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SECURING SOUTH AFRICAN STUDENTS A PLACE IN A SCIENCE COMMUNITY THROUGH CONSTRUCTIVIST CONFIRMATIVE ASSESSMENT

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ABSTRACT

Upon first entering the programme, Bachelor of Science (BSc) students are expected to adapt to a discipline-specific environment within a given university discourse community. Thus, writing within a scientific discourse convention becomes an important field of interest, especially for students who register for a BSc degree for the first time at a health science university in South Africa. However, language lecturers can approach assessment strategically to benefit science students. To this end, some assessment types can be used to assess integrated science subjects and language. That strategy would be ideal because it could determine students' proficiency levels. Therefore, this paper discusses the results of a laboratory report-writing test written by students first entering HSU against this background. This paper is embedded in a study about the assessment of students' laboratory report-writing skills upon first entering their courses. The study followed a quantitative approach with an exploratory research design. Purposive sampling was employed to select students who sat for a confirmative laboratory report writing criterion-referenced test before instruction could commence at the university. The students' written laboratory reports were marked and analysed following a marking guide regarding the aim, approach, method and findings of an experiment conducted in Grade 12. The study found that the students performed poorly in the laboratory report-writing test.

KEYWORDS: Higher Education; confirmative assessment; laboratory report writing; science;

INTRODUCTION

Most science students first entering university in South Africa (SA) are from a unique schooling background as regards the quality of education they have received. Education for the majority of black secondary school learners takes place in a second language (L2), mostly at under-resourced schools. Sefako Makgatho Health Science University (SMHSU) is largely attended by students from similar circumstances. This presupposes that language lecturers need to be creative when teaching such students, especially when assessing their written work confirmatively. Since laboratory report-writing is a common genre in the sciences, confirmative assessment of a commonplace experiment the students had conducted in Grade 12 could play a pivotal role in determining the proficiency levels of English language science students at the threshold of university study. This necessitates collaboration between language and content science lecturers in addressing or even redressing the laboratory report-writing (LRW) challenges students experience. Lecturers must create space and time for students to learn and practise how to write laboratory reports after conducting experiments. General English (GE), located within the School of Science and Technology (SST), is offered to students by the Department of Language Proficiency (DLP), a service-rendering department at SMHSU. Students in the SST of the university are expected to acquire and develop discipline-specific academic writing skills. This augurs well for teaching supportive courses, such as English for Academic Purposes (EAP) and English for Specific Purposes (ESP), to BSc students. Accordingly, it is against this background that this paper assesses the laboratory report-writing skills of BSc students first entering the Sefako Makgatho Health Sciences University (SMHSU).

THE SMHSU ENGLISH LANGUAGE COURSE IN CONTEXT

SMHSU, like most universities in SA, has a diverse student population regarding race, language, background and educational orientation. Since English is not their mother tongue, the nature of the students' writing abilities is necessarily impacted. This places high demands on lecturing staff who have to, among others, draw inferences about their students' language and writing abilities very early on in the academic year. Teaching writing skills is intended to increase the quantity and quality of students who study and pass health sciences at the university (cf. Veldtman, 2021).

Black students at HEIs use their mother tongues both in academic circles and in their social interactions outside lecture halls. The mother tongue is also lauded for its ability to serve as a stepping stone for learning an L2 (Pathudi, 2013: 2). L2 writers tend to use many of the same writing processes in their L2 as in their first language (L1). Expertise in writing can be transferred from the L1 to the L2, given at least a certain level of language proficiency (Weigle, 2007: 35; Table 2).

In the same vein, Silva (1993) points out that writing in an L2 is more constrained, more difficult and less effective. The challenge is that one cannot write in an L2 without knowing at least something about the grammar and vocabulary of that language. How much more challenging would it be for science students at SMHSU who must master a specific genre in science writing? Writing in science requires additional skills since it is a more technical form of writing.

One cannot consider students' writing skills without also considering the role of science lecturers vis-à-vis their science students. The lecturers must be competent in teaching their students effectively. They are expected to understand that scientific and technical writing is distinctly different from, for example, creative writing required in some GE language essays (Barrass, 1978: 14; Veldtman, 2021: 43).

