

Towards a better understanding of the student-lecturer-university interactions to enhance learning in engineering

Wageeh Boles

Queensland University of Technology, Brisbane, Queensland
w.boles@qut.edu.au

Prue Howard

CQUniversity, Rockhampton, Queensland
p.howard@cqu.edu.au

Roger Hadgraft

The University of Melbourne, Melbourne, Victoria
roger.hadgraft@unimelb.edu.au

Lesley Jolly

Strategic Partnerships, Brisbane, Queensland
ljolly@bigpond.net.au

***Abstract:** This study sought to investigate student perspectives on teaching and learning - to try to make explicit some of their assumptions and expectations and to explore the alignment with the practices of their teachers and academic institutions. We examined student learning preferences and how these interact with academic teaching styles, the model of delivery, and the support offered to students throughout the duration of their studies. This paper presents some results from analysis of student focus group discussions. These were conducted as part of the case studies which involved three universities in an ALTC Associate Fellowship program. The program was designed to explore the interactions between student learning styles on the one hand, and lecturer teaching styles, goals and philosophies, on the other. The study also examined how these might vary from one academic institution to the other. Some aspects of what constitutes good teaching, and barriers to student learning, as seen from the students' viewpoint were also considered.*

Introduction

There is a need to support and facilitate student success rates in engineering programs. This requires establishing a better understanding of student learning preferences, teacher teaching styles and the learning and teaching environment at the university (academic institution).

As part of an ALTC Fellowship program, field work was carried out at three universities; Queensland University of Technology (QUT), CQUniversity and the University of Melbourne. This field work represents a component of case studies designed to explore the proposition that a mismatch between learning styles, teaching styles and institutional norms impedes student commitment to and success in learning. The case studies were designed in accordance with best practice (Yin 2003) and included the conduct of student focus groups and the collection of learning style preferences. This is a follow-on paper to Boles et al (2009).

The data gathered from the focus group discussions were targeted to complement a suite of activities and data collection and analysis mechanisms. At each site, two major activities were implemented: one with students, the other with lecturers. The program worked with current students and staff across the three universities, to study interactions between students and lecturers by modelling a process of investigation, analysis, problem-solving, pedagogical design and implementation that develops a culture of shared responsibility between students and staff for enhancing learning outcomes.

Volunteering lecturers were asked to complete a learning styles survey and a teaching styles survey. In addition, an instance of their teaching was observed and they were also interviewed. Students were asked to complete a learning styles survey and participated in focus groups.

Learning styles were identified using the LSI online survey, developed in an engineering context (Felder and Solomon, 1999). For a comparable study to this one based on Felder's model see Mills et al (2005). The LSI tool uses four dimensions to describe learning preferences (Felder and Silverman, 1988). Each preference is rated on a scale from 1 to 11, with 11 being the strongest preference.

Considering the effects of discussing learning styles, Apter (Apter, 2001) states that; "Learners can become more effective as learners if they are made aware of the important qualities which they and other learners possess. Such knowledge is likely to improve their self-confidence, to give them more control over their learning, and to prevent them attributing learning difficulties to their own inadequacies." Through the case studies, this program provided an opportunity for participating students and lecturers to engage in meaningful discussions about learning and teaching styles. It therefore was assumed that the choice of the LSI instrument was justified to discuss learning styles with students in order to sensitise both students and teachers to the learning issues involved.

Since there is some evidence that students' repertoires of learning styles mature over time, we wanted to deal with three cohorts – first years, 2nd /3rd years and 4th years but in the event patchy participation reduced our ability to separate year levels.

Other barriers to learning such as personal circumstances, the need to work or intellectual difficulties were explored in focus groups in response to claims made in the literature about the characteristics of "Generation Y" (Markwell 2007; Pike and Kuh 2005), which some of our data calls into question.

The focus groups provided very rich data centred on a number of guiding questions. Analysis of students' responses and comments revealed their perspectives and views on the issues at hand. As will be clear from the following sections, analysis of those responses can assist in establishing a better understanding of the dynamics of the students-academics-intuitional interactions.

Student awareness of their own learning preferences

The focus group data suggest that students know how they prefer to learn but are unlikely to discuss their learning in terms of learning style. They are able to describe preferences for the form in which material is presented, how material is organised and how they prefer to work to acquire learning. This could be seen as covering the same ground as the learning styles inventory, if in a different language. For instance the active/reflective and sequential / global contrasts are about how students act on the material presented to them while the sensing / intuitive contrast is about the form and organisation of material, and visual/verbal is about the form of the material.

Active/reflective learning styles

Students show a slight preference for active learning over reflection in the survey results. To the extent that this tendency is real, we would expect students to be learning least in lectures and most in classes where they are asked to do something with information, probably in a group context (Felder and Silverman, 1988). Students at all three universities told us that although lectures were the 'typical' class, they did not feel they got a lot out of them.

