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Using the National Benchmark Tests in Engineering diplomas: revisiting generic academic literacy

A B S T R A C T Proficiency tests are being used more extensively at institutions of higher learning for selection, placement, for diagnostic purposes and as a means of early identification for first year entering students who might be at risk of under-performance. Given that at some institutions a high premium is placed on these test results, one of the issues at stake is the extent to which the generic test content relates to curriculum practices in the various disciplines. This article focuses on three Engineering diplomas and explores the extent to which the test specifications of the National Benchmark Test in academic literacy relate to reading and writing practices in the discipline. The contention is that there should be a relationship between the test specifications and academic literacy practices at first year level in order to provide the data necessary to appropriately place and support students who might be at risk of under-performance.

Keywords: national benchmark test; proficiency test; academic literacy; engineering diploma

Introduction

The focus of this paper is the academic literacy National Benchmark Test (NBT), a standardised, generic test of academic literacy that was developed as a university placement and diagnostic test. The NBTs assess entry level proficiencies across the higher education system and serves as an assessment service to individuals and institutions to aid the process of fair and accurate admission and placement decisions (Griesel, 2006: 4). The research question asked is whether the academic literacy NBT is appropriate to determine academic literacy proficiency of first year students in an Engineering faculty. This paper argues that similar academic literacy practices are required for entry into a university of technology and that a standardised generic test would therefore be appropriate to determine the academic literacy proficiency of students at first year level. The rationale for this study is to establish whether the National Benchmark Test in

academic literacy is able to provide the data necessary to correctly place and support students who might be at risk of under-performance. Within the South African context students might be at risk of not performing optimally as a result of inadequate preparation for the academic demands of higher education (Ross, 2010; Coetzee & Juhl, 2009; van der Merwe & de Beer, 2006); 'not having mastery over new discourses' to be acquired (Paxton, 2007: 46); and below average performance on school leaving examinations and proficiency tests (Cliff, Ramaboa & Pearce, 2007; Weideman, 2003; van Wyk, 2002). The context of this study is the reading and writing practices at first year level within Engineering departments at a university of technology. The reading and writing practices of three Engineering programmes were analysed to determine the extent to which they relate to the specifications of the NBT academic literacy test.

Although there are different literacy practices associated with different disciplines (Murray, 2010), that is not the point of the paper. The focus is the generic academic literacy for appropriate placement into a discipline and programme.

The context for proficiency tests in South Africa

The South African higher education sector has, in the last decade, succeeded in significantly increasing participation rates of students across race, culture, ethnicity and socio-economic status. However, increased access does not necessarily equate with academic success in the form of a higher proportion of qualified graduates. According to Koch and Foxcroft (2003: 193), 'while participation rates of previously disadvantaged groups have increased, the throughput and success rates of students from educationally disadvantaged backgrounds have not increased concomitantly'. Van der Merwe and de Beer (2006: 548) claim that 'unequal schooling in South Africa' has scuppered academic success because 'scholars are not well-prepared for the demands of higher education'. Coetzee and Juhl (2009: 19) raise educationists' concerns of a drop in the quality of the matriculation examinations before and after 2008, when the new curriculum was assessed for the first time without differentiation between higher and standard grade subjects.

The failure rate at universities is not improving with 'up to 50% of university students [who] fail or drop out before completing undergraduate degrees ... [while] more and more learners fail the admission examinations at universities' (Coetzee & Juhl, 2009: 19). One of the contributing factors to low throughput rates at universities is considered to be students' low levels of academic literacy in the language of learning, i.e. English (Coetzee & Juhl, 2009; Scott, Yeld & Hendry, 2007; van Dyk, 2005; van Dyk & Weideman, 2004; Weideman & van Rensburg, 2002). Research indicates that academic language proficiency is considered a prerequisite for epistemological access and success in tertiary education (Murray, 2010; Lillis & Scott, 2007; Anthonissen, 2006; van Dyk & Weideman, 2004; Weideman, 2003).

