Linking engineering students' assessment preferences to their learning approaches

Rodney A. Stewart
Griffith University, Gold Coast, Australia
r.stewart@griffith.edu.au

Angela Walker
Griffith University, Gold Coast, Australia
angela.walker@griffith.edu.au

***Abstract**: The very nature of an Engineer implies that one has an inherent passion for investigation and problem solving. The secondary school system and to some extent the traditional university system is focused on teacher-centred learning; however, this approach does not ideally foster deep learning approaches, research-based learning (RBL) and teamwork that are vital attributes of any graduate engineer. Previous studies have confirmed that engineering students thrive and feel comfortable with traditional teacher-centred learning, which is focused on exams, and rote learning. These research studies instigated a strong resolve of many engineering educators to implement project/problem-based learning (PBL) approaches in program curriculum in order to enhance graduate outcomes. This study offers one of the first attempts to link engineering students' approaches to learning with their assessment type preferences. The study empirically confirmed the proposition that deep learners also had a greater preference for deep assessment items and surface learners preferred surface assessment methods. Surface learners ranked both surface and deep assessment items on average lower than deep learners, indicating that surface learners do not have the same level of engagement in their learning through assessment in general. The paper concludes with some recommendations for engineering education policy and practice.*

Introduction

A deep approach to learning is one of the foundations of being a lifelong learner (Baeten, *et al*., 2008), and as a consequence, there is no argument that the modern university graduate needs a deep learning approach to have the ability to succeed in the modern world (Kreber, 2003; Gijbels and Dochy, 2006; Male *et al*., 2010). The literature generally supports the broad hypothesis made herein by the authors; that students in general prefer surface type assessment (Birenbaum, 2007; Furnham, *et al*., 2008; Van de Watering, *et al*., 2008). Further, it also confirms that it is, in general, difficult to induce deep learning approaches into students (Baeten, *et al*., 2008).

The engineering professional infers by its very nature, an innate, instilled and heightened deep assessment preference and approach to learning over and above other disciplines (Kreber, 2003; Leung, *et al*., 2008; Heller, *et al*., 2010). It has been noted recently that learning approaches can differ between the various disciplines (Birenbaum, 1997; Kyndt, *et al*., 2011). Remarkably little research has been undertaken on the learning approaches and assessment preferences of engineering students. Most of the published literature in this area focuses on the development of a new assessment method designed to encourage deep learning followed by an assessment on the relative efficacy in practice (Hargreaves, 1997; Nordstrom and Korpelainen, 2011). Very little research has in fact been undertaken on the study of the makeup of the engineering student psyche. It is the authors' contention that a sound understanding of the learning orientation of the typical engineering student is required before assessment aimed at nurturing deep learning can be implemented. The focus of this paper is on a second year core subject being comprised of a variety of engineering disciplines.

Proc. of the 2011 AAEE Conf. Fremantle, Western Australia, Copyright © R.A. Stewart and A. Walker, 2011

This paper is one of the first attempts to investigate the relationship between student learning approaches and assessment preferences. Undoubtedly, engineering graduates with a deep learning approach and the desire to tackle completed multi-faceted problems are desired by University and engineering employers; however, it is often not understood whether deep learning approaches are being instilled over a four year engineering program (Green, *et al*., (2009). Thus, empirical evidence needs to be documented on these student characteristics in order to better understand engineering cohorts at different levels and to strategise better ways to improve preferences for deep learning and associated assessment methods. In the modern University environment, the student is often seen as the customer (Birenbaum, 2007), and their evaluations may lead academics to develop curricula which fosters what they want, which is often surface learning, thereby perpetuating a cycle of greater surface level assessment and instilling a surface learning preference. In the short-term, this may be an appealing option, but in the long-term will not enhance graduate attributes and engineering skills.

Methodology

Participants

Data for this study was collected through a student survey of a second year civil engineering core course. Consent forms and questionnaires were administered at the commencement of a scheduled lecture period and participants were required to read the information schedule prior to completing the survey. Questionnaires were eliminated from the analysis if it appeared obvious that the student had not completed it properly or it had excessive missing data. A total of 132 respondents or (92% of the total students enrolled in the course) completed the questionnaire.

