Defining the ‘literacy gate’: Analysis of the literacy requirements of professional engineering registration

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Abstract
During and prior to professional registration with the Engineering Council of South Africa, engineering graduates are expected to engage in advanced literacy practices which represent a high level of cognitive demand. This process is the final ‘gate’ through which engineering graduates must pass in order to be acknowledged as professional engineers. This article attempts to define the literacy practices required at this professional registration ‘gate’, by analysing the documents, processes and policies pertinent to the professional registration process. The result of this analysis is the identification of nine central literacy practices (divided into three reading practices, three writing practices and three critical thinking practices) that are mentioned in documents pertaining to professional engineering registration. Our estimates indicate that almost two-thirds of the ECSA Exit Level Outcomes’ assessment criteria also require mastery of these literacy practices. Furthermore, these practices need to be scaffolded within engineering curricula from entry through to graduation.

INTRODUCTION
Professional engineering is not just a job – it is a mindset and sometimes a way of life. Engineers use their judgement and experience to solve problems when the limits of scientific knowledge or mathematics are evident. Their constant intent is to limit or eliminate risk. Their most successful creations recognize human fallibility. Complexity is a constant companion. (Engineering Council UK 2003, 3).

Most of SA’s first-year university students could not read, write or comprehend – nor could they spell (Higher Education SA Chairman, Theuns Eloff: Business Day, 13 August 2009).
The challenge facing engineering educators is developing students’ literacy practices such that they progress from the experience described above at entry into higher education to the point that they can function effectively within a world characterised by complexity. This, one can argue, should be every student’s fundamental experience of higher education. In this article, we accept the fact that most, if not all, students face one or more of the triple disadvantages (Leibowitz 2000, 20) of having to adopt academic literacy, learn in a language that is not their first and overcome a history of poor schooling. We further accept that the challenges facing university entrants are serious and overwhelming. However, we argue that an effective way of addressing this is by first clearly defining what students need to be able to ‘do’ with literacy upon graduation and thereafter. Thus, our approach in this article is to define the end-goal of engineering literacy so that students’ development of the required literacy practices can be ‘scaffolded’ (to use a Vygotskyan term) during the course of their degree programmes. In other words, in this study, we begin not from defining students’ deficiencies upon entry but rather begin from a more positive and constructive starting point: what our graduates need to be able to do when they leave the university.

This is made possible in the case of Engineering in that all Engineering degree programmes (and all Engineering graduates) must be accredited by an independent, industry-related regulatory body. The Engineering Council of South Africa is responsible for accrediting all Engineering degree and diploma programmes and defines the exit level outcomes for these programmes. In addition, after a minimum of three years in practice, all Engineering graduates must go through a professional registration process with the Council in order to be registered as a professional Engineer.

In this article, we examine the professional registration requirements, particularly the documents used therein, so as to understand what the literacy demands are of potential professional engineers. In simple words, the question at the heart of this study is: what does a candidate engineer need to do with literacy (in terms of reading, writing and critical thinking) so as to become a professional engineer in their chosen Engineering sub-discipline? This question is informed by the fact that it is the purpose of the Engineering degree programme to ‘build the necessary knowledge, understanding, abilities and skills required for further learning towards becoming a competent practicing engineer’ (Engineering Council of South Africa 2004, 2).

In order to address this question, we begin by describing the process of professional registration of Engineers. Thereafter, we provide a brief outline of the social constructivist underpinning for the study, define the approach to literacy we adopt herein and describe the methodology employed, before presenting our analysis.

**PROFESSIONAL REGISTRATION**

Upon graduation, Engineering graduates are registered with ECSA as candidate engineers. They are then expected to gain at least three years of experience working
in their chosen field. During this time, they are assigned a mentor who is responsible for preparing the candidate for the professional registration process. Professional registration is meant to establish an engineer’s knowledge, understanding and competence: ‘professional competence integrates knowledge, understanding, skills and values. It goes beyond the ability to perform specific tasks. The formation process through which engineering professionals become competent generally involves a combination of formal education and further training and experience’ (Engineering Council UK 2003, 6).

