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Academic Literacy for Science: A Starting Point for Recurriculation

Abstract

English for Specific Purposes courses are taught at many universities around the world and also play a critical role in the South African context. There is limited transparency and therefore little agreement regarding what the curricula of such courses should include. The aim of this study was to start a conversation about which academic abilities are essential for academic success by describing and evaluating the proposed outcomes of two academic literacy (AL) courses for science students at a South African university. The courses were examined by comparing the abilities addressed in each course to an extensive checklist of general AL abilities. The four-year programme course was found to cover most of these AL abilities sufficiently, but the weight of several features warranted reassessment. The three-year programme course addressed fewer of these AL abilities and the weighting of several AL abilities also needed to be reassessed. The findings suggest that the four-year extended programme course curriculum offers the better AL foundation as it appears to be more successful in sufficiently addressing a variety of AL abilities. Should the learning outcomes of the two programmes be more closely aligned, students from both programmes entering second year would be equally prepared. However, it would seem that both courses would benefit from further analysis, for example feedback from various stakeholders, and consequent recurriculation.

Keywords: English for science and technology, English for specific purposes, academic literacy, curriculum development

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1. INTRODUCTION

Due to the ever-increasing gap between secondary and higher education (see for example Van Dyk, Zybrands, Cillié & Coetzee, 2009:333; Higher Education South Africa, 2008:3), academic literacy courses in various formats are currently commonplace in most South African universities. A great deal of literature exists that argues for one approach over another – for example using discipline-specific English for Academic Purposes (EAP) courses rather than generic EAP courses, or team-teaching rather than having add-on courses (e.g. Song, 2006; Murie & Thomson, 2001; Kasper, 1997). This article accepts the advantages of situating academic literacy courses within various disciplines (see, for example, arguments made by Butler, 2013; Goodier & Parkinson, 2005; Hyland, 2002; Johns, 1995; Berkenkotter, Huckin & Ackerman, 1991; Becher, 1989). Few studies, however, explicitly describe the content of discipline specific courses, specifically in the natural sciences. The purpose of the current article is to do precisely that, by using an AL checklist of perceived essential abilities to evaluate and inform the AL curriculum design process. For this purpose, two English for Specific Purposes (ESP) academic literacy courses at the University of Pretoria are described and compared, with the initial aim of ensuring that these courses achieve the same AL outcomes, and the ultimate aim of determining how both of these might have to be recurriculated to best address students' AL needs.

One of these courses is presented to students in the University of Pretoria's four-year extended programme, while the other is presented to students in the traditional three-year curriculum[i]. Students from the four-year programme take two years to complete the BSc first year and then feed into the same second year as the three-year programme. The courses are examined by comparing the skills addressed in each course to an extensive checklist of academic literacy abilities, based on a questionnaire by Van Dyk (2014) and adapted by Fouché (2016), that addresses the construct of academic literacy. The aim is to determine 1) which AL abilities are focused on, and to which extent they are focused on, and 2) to which extent the two courses reach the same outcomes.

This paper forms part of a larger action-research study that aims to determine to which extent the AL abilities that are identified in this article address the needs of students, as well as the subjects that are serviced by these courses. It further aims to use this evaluation as a reflection on the science AL curricula and as a point of departure for curriculum development to refine these courses so as to better address necessary AL needs. We hope that the current article reveals the usefulness of the AL abilities checklist in reflecting on curricula as part of a development process. We further hope to promote transparency amongst practitioners in the field of academic literacy, consequently strengthening the field as a whole. Further, by making transparent the curricula of these two courses, this article hopes to open a conversation amongst practitioners regarding which aspects of academic literacy a first-year ESP course should ideally address, thus contributing to a deeper understanding of scientific literacy.

2. ACADEMIC LITERACY

Before academic literacy courses are described, it is useful to start by defining the concept of academic literacy, and to situate it in a relevant framework. Many researchers have defined academic literacy (e.g. Kaburise, 2012; Cliff & Yeld, 2006; Leibowitz, 2001; Lea & Street, 1998; Taylor, Ballard, Beasley, Bock, Clanchy & Nightingale, 1988). Two 'poles' seem to currently exist when academic literacy is discussed. On one side of the spectrum lies the skills-based approach, which considers academic literacy as four distinct 'skills' that can be taught in isolation (Bachman & Palmer, 1996:75). On the other side of the spectrum is what can broadly be referred to as the New Literacies Studies, which focuses on the social and cultural embeddedness of literacy practices, and the concept of multiple literacies existing in various contexts (cf. Gee, 2008; Leibowitz, 2001; Boughey, 2000; Lea & Street, 1998). We share Van Dyk and Van de Poel's (2013) more moderate view of academic literacy. These authors define the construct of academic literacy as 'being able to use, manipulate, and control language and cognitive abilities for specific purposes and in specific contexts' (Van Dyk & Van de Poel, 2013:56). This view acknowledges that literacy practices are situated in specific contexts and cultures, yet still accepts that there are specific abilities (be they generic or subject-specific) that should be acquired for students to become academically literate. It thus overcomes one of the main criticisms that have been levelled against the New Literacies Studies, namely that their real-world application is not clearly defined, specifically in terms of curriculum design (Van Dyk & Van de Poel, 2013: 50; Lea, 2004: 741; Lillis, 2003: 192). We also agree with Kern's socio-cognitive framework for academic literacy. According to Kern (2000:16-17), academic literacy consists of linguistic, cognitive as well as sociocultural/psychological dimensions. He further argues that literacy involves language use, reflection and self-reflection, problem solving, cultural knowledge, conventions, collaboration and interpretation.