The challenge for many students is not only about acquiring and developing the academic discourse of the discipline, but having to engage and be proficient in an additional language to their first language and/or the language of learning at secondary school. Although 'English has developed as a *lingua franca* of academia', many students seem to be marginalised since 'roughly 8% of the population speak English as their first language' (Anthonissen, 2006: 40). However, Blanton asserts that it is not enough for students to become fluent and literate in English (1994: 2), since higher education places demands on students' literacy that are

very different from the school setting. Given the disjuncture in school leaving results and academic performance in higher education (Coetzee & Johl, 2009; Scott *et al.*, 2007; Griesel, 2006: 5), the 'changing schooling-higher education interface' (Griesel, 2006: 1) and the low throughput rates (Scott *et al.*, 2007) it has become necessary to develop 'an assessment service that benchmarks entry levels in order to inform both admission and placement practices and curriculum responsiveness' (Griesel, 2006: 1).

With reference to the above indicators of setbacks to students' academic success, Higher Education South Africa initiated the NBTs (Griesel, 2006). The purpose of introducing large scale testing on a national level was to provide additional information to the National Senior Certificate results in order to assist institutions with placement of students onto appropriate curricular programmes such as extended programmes, tutorial programmes or language support programmes.

Large-scale entry-level testing

Large scale proficiency testing for higher education has become the norm internationally in an attempt to address the challenges of bridging the divide between secondary school and university and to promote the concomitant academic success in higher education. These tests are generally used for admission and placement purposes and to determine academic support and interventions. In the USA the Scholastic Aptitude Test and the American College Testing Program form a major part of the college and university admissions process (Syverson, 2007), the Test in English for Educational Purposes is widely used in the United Kingdom, while the Diagnostic English Language Needs Assessment is written by first year entrants at the University of Auckland (Read, 2008). Cliff, Ramaboa and Pearce (2007) and Cliff and Yeld (2006) note that many universities in South Africa have used proficiency tests in the past decade, with the most prominent tests being the Placement Test in English for Educational Purposes (PTEEP), the Standardised Test for Access and Placement (SATAP), the English Literacy Skills Assessment for Higher Education and Training (ELSA Plus), the Test of Academic Literacy Levels (TALL), the Assessment Access Battery (AAB) and more recently the NBT.

The overall purpose of the NBT in academic literacy is to determine whether a student is able to negotiate the demands of academic study in a higher education context. Academic literacy proficiency tests written nationally in South Africa assess students' ability to cope with academic reading, writing and thinking demands of higher education without relating to a subject or discipline bias (Cliff, Ramaboa & Pearce, 2007; Anthonissen, 2006; Cliff & Yeld, 2006; Van Dyk & Weideman, 2004). The NBT specifically, aims to assess the 'core academic literacy competencies that an entry-level student should demonstrate that will be sufficient indication that s/he will be able to cope with the typical demands of higher education in the medium-of-instruction, in a context of appropriate teaching, learning and curriculum support' (Cliff & Yeld, 2006: 20). As noted earlier in this article, if academic language proficiency is considered a prerequisite for epistemological access and success at tertiary level, then large scale testing should focus on the core academic literacy competencies that would provide indicators as to which students might be at risk of under-performing. The challenge for large scale testing, therefore, is to determine the core academic literacy competencies that a student in higher education would be required to negotiate.

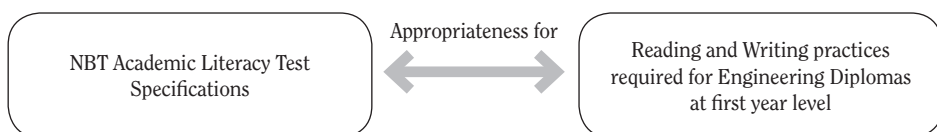
Academic literacy as a construct for test development