During this candidature, candidate engineers are expected to keep track of all training received and professional development undertaken by way of a training report. The training programme that they embark on during this time is supposed to lead to them becoming competent and well-rounded engineers, through developing within them certain professional attributes and core competencies (ECSA 2003).

After completing this candidacy period, they are able to apply for professional review. According to ECSA (2003, 8–9), the professional review allows candidate engineers to demonstrate that they:

• understand the professional environment of Engineering, including moral, ethical, environmental and safety issues;
• have developed skill in engineering judgment, can make responsible decisions, can communicate lucidly and accurately, identify problems and find solutions to these, and that they can implement these solutions; and
• have adequate technical knowledge and understanding.

Successful completion of the professional review entitles candidate engineers to be registered as professional engineers.

A SOCIAL CONSTRUCTIVIST FRAMEWORK

As has been mentioned, the purpose of this study is to describe the literacy demands placed on Engineering graduates at the point of professional registration. The motivation for this and, indeed, the next stage in this research process, would be to ascertain the ways in which these literacy practices can be scaffolded during students’ time at university. As such, this research is conducted within a social constructivist framework. Such a framework begins from the premise that individuals do not simply acquire knowledge from others. Instead, they actively construct knowledge for themselves through their interactions with others using what they already know as a foundation for future learning.

Any theory of literacy implies a theory of learning (Barton and Hamilton 1998). Our theory of learning is in line with that of Biggs (2003) who argues that students create knowledge for themselves rather than it being imposed on them through teaching. Prince and Felder (2006) suggest that the process whereby students construct knowledge for themselves is one that sees them filtering new knowledge
through already-existent schemata (or prior knowledge and beliefs). It was Vygotsky, however, who initially coined the term ‘scaffolding’ to refer to learning. According to Vygotsky, learning occurs through a process of acculturation where experienced participants (lecturers and tutors, in the case of higher education) provide learners with the tools needed for learning to take place (Norton and Toohey 2001). This suggests that it is the role of Engineering educators not to merely transmit knowledge but to provide students with the tools, including the literacy tools, needed in ‘being’ an engineer.

The importance of such an approach within the context of this study is that it suggests that attention (within Engineering degree and diploma programmes offered by UJ) should not solely be focused on the facts, theories and concepts that underpin the Engineering fields. Instead, attention should also be focused on developing the professional attributes and core competencies required of Engineering graduates. ECSA (2003) defines these core competencies as developing an engineering brief, designing a solution, documentation and implementation, and professional attributes are defined as engineering judgement, responsible decision-making and clear and accurate communication.

**DEFINING ‘LITERACY’**

Literacy has been defined in myriad ways. In this article, we make use of the approaches to literacy provided by Gee (1996), Johns (1997) and Kirsch (2003). Gee (1996) defines literacy as mastery over the ways of being, interacting, valuing, thinking, believing, speaking, reading, writing and arguing that are accepted by particular groups of people. In other words, this definition suggests that communication is about saying and doing the things that are dictated as being correct by the context in which they are said and done. Similarly, Johns (1997) defines literacy as that which encompasses the skills of reading and writing, their relation to speaking and listening and ways of knowing particular content and practices. In other words, Johns argues, literacy refers to the ways of organising, understanding, discussing and producing certain kinds of texts, whether spoken or written. Similar to both of the above definitions is that of Kirsch (2003): literacy is using printed and written information to function in society, achieve one’s goals and develop one’s knowledge and potential.

We would extend Kirsch’s definition, based on the definitions offered by Gee and Johns, in four ways. First, literacy is about producing information as well as using already-existent information. Second, literacy practices differ across social domains; what Engineers need to do with language is vastly different from what accountants do, for example. Third, literacy is predominantly concerned with reading and writing but speaking and listening are, particularly in a field such as the Engineering sciences, also important literacy practices. Finally, although literacy is used to achieve one’s own goals, it is also often used to achieve socially sanctioned, expected or required goals, such as goals defined by an institution such as the Engineering Council.
Drawing from Kirsch, in this article, we define literacy as:

using and producing written and verbal information so as to function in particular social domains, to achieve one’s own but also socially sanctioned (required) goals and to develop one’s knowledge and potential.