3. ACADEMIC LITERACY COURSES IN THE NATURAL SCIENCES

Very little research exists that reports on the course content of discipline-specific academic literacy courses. Some of the studies that do make such an attempt in the field of science and technology are described below.

Parkinson (2000), Goodier and Parkinson (2005) and Parkinson, Jackson, Kirkwood and Padayachee (2008) all describe a stand-alone course called *Communication in Science*. This course is mainly aimed at underprepared second-language first-year students. The focus of the course is on the genres that are generally required of undergraduate science students; students are firstly comprehensively exposed to these genres, and are secondly required to extensively practice writing in these genres. The main genres that are focused on are the lab report, the academic essay, posters and oral presentations. Texts are sourced mainly from popular science journals, but also from first-year science textbooks and even research articles that are not too conceptually dense. Students are encouraged to engage in pre- and post- reading activities, and to submit multiple writing

drafts to tutors. The course is organised around topics, with various activities and genres naturally emerging from these topics and accompanying texts.

Van Dyk, Cillié, Coetzee, Ross and Zybrands (2011) report on a course called *Scientific Communication Skills*. This course, which uses the broader discipline-specific approach, is presented as a stand-alone course to first-year students, in groups of 35 to 50 students, for two hours per week. Although reading abilities are the focus of the first semester, and writing abilities the focus of the second semester of this course, abilities are integrated throughout. Additional abilities that are integrated in both of the semesters are listening, speaking and cognitive abilities. Authentic science texts are used. Aspects that are paid special attention to include the following: gathering, analysing, organising and judging information; reading as an interactive process (including the interpretation of texts, and using appropriate reading strategies); the organisation of texts at micro- and macro-levels; the structure of texts; language requirements; scientific style requirements; appropriate referencing strategies; critically analysing students' own thoughts and writing (by means of class discussions, group work, peer assessment and Writing Centre visits); and academic argumentation.

Fouché (2009) describes a series of academic literacy workshops aimed at first-year students in the University of South Africa's Science Foundation Programme. Twenty three-hour workshops are held over a four-month period (one semester). Workshops are built around various academic literacy abilities and genres, and draw on materials from a broad variety of scientific subjects. The workshops cover the following topics: vocabulary, sentence writing, using scientific words and concepts in context, academic reading, paragraph writing, paraphrasing, summarising, visual literacy, distinguishing between essential and non-essential information, note-taking strategies, referencing, expository writing, argumentative writing, synthesising information, and writing a laboratory report.

Jacoby, Leech and Holten (1995) discuss an English for Science and Technology (EST) course that is built around the writing of a scientific research report. The course consists of the following subsections: the Introductory Unit which discusses the 'summary and abstract' sections of the research report; Writing Assignment 1, which discusses the 'methods and materials' section; Writing Assignment 2, which discusses the 'results' section; Writing Assignment 3, which discusses the 'introduction' section; Writing Assignment 4, which discusses the 'discussion' section; and the Final Writing Assignment, which returns to the 'Summary and Abstract' sections. Discourse structure as well as lexical and grammatical features are discussed in each of these subsections. Students are guided through the process by firstly considering genre conventions and then analysing authentic texts. This is followed by preparing the assignment, planning for the assignment, drafting the assignment and finally receiving feedback on the assignment.

Hudson (1991) reports on an academic literacy course which is aimed at Chemical Engineering students. This course is presented over a two-year period, and is structured around ten thematic units, namely General Science, The Field of Chemical Engineering,

Energy, Materials and Properties, Environment: Technical Issues and Solutions, Technology, Electronics, Computers, Equipment Design, and Physical and Mechanical Processes. Authentic materials are used for each of these thematic units.

The following section offers a description of two ESP courses that are presented at the University of Pretoria. The theory of comparative evaluation (Schröter, Coryn, & Montrosse, 2007; Ojala & Vartiainen, 2008) is used in the analysis of these two courses' curricula – this theory is further discussed in the Methodology section of this paper.

4. A DESCRIPTION OF TWO ACADEMIC LITERACY COURSES FOR SCIENCE STUDENTS

The purpose of this section is to give some background about the two courses under investigation for the current study. The first course is an AL course that is aimed at foundation-year science students in a four-year programme; for the purposes of this article, the course will be referred to as the four-year programme AL course. This course is presented by a unit that forms part of the University of Pretoria's four-year programmes. Several versions of the four-year programme AL course have been presented since 2008 – in its current format, it has been presented for approximately six years. Due to its apparent effectiveness (an observation made mainly based on anecdotal evidence), in 2012, the Faculty of Natural and Agricultural Sciences decided that a similar version of this course should be presented to its traditional three-year programme students. For the purposes of this article, this course will be referred to as the three-year programme AL course. This course is presented by the University of Pretoria's Unit for Academic Literacy (thus, not the same unit that presents the four-year programme AL course) since 2013. For a variety of reasons, including the limited time available to get the three-year programme AL course in place, and the three-year programme course creator having a different vision for the course, the four-year and three-year programme versions ultimately seemed to have vastly different curricula.

