

Places for learning engineering: A preliminary report on informal learning spaces

Rosemary L. Chang, Linda Stern, Harald Sondergaard & Roger Hadgraft

The University of Melbourne, Melbourne, Australia
{rchang, stern, harald, [roger.hadgraft](mailto:roger.hadgraft@unimelb.edu.au)}@unimelb.edu.au

***Abstract:** This is a report on an investigation of undergraduate engineering learning spaces that were newly introduced in 2008. The new spaces include formal learning spaces designed to enable student-centred, small group learning, and informal café-style spaces. The project investigates the research question: Does an availability of spaces for informal learning lead to an increase in behaviours that one might expect to be conducive to increased informal or collaborative learning? The initial findings from the survey data suggest that there may be some increased use of informal learning spaces if they are made available to students.*

Background

This paper reports on an investigation of new, undergraduate engineering learning spaces. These are preliminary findings from an ongoing, longitudinal project that explores students' behaviour, attitudes and preferences in relation to learning spaces with a particular interest in collaborative learning and informal learning spaces.

This project is being conducted at the School of Engineering at The University of Melbourne, a public, metropolitan university. In 2009 the School of Engineering enrolled approximately 4500 undergraduate and postgraduate students. In recent years the School has been encouraging more constructivist approaches to learning, which have included a movement towards active, collaborative learning and informal learning. The educational vision is to improve graduates' analytical problem-solving skills, technical skills and collaborative skills in ways that enable them to engage in modern challenges in engineering.

To facilitate this educational vision, the School opened new formal and informal learning spaces in 2008. In designing and constructing the formal learning spaces, the School was influenced by international studies such as the learning-space innovations of the Technology-Assisted Active Learning (TEAL) project at MIT (Dori *et al.*, 2003). The informal spaces drew on international best-practice and local experience (Jamieson *et al.*, 2007). An important design decision was to position the formal and informal learning spaces to enable seamless transition for students. The intention is for students leaving a formal class to immediately find themselves in informal, but study-friendly spaces, rather than being ejected into the street.

Before 2007 informal learning spaces were already available in some departments, but these new spaces were the first to be available to students of every engineering department. Informal learning spaces were already available at various year levels in several disciplines (civil, mechanical, and software engineering). However, new, large, informal learning spaces were created with attention to use of natural light, colour and student density. The furniture is arranged in zones in the style of recognisable communal arrangements (rather than, for example, traditional individual corrals). The communal arrangements are grouped to evoke bars and bar stools, dining tables and chairs, studio tables and stools, and lounges with sofas and coffee tables. The space includes plugs for students' laptops and printing facilities. These new spaces are designed for use primarily by first-year students and their introduction coincided with extensive changes to curriculum. No classes are scheduled in these spaces and students have 24-hour access using swipe cards.

The new learning spaces were under construction when the first cycle of data collection began (2007), and were first made available for formal classes and informal study in 2008. The intention was to

collect some base-line data in 2007 on student attitudes, beliefs and behaviours, and repeat the data collection in 2008 and 2009. In conducting this project, we were influenced by learning spaces developments internationally, such as the examples disseminated by Educause (Oblinger, 2006).

Research questions

This project is investigating informal learning spaces in relation to students' engagement with university life, social activities within the context of engineering, and their enjoyment of learning. The project aims to explore the question: Does an increased availability of spaces for informal learning lead to an increase in behaviours that one might expect to be conducive to increased informal or collaborative learning? We sought to explore the different behaviours that might be encouraged by the presence or absence of such spaces. For example, do students with access to social spaces and informal learning spaces spend more time on campus? In addition, we are seeking to explore whether the availability of these spaces allows students to work more collaboratively with peers outside formal classes. These questions are important to engineering education because engineering schools are preparing students who, as professional engineers, will be required to work in self-directed ways through problem solving and collaborative team work.

Since beginning this project, informal learning spaces findings coming out of the Engineering Learning Centre at The University of Queensland, Australia, supports the project hypothesis that an increased provision of informal learning spaces leads to students spending an increased amount of time on campus (Radcliffe, Wilson, Powell, & Tibbetts, 2008).