Furthermore, lecturers' collaborative role can contribute towards ensuring the subject contents and methodologies are digestible for science students through adaptation. Such collaboration lends itself to some scaffolding, which refers to various forms of material, social, linguistic or conceptual assistance able to support students' reasoning, participation and learning. Providing effective scaffolding is critical to attempts to support students in meeting twenty-first-century standards (Veldtman, 2021: 43).

Lecturers should gradually introduce information befitting the mixed educational composition and backgrounds of science students first entering university, who register for English as a compulsory subject with the Department of Language Proficiency (DLP) at SMHSU in their first year (Veldtman, 2021: 43).

Students' under-preparedness and low literacy levels are strong factors influencing their writing. Students face many complex problems in their writing, which requires a diagnostic analysis to highlight some of the commonplace critical areas requiring intervention (Chokwe & Lepalala, 2013) (see Appendix A). Therefore, if undergraduate science students' language proficiency levels at SMHSU are not on par with tertiary-level demands, it becomes crucial to teach specific skills that are lacking and negatively impact students' ability to perform well (see Figure 1; cf. Table 5). Worldwide, university students, especially additional language students, face diverse challenges in acquiring adequate skills necessary to participate in the academic discourses of their chosen disciplines (Carstens, 2008: 82; Table 5). Teaching writing skills in this context is intended to increase the quantity and quality of students who study and graduate in health sciences.

Structurally, the SMHSU's Department of Language Proficiency (DLP) is located in the School of Science and Technology in the Faculty of Health Sciences. Its staff members are located in the Basic Medical Sciences Building (Learning Guide, English for Health Sciences, 2015: 3). This department has been in existence for more than three decades. However, very limited recorded research information specifies the exact number of years. This could also be attributed to the DLP not being governed by a specific language policy. Currently, there is very little

interaction between the DLP and the rest of the departments for which it acts as a service provider (Veldtman. 2021: 44).

Language proficiency refers to the level of competence an individual possesses in using a language for both basic communication and academic purposes. There is an assumption that students enrolled in the DLP course have some basic knowledge in terms of having mastered English at the high school level, as taught in South African public schools. At this stage, learners should be taught English language skills in an academic context because 'language demands become greater at university in terms of sophisticated texts and dense information'. Therefore, the language course has been designed in accordance with NQF Level 5 and aims to develop academic literacy and academic writing skills. Another broad aim of the course is to illustrate how language is used to learn and communicate both in spoken and written forms. It further aims to create awareness among students of the academic writing process as a combination of 'thinking' and 'language' (Learning Guide, English for Health Sciences, 2015).

The DLP recognises that for the majority of its students, whose mother tongue is one of the vernacular languages spoken in SA, English is an additional or even a third or fourth language. As such, the DLP prioritises the development of academic reading and writing skills. This development is different from learning subjects like Biophysics or Psychology because an additional language cannot be taught or learnt linearly (Learning Guide, English for Health Sciences, 2015: 5).

BSc students register for a compulsory course in Health Education and Life Competencies (HELC) with the DLP annually, in which case they are provided with a learning guide, which provides an overview of what the course offers. Class attendance is compulsory. There are five tutorial sessions of 40 minutes each offered weekly. These sessions are used to generate communication skills such as reading, writing and oral discussions (Learning Guide, English for Health Sciences, 2017). Thus, this paper seeks to assess whether such offerings meet the students' needs pertaining to laboratory report-writing.

The English Language course is compulsory for all first-year BSc students. Clarke (2015: 38) argues that students' grasp of English pertains significantly to the kind of writing they produce. Students apply various writing practices and conventions learnt at school to their science writing in a university course. Ivanic (1998: 4751) refers to students who draw on their various school discourse conventions as they try to write in a scientific discourse genre as interdiscursivity, which occurs when a writer incorporates two or more discourse conventions into the creation of one text. However, Clarke (2015: 37) maintains that students' inter-discourse is not always successful. A mixture of discourse conventions would thus generally play a prominent role in determining students' writing choices.

First-year students in the Health Sciences and Basic Sciences often tend to view English as a first-year subject that does not carry much weight in relation to other content subjects. First-year students at SMHSU are no exception. The DLP offers English as a compulsory first-year

subject that carries some weighting in relation to the rest of the content subjects they have enrolled for. There is a lack of motivation, and taking English seriously remains a challenge (cf. Veldtman, 2021).

