through lectures, and tutorial tasks promoted frequent and regular processing of current group functioning. In addition, feedback from the tutor and other workgroups sometimes commented on group functioning.

4. Methods used to find out about students' experiences of, and learning outcomes from the subject

Information on the students' experiences and learning outcomes was collected by two methods. The university's standard education evaluation survey, SEEQ (Student Evaluation of Educational Quality) was administered at the end of semester, prior to final examination. In addition, a purposefully designed questionnaire was developed and administered, also at the end of the semester. The questionnaire focused on the student's experience with the online discussion tasks, and asked them to compare their experience of online and face-to-face tutorials. Students were also given the opportunity to comment and to provide additional clarification on any of their responses. Key categories were

developed in QSR Nvivo from the open-ended questions and additional comments, and the quantitative results were analysed using SPSS.

5. Results

In 2003, 101 students were enrolled in the subject. Of that total number, 33 students were based at Campbelltown and 68 students were based at Penrith campus. The results presented in this paper are based on 84 returned questionnaires (85% return rate), 29 (34.5%) from Campbelltown and 55 (65.5%) from Penrith.

Results from the **2003** evaluation administered at the end of the course show that:

- 96% of students indicated that this subject had provided them with the opportunity to develop distance communication and virtual teamwork skills. Students frequently commented on their ability to complete an assignment task in cooperation with a group member they had not met in person. This may indicate that even though students may be using long distance communication tools such as e-mail and online chat rooms for personal purposes, they had not considered these could be used for university assignment tasks. The majority of students commented that this was the first time they had been exposed to online environments to promote task-based teamwork (as opposed to leisure type activities). Their comments also indicated that they recognised the potential difficulties and limitations that distance communication and virtual teams can pose in accomplishing group assignments.
- 74% of students indicated that the subject had helped them to develop their writing skills. Students commented that it was helpful to see how others had written, some saying that when group members edited their work, this helped them to see other ways of expressing information.
- 63% of the students felt that the online discussion had encouraged collaboration between their group members. Student comments included the fact that the online environment increased the amount of collaboration. Collaboration was facilitated because it could occur in their own time, although it took some time for them to get used to this mode of working.
- 50% of students perceived that the online activities had helped them to develop a deeper understanding of the subject. Students identified the extent of feedback as being particularly important in deepening their understanding. They noticed more description in the feedback provided (than they normally receive in the face-to-face environment) and commented that it was helpful to be able to see responses from groups other than their own.
- 71% of students indicated that they received more (45%) or the same (27%) level of feedback in this subject that they normally received in face-to-face tutorials.
- 86% of students indicated that they preferred the subject be taught in combination mode (face-to-face lectures and online tutorials), rather than totally online or totally face-to-face.

Interestingly, the 2003 results have not varied too much from 2002 results on the above points, even though a new tutor was engaged and the number of students increased by one third. This suggests that the structure and content of the subject is very robust in supporting and delivering the above learning outcomes.

6. Key Conclusions

The results suggest that most of the students perceive that the subject facilitated their learning, especially in the intended areas of development of virtual teamwork and distance (written) communication skills. Students' comments indicate that the cooperative learning experience helped them to gain a deep understanding of the subject.

These positive results were made possible by incorporating into the design of the subject Johnson and Johnson's five conditions for Cooperative Learning, with the exception of considerable promotive interaction occurring face-to-face. Instead, the results were achieved with only partial, and for some members of each group, completely absent face-to-face interaction. Therefore, it is proposed that

appropriately structured online learning activities can achieve the extent and quality of promotive interaction required for successful Cooperative Learning.

6.1 Future Development

The School of Engineering and Industrial Design, in view of rationalisation and cost savings, made a decision that from 2005 it will operate on only one campus: Penrith. The decision to deliver all subjects on one campus will remove the current rationale (the physical distance that exists among group members) for students to use online communication in this subject. However, as has been illustrated in this paper, the online component of the subject provides valuable skills for designers and engineers in contemporary manufacturing workplaces and also contributes to the development of learning outcomes that might not be developed in a face-to-face setting. Therefore, the authors are seeking to partner with external educational institutions which are interested in research and development of long distance virtual teamwork skills expertise as well as providing an opportunity to expose their students to this type of environment. These institutions are encouraged to contact the authors.

Acknowledgement

The authors would like to thank Kerry Harman whose input while redeveloping this subject was invaluable, and germinated a vast number of ideas. It is also important to thank Associate Professor Heinz Luettringhaus for providing the opportunity to redevelop the above unit. Finally, we would like to thank to our colleagues for their support in developing the above subject.

References

- Bohemia, E., "Suitability of industrial designers to manage a product development group: Australian perspective", *Design Management Journal: Academic Review*, Vol.1, No.1, 2000, pp 40-54.
- Bohemia, E., "Designer as integrator: reality or rhetoric?" *The Design Journal*, Vol.5, No.2, 2002, pp 23-34.
- Bohemia, E., and K. Harman, *Comparative study of on-line and face-to-face subject delivery in Industrial Design*, paper presented at *Exploring Emerging Design Paradigm - ICSID Educational Seminar 2001*, Seongnam City, Korea, October 5-7, 2001.
- Contractor, A., "PM Helps uni straddling crucial seats". in *The Sydney Morning Herald*, pp. 3, Sydney, NSW, 2003a.
- Contractor, A., "Uni amid swinging voters may get extra \$10m". in *The Sydney Morning Herald*, pp. 5, Sydney, NSW, 2003b.
- IEAust. "Manual for the Accreditation of Professional Engineering Programs", [Adobe PDF]. The Institution of Engineers, Australia. Available: <http://www.ieaust.org.au/membership/res/downloads/AccredManual.pdf> [accessed 2000, 20 January] 1999.
- Johnson, D. W., and R. T. Johnson. "An Overview of Cooperative Learning", [article]. Available: <http://www.co-operation.org/pages/overviewpaper.html> [accessed 2003, 23 December] 1994.
- Johnson, D. W., and R. T. Johnson. "Cooperative Learning and Social Interdependence Theory", [article]. Available: <http://www.co-operation.org/pages/SIT.html> [accessed 2003, 23 December] 1998.
- National Design Review Steering Committee, Australian Academy of Design, D. Freeman, J. Goodman, S. Axarlis, P. Cockburn, R. Dinham, J. Grant, T. Russell, R. Simpson, R. Trenberth, C. Zampatti, P. Zmood, J. Boorne, H. Sebel, J. Sprouster, R. Barton, M. Moloney, E. Bevk, and W. Jehne, *Competing by Design: The National Design Review Report*, 72 pp., The Australian Academy of Design, St Leonards, NSW, Australia, 1995.

Dr Erik Bohemia

University of Western Sydney, School of Engineering and Industrial Design
Locked Bag 1797, Penrith South Distribution Centre, NSW 1797, Australia
Telephone +61 2 9852-5453, Telefax +61 2 9852-5741
E-mail e.bohemia@uws.edu.au