Further to this, we refer to literacy practices as the particular ways in which this usage and production takes place.

**DOCUMENT ANALYSIS RESEARCH**

In this study, the above-mentioned professional attributes and core competencies are analysed by undertaking a close textual analysis of the documents that explain, guide and inform the professional registration process. In this study, the primary documents analysed are as follows:

- The Engineering Council of South Africa’s Qualification Standard for the Bachelor of Engineering (which governs Engineering degree programmes in South Africa)
- The ECSA Guidelines for Registration of Professional Engineers.

However, in addition to this, the following secondary documents were also analysed:

- SAICE (South African Institution of Civil Engineering)/ ECSA Guidelines for Mentors (which outlines the procedures to be followed by mentors appointed to supervise candidate engineers)
- UK Standard for Professional Engineering Competence (which has informed the South African Standard)
- ECSA Discipline Specific Guidelines for Professional Registration in Civil Engineering, Industrial Engineering, Electrical Engineering, Chemical Engineering, Agricultural Engineering, Aeronautical Engineering, Mechanical Engineering, Metallurgical Engineering and Mining Engineering.

Having provided the necessary contextual, theoretical and methodological background which underpins this study, we will now turn our attention to discussing and defining the literacy practices demanded of engineering graduates.
THE LITERACY DEMANDS OF PROFESSIONAL ENGINEERING REGISTRATION

In total, based on our analysis of the documents listed above, we have identified nine key literacy practices that engineering graduates need to master so as to display full competence upon professional registration. In this article, we have divided these literacy practices into three broad categories: reading, writing and critical thinking. Of course, these three activities are somewhat inextricable. For example, critical thinking is often only realised through either reading or writing (or both). Indeed, as Paul (1995) argues, reading, writing, listening and speaking are not manifestations of thought already undertaken; they are modes of thinking that amalgamate critical thinking abilities. Nevertheless, in this article we discuss reading, writing and critical thinking practices separately as it allows for the grouping of related abilities under these categories.

READING

We identify three central reading practices that Engineering graduates need to have mastered by the time of professional registration. These are:

- reading across multiple text types and disciplines;
- discerning essential (or relevant) from non-essential (or irrelevant) information;
- and comprehending, summarising, paraphrasing, synthesising and referencing information from other sources.

Some of the latter processes (summarising, paraphrasing, synthesising) are more clearly writing activities, but represent an engagement with other sources of information and have thus been included under reading practices. Figure 1 illustrates the extent to which these three reading practices are explicitly mentioned or implicitly required in the ECSA Exit Level Outcomes for the B(Eng) programme. Figure 1 also presents a fourth bar which shows the total number of assessment criteria which require some form of reading practice to be employed. As can be seen in the figure, there is relative importance placed on engineering graduates’ abilities to participate in these core reading practices. There is much evidence to suggest that candidate engineers’ proficiency in these core reading practices is tested upon professional registration.
Professional engineering registrants are expected to demonstrate their proficiency in reading and engaging with a wide range of text types representing an array of disciplines. One of the core professional attributes which candidate engineers must develop is an appreciation of the professional engineering environment. This includes having knowledge of the relevant codes of conduct and legislation that bear on engineering practice, including the Engineering Profession Act (Act 46 of 2000). They are also expected to have ‘full familiarity’ with ECSA’s policy statements. Upon registration, professional engineers are also expected to demonstrate that they are able to undertake continuing professional development, whether in the form of, amongst others, participation in conferences, studying technical literature, or engaging in post-graduate study. This requirement introduces further text types with which engineers must engage: conference papers, technical reports and academic literature. As Johns (1997) points out, these different text types represent different expectations and conventions. They also make use of different types of language (legal language, technical language, academic language and so on) and, as such, engineering graduates must be able to work meaningfully across these different languages and text types.