"Yeah pretty much, I got all of it in the lecture and the next day when we went through the problems sort of had to rethink through everything and work it all out." (2nd year student)

Such reflection as arises is usually associated with some specific active task, such as refining a design, or is undertaken with the prompting and interaction of teachers. It was clear from the focus groups that there are other important aspects of the mode of learning not captured by the active/reflective contrast. In every focus group when asked what was most helpful to learning, students were quick to identify each other as the most important thing.

This collaboration is clearly active learning but is not without its reflective aspects – learning by asking and discussion. This also indicates that students, who found it difficult to understand the material as presented by the lecturer, in her style, would be exposed to a variety of presentation and delivery styles (those of fellow students). One might conjecture that this could be a contributing factor to achieving better understanding.

Sensing/intuitive learning styles

On the second dimension, survey results show a tendency for students to prefer sensing approaches rather than intuitive ones. That means they like clearly defined facts, well-established methods of problem solving and clear connection to real world applications. Students at all three universities told us that their preferred mode of working was by working through example problems and this fits with a ‘sensing’ approach. They all wanted practical learning with clear real-world application and relevance, delivered in a well-organised way.

“The well organised ones are really quite helpful in showing you how it all works in the real world.”
(3rd year student)

However, although the sensing/intuitive dimension is about preferences in the organisation of information, it is sometimes difficult to distinguish from the global/sequential contrast.

Visual/verbal learning styles

The results show that this is the dimension with the clearest bias, towards visual learning styles. Pictures (not equations which are read as sentences), hands-on demonstrations and simulations are all likely to appeal to a student’s preference for visual learning.

Although lecturers tend to think of PowerPoint as bringing a visual dimension to their teaching, students disagree.

“The visual things for me that really work are when they turn off a PowerPoint thing and actually write stuff up, watching them go through the steps.” (3rd year student)

In fact both teachers and students use PowerPoint as lecture notes, while visual learning happens by watching things happen, whether that was watching the emergence of a diagram on the board (as opposed to the more static style of PowerPoint illustrations), or watching or taking part in practical work. This also aligns with a sensing learning style, which favours active, practical work.

Global/sequential learning styles

There is no very clear preference showing on this dimension, and this concurs with students’ own testimony that sometimes they prefer to work in steps through a problem, while at other times they need the ‘big picture’. The distinction between this dimension and that of sensing/intuitive is not clear.

“I actually got a mix, I see big picture, and the small details which would include practicals, and sitting down and thinking and you slowly build and get that big picture in the end. More than one style.” (1st year student)

When the focus group data was analysed thematically, it was judged to fall into three main dimensions, forms of information (eg visual/verbal), organisation of information (eg sensing/intuitive) and mode of working (eg active/reflective and aspects of sensing/intuitive). No pattern was discerned that closely corresponded to the global/sequential dimension of the survey instrument.

Learning and teaching styles at different institutions

The number of students responding to the survey from each university was highly diverse with 99 respondents from QUT, 48 from Melbourne and only 9 from CQUniversity.

Figure 1 shows the survey results from each on the participating institutions as well as the total responses. However, the similarity in shape of the distributions suggests that there are no major

dissimilarities between the three populations. These were also similar to those obtained in another study conducted by Mills and colleagues (Mills et al, 2005).

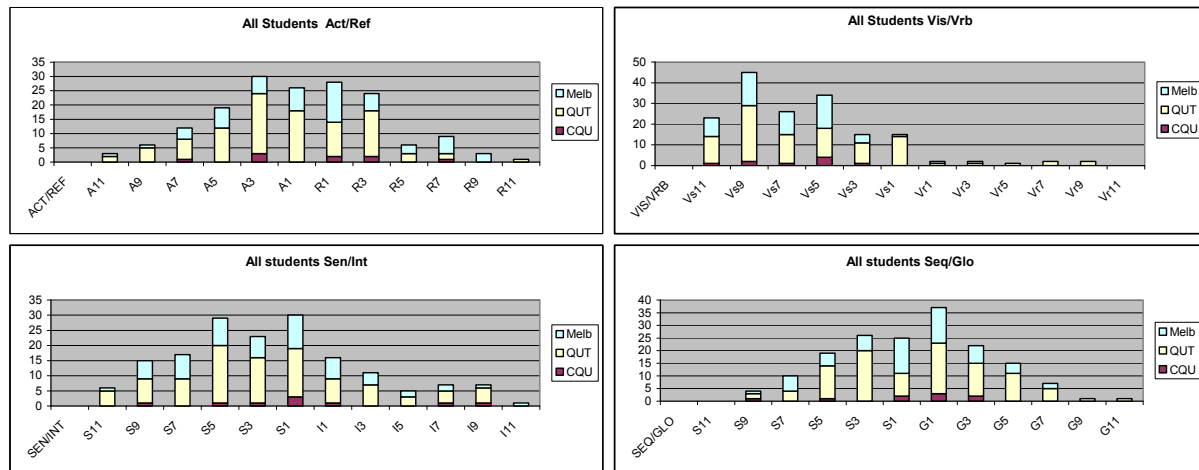


Figure 1: Students' learning styles (ACT/REF: Active/Reflective; SEN/INT: Sensing/Intuitive; VIS/VER: Visual/Verbal; SEQ/GLO: Sequential/Global.)

