Language Characteristics of Reflective Writing

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BACKGROUND

The development and assessment of graduate attributes of engineering students is receiving increasing attention. Changing expectations of accreditation institutions such as Engineers Australia and EurACE, from requiring opportunities for students to develop attributes, to requiring all graduates to demonstrate attributes are one of the drivers. Concurrently TEQSA, in administering their Act will be looking for providers to demonstrate outcomes that employers are seeking. One way that some educators are assisting students to develop and demonstrate graduate attributes is to partake in reflective practice and, in particular, the use of reflective writing as evidence of learning and graduate attribute development.

Among the various issues that face educators in moving towards greater use of reflective writing, the trend towards larger class sizes and the casualization of the teaching workforce presents problems of training relatively inexperienced staff to provide feedback on, and conduct assessment of, reflective writing. This issue is exacerbated if there are multiple tutors for one cohort of students where equity of assessment of free form writing is important but difficult to achieve.

PURPOSE

The purpose of our program of research is to assist engineering educators to prescribe and assess reflective writing. In particular we wish to answer the questions 'How do students exhibit cognition in writing tasks?' and 'How do students exhibit affectivity in writing tasks?'. The work reported here is a subset of that research into how students use language in those tasks.

DESIGN/METHOD

A large body of reflective writing from 1st year tertiary students studying a subject on sustainability and human-environment interaction were analysed using language-parsing software. The intent of the analysis was to search for the types of verb phrases students use when writing about cognitive understanding and affective behaviour. Over 3,500 journal entries were analysed. These phrases were linked to verbs educators use to describe student performance in the cognitive and affective domains.

Verbs were used because they indicate that the student has taken some action, or that they were describing action taken by others. From within the subset of verbs used in the student writing, a classification was made to divide them into verbs describing personal action on the part of the student and those reporting the action of others.

RESULTS

The analysis showed that there was not good alignment between the verbs commonly used by educational researchers to describe student action and the verbs the students used in their writing. It also showed that the vast majority of the verbs written were to describe the actions of others, even though the journals were intended for reflective writing.

CONCLUSIONS

The use of the language parsing software proved to be very effective in quickly displaying instances and statistics on word use in a very large *corpus* of writing. There would be value in creating a set of verbs that students use to describe their own actions, and in analysing the information provided to students. This could assist in giving guidance to assessors of the student work.

KEYWORDS

Reflection, assessment, language analysis, Sketch Engine, cognitive domain, affective domain

Introduction

Accreditation and other authorities are paying increasing attention to students demonstrating the development of the full range of graduate attributes required for professional practice. Engineers Australia for example has in the past designated three broad areas of learning that it expects engineering graduates to have developed capabilities in; namely PE1 (knowledge of the discipline), PE2 (engineering ability) and PE3 (professional attributes). Knowledge of the discipline is something that higher education institutions have been adept at teaching and assessing for a long time. This declarative knowledge domain refers to the knowledge of things (Biggs and Tang, 2011) and is assessed by the learner declaring this knowledge back to the teacher to check if what is learnt corresponds to what was taught. In the levels of Bloom's taxonomy of cognitive thought (Bloom, 1956), it will usually be taught and assessed in the lower three levels of knowledge, comprehension and application. Engineering ability is more likely to be functioning knowledge and is the basis of action, for example solving a novel problem or creating an engineering design. Functioning knowledge will of course be dependent on declarative knowledge, but by necessity uses the upper levels of cognitive processes including analysis, evaluation, and synthesis. Assessment of knowledge in the upper three levels of Bloom's hierarchy is more complex because there is no longer a one-to-one relationship between problems and answers. For example, Reidsma (2009) used analysis of text from design journals to help understand how students were acquiring skills of the design process. As class sizes inexorably increase, the assessment of student performance in the domain of functioning knowledge also becomes more difficult because of problems around maintaining validity and reliability of assessment. The professional attributes are based in both the cognitive domain and affective domains where the emphasis is on providing a value context to the cognition. The literature on assessment of learning in the affective domain is sparse.