In 2014, the course coordinators of these two courses decided that the curricula of both courses should be reassessed to determine whether students reach the same outcomes in the courses, and to determine whether the curricula of both courses could be improved to better address the knowledge base of scientific literacy addressed in each. The main reason for this is that students from both the four-year programme stream and the three-year programme stream eventually feed into the same second-year science subjects. Thus, students from both streams should ideally enter the second year having attained similar academic literacy outcomes. It was decided that the best approach for evaluation would be to do a comparative evaluation and that the first step would be to design a checklist which would help with the identification and evaluation of essential AL abilities.

In order to facilitate a description of two academic literacy courses that are presented to science students at the University of Pretoria, a checklist was created that is based on

Van Dyk's (2014) Questionnaire on Academic Literacy. This checklist (Figure 1) contains a comprehensive range of abilities that are generally seen as falling under the generic umbrella of 'academic literacy'. Of course, few courses can, or even should, address all of the aspects mentioned on the checklist. It is merely meant to serve as a useful tool that can be used to unpack the focus of various academic literacy courses. As recommended by Bachman and Palmer (1996:76), the items on this checklist are not centred around specific skills but rather as a 'specific combination of language ability and task characteristics'; in other words, each item is centred around an 'ability-task'.

A limitation of using this checklist in the current study is that it is not focused on abilities that are specifically required from students in the natural sciences. It would be worthwhile to, after careful consultation with subject experts, adapt this checklist to various disciplines. However, we still believe that it is valuable in its current form as a descriptive tool for the courses under discussion as a more generic skills list is required to cater for very different science courses.

Course 1

Four-year extended programmes are increasingly seen as a viable option to increase the low participation rates in South African higher education (Council on Higher Education, 2013, 2009). These programmes generally have slightly lower entrance requirements than their three-year (the norm in South African higher education) equivalents, and aim to give students additional support so as to enable them to better cope with their subject content. At the University of Pretoria, the first semester of the three-year programme is stretched over 18 months. Students receive additional tuition during these 18 months, but are required to achieve the same outcomes as their three-year programme counterparts. The only exception to this is the extended programme AL course, which is only presented for the first two semesters (or 12 months).

The course supports four-year extended programme natural sciences students from three broad fields: biological sciences, physical sciences, and mathematical sciences. As a result of the wide variety of students taking this course, an adjunct-course approach was not feasible – there is no single course that is shared by all these natural sciences students other than the extended programme AL course. As a result, the broader discipline-specific approach[ii] was decided upon; thus, the course draws on material from several scientific fields (and, as far as possible, from students' various subjects).

The course is presented for two double periods (thus four periods of 50 minutes each) per week for a duration of 28 weeks (two semesters of 14 weeks each), to classes of approximately 50 students. The approach taken in the classes is that of facilitation rather than lecturing, and classes often take on a workshop format. Peer- and group work is heavily relied upon, and valuable learning opportunities are made possible as a result.

Topics that are addressed include: writing coherent and cohesive sentences, paragraphs and essays; reading strategies; note-taking strategies; time management; vocabulary-

building strategies; learning styles; visual literacy; classifying information; and conducting research (including an extensive section on referencing and avoiding plagiarism). All of these topics are dealt with in the context of the sciences; for example, students would take notes on a section from a science textbook, or would write paragraphs that are typically required in their science assignments and tests (for example giving a definition and description of an object or substance, or describing a process, such as the process followed when doing a specific experiment). However, some topics that are often addressed in English for Science and Technology courses, such as writing a laboratory report, are not explicitly addressed in the current curriculum. Thus, future research should determine whether the topics covered in this course are specific enough for first-year science students.

Material is sourced from science textbooks, popular science magazines, newspapers and scientific journals. Although most of the material is science-specific, some sources for referencing are generic. Furthermore, not all material is academic in nature (for example material from popular science magazines and newspapers). This is because these sources often address general and popular scientific topics in a manner that is accessible to all science students. We believe this to be valuable for first-year students who have not specialised in any specific scientific field. However, this assumption should be tested through future research, for example by interviewing students and subject lecturers on the topic.

Continuous assessment is essential to monitor progress and track student development therefore; students submit small assignments on a weekly basis. In addition, a large assignment is submitted towards the end of each semester – these assignments aim to integrate and assess all the abilities that were dealt with in class throughout the semester. Students are encouraged to take drafts of all assignments to tutors before submission for additional input, and are also required to submit drafts through Turnitin (a plagiarism-management software application) so as to discourage plagiarism. Moreover, students write two semester tests and one examination per semester.

Course 2

The three-year programme AL course has a slightly different audience from Course 1 as the course caters for students enrolled for a mainstream natural sciences degree programme. The cohort is made up of students from the biological sciences, mathematical sciences, consumer sciences and physical and earth sciences. As with the first course, the wide variety of students taking this course makes an adjunct-course approach unfeasible as no single course is shared, and a broader discipline-specific approach is most viable.