Theoretical framework

Internationally, as engineering schools grapple with how best to prepare effective engineers in the twenty-first century, we are seeing a move away from transmission models of learning and teaching, towards more constructivist models. Social constructivist work in learning suggests that learning occurs with individuals in a social context (Piaget, 1955; Vygotsky, 1978). In terms of learning spaces, there is evidence that the social dimensions of human interaction are influenced by the physical environment (Graetz & Goliber, 2002). One question, then, is: What kinds of spaces support the social dimensions of learning? Some answers have included providing spaces other than lecture halls and tutorial rooms—and activities beyond lectures, such as dialogue and debate, small and medium group activities, group projects etc.

The social dimensions of learning suggest that formal class time with academic staff is not the only opportunity for engineering students to learn. Rather, informal learning (ie learning outside class time) can occur both in informal learning spaces (outside classrooms) and in formal learning spaces when students have access outside scheduled classes.

While there is debate about conceptualizing the boundaries between formal and informal learning (which is beyond the scope of this paper), we have accepted the dichotomy. We have applied a growing body of literature relating these concepts (Eraut, 2000; European Commission, 2001; Trinder, Guiller, Margaryan, Littlejohn, & Nicol, 2008) to arrive at a definition in which the presence or absence of a teacher, formal institution and certification are key. In particular we are applying the definition of Trinder et. al. (2008) for informal learning:

Learning which is not provided by a formal educational or training institution and typically does not lead to certification. Informal learning results from *daily, social life activities related to education* [italics added], work, socialising with others or pursuit of leisure activities and hobbies. Informal learning may be structured or non-structured in terms of learning objectives, learning time or learning support. Informal learning may be intentional or non-intentional (incidental) from the learner's perspective. (Trinder et. al., 2008, p.13)

In practice, universities are using their understanding of informal learning to provide informal learning spaces, or "spillover spaces" (Van Notes Chism, 2002, p. 10), which are described using metaphors such as learning streets (Nair, 2007), and watering holes and caves (Thornburg, 2007). In university libraries, active and collaborative learning have influenced the trend in learning commons (Schader, 2008).

There is a growing body of work relating to learning spaces across the education sector. There is well-publicised research activity that examines the interconnections of learning spaces and learning technologies (Joint Information Systems Committee (JISC), 2006; Oblinger, 2006) and a growing body of literature regarding learning spaces in the K-12 sectors (Fisher, 2007). In terms of evaluation, there is activity on evaluating learning spaces in higher education (The Carrick Institute for Learning and Teaching in Higher Education, 2008). Additional activity includes the development of a comprehensive model for evaluating learning spaces through the full life-cycle of conceptualisation, design, construction, post-occupancy, and feedback into subsequent construction (Lee, Dixon, & Andrews, 2008). The project we are reporting on focuses on questions of post-occupancy.

Methodology

This paper reports preliminary findings from the first two survey cycles. The survey was designed to collect quantitative data relating to student behaviour, attitudes and beliefs in relation to their engagement with university life, social activities within engineering and enjoyment of learning, with a particular focus on learning spaces (See Appendix 1). The surveys involved 1721 students in Semester 2, 2007 and 1279 students in Semester 1, 2008.

Surveys were administered in 2007 to all first-year engineering students and students of all years from the department of software engineering, and in 2008 to potentially all students in all engineering subjects at undergraduate and postgraduate levels. Surveys were distributed by adding 10 extra questions to the institutionally produced subject (or course) survey that is administered in every subject. Data was collected using 5-point Likert items. All data were collected following university human ethics protocols.

The low response rate in the second survey cycle reflects the challenges of administering a large-scale survey across multiple departments. In 2007, the lead researcher approached subject co-ordinators directly to promote the additional survey questions (which required students to turn over the survey sheet to find them). However, in 2008, as a result of a new administrative structure, we did not directly approach the coordinators, which may explain the significant drop in survey completions relative to 2007.

The quantitative data were compiled and aggregated by the centralised University Planning Office, and data were analysed using scripts written in Awk.

Findings

The findings we are reporting come from the preliminary stages of an ongoing project. We are reporting on the comparisons between 2007 and 2008 survey cohorts in terms of percentage of agreement to ten questions (Appendix 1) and also looking at agreement in terms of year levels and departments. Analysis of correlations is in progress.

