

Mapping student approaches to learning within a civil engineering program

Graham A Jenkins

Griffith University, Gold Coast, Australia
graham.jenkins@griffith.edu.au

David Edwards

Griffith University, Gold Coast, Australia
d.edwards@griffith.edu.au

Kali Prasad Nepal

Victoria University, Melbourne, Australia
kali.nepal@vu.edu.au

Mark Bolton

Griffith University, Gold Coast, Australia
m.bolton@griffith.edu.au

***Abstract:** Most civil engineering programs include a broad curriculum covering a range of relevant engineering and generic skills, combined with a range of teaching and learning environments. This provides both the breadth and the depth of civil engineering knowledge required by graduates to practise as “work-ready” professional engineers with an appropriate level of specialisation. The approach to learning adopted by students will have a strong influence on their ability to act as “life-long-learners”. Integration of courses within the engineering program is one way to improve student performance by motivating them to move beyond surface approaches to their learning. However, the learning approach adopted by students varies from course to course depending on the student’s perception of the teaching and learning environment. This paper describes an investigation into the way in which students approach their learning across a civil engineering program. A survey of students has been undertaken to identify where students adopt deep and surface learning approaches. The variation in the way students approach their learning has been investigated across all years of the program, as well as within year-based cohorts of students. The study has identified opportunities within the program to facilitate the development of “life-long-learner” skills by students.*

Introduction

As with most engineering programs across the world, the Civil Engineering Program at Griffith University comprises eight semesters of study, with 72% of the courses being compulsory. Civil Engineering is a diverse profession, and these compulsory courses cover a range of engineering and generic skills across the diverse disciplines of structural and geotechnical engineering, engineering management, water engineering and civil design. The program also includes 16% of elective courses and a Work-Integrated-Learning course. In line with the Griffith University Strategic Plan 2009-2013, this broad curriculum combined with a range of teaching and learning environments, provides both the breadth and depth of civil engineering knowledge required by graduates to practise as “work-ready” professional engineers with an appropriate level of specialisation. It is also designed to provide students with the appropriate skills to act as “life-long-learners”. However, the approach to learning adopted by students will also have a strong impact on their ability to act as “life-long-learners”.

Many chemical engineering students view an engineering program as simply a list of courses that need to be “ticked-off”, or passed in order to achieve the short-term goal of graduating (Abbas and Romagnoli, 2007). They also identify that it is often a “daunting challenge” to motivate students to move beyond this shallow approach to their learning, and that integration of courses within the engineering program is one way to improve student performance. However, Biggs *et al.* (2001) and Lucas and Meyer (2005) identify that the learning approach adopted by students varies from course to course depending on the student’s perception of the teaching and learning environment.

“Life-long learning”, which is essential for “today’s graduates” (Kember *et al.*, 2007), requires the development of a number of generic capabilities including critical thinking, self managed learning, adaptability, problem solving, communication, interpersonal and groupwork skills (Kember and Leung, 2005). Kember (2009) has shown that these generic capabilities are developed in students when they are given the chance to practise their use. In this context, the teaching and learning environment is a broader concept than simply being the physical space in which teaching and learning takes place. Fraser (1998) identifies that this “...refers to the social, psychological and pedagogical contexts in which learning occurs and which affect student achievement and attitudes”. However, Lucas and Meyer (2005) and Tight (2003) also indicate that “...university teachers...need to be continually aware that each student is situated differently ... and will perceive his or her situation differently”. The quality of the learning outcomes are related to both the nature of the teaching and learning environment provided and the degree of engagement of the student (Biggs *et al.* ,2001).

This study aims to enhance the learning practices of engineering students in relation to development of their “life-long learning” skills by identifying the way in which students approach their learning across the Civil Engineering Program at Griffith University. The paper describes the survey of students within the Civil Engineering Program to identify deep and surface learning approaches that have been adopted by students. The variation in the way students approach their learning has been investigated across all years of the program, as well as within year-based cohorts of students. The study has identified opportunities within the program for students to develop skills to act as “life-long-learners”.

Methods

Variation in the way students’ approach their learning was investigated to determine the way in which the current teaching and learning environments influence students. This included both variation across all years of the program, as well as variation within year-based cohorts of students. This study forms a “cross-sectional, explanatory study”, using the classification system for non-experimental quantitative education research described by Johnson (2001). The original Study Process Questionnaire (SPQ) described by Biggs (1987a) is a 42 item self-report questionnaire designed to assess the extent to which a respondent endorses different approaches. The Study Process Questionnaire (R-SPQ_2F) developed by Biggs *et al* (2001), which was adopted in this study is a reduced form of the SPQ consisting of 20 statements as shown in Table 1, with the statements customised to reflect Griffith University terminology where course is used for a unit of study. The R-SPQ_2F classifies student learning styles into Deep and Surface with sub-categories of Motivational (Interest) and Strategic (time and effort), with Table 1 identifying the learning styles related to each of the statements. The survey participants were not advised as to which statements related to the different learning styles.