The course, which is presented for 14 weeks, consists of two 50-minute lectures per week to classes of approximately 70 students. Moreover, the course comprises an online section where students complete multiple-choice questionnaires on the texts that they deal with in class. Pearson's MyFoundationLabs also forms part of the course structure;

this online programme has a reading level, reading skills and writing skills component. Students have to complete these activities in their own time. As is the case with the four-year programme AL course, classes often take the form of workshops, with peer- and group work being used extensively. The course is structured around a variety of topics, for example 'particle physics', 'DNA' and 'bacteria'. Several reading strategies, mainly focused on identifying main ideas, are applied to each of the topics. Other abilities such as paraphrasing and paragraph writing are addressed to a limited extent in some of these topics. The texts are mainly selected from different popular science journalism sources.

Assessment also involves continuous assessment, which includes a paragraph, an essay outline, two one-page essays and a semester test in the form of a two-page essay. The examination is a computer-based test (CBT) that mainly focuses on academic vocabulary.

5. METHODOLOGY

The methodology of the research is based on the theory of comparative evaluation. Evaluation is a critical element of the scientific enterprise; it is usually in the form of a peer review (Schröter, Coryn, & Montrosse, 2007). However, comparative evaluative research can be essential to reactively improve quality to gain a better understanding of the research problem, especially when it is used to benchmark educational development, as shown by Ojala and Vartiainen (2008). Therefore, this type of evaluative research can contribute to the understanding of curriculum development in academic literacy, especially in this study where the focus of the research was to evaluate the curricula of two AL modules offered to science students, where students from both groups feed into the same second year. The ideal is that students should have mastered the same academic literacy abilities to be equally prepared for the rest of the degree.

The research tool used for this study is an AL abilities checklist that was adapted from Van Dyk's (2014) Questionnaire on Academic Literacy. This checklist covers a comprehensive list of academic literacy abilities that are in line with Van Dyk and Van de Poel's (2013) conception of academic literacy, as well as Kern's (2013) socio-cognitive framework for academic literacy. The authors of this paper agree with the academic literacy abilities included in the checklist , but felt that three significant aspects had not been addressed; these have been added (also see Fouché, 2016). These abilities are: 1) the ability to listen effectively in class, as students need to assimilate a considerable amount of information; 2) the ability to create visual data, as data is produced at an unprecedented rate and science students need to incorporate visual data in their writing to help readers make sense of information (Keim, Mansmann, Schneidewin & Ziegler, 2006), and 3) the ability to summarise and paraphrase appropriately. The aim of using the checklist is to standardise the evaluation process and to determine whether abilities considered as important are addressed.

Three lecturers who are involved with the four-year programme AL course, and four lecturers who are involved with the three-year programme AL course, were asked to complete the checklist. The checklist responses for each of the two courses were compared and where answers differed, the researchers and lecturers discussed the answers to reach a consensus. No students were involved in this research.

The extent to which academic abilities were addressed in the modules under discussion was divided into four categories: *addressed extensively*, *addressed a lot*, *addressed to a limited extent* and *not addressed at all*. These four categories were qualified as follows: *addressed extensively* was considered to apply to abilities addressed throughout the course, and that were the focus of several lessons in the course; *addressed a lot* was considered to apply to abilities that were addressed regularly during the course; *addressed to a limited extent* was considered to apply to abilities that were addressed during, but were not the focus of, the course – these include abilities that were part of the hidden curriculum (learning experiences that was not explicitly taught); and *not addressed at all* was considered to apply to abilities that were not addressed in any form.

The results of the questionnaire were, firstly, grouped according to these categories to get an overall picture of the extent to which the abilities were addressed in the course. Secondly, the significance of these groupings was assessed. These groupings do not in themselves indicate the value of an academic literacy course as not all aspects have the same importance at first-year level, and not all would be equally important for science students; therefore, the time available should not be equally apportioned. Thirdly, then, as a result of this assessment, the focus points of the two courses were identified and, based on this information, tentative suggestions were made for the improvement of the courses.

CHECKLIST OF ACADEMIC LITERACY ABILITIES								
	Degree to which ability is addressed in the four-year programme AL course				Degree to which ability is addressed in the three-year programme AL course			
	Addressed extensively	Addressed a lot	Addressed to a limited extent	Not addressed at all	Addressed extensively	Addressed a lot	Addressed to a limited extent	Not addressed at all
1. Listen effectively in class			x				x	
2. Take effective notes during class			x				x	
3. Take notes from reading material (such as annotating, linear outlines, mind maps)		x					x	
4. Paraphrasing and summarising information		x				x		