As can be seen in Table 1, 66% of the cohort was in their third semester of study (the start of the second year of the four year engineering degree). Unsurprisingly 88% of the group were male and the majority of students were recent secondary school graduates (1 year), with 57% within the 18-20 age group followed by 32% in the 21-23 age group. Being a young group it was not surprising that 72% had no prior industry experience with 17% having 0-6 months of industry experience. Interestingly 33% of the students identified as having English as a second language. International students often make up around 20-30% of engineering courses at the University.

Table 1 Details of participants.

Age (Years)	Percent	Industry experience (including work experience)	Percent	Semester of engineering study	Percent
18-20	57	None	72	1st Sem	6
21-23	32	0-6 months	17	2nd Sem	5
24-26	8	7-12 months	2	3rd Sem	66
27-30	2	1-2 years	5	4th Sem	10
31-40	1	3-5 years	3	> 4th Sem	13
		5+ years	1		

Questionnaire instrument

The questionnaire was comprised of five main sections: Part A collected basic student demographic information; Part B was designed to elicit the students' view on their own personal approach to learning; Parts C and D were structured in a similar way to collect the students' assessment preferences; and Part E was designed to elicit information about how students perceived the extent to

which different assessment types are linked to the development of graduate attributes. Data analysis and results pertaining to this latter part of the questionnaire is not covered in this article.

Part B: Student approaches to learning

Using Biggs' *et al*., (2001) Revised Study Process Questionnaire, the approaches to learning section (Part B) consisted of 20 items designed to classify students into two primary groups, namely, having either a Surface Learning Approach (SLA) or Deep Learning Approach (DLA).

The 20 Likert-type items were graded on a 5-point scale where 1 = "*This is never or only rarely true of me*" and 5 = "*This is always or almost always true of me*". Table 2 provides some examples of types of questions as detailed in Bigg's *et al*., (2001) questionnaire. For a student to be classified as having a DLA their mean survey responses needed to satisfy two criteria: (a) the aggregate mean of their responses to Deep Learning type questions needed to be equal or greater than 3.00; and that (b) this aggregate mean DLA value was greater than their aggregate mean SLA value.

Table 2 Student approaches to learning question examples.

	Part B: Student approaches to learning
Deep Learning Approach (DLA)	"I find that at times studying gives me a feeling of deep personal satisfaction"
	"I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied"
Surface Learning Approach (SLA)	"My aim is to pass the course while doing as little work as possible"
	"I only study seriously what's given out in class or in the course profile"

Parts C and D: Assessment type and question type preferences

The assessment type preference (Part C) and assessment question type preference section (Part D) consisted of 31 Likert-type items graded on a 5-point scale where 1 = "*Not at all*" and 5 = "*To a very great extent*". Table 3 provides some examples of typical questions included in Parts C and D of the questionnaire.

Table 3 Assessment methods question examples.

	Part C: Assessment type preferences	**Part D: Assessment question type preferences**
SAP	"I prefer module tests (quiz)" "I prefer short multiple choice examinations"	"I prefer questions requiring the reproduction of facts" "I prefer questions that require comparing different concepts/ideas"
DAP	"I prefer an engineering design assignment having multiple possible solutions" "I prefer major exams with questions requiring problem solving and application of course material to relatively new situations"	"I prefer questions requiring the application of material learnt to new situations" "I prefer questions that require an overall view of the relationships between all topics learnt"

- SAP types of assessment included quizzes; tutorial assignments; defined laboratories and field work; short technical reports; examinations on course material; and, technical reports on defined problems.
- DAP types included major design tasks with multiple possible solutions; major examinations requiring problem solving and application of prior knowledge and complex laboratory/field work; and, critical thinking/and judgement to solve multi-faceted engineering problems in an assignment or exam situation.

For analysis purposes the mean aggregate from *the combined* Parts C and D was calculated for each student to determine a value for their Surface Assessment Preference (SAP) and Deep Assessment Preference (DAP).

Results

The main focus of this paper was to examine the correlation between a second year engineering students' approach to learning and their assessment type preference.

Student learning approaches and assessment preferences

In Table 4, an analysis of the Part B results (student learning approach) found that 62% of the total cohort was classified as SLA-type students. This result was confirmed by combined Parts C and D (student assessment preference) where a similar percentage of the total numbers of students were identified as having a SAP (60%).