In addition, candidates for registration as professional engineers must demonstrate their proficiency in the high-level reading practice of being able to discern relevant from irrelevant information. There is much emphasis, both in the degree programme
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standard and in the professional registration guidelines, on candidate engineers being able to source relevant information and resources to inform their engineering designs, solutions and research. This is most explicitly stated in the programme standard’s first Exit Level Outcome – namely problem solving. Here, it is stated that candidates must be able to identify necessary and applicable engineering information, knowledge and skills (ECSA 2004).

Having sourced relevant information, candidate engineers are then expected to be able to summarise, paraphrase and synthesise this information in their own writing. This, of course, relies on them first being able to read with adequate comprehension. These processes are required in order to produce a technical or research report, in addition to a large number of smaller and less formal communication types. If one returns to the need for candidate engineers to demonstrate their ability to engage in continuing professional development by, amongst others, participating in conferences, producing journal papers and engaging in post-graduate study, it can be seen that there is a significant need for engineering graduates to be able to work and engage with sources in the above-mentioned ways. However, in the South African context, Angelil-Carter (2000) has shown that the adoption of these reading/writing processes takes place through a lengthy and complex learning process that requires practice and development over time.

Writing

As in the case of reading-related activities, we identify three central writing practices that Engineering graduates need to master by professional registration. These are:

• language competence,
• audience-awareness,
• and purpose-awareness (or text-type awareness).

Figure 2 illustrates the extent to which these three writing practices are explicitly mentioned or implicitly required in the ECSA Exit Level Outcomes for the B(Eng) programme. The figure also includes a fourth bar which illustrates the total number of Exit Level Outcome assessment criteria which require these writing practices to be employed. As can be seen in Figure 2, there is great importance placed on engineering graduates’ writing abilities, with almost one quarter of assessment criteria directly or indirectly aimed at assessing graduates’ writing abilities. This strong emphasis continues into the professional registration process.
Clear and accurate communication is a fundamental tenet of the professional registration process. In fact, communicative competence is listed as one of the four main attributes of a professional engineer across all of the sub-disciplines – candidate engineers must be able to communicate lucidly, accurately and confidently. The South African Institution of Civil Engineering (SAICE) requires its candidate civil engineers to write essays which are assessed according to three broad criteria, one of which is grammar and syntax. This is seen as an umbrella term for issues such as sentence construction, use of verbs and tenses, concord, spelling, punctuation, use of jargon, use of acronyms and use of abbreviations. In effect, therefore, for civil engineers, language competence accounts for one-third of their professional assessment. However, it is important to bear in mind that it is our opinion that language competence is of little value if candidate engineers are unable to engage in the higher-order reading, writing and critical thinking processes also discussed herein. In fact, much research has shown that a focus too heavily in favour solely of grammatical correctness serves to stifle student-writing and makes it more difficult for them to engage in those higher-order processes (Zamel 1987; Winer 1992; Tsui 1996).

In addition to being linguistically competent, there is also a strong need for candidate engineers to demonstrate their ability to tailor their communications (whether oral or written) to specific audiences. In particular, candidate engineers must be able to
‘communicate effectively, both orally and in writing, with engineering audiences and the community at large’ (ECSA 2004, 6). It is interesting to note that the concept of ‘cross-disciplinary literacy’ is also mentioned in the Programme Standard. This suggests that although Engineering graduates must have mastered unique engineering literacy practices by the time of professional registration, they should also have at least a working knowledge of the literacy practices common to other disciplines with which engineering comes into contact. Such disciplinary boundary crossing requires the ability to identify particular audiences’ needs (whether in terms of level of detail or explanation, type of vocabulary adopted or such) and work towards meeting those needs; this is vital for engineering graduates to be successful. However, too often, in university classrooms, student writing is not undertaken with any particular audience or purpose in mind (Ivanič 1998) and assignments are not structured in such a way that students are given practice in meeting the needs of specific target audiences (other than their lecturer).