5.	Have an appropriate reading speed			x			x		
6.	Use appropriate reading strategies for different goals		x				x		
7.	Understand assigned reading			x		x			
8.	Understand academic vocabulary		x				x		
9.	Use academic vocabulary		x				x		
10.	Understand subject terminology		x					x	
11.	Use subject terminology		x					x	
12.	Use the conventions of academic language (formality, vocabulary, exact language, objective language etc.)		x				x		
13.	Use subject-specific conventions			x				x	
14.	Participate in academic discussions (during and outside of class, with students and lectures, in spoken or written form)	x				x			
15.	Do oral presentations in class	x							x
16.	Analyse and comprehend (know what to do) assignment and exam questions	x							x
17.	Structure writing (for exams, tests or assignments)	x				x			
18.	Produce writing (for exams, tests or assignments)	x				x			
19.	Apply relevant processes involved in academic argumentation (fact/opinion, ir/relevant information)		x				x		
20.	Develop a main argument or thesis			x		x			
21.	Write short coherent pieces of text	x				x			
22.	Write long coherent pieces of text	x							x
23.	Interpret visual data		x					x	
24.	Create visual data		x						x
25.	Integrate visual data with written work		x						x
26.	Understand underlying concepts of empirical research (including methodologies)			x					x
27.	Apply underlying concepts of empirical research (including methodologies)				x				x
28.	Use different sources for research (databases, books, scientific journals, the Internet, etc.)		x					x	
29.	Process and interpret gathered data		x					x	
30.	Use appropriate search strategies for research purposes			x				x	

31.	Reference a variety of sources (in-text [direct and indirect quoting] and bibliography)	x					x		
32.	Use evidence from texts to support ideas	x					x		
33.	Use evidence from texts to challenge ideas			x					x
34.	Identify relevant information		x					x	
35.	Identify reliable information			x				x	
36.	Synthesise (integrate) information from various sources	x						x	
37.	Refer to different points of view appropriately			x				x	
38.	Use appropriate time-management strategies		x					x	
39.	Use appropriate learning strategies (such as using various learning styles)			x					x
40.	Use a computer				x				x
41.	Understand the functions a computer offers (e.g. using MS Word, MS Excel, MS PowerPoint etc; creating graphs, inserting pictures etc.)			x					x
42.	Using appropriate format and layout when typing assignments		x						x

This questionnaire is adapted from Van Dyk (2014). Questions 1, 4 and 25 were added by the authors of this article

Figure 1: Checklist of academic literacy abilities addressed in the two modules

6. RESULTS AND DISCUSSION

6.1 Abilities focused on in Course 1

Several abilities were identified as being addressed extensively in the course. First of all, it is clear from the checklist that the ability to write at an academic standard is the main focus of the course. Abilities such as structuring writing (for exams, tests or assignments) and supporting the main argument by using synthesised sources, with the necessary referencing of such sources, are shown to be particularly important in the curriculum of this course. Three other abilities were also found to be addressed extensively in the course. Firstly, students are required to present research orally before an audience in three oral presentations that are spread throughout the year (oral presentations form part of assignments for some subjects in the BSc curriculum and as it improves student confidence (Ferris, 1998); it can also influence class participation and attendance). Of

these, two form part of major assignments. Then, participating in academic discussions in class is a natural product of facilitation: students are expected to come up with answers individually, in pairs and in groups; thereafter, whole-class discussion is encouraged. Thirdly, the ability to analyse and comprehend exam questions is addressed not only as the focus of a lecture, but also in continual feedback on tests and exams, and in revision classes.

Abilities that were addressed throughout the year were largely those abilities that, according to the authors, underlie academic literacy, such as the ability to read strategically and take effective notes while reading, to paraphrase and summarise effectively, to understand the concept and use of academic conventions, academic vocabulary and subject terminology, to apply relevant processes seen as necessary for argumentation, and, finally, to understand the functions a computer offers so as to learn to present written work in the format expected in subsequent years. The use of computers is considered important for academic literacy, as it is used to structure and produce writing, to do research, to reference properly, and to interpret and create visual data.

Then, while the ability to process data is addressed extensively in the writing of assignments, there are three aspects of data processing which receive slightly less attention: processing and interpreting data, identifying relevant information and using a variety of sources available for research purposes. The interpretation, creation and integration of visual data are addressed primarily in the second semester of the course. Finally, another aspect to which attention is given is time management, which is considered to be of importance for success at tertiary level (George, Dixon, Stansal, Gelb & Pheri, 2008; Misra & Mckean, 2000).

Some aspects, while seemingly closely related to those that are addressed throughout the year, were found to be addressed to a limited extent only. Therefore, even though taking notes was practised at various stages during the course, as topic in class it was referred to only briefly. Similarly, having an appropriate reading speed and understanding assigned reading was put into practice in one lecture only. Listening effectively in class is not addressed directly, but is practised in that lecturers purposefully give verbal instructions throughout the year that students are expected to follow. Even though the focus of the course is primarily on the writing of academic texts (as was seen previously), less emphasis was found to have been placed on certain aspects of academic writing: developing a main argument or thesis, using appropriate search strategies when doing research and identifying reliable sources of information, accommodating different points of view, using evidence to challenge ideas, and using subject-specific conventions. Similarly, understanding the underlying concepts of empirical research is introduced only briefly. Understanding the functions a computer offers is referred to only as required for the presentation of assignments and is not dealt with on a technical level – it should be noted, though, that students take a separate computer literacy course that deals with these functions. Finally, learning styles are the focus of only two lectures and are not referred to further in a significant way.