Table 4 presents the cross-tabulation data comparing the various categories to determine if students who indicated they were SLA-type students also had a SAP. Interestingly, of the 82 students that were found to have a SLA, 65% (or 53 students) of that group *also* indicated that their assessment preference was surface orientated. Therefore, this equated to 40% of the total cohort identified as having both a SLA *and* a SAP, supporting anecdotal evidence that a significant proportion of students simply want to jump through the hoops presented to them with the minimum amount of work possible. The remaining 60% were distributed evenly through the remaining 3 combination categories (approximately 20% each).

Table 4 DLA_or_SLA * DAP_or_SAP cross-tabulation.

			DAP_or_SAP		Total
			DAP	**SAP**	
DLA_or_SLA	**DLA**	Count	24	26	50
		% within DLA_or_SLA	48%	52%	100%
		% of Total Cohort	18%	20%	38%
	SLA	Count	29	53	82
		% within DLA_or_SLA	35%	65%	100%
		% of Total Cohort	22%	40%	62%
Total		Count	53	79	132
		% of Total	40%	60%	100%

Figure 1 presents a comparison of DAP and SAP mean values clustered according to respondent SLA and DLA classifications. The SAP value in this graph represents the overall mean value for all SAP related items in both parts C and D of the questionnaire. Similarly, DAP represents the overall mean value for all DAP-related items listed in both parts C and D of the questionnaire. The Overall Assessment Preference (OAP) was the clustered mean for *all* questions in parts C and D (i.e. mean of all SAP and DAP items).

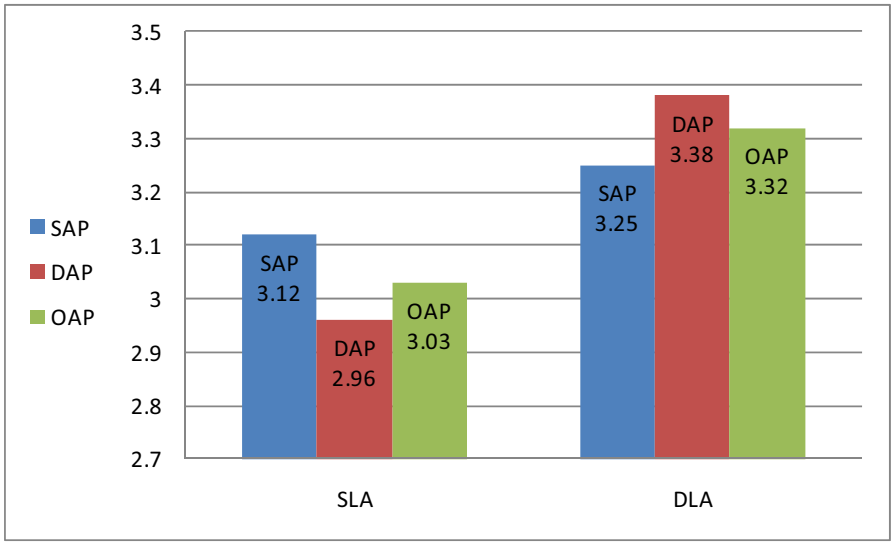

Figure 1: Relationship between learning approach and assessment preference

It is evident in Figure 1 that students with a SLA had a higher SAP mean value than DAP, (3.12 verse 2.96; t = -2.575; p< 0.05). Confirming expectations, students with a DLA also had a DAP mean value higher than their SAP, although not statistically significant (3.38 verse 3.25; t = -1.634; p = 0.109). Of particular note is the significant difference between the DAP mean value between the SLA and DLA clusters (3.38 verse 2.96; t = 3.922; p< 0.001). Interestingly, students with a DLA had both a higher mean SAP and DAP value than SLA students, expressed as the Overall Assessment Preference (OAP), indicating that they are more enthusiastic towards both learning and assessment than SLA students in general (3.32 verse 3.03; t = 3.490; p <0.001). Meaning that the DLA students gave consistently higher scores to all questions generally where for parts B and C the Likert-type grading being 1 = "*Not at all*" and 5 = "*To a very great extent*". Their score therefore indicated that they "liked" assessment in a general sense much more than their SLA counterparts. This result provides some indication that DLA type students have greater enthusiasm toward all forms of assessment in general, which sets them apart from SLA learners. Conversely, students in the SLA cluster lacked general motivation towards either type of assessment activity, but when given the choice would likely choose surface learning based assessment. This confirms our hypothesis that SLA students might be more likely to view assessment as a series as gates they need to pass through to obtain an engineering qualification.