Furthermore, just as candidate engineers are required to be able to read across a number of different types of texts (as discussed in the above section), so too are they expected to be able to produce a wide array of texts. These include proposals, technical reports and presentations. Amongst the assessment criteria in the Exit Level Outcomes listed in the Programme Standard for the B(Eng) qualification, it is mentioned that student-graduates should be able to formulate and present engineering solutions in an appropriate form. In addition, they should use ‘appropriate structure, style and language for purpose and audience’ (ECSA 2004, 6). They should also be aware of the conventions governing use of graphical or other visual materials. These conventions need to be made explicit to students during their time at university (Lillis 2001; Lensmire 2000). However, because they are not expected to master just one type of text, students must be provided with an understanding of how different types of texts make use of different conventions (Johns 1997; Elbow 1991). This requires of engineering educators to identify the main types of texts that students will be expected to produce after graduation and unpack the specific conventions of each of these text-types, providing multiple opportunities for student-engineers to produce such texts.

**Critical thinking**

With regard to critical thinking, we identify three central practices that Engineering graduates need to master by professional registration. These are:

- argument, evaluation and reasoning;
- reflection and independent learning;
- and relational and analytical thinking (or the ability to apply knowledge).

It bears repeating that although these activities are mental processes that may seem far removed from literacy *per se*, each of these is made manifest through reading and writing (or listening and speaking) and, as such, are considered in this article to be particular kinds of literacy practices. Indeed, as Paul (1995) argues, writing
lacking purpose, focus, documentation and logic reflects thinking lacking these things. Figure 3 illustrates the extent to which these three critical thinking abilities are explicitly mentioned or implicitly required in the ECSA Exit Level Outcomes for the B(Eng) programme. The figure also includes a fourth bar which indicates the total number of Exit Level Outcome assessment criteria that require these critical thinking abilities to have been developed. As can be seen in the figure, there is significant importance placed on engineering graduates’ ability to think critically, clearly and independently, with almost half of assessment criteria directly or indirectly aimed at assessing these abilities. Once again, this strong emphasis at graduation continues into the professional registration process.

![Figure 3: Percentage of ECSA ELO assessment criteria mentioning/requiring selected critical thinking practices](image)

There is a noticeably strong emphasis placed on argument, reasoning and evidence in the documentation pertaining to engineering standards and professional registration. Six of the 10 main Exit Level Outcomes for the B(Eng) qualification (ECSA 2004) include assessment criteria which require argumentation, evaluation or reasoning. Some examples include: a successful candidate ‘evaluates possible solutions and selects best solution’ (ELO1), ‘acquires and evaluates the requisite knowledge, information and resources’ (ELO3), ‘draws conclusions based on evidence’ (ELO4) and must ‘reason about and make judgment on ethical aspects in case study context’
Defining the ‘literacy gate’: Analysis of the literacy requirements of professional engineering registration (ELO10). This impetus is echoed in the UK Standard for Professional Engineering competence where it is suggested that engineers must ‘use a sound evidence-based approach to problem-solving’ (Engineering Council UK 2003, 12).

Furthermore, according to ECSA (2003, 8–9), the professional review is designed to allow candidate engineers the opportunity to demonstrate that they:

- have an understanding of the professional environment, including moral, ethical, environmental and safety issues
- have developed skill in engineering judgment, can make responsible decisions, can communicate lucidly and accurately, identify problems and find solutions to these, and that they can implement these solutions
- have adequate technical knowledge and understanding.

It is the second point above that appears to have the most relevance to the question of argument, evaluation and reasoning, as it points to the need for candidate engineers to be able to identify various options for action, weigh up these competing options, and make informed decisions. This clearly relates to the skill of argumentation. It further points to being able to communicate these decisions and the attendant arguments either in written or verbal form. The emphasis here is on clarity and accuracy of language but implicit, we would argue, is an expectation that the conventions of argument and argumentation (particularly in written form) are understood. Equally, the ability to identify problems and potential solutions to these problems similarly requires argumentation so that potential solutions can be weighed up against each other. According to Paul (1995), students (and we include Engineering graduates here) do not need to merely state facts; instead they need to reason, based on evidence as well as consider criteria on which to base their judgments, analyse the subject in relation to these criteria and then select evidence that supports the judgments they have made. This is particularly important given the degree of complexity facing the engineering environment today, as mentioned by the Engineering Council UK in the introduction to this article.