Academic literacy in higher education is more than communicative competence or the use of discrete language skills that are transferred from one context to another. According to a UK university, 'academic literacy indicates a fluency in the particular ways of thinking, doing, being, reading and writing which are peculiar to academic contexts ... far more than surface features of grammar and vocabulary' (Lillis & Scott, 2007: 16). Bachman and Palmer (1996) suggest that it is not useful to think in terms of language usage as applying a set of skills, but to think in terms of specific activities or tasks in which language is used purposefully. Core academic literacy competencies for testing, according to Bachman & Palmer (1996: 44), could broadly be identified as 'a set of specific language use tasks that the test taker is likely to encounter outside of the test itself and about which we want our inferences about language ability to generalise'. Therefore, in order for a test to discriminate between those students who are deemed to be proficient in entry-level academic literacy practices and those who are not, it should measure academic literacy practices that would be required for reading and writing at first year level of study. Reading and writing in this sense ascribe to Lea and Street's notion that 'academic literacy in higher education points to reading and writing in the different disciplines where such reading and writing constitute the central process through which students learn new subjects and develop their knowledge' (1998: 160). In other words, the test specifications and test items should be reflective of 'the target language use domain' (Cliff & Yeld, 2006: 20). In addition, the test specifications should relate to theoretical constructs to subscribe to construct validity and provide dependable measurement in order to be reliable (Green & Andrade, 2010: 329).

Research Design

The under-pinning premise for this research was to identify the practices and competencies required for reading and writing that students should be able to engage with at first year level and to compare the data with the NBT academic literacy specifications. The findings would determine to what extent the specifications of NBT in academic literacy would be appropriate for Engineering diplomas. (Refer to Figure 1 below.) To this end, interviews were conducted and the data were analysed deductively using the NBT test specifications as pre-set codes for analysis.

Figure 1: Comparison of NBT specifications with reading and writing practices in curriculum



The National Benchmark Test specifications for academic literacy

Most academic literacy proficiency test developers in South Africa (for PTEEP, TALL, SATAP, NBT) have drawn on the seminal research of Bachman (1990), Bachman and Palmer (1996), Cummins (2000), and Blanton (1994) amongst others, with reference to the language, thinking and reasoning approaches required for success in higher education. In the case of the NBT, 'the focus is on the knowledge and understanding of the organisational and functional

aspects of the language of instruction. Successful students, by implication, are those who are able to negotiate the grammatical and textual structure of the language of instruction and to understand its functional and sociolinguistic bases' (Cliff & Yeld, 2006: 20). These language structures were operationalised by previous test developers into test specifications, which in turn were used to set test items based on contextual reading texts. It should be noted that the test specifications for the NBT are similar to the PTEEP, SATAP and the TALL tests.

The test specifications of the National Benchmark Test in Academic Literacy aim to assess students' ability to:

- Make meaning from text, typical to that encountered in tertiary studies;
- Understand vocabulary related to academic study, in context;
- Identify and track points and claims made in texts;
- Evaluate evidence used to support claims made by writers;
- Extrapolate and draw inferences and conclusions from text;
- Differentiate main from supporting ideas in the overall and specific organisation of a passage;
- Identify text differences that relate to writers' different purposes, audiences, and kinds of communication;
- Understand and interpret information that is presented visually (e.g. in tables and flow-charts); and
- Understand basic numerical concepts and information used in text.

(www.nbt.ac.za)

Given these test specifications the questions asked are whether the academic literacy NBT is appropriate to determine academic literacy proficiency of first year students in an Engineering faculty, and whether such a test will provide the data necessary to correctly place and support students who might be at risk of under-performance.

Data generation and analysis

Semi-structured interviews were conducted with first year level lecturers in three Engineering departments to establish the reading and writing practices required of students in their respective subject areas (refer to Table 1). The interviews focused mainly on Semester 1 (S1) courses where reading and writing practices were required as part of knowledge production and presentation. Calculation and formula intensive subjects did not form part of the research sample. The NBT specifications for academic literacy formed the basis of the interview protocol in terms of how these specifications related to the reading and writing practices in the various subjects.