Students were asked to identify their own response to each of the 20 statements as either (1) This is **never or only rarely true** of me; (2) This is **sometimes true** of me; (3) This is **true of me about half the time**; (4) This is **frequently true** of me; or (5) This is **always or almost always true** of me. The resulting numerical scores were analysed for each of the statements answered. Students were advised that there was no *right* or *wrong* answer to the statements presented, and that their response would depend on their own study style and the course being studied. Each student response was analysed by determining the average response scores for each of the sub-categories of learning style, based on the statements identified in Table 1. The average score for each course cohort was then determined for each of the four (4) sub-categories of learning style. This was further combined to produce an average score for both the Deep and Surface classes for each course cohort. Individual responses were not made available to anyone in the teaching team in any of courses surveyed.

Table 1 Details of the R-SPQ 2F student survey

#	Statement	Style*
1.	I find that at times studying gives me a feeling of deep personal satisfaction.	DM
2.	I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.	DS
3.	My aim is to pass the course while doing as little work as possible.	SM
4.	I only study seriously what's given out in class or in the course profile.	SS
5.	I feel that virtually any topic can be highly interesting once I get into it.	DM
6.	I find most new topics interesting and often spend extra time trying to obtain more information about them.	DS
7.	I do not find this course very interesting so I keep my work to a minimum.	SM
8.	I learn some things by rote, going over and over them until I know them by heart even if I do not understand them.	SS
9.	I find that studying academic topics can at times be as exciting as a good novel or movie.	DM
10.	I test myself on important topics until I understand them completely.	DS
11.	I find I can get by in most assessments by memorising key sections rather than trying to understand them.	SM
12.	I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.	SS
13.	I work hard at this course because I find the material interesting.	DM
14.	I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.	DS
15.	I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with the topics.	SM
16.	I believe that the lecturer shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.	SS
17.	I come to most classes with questions in mind that I want answering.	DM
18.	I make a point of looking at most of the suggested readings that go with the lectures.	DS
19.	I see no point in learning material which is not likely to be in the examination.	SM
20.	I find the best way to pass examinations is to try to remember answers to likely questions.	SS

* DM – Deep Motivational; DS – Deep Strategic; SM – Surface Motivational; SS – Surface Strategic

Survey Results

The questionnaire was administered to approximately 800 civil engineering students in most of their first, second and third year courses during the 7th and 8th weeks of semester one (1) during 2011. The questionnaire was distributed in a class break and collected upon completion, ensuring a high response rate from students in each class. Students were requested to frame their responses in terms of each course. There were 238 responses from first year courses, 291 responses from second year courses and 272 responses from third year courses, for a total of 801 responses. The average scores for each of the four (4) learning style categories in all of the courses surveyed are shown in Figure 1. The results show that the students identify that they are adopting a deep learning style rather than a more surface style. This trend appears to be relatively consistent across all of the courses surveyed, with the Surface Motivational score significantly lower than the other learning style sub-category scores.

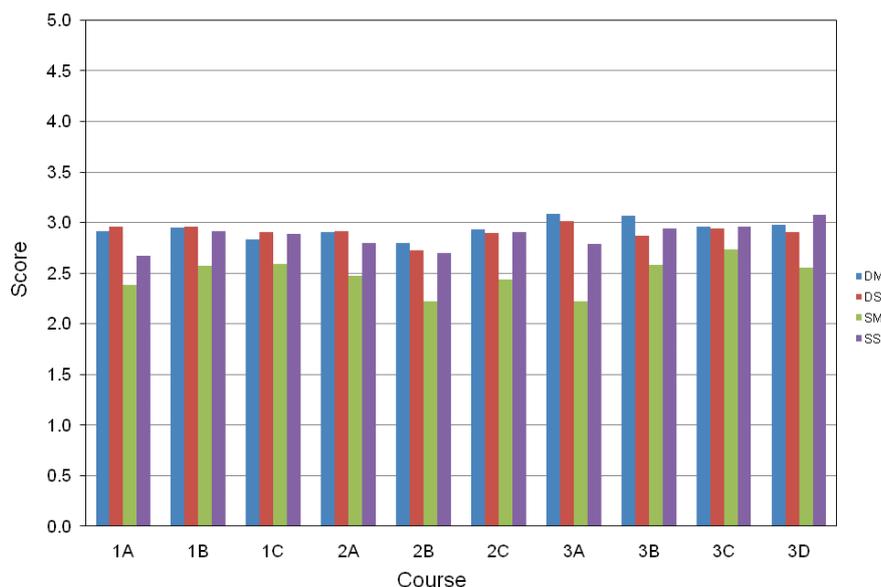


Figure 1: Average R-SPQ_2F scores for civil engineering courses

The courses identified in Figure 1 have been coded with the first character of the course identifier being the year level of the course and the second character, a letter (A-D), being randomly assigned. While the student group from all courses consistently reports a lower Surface Motivational score than for the other three sub-categories, there are also significant differences between the scores for courses at the same level. Although essentially the same group of students were surveyed for each course at a year level, it does appear that they were directing their responses towards each individual course.