Table 1. Percentage of Agreement 2007 and 2008

	1	2	3	4	5	6	7	8	9	10
2007	66%	52%	81%	56%	50%	48%	38%	57%	57%	77%
2008	67%	50%	89%	60%	47%	51%	47%	56%	60%	79%

In comparing the percentage of agreement with respondents from 2007 and 2008 we can see in general that responses to some questions tend to be up and some tend to be down. And agreement tended to be higher in 2008. In each year, the highest responses were to Q3 "I regularly attend my scheduled engineering classes (lectures, tutorials, and laboratories)". In addition, the statement on attitude towards learning engineering gained high positive responses (Q10). Students' reporting of current use of informal spaces was slightly positive in terms of their general use (Q4), but sometimes slightly negative in terms of specific uses (Q5 & 6). And their anticipated use of informal learning spaces if more were available was positive but again relatively low (Q8). At present, it is hard to draw any strong conclusions and the researchers are committed to collecting more data. In addition, we offer the

following caveats: (1) that the two cohorts of students surveyed (2007, 2008) did not represent the same proportion of engineering disciplines or year levels, and (2) that due to administrative changes in 2008, it is likely that students from the two cohorts surveyed heard differing explanations of the survey prior to filling it in.

Some departments (software engineering, chemical and biomolecular, and mechanical) already had informal learning spaces in 2007. Students in these departments had higher responses to Q3 “I regularly attend my scheduled engineering classes” and Q4 “I frequently use non-classroom spaces”. While we expected that students from departments with informal learning spaces might have higher responses, their responses to collaboration in informal learning spaces (e.g. Q6) were similar to responses of students in departments without informal learning spaces. Interestingly, students from software engineering reported the most positive attitudes to an increased availability of informal learning spaces (Q8: “If there were more non-classroom spaces on campus, I would use them more often.”)