One should bear in mind that these students are not English language students *per se*. They are enrolled within a science discourse community and, as a result, are automatically initially exposed to science education literature, which introduces them to writing genres in a science context. Such genres include, but are not limited to, textbooks, laboratory manuals produced by their respective departments, research articles, etc. At the same time, these students are primarily subject to the pedagogies subscribed by the DLP, notwithstanding that science curricula at the first-year level should be guided by the needs and interests of the students (cf. Table 5). The DLP does not necessarily focus on the science content of the subjects for which the students are registered but rather presents General English (GE) and not English support courses such as English for Specific Purposes (ESP) or English for Academic Purposes (EAP). This can be regarded as a shortcoming in curriculum design, given the discussion ensuing in this literature review. Since ESP is an approach and not a product to be taught, curricular material will inevitably be pieced together, some borrowed and others specifically designed (cf. Hutchinson & Waters, 1987; Ngoepe, 2012: 61). This should be the case with DLP.

First-year BSc students fall within the realm of two distinctive discourse communities: they engage with lecturers and coursework, which calls for a different set of roles and interactions. If not properly managed, this can defeat the purpose of both these communities (see Research Methodology). The students should be prepared to function effectively in a science discourse community. The DLP currently structures its offerings within the framework of the four language skills in pairs, namely reading and writing and listening and speaking for academic purposes (www.smu.ac.za). Ngoepe (2012: 72) labels these skills macro skills that must be used as a foundation for the acquisition and development of identified skills that should dovetail with students' needs. The DLP has yet to customise language teaching in accordance with the needs of BSc students entering university. It has to create a bridge to address deficiencies and simultaneously prepare students for the specifics, which should not differ from the scientific, academic writing they are expected to produce in their content subjects. This would also align with the university's broader approach to adopting a student-centred strategy.

ASSESSMENT

An assessment is a tool used to collect information, give feedback and determine whether the students have reached an agreed level of proficiency to proceed to the next level. Consequently, assessment tasks, which are of major importance in academic contexts, can be varied (De Chazal, 2014: 291). Classroom assessments are activities teachers and students undertake to provide information applied as feedback to modify teaching and learning activities (Tomanek, Talanquer & Novodvorsky, 2008: 1115). The strength of assessments lies therein, as they can reveal and support learning. This depends on the extent to which student responses to tasks authentically reflect their thinking and understanding (Kang, Thompson & Windschitl, 2014:

675). There are two main purposes for assessment. First, it is used to evaluate students' learning against some pre-set, possibly external standard, often towards the end of a course of study in some modules. Second, it is used to discover students' strengths and weaknesses during the course of study to guide and enhance learning (cf. Ngoepe, 2017).

Over the past two decades, positive developments regarding student assessment in Higher Education (HE) include a wider variety of assessment tasks, greater transparency in assessment criteria, and growing awareness of developing effective feedback processes (Carless, 2015: 1). For example, assessment based on integrated science content and language would be ideal in a language support course context (Barrett, 2014: 74). In this paper, language lecturers assess laboratory reports written by students first entering SMHSU BSc. This presupposes collaborations among language and science content lecturers.

According to Tomanek, Talanquer and Novodvorsky (2008: 1115), classroom assessments refer to activities undertaken by both lecturers and students to provide information that is used as feedback to modify teaching and learning activities. The strength of assessments is that they can reveal and support learning. Kang, Thompson and Windschitl (2014: 675) argue that this depends on the extent to which students' responses to tasks authentically reflect their thinking and understanding (see Figure 1).

Lecturers can identify knowledge deficiencies, set learning goals and gauge the level of support needed to ensure that all students achieve what they were taught through the relevant assessment types. To this end, collaboration is key. When lecturers collaborate to plan, design and deliver assessments, this allows them to compare and discuss students' work. It also allows them to manage and improve their understanding of learning goals and assessment criteria. In addition, they develop a better understanding of where students are in their learning process. Essentially, all assessment information about students should form a continuous feedback loop to the lecturer (Teachers' Guide to Assessment, 2016: 7; cf. Ngoepe, 2020).