Furthermore, the literacy practices of engineering graduates must be advanced to the point that they are able to engage in reflection and independent learning. There is much emphasis on candidate engineers being able to:

- identify the limits of their own personal knowledge and skills which includes engaging in formal learning of new engineering theories, and techniques (Engineering Council UK 2003),
- ‘demonstrate competence to engage in independent learning through well developed learning skills’ (ECSA 2004, 7), and
- discern ‘boundaries of competence in problem solving and design’ (ECSA 2004, 7)
In most engineering sub-disciplines, candidate engineers are required to produce training reports which, according to the Guidelines for Registration of Civil Engineers (South African Institution of Civil Engineering in collaboration with ECSA, 2003), should describe their training and experience, explain the role they played (including their responsibilities), indicate objectives achieved, expand on problems encountered and emphasise personal experience (and lessons learnt). The expectation that emphasis be placed on personal experience and learning suggests that there is a desire for these reports to not merely be descriptive but for them to have a strong reflective stance. Such reflection and metacognition is a particular literacy/cognition practice that needs to be developed, the importance of which resides in the fact that it is a key means by which learning is consolidated. As Paul (1995) argues, in order to solve problems on their own, students must practice figuring problems out for themselves.

Further, Felder and Brent (2002) suggest the following three strategies for equipping students with the ability to engage in life-long learning: helping students understand how learning happens, requiring them to practice independent learning, and making what is being taught personally relevant. Each of these requires engagement in reflection so as to consolidate learning. It is clear that candidate engineers need to be introduced to the habit of reflecting on what they read, write and do so that they can integrate newly acquired knowledge into their frame of prior knowledge and experience. This may seem far removed from literacy but it is important to note that writing involves exploring one’s thoughts and learning and, as we conceive it, is not simply the mechanistic skill of reproducing ideas (Zamel 1987). Writing is thus a key means by which the development of reflection and independent learning can take place. Indeed, as Leibowitz (2000) argues, reflection is a key aspect of writing.

Finally, engineering graduates need to be able to think relationally and analytically, applying learned knowledge to new, unseen contexts. ECSA (2004) clearly state that students must be able to assess the impacts and benefits of their designs in the social, legal, health, safety and environmental domains. In particular, it is advocated, in Exit Level Outcome 8 (ECSA 2004), that candidate engineers should use a systems approach. Paul (1995) defines systems thinking as being able to not only solve problems but also understand their causes and relate them to other problems. Thus, professional registration requires engineering graduates to be aware of the larger social contexts for the decisions they make so that all factors are taken into consideration and those decisions are fully informed. In terms of problem solving, it requires these candidates for professional registration to be able to identify problems, rationalize them into their component parts, identify potential causes of the problem and understand how possible solutions might affect the problem and its causes.

The ability to think relationally and analytically is thus a core expectation of potential ECSA registrants, as are the other key literacy practices discussed above. However, the implications of this for engineering educators are far-reaching. It is these implications that are addressed below.
DISCUSSION

We have identified nine central literacy practices (conceived broadly as reading, writing and critical thinking) that are mentioned, either implicitly or explicitly, in documents pertaining to the registration of professional engineers three to four years after graduation. Once again, some of these practices (for example, relational and analytical thinking) are mental thought processes and may not appear directly to involve literacy as such (narrowly conceived). However, it is through writing and speaking that engineering graduates make these mental thought processes known and, as such, they require practice which requires them to express (in writing or verbally) relations between concepts, ideas, parts and so on. Figure 4 summarises the extent to which reading, writing and critical thinking abilities are required in the ECSA Exit Level Outcomes for the B(Eng) programme. As can be seen in the figure, the literacy practices discussed herein constitute a significant element in the requirements placed on graduates, with almost two-thirds of the assessment criteria directly or indirectly requiring one or more of the nine literacy practices discussed herein. It has also been shown how these practices are again tested upon professional registration with the Engineering Council of South Africa.