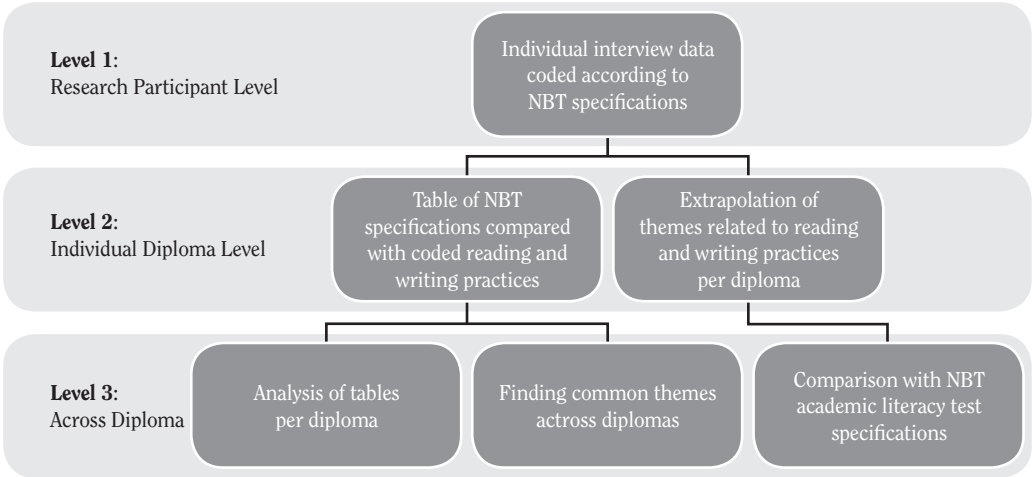
The interview data were analysed on three levels (refer to Table 2). On the first level, the data for each interview were analysed by means of open coding using the framework for the NBT test specifications, for example, vocabulary or separating the main idea from supporting ideas. On the second level, the coded data were tabulated verbatim according to the NBT academic literacy test specifications (represented vertically) in order to establish the reading and writing practices required across the subjects within a diploma (represented horizontally). At this level, themes on reading and writing practices relating to a specific diploma were extrapolated. The third level of data analysis focused on finding common themes in reading and writing

Table 1: Research Design

Engineering Departments	Number of Research Participants and Subjects	Research Method	Interview Protocol
Diploma A	7 Participants 4 Subjects	Semi-structured interviews	(1) NBT academic literacy test specifications (2) Reading and writing practices required at first year level
Diploma B	3 Participants 3 Subjects		
Diploma C	2 Participants 2 Subjects		

practices that emanated across the three Engineering programmes of this study. The data were compared with the NBT test specifications to determine whether the NBT in academic literacy would be appropriate to assess first year Engineering students’ ability to deal with the academic demands of their discipline.

Table 2: Levels of Analysis



Findings and Discussion

The findings and discussion will focus on the analysis of levels 2 and 3, i.e. the analysis per diploma followed by the common themes across diplomas. The verbatim data below represent the findings per diploma and do not focus on individual research participants’ perceptions and comments.

Using jargon, drawing conclusions and finding solutions

With reference to Diploma A the reading required included journal articles, text books and course notes, while the writing requirements were limited to assessments, expository or argumentative essays, reports and paragraphs. With reference to the use of vocabulary, terms and concepts were rated as very important in facilitating meaning and understanding of

subject matter. Students 'need to know how to work out the meanings of words, concepts in context, there's a lot of jargon that's discipline specific ...if they can't understand the words we use ... they can't take it forward'. Extrapolation, making inferences and drawing conclusions related to text as well as calculations, since 'they would need to do the calculations to get the info out'; this specification was 'extremely important' in order to 'evaluate information, draw conclusions, find solutions and not just [make] claims but produce evidence for those claims'. In another subject 'they interpret results to make meaning and extrapolate what [they've] done on a smaller scale to a bigger scale'.