Table 2 Distribution of average response scores by the course year of study

Level	DM	DS	SM	SS	Deep	Surface
Year 1	2.89	2.94	2.51	2.81	2.91	2.66
Year 2	2.88	2.86	2.39	2.80	2.87	2.60
Year 3	3.03	2.93	2.51	2.94	2.98	2.73
Overall Average	2.93	2.91	2.46	2.85	2.92	2.66

Table 2 shows a breakdown of response scores by year of study in which the course sits in the degree. The Standard Deviations were consistently in the range 0.60 to 0.77 for all of the data presented. The results show a similar pattern for each year, with the Deep score exceeding the Surface score. The Surface Motivational score is significantly lower than the other scores for all of the years. This pattern is also reflected in the overall average of the data across all students surveyed in all of the courses.

All of the courses surveyed as part of this study adopted similar learning environments that are characterised by lectures and tutorials/workshops with assessment based around individual assignments, mid semester tests and final exams. Some of the courses included laboratory sessions, although none included project-based assessment as a major component of the learning environment. This study will continue in Semester 2 of 2011, with a more diverse range of learning environments adopted. This will provide useful insights into the influence of learning environments on student learning styles as a number of these courses adopt project-based learning environments. It appears that the strong civil engineering focus within the courses may encourage students to adopt a more Deep approach to their learning, helping students to develop their skills as “life-long-learners”.

Biggs (1987b) reported reference scores on his SPQ for male Australian University science students with a sample size of 139. The scores, rescaled as an average item score as adopted in this study are shown in Table 3. Biggs (1987b) also reported reference scores for female Australian University science students and male and female Australian CAE science students. No significant differences in scores were reported between male and female students or between University and CAE students. The results for all sub-categories were significantly lower in the current study than those found in the reference scores reported by Biggs (1987b). This does not appear to be an artefact of any individual course but is general across all years and courses. Differences in the scores may be due to the way in which the students interpret the words Rarely, Sometimes, Frequently and Almost Always.

Table 3 SPQ Responses from male Australian University science students: Source Biggs (1987b)

Level	DM	DS	SM	SS	Deep	Surface
Mean	3.09	3.12	3.13	3.16	3.11	3.15
SD	0.70	0.65	0.69	0.64	0.67	0.67

The results of the current study are consistent with the results reported by Leung *et al.* (2006) for Chinese construction engineering students using a modified SPQ. This test used three items with a seven (7) point scale corresponding to each learning motive/learning strategy. Students from three (3) top 10 Chinese universities as well as three (3) other top 100 Chinese universities and three (3) Hong Kong universities participated in the investigation. Turner (2004) used the original version of the SPQ on 1st year engineering students at James Cook University, although no numeric scores for Deep or Surface approaches were reported. The study concluded that a large proportion of the 1st year engineering students were “Surface or Surface-achieving oriented”. However, “a significant number of students with strong deep orientations or a lack of clear preference for approaches to learning”.

Ng *et al.* (1997) administered the original version of the SPQ to the 1st year computer engineering students at the School of Applied Science, Nanyang Technological University, Singapore during a normal lecture period. The sample size of 300 included 75 % male students and 25% female students. It was found that students coming to university from Junior College scored higher in the Surface approach than the Deep approach. Rescaling to an item average score as used here produced a Surface approach score of 2.94 and a Deep approach score of 2.74. Students who had completed a Diploma before commencing university scored 2.98 for the Surface approach and 2.92 for the Deep approach

The results of the current study are also consistent with those of Zeegers (1999) who reported a longitudinal study (over 30 months) of science students at Flinders University using the full SPQ. This showed little change in study preferences over the reported period. However, there is a significant difference between the SM scores for these students and those observed for the Griffith University engineering students. This difference is consistent with the difference observed between the Biggs (1987b) Australian reference data for science students and the current study. A similar pattern is apparent from the individual course level data from the current study.

Conclusions

As with most engineering programs across the world, the Civil Engineering Program at Griffith University comprises eight semesters of study. The program is designed to provide students with the appropriate skills to act as “life-long-learners”. However, the approach to learning adopted by students will also have a strong impact on their ability to act as “life-long-learners”. A reduced form of the Study Process Questionnaire (R-SPQ_2F) was applied in this study to courses taught across the first three (3) years of the Civil Engineering Program. The R-SPQ_2F classifies student learning styles into Deep and Surface with sub-categories of Motivational (Interest) and Strategic (time and effort) in each case. The results show the civil engineering students are identifying as adopting a deep learning style rather than a more surface style. This trend appears to be relatively consistent across all of the courses surveyed. The Surface Motivational score is significantly lower than the other learning style sub-category scores in all of the courses surveyed. All learning style sub-categories were lower

in the current study than those found in the reference scores reported by Biggs (1987b), although they are consistent with the results reported for Chinese construction engineering students. This study will continue in Semester 2 of 2011, in which there is a more diverse range of learning environments adopted in the range of courses within the Civil Engineering Program. The continuation of the study will provide useful insights into the influence of learning environments on student learning styles. However, the current study has identified that the strong civil engineering focus within the courses may encourage students to adopt a more Deep approach to their learning, across all years of study.

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