While working through examples was the prominent mode of working for all students, those at CQUniversity appear to have adapted to the unique teaching modes of a distributed multi-campus program in interesting ways.

Live video and audio feed is used to connect students on remote campuses with the main classroom but those sessions are also recorded and video streamed on the web and all students have access to them later (within 24 hours). Normally visually-dominant students appear to have learned some listening (verbal?) skills through exposure to the system. Students on all campuses learned to use the technology to support their preferred mode of *working through examples*. They liked having the extra access to the technology which let them do that, at their own pace and in their own time.

It's got advantages and disadvantages; it's annoying when you have got PowerPoint up and the lecturer is talking, unless you are on the campus that the ISL is coming from; all you can hear is the voice which is 50% of the time foreign, with the PowerPoint and that is annoying; but at the same time it is really good being able to go home [and] watch the lecture online pause it if you want. (2nd year student)

"And it's two years of constant ISL lectures – you are going to get used to the slides and listening to voice in the background." (3rd year students)

Teaching styles and good teaching

Our research plan embodied an assumption that the match (or creative mismatch) between teaching style and learning style would be a significant factor in successful learning. Students' comments during the focus group meetings suggest that they are more concerned about the lack of enthusiasm of teaching staff, and hence decrease in their own motivation, than teaching styles. While boring lectures, disorganised courses and lack of resources are problems to be overcome, students don't seem to have much awareness of teaching styles. This may be due to a perceived inability to influence or change teaching styles.

Students have very decided opinions about what constitutes good teaching, although there was no data on many of the teachers mentioned by the students, so we could not correlate a particular teacher's style with student perceptions. Students participating in the focus group discussions were not necessarily attending classes by the participating academics, or those considered "good teachers." However, students identify good teachers by their *enthusiasm* for their subject and their *care* for students' understanding of it. It is interesting to note here that this care for students' understanding was interpreted and equated to lecturer's good organisation.

Students tell us that they have learned to cope with whatever style they encounter but will be motivated by enthusiasm and care. Each individual focus group could clearly identify bad teachers, and all bad teachers were similar in their disorganisation and /or lack of interest in the subject they were teaching.

“Yeah, I find there is one teacher in my life; she loves what she was doing, and because she loved what she was doing she loves it, I am going to give it a shot and that is when I started liking that particular subject, because she was so enthusiastic about it; if she can be so enthusiastic about it so can I.” (3rd and 4th year students)

Interestingly, students often mention that lack of opportunity for active learning, especially practical and hands on work, strikes them as indicating lack of interest on the teacher’s part.

Institutional barriers to student learning

Analysis of the student focus group data and the research literature on the barriers to student learning resulted in much detail which cannot be discussed fully in this paper. Therefore, in what follows, only aspects of institutional barriers will be discussed. It must be noted that the collected data were limited, and one should not use the results of the analysis presented here to draw generalised conclusions.

Our data gave no grounds for suggesting that engineering students face barriers that other students do not. In the main, the data did not, for instance, suggest that engineering presented a special barrier as a particularly difficult program. However, the following student comments do refer to the engineering program difficulty.

“I have actually noticed with this course a bit too, because it is, compared to other some of the other course around uni here, because I live on college some of them have a lot lighter workload than we do and a lot less work you have to do every week. So they are kind of out and about doing things and you have got to use a lot of willpower to stay in your room and do your work.” (1st year student)

Just as students are impatient of courses that don’t make the best use of their time, so they cite poor and complicated organisation as a major institutional barrier. The original research hypothesis was that the sandstone university would rely heavily on theory and traditional modes of teaching, that the regional university would offer most support for teaching and learning and the technical university would provide most practical hands on training with real world relevance. To some extent these factors were significant but they did not map onto university type in the way expected. For instance, both Melbourne and CQUniversity offer more open access common spaces for students to work in. Since students rely on each other for learning support this kind of facility is highly valued by the students, even if at times they are hard places to work in (eg, noisy and crowded).

CQUniversity does indeed offer extra formal learning support in writing and maths but students there told us they did not need that kind of support. Instead they valued the active and interactive Problem Based Learning curriculum there and the co-op organisation which sent them into industry for twelve months. The practical industry focus of QUT was valued by its students who favoured it, in comparison with the local sandstone university, but the students who spoke most positively about the difference had not attended the sandstone institution. Those who had were inclined to see them as more similar than different.