The ability to separate the essential from non-essential information was considered an important skill at first year level. Students should be able to 'pick out main ideas, look for topic sentences, main ideas and supporting ideas, they should be able to interact with the text and give me the crux of that piece of reading'. This was not only limited to text, as students were required 'to decide what they're going to use in the calculation, what is excess and what they need'.

Articulating meaning in written text

The use of correct sentence, paragraph and discourse structure as a communicative function of writing was not applicable to all subject areas. In one subject this specification was not considered 'a core part' because 'they don't write that much as it's more numerical than language', while in another subject 'there must be a topic sentence with supporting sentences with examples and illustrations'. Although the 'sentence structure is required to make sense' students sometimes 'swop their words around and it changes the whole meaning of the sentence'. The ability to identify discourse structure, to present or interpret an argument and the logical development of content were considered to be important by all research participants. At first year level students 'should be able to persuade others, [to see] the link between the introduction and conclusion ... they must know linking words and coherence', that the 'content must relate to the thesis statement'. However, in other subjects this was not required because 'that's more essay related' and 'we don't expect them to go that deep into inferring this from the way the sentence is written'. The use of grammar and syntax in articulating meaning in written text was noted as the 'biggest problem ... their grammatical errors and the way they construct their sentences, it becomes a problem'.

The importance of text genre was mostly associated with the requirements of report writing where students 'must know style, register, tone, that there are different kinds of reports, formal and informal as well as [how this relates to the] purpose and audience'. Students should be able to 'disassociate themselves' and write 'in the third person' because with report writing 'there is a style, a certain order of writing'. According to the interviewees text genre, the use of non-literal language, ambiguity, connotations and metaphors were not relevant to all subjects since the content knowledge was considered to be primarily factual and objective, and they 'don't use figurative language'.

'Numeracy is a big deal' – relating text to numerical and visual representations

The ability to understand information presented visually and to understand numerical concepts formed an integral part of this programme at first year level. Students were required to interpret and generate various forms of visual representations of information. For example,

students 'will work from data to sketch, translate information into graphical representation' and there 'is a lot of work in the form of tables and graphs which summarise, give a picture of the data ... they've got to know how to use them'. Similarly 'they do a lot of calculations' because 'numeracy is a big deal'. Students would need to 'work out values, distances, directions, fractions, comparisons, it's about manipulating calculations'. However, the ability to engage with calculations was not about numbers only. Students should 'understand what they're reading to do the calculation, questions are verbal with numerics in it, they've got to put the two together'.

Language challenges and discussion

The difficulties that students encountered regarding language use covered a broad range of practices that students were required to apply at first year level. In some cases 'students just don't have the necessary vocabulary, they struggle to read, they come here with very low language and writing abilities' and 'they're battling with language skills'. These '[battles] with language skills' seem to resonate with research that foregrounds the under-preparedness and the low levels of academic literacy competencies of first year university students (Coetzee & Johl, 2009; Scott, Yeld & Hendry, 2007; Van Dyk, 2005; Van Dyk & Weideman, 2004). Using the language of learning (English), to engage with the academic demands of a discipline remains one of the biggest difficulties with which students need to contend (refer to Anthonissen, 2010). Although this seems to be a phenomenon with South African nationals, 'foreign students struggle with a language barrier as they don't have a good comprehension of English'. One of the misperceptions of Engineering programmes seemed to be that 'students come here thinking that they have to be good at Maths and Physics but they need to know how to write an argumentative essay'.

The data for this diploma showed that there were commonalities between the NBT specifications and the academic literacy practices required for the various subjects at first year level. The academic literacy requirements differed from one subject to another depending on the nature of the subject, whether it was more textual or numeracy based. However, it was apparent that all the subjects required academic literacy practices to enable and facilitate teaching and learning. Although certain subjects were numeracy based the principles of reading texts and scaffolding information applied to numerical structures as well. For example, when separating essential from non-essential information, 'they have to decide what they're going to use in the calculation, what is excess and what they need'. The least important test specification indicated by all interviewees was metaphorical language use. This could be attributed to the factual nature of the subject matter. For example, students needed to use actual measurements, draw conclusions from graphs or maps and present the facts in text format.