Confirmative assessment, which is tantamount to quality assessment, can have a greater positive impact on student learning than any other intervention. Its primary purpose is to promote learning and to show evidence of how students are progressing according to the defined standards throughout the period of learning as well as achievement at the end of the learning period (cf. Teachers' Guide to Assessment, 2016: 5; cf. Confirmative assessment). Hence, the confirmatory assessment of students' laboratory writing skills in this paper. The hope is that the SMHSU DLP will develop from the findings presented in this paper.

Confirmative assessment

Confirmative assessment is regarded as the new paradigm for continuous improvement and is an extension of summative assessment. It involves the process of collecting, examining and interpreting data and information to determine the continuing competence of students or the continuing effectiveness of instructional materials. This process is undertaken to determine if the instruction is still successful after a year and if the lecturer's teaching technique is still on

point. Furthermore, this kind of assessment builds on the findings and recommendations generated during formative and summative assessments (cf, Veldtman, 2021: 14). Therefore, it is necessary to take this kind of assessment as it allows lecturers to determine whether it is still a success one year down the line (Prasanthi & Vas 2019: 95). Hence, the assessment of an experiment performed previously by BSc students first entering SMHSU. The students' laboratory reports will be assessed based on an experiment conducted at a Senior Certificate (SC) level. Revealing what students know is important throughout a unit (Kang, Thompson & Windschitl, 2014: 675), which is significant for both language and content subject lecturers in a collaborative science context.

Confirmative assessment is especially useful for underprepared students. The assessments identify, explain and confirm the value of their performance and the improvement intervention over time. To this end, the main element distinguishing confirmative assessments from formative and summative assessments is the time factor. The heuristic or rule of thumb is that confirmative evaluation should take place six months to a year after implementation (cf. Veldtman, 2021:14). Thus, the BSc students were assessed at the beginning of the academic year (cf. Veldtman, 2021).

Confirmative assessment expands traditional evaluation to measure long-term effects and performance improvement. Accordingly, data are collected and analysed to determine the continuing effectiveness and improvement of programmes or courses. Confirmative evaluation can, therefore, demonstrate the results of a programme or course and function as a tool to measure individual student performance improvement alongside the results of a change effort (Giberson, Tracey & Harris, 2006: 43). Similarly, the continuing effectiveness of the written laboratory report is determined.

Laboratory report writing assessment

The laboratory report is a key assessment and critical genre for students to master during the undergraduate years (Drury & Muir, 2014: 79). Laboratory report-writing is a practical skill that BSc students first entering SMSHU should be able to master in the milieu of a scientific culture. It is a process that requires dedication from students to familiarise themselves with published textbooks in their fields, conducting research, and finally, writing up their results (Weissberg & Bucker, 1990: iv). Sensitising students to various registers of science writing and increasing their science literacy could be achieved by comparing academic scientific writing, which includes textbooks and research articles containing popular science writing (Boynton, 2018: 6). Understanding that writing is a skill to be learnt rather than a talent possessed only by some can increase the motivation to write (Truax, 2017).

Students first entering a Bachelor of Science (BSc) programme are expected to adapt to a discipline-specific environment within a given university discourse community. Hence, writing within a scientific discourse convention becomes an important field of interest, especially for students registering for a BSc degree at SMHSU. This implies that students are expected to write laboratory reports on experiments conducted. Such reports should meet the requirements of tertiary-level disciplinary writing (cf, Veldtman, 2021).

In SA, education for many black secondary school learners takes place in an L2, mostly at under-resourced schools. In addition, the BSc student intake at SMHSU predominantly comprises black students from similar circumstances. The lack of the requisite language proficiency standards among disadvantaged students affects their academic performance. Thus, most black students whose home language (HL) is not English have not yet reached adequate proficiency levels that would enable them to cope with the written English used in academic discourse (Tshotsho, 2014: 425; cf. Table 2). In this regard, acquiring laboratory report-writing skills poses a challenge to SMHSU BSc students since they are expected to master these skills to progress academically within a science context. Moreover, they need to show competence in using laboratory equipment.

The laboratory report-writing skills of BSc students first entering SMHSU have always posed significant challenges, especially to students whose L1 is not English. Because SMHSU offers tuition in all disciplines in a single medium, English, warrants an investigation of the laboratory report-writing skills of such BSc students (cf. Table 3; Ngoepe, 2020: 230). Therefore, their laboratory report-writing skills were assessed within the framework of the conventions of scientific writing (Veldtman, 2021: 3).