There is increasing pressure from accrediting organisations such as Engineers Australia via the Washington Accord, the European Network for Accreditation of Engineering Education via the EurACE quality label, and the Tertiary Education Quality and Standards Agency (TEQSA) for quality assurance and accountability for the outcomes and capabilities of graduates. Consequently, the performance of higher education institutions is increasingly benchmarked against how effectively graduates attain a specific list of qualities or competencies necessary for professional practice. Examples of trends in this direction are discussed in Prpic and Moore (2012).

Over a number of years, the authors have required students at various year levels to use reflective writing to help them learn. We were interested to determine whether there were characteristics of the writing that we could use to help determine the student's level of operation within the cognitive and the affective domains. In one large first year subject (enrolments 700 per year) coordinated by the first author, students intending to major in the design disciplines such as engineering and architecture study concepts of sustainability, systems, complexity, and human-environment interaction. Unlike traditional science based subjects in engineering courses, the topics are still hotly debated and students not only need to develop understanding of the meaning of the terms but also develop their value systems in response to the concepts. A significant part of the learning involves students writing a weekly journal reflecting on the lectures, tutorials, and readings for the week and how they have influenced their understanding, values, and actions. We have chosen this set of writing to begin to explore how students express their understanding. The journals were weighted at 20% of the total subject assessment. Being such a large subject, we have many tutors who are involved in assessing work and providing feedback. Despite efforts in providing detailed student instructions, examples, marking rubrics for students and tutors, and extensive discussion around how to assess the journals, we still observed a lot of variability between the tutors in assessing the writing.

Literature Review

The cognitive level on which teachers expect students to operate at various moments were classified by Bloom (1956), and subsequently modified by Anderson and Krathwohl (2001). The domain describes a hierarchy of cognitive development. They devised and classified a set of verbs that describe what a student should be doing to develop at a particular cognitive level. Biggs and Tang (2011) describe the earlier work of Biggs that also described a taxa of verbs associated with levels of cognitive operation of students called SOLO (Structure of the Observed Learning Outcomes). This schema differs from Bloom's taxonomy in that it concentrates on describing the outcomes of the learning, or understanding, rather than the activity that the student is undertaking. Paul Ramsden, in the forward of first edition of Biggs and Tang (2011) describes SOLO as the method of choice for assessing a range of writing.

The affective domain relates to values and attitudes. From a student learning and professional practice point of view it is an important adjunct to the cognitive domain because it helps us understand the actions of people. As Garland (1999) points out, there is no point in having people master the cognitive thought around learning a particular issue, for example safety in the workplace, if they have no commitment to apply that learning. Like the cognitive domain, there are a number of levels to describe a person's level of operation as outlined in Clarke (2010) citing Krathwohl et.al. (1973). The lowest level is *receiving*, where a learner is ready and able to accept new knowledge about the existence of alternate values. *Responding* is where a learner participates in the initial reception of the knowledge and follows receiving. *Valuing* follows, where the learner attributes their own values to the knowledge or at least acknowledges that the knowledge has value to others. *Organizing* refers to a process of finding relationships between the new values being learnt and values already held by the learner. Finally, *internalizing* refers to a person taking on and living the new value set.

In reflective journals students have the opportunity to write about the learning of new concepts and challenges to their thoughts on values, however this is difficult to assess. Although Moon (2006) acknowledges there are some authors that reject the idea of summative assessment of journals, she makes a clear case for assessment in some form. Moon (2006) outlines a range of approaches to assessment, but none of them appeared to capture the two-dimensional view of the cognitive and affective domains in which we were interested. We therefore concluded that there might be some value in analysing the writing of students to ascertain how they are currently using language to help us design better specifications or instructions for students on what to write, and better criteria for assessors on how to assess and provide feedback.