Teachers who were approachable were valued at all of the institutions and everywhere students had most vocal complaints for poor organisation both at the course and the program level.

Poor organisation includes matters of constantly changing curriculum structure (so that courses have to be taken out of sequence or become unavailable before some students have completed their degree), lack of clarity in the aims and requirements of a single course, and poorly organised websites.

In the absence of students who left engineering programs due to one or more of the identified barriers, we can only make conjectures from what currently enrolled students told us. The data collected were gathered from ongoing students and so we are unable to say which barriers contribute to attrition. However, some of these students had reported failing courses and repeating them. It is uncertain to what extent the barriers mentioned previously had on the failure of these students in these classes.

Conclusions

This paper presents some outcomes of our investigations of the connections and interactions between students, academics and their institutions. Analysis of focus group data conducted as part of these investigations showed that students already had much to say about their learning patterns and strategies in a fluent manner. They thought about learning in terms of the form in which material is presented (visual/verbal), how material is organised (sensing/intuitive, sequential/global) and how they prefer to work to acquire learning (active/reflective).

These concepts cover most of the dimensions of learning styles but in three slightly different dimensions, rather than Felder's four. They respond positively to those situations that match their preferences but have learned that there is not much to be done about the others except endure.

Every student group was able to discuss their preferences in learning. No variation in learning styles assessment results across universities was observed. However, CQUniversity students showed some adaptation to the technology used for the teaching modes of a distributed multi-campus program.

Students identify good teachers as those who are enthusiastic and well-organised. Enthusiasm and organisation are deemed by students as being more important than style, perhaps because these can indicate a lecturer's care for the students. This suggests that academics wishing to improve the learning environment need give higher priority to addressing the basic issues of organisation and enthusiasm, and then they can begin to consider the balance of teaching styles and associated impact.

In terms of institutional barriers, students commented that poor organisation at course and/or program level was the most significant factor. Student comments also revealed that facilities that supported peer learning were highly valued.

There is still much to be learnt about the complexities of engineering students' characteristics and the influence of teaching styles and institutional factors on their learning. It is through better understanding of the issues involved that institutions and academics, individually and in groups, can identify and respond to opportunities for enhanced learning. It is hoped that this work can be seen as a small but valuable contribution in this direction.

References

- Apter, MJ (2001). *Motivational styles in everyday life: a guide to reversal theory*. American Psychological Association. Washington DC.
- Boles, W., Hadgraft, R., Howard, P. (2009) Exploring synergies between learning and teaching in engineering: a case study approach, *Australasian Journal of Engineering Education*, Vol. 15, No 1, 19-25.
- Soloman, B. and Felder, R. (1999) Index of Learning Styles (ILS). Accessed at <http://www.engr.ncsu.edu/learningstyles/ilsweb.html> on August 2009.
- Felder, R. and Silverman, L. (1988). Learning and Teaching Styles in Engineering Education, *Engineering Education*, 78(7), 674-681.
- Markwell, D. (2007). *A large and liberal education. Higher Education for the 21st Century*. Melbourne, Australia: Australian Scholarly Publishing & Trinity College, The University of Melbourne.
- Mills, J., Ayre, M., Hands, D. and Carden, P., (2005). Learning about learning styles: Can this improve engineering education? Mountain Rise, Accessed at http://www.wcu.edu/facctr/mountainrise/archive/vol2no1/html/learning_about_learning.html on August 2009.
- Pike, G. R., & Kuh, G. D. (2005). First and second generation college students: A comparison of their engagement and intellectual development. *Journal of Higher Education*, 76, 276 – 301.
- Yin, R.K. (2003) *Case Study Research: design and methods*. Sage, Thousand Oaks, CA.

Acknowledgements

We would like to acknowledge the support of the Australian Learning and Teaching Council, ALTC, for funding this work through an Associate Fellowship program. We would like to also acknowledge the valuable contributions of Ms Hilary Beck (Project Officer). We appreciate the valuable advice, insights and support of Prof Neil Page (Program Evaluator) and the Project's Reference Group: Prof Tom Angelo, Prof Holger Maier, A/Prof Julie Mills, Dr Martin Murray, Prof Peter O'Shea, and Ms Jillian Rowe. We also thank the colleagues and students who participated in this study.

Copyright © 2009 Remains the property of the author(s). The author(s) assign to AaeE 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 author(s) also grant a non-exclusive licence to AaeE to publish this document in full on the World Wide Web (prime sites and mirrors) on electronic storage and in printed form within the AaeE 2009 conference proceedings. Any other usage is prohibited without the express permission of the author(s).