Only two of the aspects of academic literacy as listed on the questionnaire were not addressed at all. The first was applying underlying concepts of empirical research (in contrast to understanding the underlying concepts of empirical research, which was introduced briefly), while the second aspect is the basic use of a computer.

6.2 Discussion of abilities focused on in Course 1

As reading strategically is considered an important academic literacy ability in all subject fields, it should be addressed to a greater extent. However, having an appropriate reading speed of 280 words per minute (Hasbrouck & Tidal, 2006) and understanding required reading, once the concepts have been introduced, depend on application by students. The teaching of reading abilities could be scaffolded (see, for example, Pretorius, 1995:41) by introducing these concepts in detail, and then referring back to them throughout the course whenever they might be applicable.

It would seem that more attention should be given to the taking of effective notes (both from study material as well as in class) and to the ability to listen effectively as both these abilities are deemed to be fundamental to academic success (Van Der Meer, 2012; Marais, 2009). Furthermore, using academic and subject-specific conventions, as well as academic and subject vocabulary is seen as central to the concept of academic literacy; thus, the degree to which they are addressed might need to be reassessed. In contrast, the viability of the weighty emphasis on oral presentations might need reassessment; from the courses described in the literature review, only one AL course incorporated oral presentations – this would seem to support that oral presentations generally do not warrant much emphasis in science-based academic literacy courses.

The extent to which the writing of academic texts is addressed in the course is in keeping with what might be considered the main purpose of discipline-specific academic literacy courses, as suggested by the earlier discussion on such courses, only one of which did not focus on writing. However, the type of writing that is focused on (for example essay writing as opposed to writing laboratory reports) should be re-examined. Similarly, a competent handling of assignment and exam questions is considered by many universities to be essential to increase students' comprehension strategies (e.g. Gillett, 2014; Monash University, 2014; Bureau of Study Counsel: Harvard University, 2011). Being able to develop a main argument or thesis, to use appropriate search strategies and to identify reliable information are abilities that would and should bolster the writing process which is so important to the academic literacy process (Van Dyk *et al.*, 2009:334; Archer, 2008:248; Weigle, 2002:4), yet these abilities are not focused on very much. These aspects should therefore possibly be given more primacy in the course. Similarly, being able to apply relevant argumentation processes, to use a variety of sources in research and to identify relevant information are important abilities at this level and they might need to be addressed more extensively in the course. Moreover, the interpretation of visual data is required throughout the undergraduate years of natural sciences students and it could be argued that it therefore needs to

be addressed more comprehensively in the course. In contrast, the course designers feel that the ability to understand the underlying concepts of empirical research, to incorporate contrasting ideas, to challenge ideas and to interpret data are aspects that feature at post-graduate level rather than undergraduate, and these abilities are therefore introduced at a basic level only. Being able to apply the underlying concepts of empirical research is similarly considered to be outside the scope of an undergraduate academic literacy course and is not addressed at all.

Further, time management (George *et al.*, 2008; Misra & Mckean, 2000) and learning strategies, though important to academic success, probably do not warrant further emphasis, as it is up to students to apply the strategies that have been acquired in class.

Finally, the professional presentation of assignments is an important ability for students in science faculties to acquire, as the completion of assignments by means of basic available software is regularly required. Understanding the functions a computer offers underlies this aspect, but does not need to be addressed more than to a limited extent. Addressing the basic use of a computer is not considered to be the domain of this course. Indeed, as mentioned above, a course designed to introduce all aspects of computer literacy runs concurrently with both AL courses.

6.3 Abilities focused on in Course 2

It is clear from the checklist that only a few abilities are addressed extensively. The main focus is on academic writing, but this only includes writing short coherent pieces of text (specifically paragraphs and three one-page essays). The course comprehensively addresses the planning and outline of an essay, developing thesis statements and topic sentences, as well as identifying the audience and purpose of texts. The lecturers give students time in class to discuss or look for the answer and then gain feedback from the class before giving the correct answer. Students therefore continuously participate in academic discussions. Amongst the abilities that were addressed a lot throughout the semester, reading strategies feature most prominently, and could be considered the second most important outcome of this course. Specifically, understanding assigned reading was addressed comprehensively throughout the course.

Other reading abilities that are addressed a lot during the course include using appropriate reading strategies and having an appropriate reading speed. These abilities were addressed solely through the online component of the course. Furthermore, understanding and using academic vocabulary, along with the ability to use the conventions of academic language was also addressed a lot. Lastly, the ability to apply relevant processes involved in academic argumentation along with summarising, paraphrasing, referencing and the use of evidence from text to support ideas were also addressed a lot.

As the course is achieved through facilitation, guided by a question and answer approach, students have to listen effectively and take notes in class, abilities which are therefore

implicitly addressed. Taking notes from reading material is not addressed explicitly in the course either, but students are expected to do planning for one essay where they include the notes they made from different readings. Moreover, the ability to understand and use subject terminology, along with the ability to use subject-specific conventions, is addressed to a limited extent. Identifying relevant and reliable information, using appropriate search strategies for research purposes, accommodating different points of view, using different sources for research, processing and interpreting gathered data and synthesising information from various sources are only addressed to a limited extent. Time management is only addressed to the extent that it is expected that students should submit assignments on time – it is therefore a hidden curriculum outcome. Lastly, interpreting visual data is also only addressed to a limited extent – there are only two instances where students need to interpret a visual element at a basic level.