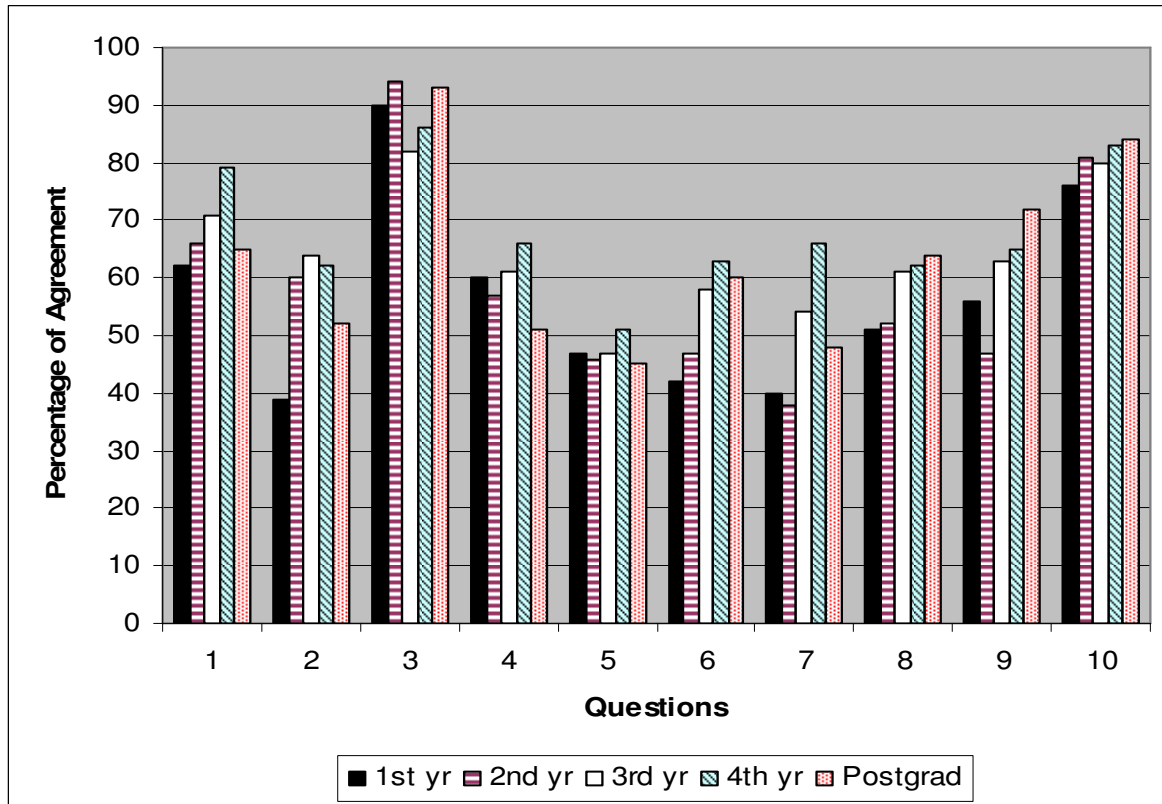


Figure 1. Percentage of agreement by year levels, 2008

We also examined the percentage of agreement by year level in 2008. In general, first-year students tended to have lower levels of agreement with survey questions, most notably on Q2 (“I frequently talk about engineering with my classmates”). Apart from Q3, forth-year students had the highest levels of agreement among undergraduate students. Since many of the survey questions are associated with issues of student engagement (Kuh, 2001), it could be argued that students with lower levels of engagement had self-selected out of engineering or even university studies by forth-year. Postgraduate coursework students had varied levels of agreement. It is worth noting that at this university many postgraduate students live in cramped accommodation, so it makes intuitive sense that they respond positively to Q7 (If there were more non-classroom spaces on campus, I would use them more often), and also reported a very high positive attitude to potential access to informal learning spaces in Q8 (Using the non-classroom spaces has a positive effect on my learning).

In terms of the research question, first-year students who had access to the new, informal learning spaces did report the highest agreement among the year levels (68%) of use of non-classroom spaces (Q4); however, relative to other year levels, first-year students reported lower levels of use of non-

classroom spaces for socializing (Q5), or working with classmates (Q6), which suggests use of non-classroom spaces for solitary activities (possibly studying, Internet research, social emailing etc). This raises the question of what kinds of learning activities the students of different year levels had experienced. Given that the survey was administered in the first semester of the first-year students' enrollment, it is possible that first-year students had not experienced learning activities that encouraged or required collaborative learning or formal group work outside class time. In contrast, the responses to using non-classroom spaces to work with classmates rose each year from first-year to forth-year.

We are not including discussion of 2007 by year level because the respondents were dominated by first-year students.

Future plans and recommendations

We plan to continue with the longitudinal study. In 2009, data collection will include a third round of surveys with careful consideration of the method of communicating with course coordinators. We will also conduct focus groups to capture engineering students' voice. The focus groups will be designed to explore more deeply the issues of how students use the new spaces and whether they would like more access to similar spaces outside of scheduled class times.

In terms of teaching practice, we recommend that engineering lecturers include discussion of and even scaffolding in relation to informal learning with students to support their meta-cognitive development and experiences of learning in this area. Typically, collaborative learning experiences are increasingly built into undergraduate curriculum each successive year. We would recommend that learning activities and tasks that encourage collaborative learning not be held reserved for upper-year students (for example "...and in forth-year they can choose a group project"), and that teaching staff support in educational development could facilitate this change in emphasis.

In terms of recommendations for engineering education, since learning spaces is a relatively new research field—and some argue, an under-researched field (Temple, 2008)—we recommend continued efforts to contribute to evidence-based practice in this aspect of engineering education. While it has not been within the scope of this study to investigate the impact of new learning spaces on teachers' practice, there is much to be explored in this area—including the ways that new learning spaces may influence teachers' goals, strategies, and approaches to feedback and assessment. In addition, we also recommend extending investigations to include evaluations student learning outcomes. Such strands of investigation would add to our understanding of engineering education.

Acknowledgements

The researchers would like to acknowledge Bill Jones from The University of Melbourne, Planning Office for his assistance in administering the surveys.