Methodology and Method

Methodology

The methodology chosen for this initial analysis was computerized language parsing of writing to produce statistical characteristics of the writing. This methodology was chosen because it allowed a very large body of writing to be analysed quickly for the manner in which students used the key verbs from the various taxa. It also allowed us to observe emergent properties of the writing by searching the corpora for interesting aspects of the concordance of words used in the writing. Inferences have been made based on this analysis, but future research will use complementary methodologies such as NVIRO analysis of a small subset of the writing.

Method

Ethics approval was obtained to use journal entries written by students doing pre-requisite study for design-based degrees such as engineering and architecture. The instructions for the journal writing were broadly to describe and discuss the learning materials from the

learning affected their values and actions.   The subject Reshaping Environments from the first year of the Bachelor of Environments degree at the University of Melbourne has enrolments of around 750 students per annum. Students write a weekly reflective journal to connect and reflect on their learning. Journals written in semester 2, 2011 were used in our investigation. There were about 3600 journals and over three million words available for analysis.

The online software SketchEngine (Kilgarriff et.al. 2004) was used for language analysis. The journal entries were converted to plain text files to create a *corpus*, which is a collection of writing for analysis. The software analyses each sentence of the *corpus* and tags the parts-of-speech for each word in the sentence. For example, it identifies the verbs, nouns, pronouns, and adjectives in each sentence. Through an interactive interface, the user can then generate various views of the *corpus*. For example, every occurrence of the verb with the route 'design' can be listed along with other words that appear before or after it. This is called a concordance. Furthermore, a view of the verb design can be generated along with the frequency of use with adverbs such as sustainable, green or user-friendly. A screen shot of the output is shown in Figure 1. The software is very powerful in analysing language.

design (verb)   Reshaping 2001 S2 freq = 311 (100.3 per million)