Several abilities are not addressed at all. Students do not submit any typed assignments. They therefore do not need to apply abilities regarding the layout and formatting of assignments. Furthermore, students are not expected to create visual data nor are they expected to integrate visual data into written work. Students are also not given the opportunity to write long pieces of coherent text or do oral presentations. Other abilities that are not addressed at all are the ability to analyse and comprehend assignment and exam questions, using evidence from texts to challenge ideas, learning strategies, and understanding and applying the underlying principles of empirical research.

6.4 Discussion of abilities focused on in Course 2

Reading forms the bulk of the course. The ability to identify topic sentences, thesis statements, the audience and the purpose of a text are dealt with exhaustively. However, the course hardly addresses reading abilities beyond this.

This course does not include oral presentations at all as the course developer did not see the need for this; however, the BSc curriculum requires students to do oral presentations from their second year, so this AL ability is considered important. There is a focus on the ability to listen effectively in class, but this is only practiced and never addressed directly. The same goes for note-taking; students are expected to take notes in class, but note-taking methods are never overtly addressed and must therefore be introduced. More attention should possibly be given to the taking of effective notes from reading material, as this is also an important skill to master for academic success. Furthermore, being able to understand and use subject terminology, along with the ability to use subject specific writing conventions, should be essential to any English for Specific Purposes course.

Students are not given sufficient opportunities to write longer assignments (as are often required in science subjects) or to become acquainted with the concept of developing a main argument which is supported by the use of relevant, appropriate and synthesised sources, with the concomitant referencing of such sources. Writing is a vital ability for students to learn (Archer, 2008; Weigle, 2002) and it therefore seems important that

abilities such as being able to identify relevant and reliable information, using evidence from texts to support ideas and referencing should be covered more extensively. Furthermore, it might be advisable to explicitly address all of the above abilities instead of expecting students to 'pick up' these abilities unconsciously while engaged in other activities. In addition, being able to use appropriate search strategies for research purposes, accommodating different points of view, and using evidence to challenge ideas and synthesise information from various sources should bolster the writing process as mentioned above. The curriculum could be tailored much more effectively so as to spend more time on these abilities. More attention should be given to the interpretation and manipulation of visual data as this is of great importance in students' higher education studies (Bleed, 2005); this is especially true for students from the natural sciences. Another aspect that should be considered for inclusion is analysing and comprehending exam questions, as this ability is not included in the curriculum at all, despite its apparent importance to success at university level (Gillett, 2014; Monash University, 2014; Bureau of Study Counsel: Harvard University, 2011; Cornell University, 2007). As was the case for the four-year programme AL course, the ability of understanding and applying empirical research was considered to fall outside the scope of an undergraduate AL course for natural sciences students.

Learning styles and time management are completely neglected in this course. It might be to the advantage of students to give one lecture or online lesson on these abilities, as they are important to academic success (Friedman, [n.d.]; George *et al.*, 2008). All the assessments are hand-written; therefore, the ability to use a computer for academic work is not addressed at all. This should be reconsidered, considering that students are required to type the majority of their assignments in their content courses in the Faculty of Natural and Agricultural Sciences at the University of Pretoria.

6.5 A comparison of the two courses

A major realisation was that it is difficult to develop two separate science AL curricula that do not have the same number of contact sessions per week or are of the same duration, but are expected to have very similar outcomes, especially as AL abilities are something that students need time to develop. The best approach would have been to make more time in the curriculum for AL (also see the argument for a flexible curriculum, as is made by the Council on Higher Education [2013]); however, this is not currently feasible as there is no more time in the undergraduate curriculum to allocate to AL. Therefore, the most feasible approach in this context has been to re-evaluate the AL curricula and determine how they could be aligned to reach the same outcomes.

As can be seen from the above analysis, the second course disregards (or addresses to a very limited extent) several AL abilities that are seen as integral to the first course – abilities that, from previous descriptions of EST courses, would seem to be important for a natural sciences AL curriculum. The most prominent amongst these is the exclusion of the creation of visual data and their integration with written work, which, from an

examination of content-subject study material, seems to be an ability that is heavily drawn upon; therefore, including this into a science AL course is important. Another aspect that is not addressed in the three-year programme AL course at all, in contrast to its four-year counterpart, is doing oral presentations. Although anecdotal evidence suggests that oral presentations are not a crucial skill at first- or second-year level, research by Ferris (1998) shows that oral presentations increase confidence. Low confidence is a facet that inhibits class participation; therefore, including oral presentations might ultimately benefit students' ability to participate in academic discussions.

By limiting students to short pieces of coherent writing in the three-year programme AL course, students are not given the opportunity to practise the ability to develop a main argument or to write coherently and carry the argument throughout the text by supporting it with evidence. Considering that, for the most part, students have to produce longer pieces of writing for their content subjects, this is particularly problematic. In this respect, it might be useful to include opportunities for students to submit longer pieces of writing, as is the case with the four-year programme AL course. Both courses should, however, examine the type of writing that is required from students, and ensure that this is in line with what is expected from students in their science subjects.