While certain academic literacy practices were relevant to certain subjects for reading and writing, there was a significant overlap with what was required in all subjects, such as the use of vocabulary in context, extrapolation, drawing conclusions and separating essential from non-essential facts or numbers. The data showed that this diploma programme required of students to be analytical thinkers who should be able to analyse graphs and maps, do calculations and be numerate while simultaneously being able to engage with text at a deeper level than communicative ability.

Hard facts in science are important

In Diploma B, the reading texts were limited to journal articles and course notes. Written tasks included research essays, discursive writing and reports. With reference to vocabulary, students were required to establish meanings from context as well as 'engage in the discourse of the discipline'. The ability to understand and work with metaphor in language, i.e. the capacity to perceive language connotation, ambiguity, idiomatic expressions, and figures of speech (Cliff & Yeld, 2006: 25) was not considered high priority as content was 'mainly factual' and 'hard facts in science are important'. However, the use of metaphorical language could not be ignored as text headings sometimes had figurative connotations and students 'need to understand the implications of these headings'. While not all texts had literal interpretations, students needed to understand that connotation and idioms add value to extracting appropriate meanings in context.

Applying insights, discourse structure and critical appraisal of texts

The capacity to draw conclusions and apply insights were required to 'assess the information at hand', in order to link that information with prior knowledge before drawing conclusions about sources or reading texts. 'The most important part of the report was the conclusions [since] that can only be drawn from the facts that you have' and 'back it up with substantial evidence'. It was also important 'to understand what is implied in the text and relate it to the subject'. The ability to structure correctly at sentence, paragraph and essay level, 'using the right transitions in between' was key to written text. Students seem to be able to structure at sentence level when 'they come here but we need to work on the paragraph and the essay'. The ability to write a summary 'in their own words as they understood it', was perceived as providing evidence of students' understanding of text. In terms of text genre, students were required to differentiate between formal and informal, informative and persuasive texts, and subjective and objective writing. The critical appraisal in selection of texts was important to 'see whether authors carry the same point of view'. Understanding text genre was therefore, not only about recognizing different registers, tone and style, but included critical appraisal of texts and identifying the 'different kinds of writing', the nuances and textual features that contribute to creating meaning of what was read.

Academic literacy practices in reading and writing were fundamental to this diploma which required more advanced levels of discourse structure, metaphorical language use and the ability to engage with different text genres than in Department A. Based on the findings there seemed to be a distinct need for students to develop academic literacy competencies that aligned with the NBT specifications.

Skills in scaffolding understanding

Students studying towards obtaining the diploma in Department C were required to engage in extensive reading across the different genres of text books, journal articles, magazines, newspapers and theses. The writing requirements included assignments and technical reports. With reference to vocabulary, students needed to know the scientific and lexical meanings and 'that words have different connotations based on the context in which they are used'. Students needed to be able to 'analyse text, make inferences ... that's a major

requirement ... they need to use context clues to scaffold their understanding'. This implied that students needed to be able to identify text structure in order to extract the 'context clues'. Extrapolation was not limited to text – students were required to integrate information from graphs, 'make a final conclusion ... and extrapolate data'. With reference to discourse structure, students should know 'how one sentence leads to the next, to structure a paragraph and write a topic sentence with supporting ideas and linking sentences'. Particular attention was paid to the 'scientific way of doing things' when explaining experimental procedures, that 'it's got to follow logically'. Grammar needed to be 'scientifically correct, with correct word and sentence structure'.