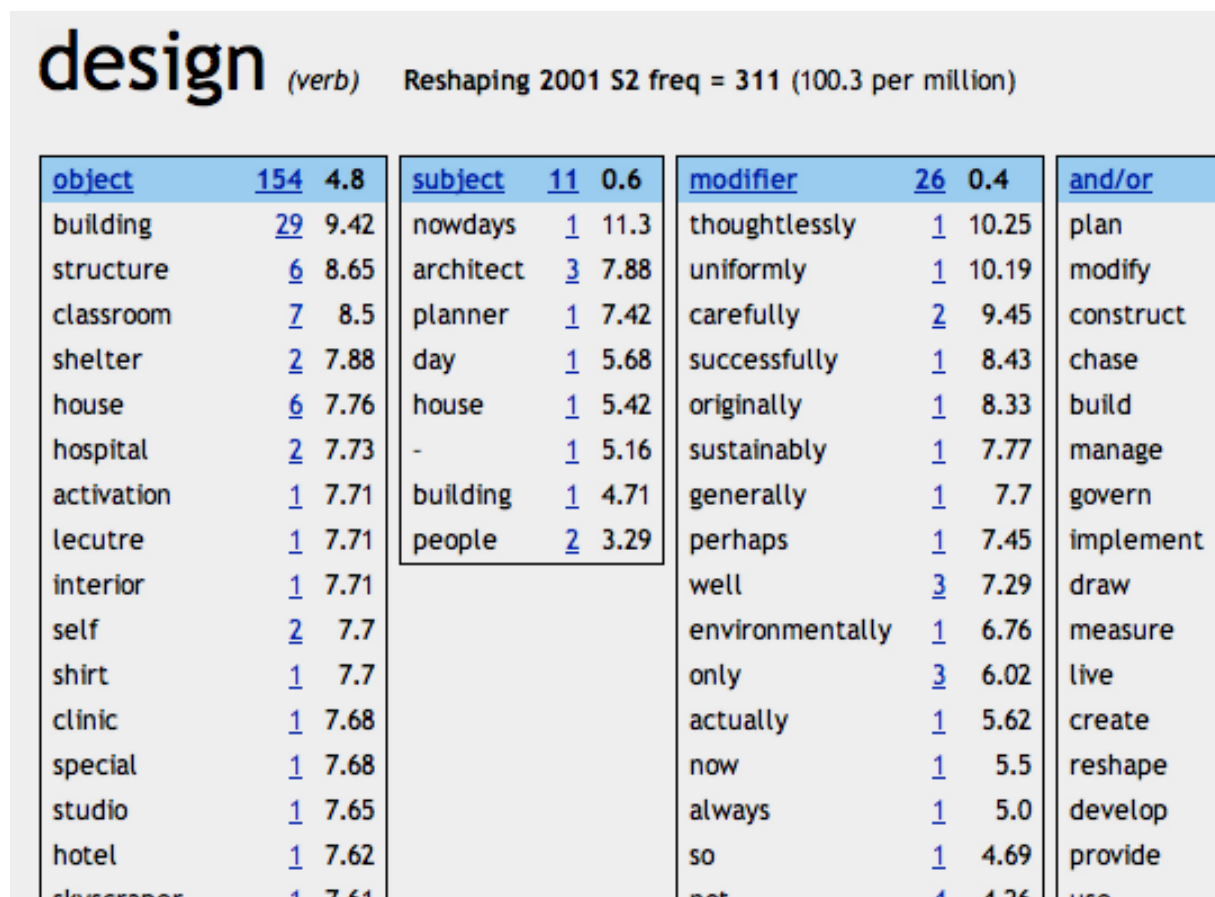| object	154	4.8	subject	11	0.6	modifier	26	0.4	and/or
building	29	9.42	nowdays	1	11.3	thoughtlessly	1	10.25	plan
structure	6	8.65	architect	3	7.88	uniformly	1	10.19	modify
classroom	7	8.5	planner	1	7.42	carefully	2	9.45	construct
shelter	2	7.88	day	1	5.68	successfully	1	8.43	chase
house	6	7.76	house	1	5.42	originally	1	8.33	build
hospital	2	7.73	-	1	5.16	sustainably	1	7.77	manage
activation	1	7.71	building	1	4.71	generally	1	7.7	govern
lecutre	1	7.71	people	2	3.29	perhaps	1	7.45	implement
interior	1	7.71				well	3	7.29	draw
self	2	7.7				environmentally	1	6.76	measure
shirt	1	7.7				only	3	6.02	live
clinic	1	7.68				actually	1	5.62	create
special	1	7.68				now	1	5.5	reshape
studio	1	7.65				always	1	5.0	develop
hotel	1	7.62				so	1	4.69	provide
skyscraper	1	7.61				not	4	4.26	use

Figure 1: Typical output screen of SketchEngine showing the word sketch for 'design'. It shows how the verb design is linking to other words in the same sentence along with the frequency of occurrence (the integers) and a score, which is a statistic of how strong the association between those two words is compared to other pairs in the *corpus*. In this example, the verb design appeared around 100 times per million words. As a noun, design occurred 150 times per million.

For the *corpus*, frequency analysis was first performed to find the occurrence rates of each word used according to its part of speech (because some words can take on multiple roles). The verbs from the *corpus* were compared to the verbs from those commonly associated with Bloom's taxonomy of cognitive thought, and with the affective domain. Only those with a

frequency of occurrence greater than 50 per million were considered. Then word sketches, like that shown in Figure 1, were created for each verb that occurred in both the *corpus* and the taxa lists. These were analysed visually to discover the proportion of uses could be attributed to the personal action of the students rather than descriptions of the actions of others.

The results data was then analysed to help inform our understanding of the research question of whether student reflective writing exercises can be used for classifying the levels at which students were operating.