In support of this, Parkinson et al. (2007: 443) assert that the laboratory report genre is the most frequently written by undergraduate science students. To this end, Veldtman (2021: 4) opines that it is essential for BSc students first entering SMHSU to master essential laboratory report-writing skills. Therefore, a genre-based approach to teaching academic writing can be advocated for.

WRITING IN A SCIENCE COMMUNITY

A distinction is often made between science writing and scientific writing. Science writing can serve as an umbrella for all writing about science and scientific content, with the added assumption that the writer has scientific training (Merkel, 2019(b)). However, lecturers at most career levels agree that there is an irony in their expectations of students' writing abilities. While students are expected to write well, and their abilities are often bemoaned, relatively few lecturers actually teach writing skills (Merkle, 2019 (a).

Writing has an uncontested place in the science discourse community. This is partly why scientists must write; they are not exempt from the process of writing. They must write to produce appropriate forms of writing that fall within the realm of scientific writing, which, in turn, prompts scientists to think, plan and organise. Similar yardsticks and expectations can also be formed concerning the type of writing in which science students at SMHSU are expected to engage and then produce written laboratory reports, thus reflecting the styles and approaches of scientific experts. Students can only benefit from good writing skills taught in relation to why and how scientists should write (Veldtman, 2021: 30).

The task of academic writers is to join a 'conversation' in their fields. This can, however, be a challenging perspective for students to achieve, irrespective of the levels of their degrees

(Merkle, 2021). However, writing opens students up to criticism from the scientific community and the possibility that they might need to return to the data collection stage for additional information (Grogan, 2020). Students first entering university are regarded as access seekers to a discourse community, which would enable them to engage in the practices of such distinct communities (Jackson et al. 2006: 261; see Methodology).

Berkenkotter, Huchkin and Ackerman (1991: 191) point out that discourse communities come into existence by emerging from the relevant discourse through which members of similar communities communicate (Jackson et al., 2006: 261). Therefore, members of a science discourse community could include lecturing staff and students. Thus, SMHSU lecturers and students constitute an essential science discourse community.

Developing essential writing skills would not only benefit students entering a science programme with their studies but also in their workplaces, where they can practicalise the theoretical knowledge imparted at Institutions of Higher Learning (IHL). According to Drury and Muir (2014: 79), employers and the government expect science graduates to have developed high levels of written communication skills within their degree programmes. Ideally, their writing styles should comply with the requirements of academic writing by the end of their degree programme.

Ideally, students should conform to the conventions of the science genre which they should be taught. This involves practical steps and structured approaches guided by meticulous observation, planning and discipline (Clarke, 2015: 22; see Appendix A). However, a technical writing style can be challenging. For example, translating units of measurement into Standard English (SE) and writing a clear description are genre-specific skills that students must be taught. For English language science students in the SMHSU context, this would involve acquiring new skill sets and writing tools to meet the demands of a particular discourse community of which they have become a part (cf. Veldtman, 2021).

Academically, students need to build their knowledge base and perform different roles within science discourse academia. Lebrun (2009) points out that presenters of information, such as BSc students first entering the programme, must be credible. They must be knowledgeable on the subject and content and need to be balanced with the language aspects drawn from believable and accurate conclusions. This paper assessed SMHSU science students to determine how they observe, plan, remember and communicate their laboratory report-writing skills.

Furthermore, if a student is expected to design an experiment, the design should be written down. The written design can then be expanded as the student conducts the experiment, thus providing a detailed and organised basis for the final report. The student should follow specific steps, namely indicating the purpose of the report, the problem to be solved and the predictions made (Ngoepe, 2012: 52; cf, Appendix B). These are pertinent areas that content subject lecturers and English lecturers need to familiarise with and immerse themselves in. It should become apparent to lecturers involved in developing students' academic writing skills within

a science milieu that some writing essentials should be taught because of the specific academic genre involved.