Another noteworthy exclusion from the three-year programme AL course is the application of word-processing functions of a computer to type and format assignments (seeing that most content-subject courses in the natural sciences faculty require typed assignments). A further pitfall of the four-year programme AL course is that analysing and comprehending assignment and exam questions is not addressed. Teaching students the ability to discern key components in a question and to determine what the question is actually asking might be of great value to them.

Lastly, both courses could benefit from a reassessment of the source-material that is used in classes. The scientific nature of this material should be carefully considered to reflect the study fields of the students taking the various courses, and consideration should be given to include sufficient material from textbooks and journals – sources that students are likely to frequently encounter in their studies.

7. CONCLUSION

The aim of this study was to consider which academic abilities are essential for academic success by describing and evaluating the proposed outcomes of two AL courses for science students at the University of Pretoria. This was done by using an AL checklist to describe and compare two similar academic literacy courses for science students so as to determine to which extent certain academic literacy abilities are addressed in each course, and to determine whether the same outcomes are reached in both courses. In so doing, the authors were able to reflect on the effectiveness of the modules and the importance of specific AL abilities to science AL courses. The process of comparative

evaluation guided the authors in thinking about the structure, assessment and purpose of the individual courses.

One of these courses is presented to students in the University's four-year programme, while the other is presented to students in the traditional three-year programme. This is important as students from both programmes ultimately feed into the same second-year courses. Students exiting both programmes should therefore acquire the same level of academic literacy before they enter the same second year. The courses were examined by comparing the abilities addressed in each course to an extensive checklist of academic literacy abilities. The comparison showed 1) to which degree certain abilities were focused on, and 2) to which extent the two courses reached the same outcomes.

The four-year programme AL course was found to cover most of these aspects sufficiently, with particular emphasis on academic writing. However, the weight of some of the particular features was found to warrant reassessment in the light of their importance to the success of academic literacy attainment. These were: reading strategically; taking notes; using academic conventions, academic vocabulary and subject terminology; taking effective notes in class; listening effectively; applying relevant argumentation processes; using appropriate search strategies and identifying reliable information. Similarly, it might be advantageous to introduce the ability to work with visual representation (though otherwise adequately addressed) earlier in the course than is currently the case. The suggested changes will still need further consultation with relevant role-players before implementation.

The three-year programme AL course was found to cover some of the academic literacy aspects sufficiently. Yet, in relation to the four-year programme, this course seems to be less successful in obtaining a wide variety of AL outcomes. The weighting of most of the abilities taught in this curriculum needs to be reassessed to ensure the success of academic literacy attainment. Apart from the fact that this curriculum does not address various seemingly crucial abilities, the texts are not academic in nature as they are mostly science journalism texts – texts that rarely form part of students' study material.

The best approach for moving forward would be to use the four-year programme as a foundation as it appears to incorporate more academic texts and is more successful in attaining necessary outcomes, based on the variety of academic literacy abilities addressed, and the extent to which they are addressed. By using this approach, the learning outcomes would be very closely aligned, so that students have similar abilities when feeding into the same second year. Importantly though, further research is needed, such as a needs analysis on the expectations of the different stakeholders (e.g. the students and subject lecturers).

Using the checklist to evaluate the AL courses and the extent to which AL abilities are addressed in the given curricula has assisted in benchmarking these courses. This benchmarking will be strengthened if done in conjunction with subject specialists across the science curriculum to determine which AL abilities they expect students to learn. Therefore, the next step in this action-research process will be to interview subject

specialists across the science curriculum to identify the abilities they believe are important in an AL curriculum, and to determine to what extent they feel these abilities should be addressed. Evaluating the current curricula in conjunction with the feedback from subject specialists will help the authors to develop an AL curriculum for science students that is more subject specific.

This article was the first stage of an action-research cycle. In future, further aspects that will be reported on are 1) stakeholders' perceptions of necessary AL abilities, 2) empirical evidence about the effect of the courses and 3) how the courses were adapted based on the feedback received in (1) and (2). The additional data sets in (1) and (2) will assist in providing a more comprehensive picture of the abilities needed in science AL courses. At a time where 'attention has shifted from an almost exclusive focus on access to include a concern with graduation rates and with general efficiency and quality matters' (Yeld, 2010:26), it has become vital to be transparent about what we teach, how we teach it, and whether what we teach works. We hope that this article will contribute to precisely that aim.

8. END NOTES

[i] This article is based on the 2013 three-year programme curriculum. This curriculum has since been adapted based on the research conducted in this article, and will be further adapted for the 2015 student intake.

[ii] See Braine (1995) and Kennedy and Bolitho (1984) for a description of this type of course, which has also been referred to as the specialised approach (e.g. Carstens, 2013) and theme-based courses (Adamson, 1990). Other modes of delivery that were deemed inappropriate for this course were the team-teaching approach (Dudley-Evans, 1995) and the adjunct model (Rosenthal, 1996; Johns, 1995; Snow & Brinton, 1988).

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