Appendix 1: Survey questions

1. I regularly talk to many students in my engineering subjects.
2. I frequently talk about engineering with my classmates.
3. I regularly attend my scheduled engineering classes (lectures, tutorials, and laboratories).
4. I frequently use the non-classroom spaces (e.g. cafes, libraries, lounges, lawns) on campus.
5. I often use the non-classroom spaces to socialize.
6. I often use the non-classroom spaces to work with classmates.
7. I often study in areas near the Engineering buildings.
8. If there were more non-classroom spaces on campus, I would use them more often.
9. Using the non-classroom spaces has a positive effect on my learning.
10. I enjoy learning about engineering.

References

- Dori, Y. J., Belcher, J., Bessette, M., Danziger, M., McKinney, A., & Hult, E. (2003). Technology for active learning. *Materials Today*, December, 44-49.

- Eraut, M. (2000). Non-formal learning, implicit learning and tacit knowledge. In F. Coffield (Ed.), *The Necessity of Informal Learning*. Bristol: Policy Press.
- European Commission. (2001). Communication: Making a European area of lifelong learning a reality. Retrieved 4 June, 2009, from www.europa.eu.int/comm/education/life/index.htm
- Fisher, K. (2007). Pedagogy and architecture. *Australian Architecture*, Sept/Oct, 55-57.
- Graetz, K. A., & Goliber, M. J. (2002). Designing collaborative learning places: Psychological foundations and new frontiers. *New Directions for Teaching and Learning*, 92(Winter 2002), 13-22.
- Joint Information Systems Committee (JISC). (2006). Designing spaces for effective learning: A guide to 21st century learning space design. Retrieved 17 January, 2009, from http://www.jisc.ac.uk/uploaded_documents/JISClearningspaces.pdf
- Kuh, G. D. (2001). Assessing what really matters to student learning: Inside the national survey of student engagement. *Change*, 33(3), 10-17 & 66.
- Lee, N., Dixon, J., & Andrews, T. (2008). Project proposal: A comprehensive learning space evaluation model. Retrieved 1 March 2009, from <http://www.swinburne.edu.au/spl/projects/files/A%20comprehensive%20learning%20space%20evaluation%20model.pdf>
- Nair, P. (2007). The great learning street debate. In *The language of school design: Design patterns for 21st century schools* (2nd ed., pp. 101-109). Minneapolis: DesignShare.
- Oblinger, D. (Ed.). (2006). *Learning spaces*. Washington: Educause.
- Piaget, J. (1955). *The child's construction of reality* London: Routledge and Kegan Paul.
- Radcliffe, D., Wilson, H., Powell, D., & Tibbetts, B. (2008). Designing next generation places of learning: Collaboration at the pedagogy-space-technology nexus. Retrieved 3 March, 2009, from <http://www.uq.edu.au/nextgenerationlearningspaces>
- Schader, B. (Ed.). (2008). *Learning commons: Evolution and collaboration essentials*. Oxford: Chandos Publishing.
- Temple, P. (2008). Learning spaces in higher education: An under-researched topic. *London Review of Education*, 6(3), 229-241.
- The Carrick Institute for Learning and Teaching in Higher Education. (2008). *Draft report: Places & spaces for learning seminars* Canberra: Carrick Institute.
- Thornburg, D. D. (2007). Campfires in cyberspace: Primordial metaphors for learning in the 21st century. Retrieved 1 April, 2009, from <http://www.tcpd.org/Thornburg/Handouts/Campfires.pdf>
- Trinder, K., Guiller, J., Margaryan, A., Littlejohn, A., & Nicol, D. (2008). Learning from digital natives: bridging formal and informal learning. Research project final report. Retrieved 4 June 2008 from <http://www-new1.heacademy.ac.uk/assets/York/documents/LDN%20Final%20Report.pdf>
- Van Notes Chism, N. (2002). A tale of two classrooms. *New Directions for Teaching and Learning*, 92(Winter 2002), 5-13.
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes* (A. R. Luria, Trans.). London: Harvard University Press.

Copyright statement

Copyright © 2009 Chang, R.L., Stern, L., Sondergaard, H., and Hadgraft, R.: The authors assign to the REES organisers and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to REES to publish this document in full on the World Wide Web (prime sites and mirrors) on CD-ROM and in printed form within the REES 2009 conference proceedings. Any other usage is prohibited without the express permission of the authors.