![Figure 4: Percentage of ECSA ELO assessment criteria mentioning / requiring broad literacy practices](image)

According to ECSA (2004), evidence to show that a candidate has met the assessment criteria listed under the Exit level Outcomes should be derived from major work
or from multiple instances of minor work. This is an important implication of this project: engineering students, while students or during their candidacy, are unlikely to acquire these practices by osmosis. Instead, they need to be systematically developed and ‘scaffolded’ during the course of their four year degree. As Felder (1982) argues, if students (in their jobs) are going to need to engage in activities such as synthesising problem solutions through disciplinary boundary-crossing, they need practice while they are at university.

Candidate engineers are expected to undertake literacy practices and cognitive functions that are somewhat advanced. These are not mechanistic, technical skills that can be absorbed simply or easily. They are practices that are learned and developed over time. As such, Engineering educators should take cognizance of these expectations and development of these practices and functions should be explicitly built into curricula. This may require what Paul (1995) terms a shift from teaching the memorization of facts to the learning of critical thinking. In the complex engineering environment facing our graduates today, assessment of engineering students, if it is not doing so already, must focus on these higher-order reading, writing and critical thinking demands. This may require the development of new kinds of teaching, learning and assessment.

According to Paul (1995), students internationally cannot reason, analyse and engage in argument. He continues by stating that this problem proliferates throughout the primary, secondary and tertiary education sectors. With regard to the tertiary education environment in particular, Paul argues that each discipline should be treated as a way of thinking where an engineer, for example, is not defined as such to the extent that s/he can recite engineering facts, but is rather defined as such to the extent that s/he thinks like an engineer.

Having defined the above literacy demands placed on engineering graduates at the ‘gate’ of professional registration, it is clear that this is but the starting point. Attention now needs to be paid to addressing the following questions:

- Are (and if so, how are) these literacy practices enacted by professional engineers in their jobs?
- Are (and if so, how are) they being developed in engineering curricula in South Africa?
- How can these literacy practices be better incorporated into engineering modules across the curriculum as opposed to in discrete communication or academic literacy modules?

Indeed, the value of this initiative will only be fully realised once these questions have also been addressed.
CONCLUSION

The argument presented in this article has five strands.

(1) The article begins from two premises. First, it recognises that reading, writing and critical thinking have the potential to perform a gate-keeping function within Higher Education. Second, it acknowledges that it is the function of the University to prepare students to meet their commitments to their employers and to society at large.

(2) After their time at University, Engineering graduates undergo a rigorous process of registration with the Engineering Council of South Africa. During their candidature for this registration process, the engineering graduate is expected to engage in literacy practices that are somewhat advanced and which represent a high level of cognitive demand. This process, quite explicitly, is the final ‘gate’ through which engineering students must pass in order to be acknowledged as professional engineers in South Africa.

(3) This article presents an attempt at defining this professional registration ‘gate’ more explicitly in terms of the literacy practices that are required. It has done so by undertaking a document analysis of the documents, processes and policies pertinent to the professional registration process.

(4) The result of this document analysis is the identification of nine central literacy practices (conceived broadly as reading, writing and critical thinking, each divided into three further sub-items) that are mentioned, either implicitly or explicitly, in documents pertaining to the registration of professional engineers three to four years after graduation. Our estimate indicates that almost two-thirds of the ECSA ELO assessment criteria mention or require one or more of these broad literacy practices.

(5) The literacy demands placed on candidate engineers at professional registration are not mechanistic, technical skills that can be absorbed simply or easily. Instead, they are practices learned and developed over time. These practices therefore need to be scaffolded from entry to university through graduation to professional registration and it should not be expected that students will acquire these practices by osmosis.

NOTE

It should be noted that the quantitative estimates of ECSA ELOs requiring the broad literacy practices identified herein is merely an estimate and is open to re-interpretation. The exact percentages quoted are less significant than the relative importance of these literacy practices which the figures in this article depict.

REFERENCES


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