Cognition

Each level of Bloom's cognitive taxonomy has associated with it a set of verbs that describe what a student "does" at that level. The verbs from Blooms modified taxonomy of cognitive thinking described by Anderson and Krathwohl (2001) are shown in Table 1. The verbs with numbers in brackets are the frequency of use per million words in student journals for words with a frequency greater than 50. The threshold figure of 50 is somewhat arbitrary, but with journals from around 350 students who each wrote up to 12 journals each, rates of occurrence less that this were judged to indicate that it was not typical of the student population.

Table 1. Verbs from the cognitive domain with an indication of those commonly used by students in their reflective journals.

Remembering	Defines (314), describes (116), identifies (92), state (85), knows, label, list, match, names, outlines, recalls, recognizes, reproduces, selects
Understanding	explains (120), comprehends, converts, defends, distinguishes, estimates, extends, generalizes, gives an example, infer, interprets, paraphrases, predicts, rewrites, summarizes, translates
Applying	use (1223), changes (498), show (392), relates (332), Apply (213), solve (180), produces (187), constructs (94), demonstrates (74), discovers (54), computes, manipulates, modifies, operates, predicts, prepares,,
Analyzing	Analyzes (408), relates (332), compares (118), breaks down, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infer, outlines, selects, separates
Evaluating	relates (332), explains (120), compares (118), supports (117), describes (116), evaluates (61), appraises, concludes, contrasts, criticizes, critiques, defends, discriminates, interprets, justifies, summarizes
Creating	creates (343), relates (332), explains (120), tell (118), designs (100), plan (71), categorizes, combines, compiles, composes, devises, generates, modify, organizes, rearranges, reconstructs, reorganizes, revises, rewrites, summarizes, writes

In a substantial piece of learning, the student is likely to be doing different activities at different times. For example, at times they may be doing knowledge gathering or comprehending activities characterized by verbs like list, describe, or rank. At other times, in the same piece of learning they may be engaged in higher level cognitive activities such as designing or evaluating. It is evident from Table 1 that the correspondence between the verbs students use and those educators use to describe student behaviour are not very well aligned because many of these verbs do not feature in their writing. Furthermore, given that part of the student's writing is describing what others are doing in their research papers, text book chapters, videos and so forth we find it surprising that students were not using more of these verbs to describe their own actions or the actions of other authors. We are yet to analyse the readings given to the students to measure the frequency of verb use by the authors of the readings, but needless to say, if the authors of the readings are not using a wide range of language or techniques for the students to model their writing on, then it would be unreasonable to expect that of the students.

When we looked in the word sketches for evidence of students describing their own actions, we found very scant evidence. For example, verbs based on the lemma categoriz(s)e were only use 34 times in total (about 11 per million) and on only 4 occasions was the verb used to describe the action of the reflective journal author as opposed to the work of others the journal author was writing about.

In total there were around 210 verbs with a frequency of use greater than 50 per million. This compares to 98 verbs in Blooms taxonomy, of which 32 were drawn from the 210 higher use verbs.

Affectivity

Table 2 shows verbs associated with the affective domain as described by Krathwohl et.al. (1973)

Table 2. Verbs from the affective domain with an indication of those commonly used by students in their reflective journals.

Receiving Phenomena: Awareness, willingness to hear, selected attention.	hold (73), identifies (92), describes (116), follows (118), ask (148), chooses (155), give (459), use (1223), locates, name, points to, selects, sit, erect, reply
Responding to Phenomena: Active participation on the part of the learners. Attends and reacts to a particular phenomenon.	answers (50), tell (118), presents (181), read (232), write (290), discusses (398), help (523), assists, aid, complies, conforms, greet, label, performs, practices, recites, reports, selects
Valuing: The worth or value a person attaches to a particular object, phenomenon, or behaviour. Valuing is based on the internalization of a set of specified values, while clues to these values are expressed in the learner's overt behaviour and are often identifiable.	differentiates (53), demonstrates (74), completes (76), form (89), follows (118), explains (120), read (232), work (386), initiates, invites, join, justifies, proposes, report, selects, share, studies
Organization: Organizes values into priorities by contrasting different values, resolving conflicts between them, and creating an unique value	alter (55), completes (76), identifies (92), compares (118), explains (120), relates (332), adheres, arranges, combines,

system. The emphasis is on comparing, relating, and synthesizing values.	defends, formulates, generalizes, integrates, modifies, order, organizes, prepares, synthesizes
Internalizing values : Has a value system that controls their behaviour.	act (119), questions (125), influences (157), solve (180), discriminates, displays, listens, modifies, performs, practices, proposes, qualifies, revises, serve, verifies

As was observed for verb use in the cognitive domain, the words were generally used in student writing to describe the actions of others rather than the journal author.