Dealing with data in a scientific way

Given the different reading and writing practices with which students needed to engage, genre was an important component of this programme. In terms of reading practices, students were required to appraise texts for 'gathering information and getting the text data', while for writing practices students needed 'to state a strong argument and opinions need to be supported by facts'. At first year level 'different genres of letter writing, descriptive writing, describing processes in a scientific way' and logical, succinct summaries formed part of the writing requirements. An abstract was required for the report, which included 'extracting information, writing a summary of the report' and 'separating what is relevant and what's not'. Numeracy and visual literacy were noted as core competencies at first year level. With visual literacy students were required to 'explain the visual in terms of text and represent the text in terms of the visual'. For example, they needed to 'take the raw data and then either make a graph or a table and discuss what the graph tells them'. Separating essential from non-essential data was equally relevant to text as to numerical equations in order 'to extract equations relevant to what they are going to use and work out ratios and percentages'.

The data showed that for this diploma, with the exception of non-literal language use, all the NBT academic literacy competencies and practices were required in order to understand and make meaning of content.

Conclusion

A common feature of first year writing in Engineering was the technical report, which could be an integrated task across one or more subjects. The report necessitated the application of several academic literacy practices to be scaffolded in a specific order. These practices were embedded in the NBT specifications. For example, students would need to engage in critical appraisal of information (genre), plan the various stages of the report (discourse structure), use the jargon of the discipline (vocabulary), use grammar and syntax correctly, make inferences and draw conclusions to support an argument and use numeracy or visual representations to verify claims. These competencies required a certain level of thinking, reasoning and writing demands that students should be able to apply at first year level. As a discipline, Engineering was considered to be 'mainly factual', where students 'disassociate themselves because there is a style, a certain order of writing'. Since this writing genre was very different from the narrative, expository writing practised at school level students might not all enter higher education with the requisite skills and competencies to write a scientific report. Although not all subjects

required report writing competencies in S1, cognisance should be taken that there are other forms of writing with related competencies that might be required for vertical integration as students progress to subsequent semesters.

The findings showed that there was a noteworthy relationship between the test specifications of the NBT and the academic literacy practices required for reading and writing practices at entry level in Engineering. The ability to use scientific jargon correctly, 'that's discipline specific', interpreting 'results to make meaning', separating essential from non-essential information for summaries, abstracts and numerical calculations and the correct use of discourse and grammar structures all relate to the need to inculcate appropriate reading and writing practices in each diploma programme. Given the significant commonalities between the test specifications and the academic literacy requirements of the programmes one may conclude that the NBT should provide sufficient indication that a student will (or will not) be able to cope with the typical demands of reading and writing in Engineering, within a context of appropriate teaching, learning and curriculum support (Cliff & Yeld, 2006: 20). In addition to the test score, the use of benchmarks with clarifications which classify a student as proficient, intermediate or basic, provides further data to place and support students who might be at risk of under-performance. To this end, for the three Engineering programmes, the NBT would have fulfilled its mandate of providing 'an assessment service that benchmarks entry levels in order to inform both admission and placement practices and curriculum responsiveness' (Griesel, 2006: 1).

The early identification of students who might be in need of additional academic support is an imperative of the NBTs since not all students enter higher education with the requisite academic literacy skills to learn in the discipline. According to Murray (2010: 61) the academic literacy practices that students require for higher education need to be learned within the context of their discipline area, since 'academic literacy is something with which few students enter university adequately equipped'. Kaiser, Reynecke and Uys (2010: 57) suggest that an integrated approach to academic development and subject-based content should be adopted since 'academic literacy skills will be acquired more effectively when the language is learned in conjunction with meaningful content and purposive communication, and where the language is not the object or purpose of the learning' but the vehicle of instruction.

In response to the agenda for widening participation, universities are having to address major challenges around the English language competence of students entering higher education many of whom lack the language skills they need to meet the demands of their diploma course. Institutions are under unprecedented pressure to respond and ensure they are meeting their duty of care to the students concerned. This study highlights the pivotal role of academic literacy as a vehicle for epistemological access in teaching and learning in Engineering programmes since 'academic behaviours underlie success in all academic areas' (Blanton, 1994: 8). However, the value of the NBTs will only be realised should appropriate support structures be in place to assist students early in the first year of study. With the necessary concerted efforts to use the NBT results judiciously together with early academic intervention measures, improved academic access and throughput rates might just be that more achievable.

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