Conclusion

This paper has provided preliminary data to confirm the authors' hypothesis that second year engineering students are: a) surface type learners, where it was found that 62% of the total cohort identified as having a SLA; and, b) that they have a surface assessment type preference (SAP = 60%). Collectively, 40% of the second year cohort had *both* a SLA *and* a SAP, which was the overwhelmingly dominant learning and assessment combination. Of interest was the finding that DLA type students have a heightened enthusiasm for assessment in general, supporting the proposition that deep learning is inherent and cannot be taught nor imparted. Further planned investigations will assist to determine if and how learning strategies change as a student progresses through the engineering degree.

There is undoubtedly an acknowledgement within the university system that for the benefit of the student, this surface approach to learning needs to be corrected in order to provide students with the deep learning skills they will need in, and demanded by, the engineering profession. The answer to the problem of changing the learning approaches and general mindset of an undergraduate student is some distance away from being solved. This research has introduced an ongoing research program designed

to show that instilling deep learning approaches early in a student's development will foster preferences for assessment that requires critical thought and problem solving, thereby reinforcing an even greater desire for deep learning not only in the later stages of the engineering degree but as a professional engineer. Familiar and consistently offered surface assessment perpetuates a cycle of rote learning, ultimately leading to those students perceiving engineering education as a highly structured gateway process with a degree as the final outcome, instead of a deeper aptitude developing educational process which goes beyond the crediting of a qualification.

References

Baeten, M., Dochy, F., & Struyven, K. (2008). "Student's approaches to learning and assessment preferences in a portfolio-based learning environment". *Instructional Science, 36*(5-6), 359-374.

Biggs, J., Kember, D., & Leung, D.Y.P. (2001). "The revised two-factor study process questionnaire: R-SPQ-2F". *British Journal of Educational Psychology, 71*, 133-149.

Birenbaum, M. (1997). "Assessment preferences and their relationship to learning strategies and orientations", *Higher Education*, 33(1), 71-84.

Birenbaum, M. (2007). "Assessment and instruction preferences and their relationship with test anxiety and learning strategies", *Higher Education*, *53*(6), 749-768.

Furnham, A., Christopher, A., Garwood, J., & Martin, N.G. (2008). "Ability, demography, learning style, and personality trait correlates of student preference for assessment method". *Educational Psychology, 28*(1), 15-27.

Gijbels, D., & Dochy, F. (2006). "Students' assessment preferences and approaches to learning: can formative assessment make a difference?". *Educational Studies, 32*(4), 399-409.

Green, W.,Hammer, S., & Star, C. (2009) "Facing up to the challenge: why is it so hard to develop graduate attributes?". *Higher Education Research & Development, 28*(1), 17-29.

Hargreaves, D.J. (1997). "Student learning and assessment are inextricably linked". *European Journal of Engineering Education, 22*(4), 401-409.

Heller, R.S., Beil, C., Dam, K., & Haerum, B. (2010). "Student and faculty perceptions of engagement in engineering". *Journal of Engineering Education, 99*(3), 253-261.

Kreber, C. (2003). "The relationship between students' course perception and their approaches to studying in undergraduate science courses: A Canadian experience". *Higher Education Research & Development, 22*(1), 57-75.

Kyndt, E., Dochy, F., Struyven, K., & Cascallar, E. (2011). "The direct and indirect effect of motivation for learning on students' approaches to learning through the perceptions of workload and task complexity". *Higher Education Research & Development, 30*(2), 135-150.

Leung, M.Y., Lu, X., Chen, D., & Lu, M. (2008). "Impacts of teaching approaches on learning approaches of construction engineering students: A comparative study between Hong Kong and Mainland China". *Journal of Engineering Education, 97*(2), 135-145.

Male, S.A., Bush, M.B., & Chapman, E.S. (2010). "Perceptions of competency deficiencies in engineering graduates". *Australasian Journal of Engineering Education, 16*(1), 55-67.

Nordstrom, K., & Korpelainen, P. (2011). "Creativity and inspiration for problem solving in engineering education". *Teaching in Higher Education, 16*(4), 439-450.

Van de Watering, G., Gijbels, D., Dochy, F., & Van der Rijt, J. (2008) "Students' assessment preferences, perceptions of assessment and their relationship to study results". *Higher Education, 56*(6), 645-658.

Copyright statement