In examining the word sketches we observed that the verb *believe* was quite common with a frequency of 514. In fact, the phrase "I believe" occurred at the rate of 279 per million. Once again, this points to the idea that students use different words to describe their actions compared to the words educational researchers use to describe those same actions. It also points a way forward in this research, which is to create a taxonomy of verbs that students use to describe their own actions in the cognitive and affective domains. Such an exercise may assist in creating better guidance for assessing student levels of thought and behaviour by tutors, and may assist the longer term effort of semi-automated marking of written work.

Conclusions

In this paper, the weekly journals of approximately 350 students written for one subject were examined to begin to analyse how the writing correlated to verbs used to describe cognitive and affective thought. The analysis was performed primarily using a software package that allowed statistical analysis of what words were used and how they were used from a linguistics point of view. The objective of the analysis was to discover if we could use the analysis to assist in improving student instructions or assess the level of student thought from the writing.

It was discovered that the students used a rather narrow range of verbs when compared to those used by education researchers to describe modes of cognitive thought and affective behaviour. Given that a significant proportion of the journals were describing their reading and lecture materials, the narrow use of verbs may be a trait that is common to those readings and an indication that information with a wider range of verbs should be introduced to students.

The method of using SketchEngine was found to be very powerful in quickly displaying instances and statistics of particular word usage.

We concluded that the verbs used by students to describe their own actions did not necessarily correspond well with verbs used by educational researchers to describe those actions. It indicated that there may be value in establishing a set of verbs commonly used by students and divided into the same hierarchy used by the educational researchers. This could assist assessment of journal writing.

References

Anderson, L. & Krathwohl, D. A. (2001) *Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives.* New York: Longman

Biggs, J. and Tang, C (2011) *Teaching for Quality Learning at University*, 4th edition, Open University Press, New York.

Bloom, B.S. (1956). *Taxonomy of educational objectives, the classification of educational goals - Handbook 1: Cognitive domain.* New York: McKay.

Clark, D. R. (2010). *Bloom's Taxonomy of Learning Domains*. Retrieved Aug 1, 2012 fromhttp://nwlink.com/~donclark/hrd/bloom.html#three

Garland W.J. (1999) Learning 101 A STUDENT GUIDE TO EFFECTIVE LEARNING. Available at http://www.nuceng.ca/teach/learn101.PDF Accessed 1 August 2012.

Kilgarriff, A., Rychly, P., Smrz, P., & Tugwell, D. (2004). *The Sketch Engine.* Paper presented at the Proc EURALEX 2004. from http://www.sketchengine.co.uk

Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1973). *Taxonomy of Educational Objectives, the Classification of Educational Goals. Handbook II: Affective Domain.* New York: David McKay Co., Inc.

Moon, Jennifer A., (2006) *Learning Journals: A handbook for reflective practice and professional development.* 2nd Edition. London, Routlege.

Prpic, J. K., & Moore, G. (2012). E-Portfolios as a Quantitative and Qualitative Means of Demonstrating Learning Outcomes and Competencies in Engineering. In *Outcome-Based Science, Technology, Engineering, and Mathematics Education: Innovative Practices* (pp. 124-154): IGI Global.

Reidsma (2009) Assessing reflective writing: Analysis of reflective writing in an engineering design course. *Journal of Academic Language and Learning.* Vol. 3, No. 2, 2009

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