METHODOLOGY

This paper is premised on social constructivism (SC). Kang et al. (2014: 675) assert that SC is not intended to be a solitary approach. Instead, its ontologies and epistemologies are developed as a result of collaborative learning characterised by reading and interpreting, group work, creative thinking, and the production of a final product translated into an appropriate and scientific genre within a given context and culture. Thus, constructivist learning is a process in which people construct meaning and make sense of their experiences (Merriam & Caffarella, 1999). Learners' involvement in actively constructing knowledge in a culturally and socially supported learning environment enables them to develop a deeper understanding, more generalisable knowledge, and the confidence to apply such knowledge in different settings (Kang et al., 2014: 676) such as the science laboratory (see Appendix A). Since this paper is embedded in a study which assessed laboratory writing skills of newly entering BSc science students and included science content lectures in the sample, there is room for a deeper understanding of the phenomenon, more generalisable knowledge and growing confidence in applying the knowledge in different settings (cf. Veldtman, 2021).

Social constructivism is based on reality, knowledge and learning. First, it highlights that reality cannot be discovered by individuals because does not exist prior to social inventions. Second, knowledge is created when individuals make meaning through interacting with each other and their environments (Amineh & Asl, 2015: 13). Writing is a key element in the formation of social realities, institutions and personal identities in almost every domain of professional life and the sciences (Clarke, 2015: 1). Lastly, learning as a social process refers to meaningful learning that takes place when individuals engage in social activities such as interaction and collaboration (Amineh & Asl, 2015: 13). Writers seek to embed their writing in a particular social world they reflect and conjure up through approved discourse (Hyland & Salger-Meyer, 2008:1; cf. Appendix A), such as scientific discourse as in this paper.

A sense of community evolving from the social constructivist approach depends on common interests, assumptions and shared understanding, which, in turn, create meaningful communication. The concept of community provides a means of analysing communication as a joint and socially situated accomplishment. When applied to academic domains, the expression of community in the notion of a discipline offers researchers a framework for conceptualising the expectations, conventions and practices that influence academic communication (Hyland & Salager-Meyer, 2008: 22).

This study is premised on both the quantitative approach and exploratory research design (cf. Richards, Ross & Seedhouse, 2012: 308). Quantitative research tends to count occurrences across a large population and uses statistics and replicability to validate generalisations from survey samples and experiments. It also attempts to reduce contaminating social variables (see Appendix A). An initial foray into the social setting leads to a more informed exploration as

themes and focuses emerge (Holliday, 2016: 6). The study assesses the laboratory reports of BSc students first entering the programme.

Purposive sampling was employed in this paper. Devers and Frankel (2000: 265) assert that purposive sampling strategies can be used in qualitative research and can be revised throughout the research process as more knowledge of the setting and subject is obtained. Furthermore, purposive sampling allows decisions to be made about the selection of participants (Davis, 1995: 278) and provides more in-depth findings than other probability sampling methods (Gentles et al., 2015). Two hundred and fifteen (215) out of a total population of four hundred and fifty (450) students first entering SMHSU BSc were selected purposively and constitute the population sample of the paper.

SMHSU is a higher education institution (HEI) categorised as a traditional public university (SMU NEWS, 2015). Although there are 21 standalone universities in SA, SMHSU can be classified as a standalone health sciences university and the first of its kind in SA. Standalone universities are defined as 'universities that are not related to a parent system, they have at least one medical school, and do not offer a comprehensive set of academic programmes such as liberal arts or engineering' (Vagelos 2002: 38).

The BSc students sat for a one hour and forty-five-minute criterion-referenced test in the form of a laboratory report-writing task on a Biology experiment they had performed in Grade 12, in line with the curriculum. The test was written before the commencement of teaching in the first term (see Confirmative assessment; cf. Veldtman, 2021). Data were collected in terms of the aim of the experiment, apparatus, method and findings from the students' written laboratory reports before the start of teaching. Criterion-referenced testing is used to determine whether each student has achieved specific skills or concepts. Test scores were reported and interpreted within a specific context (Dreyer, 2000: 270).

L2 researchers often use one or more measures of central tendency to provide precise quantitative information about the typical behaviour of students regarding phenomena. Three commonly used measures of central tendency are mode, median and mean. Mode is the most frequent score obtained by a particular group of students; the median is the score at the centre of the distribution, that is, the score dividing the group in half; and the mean or the arithmetic average is the most common measure of central tendency (Mackey & Gass, 2005: 254; McIntosh & Morse, 2015: 1).

To this effect, the data were analysed quantitatively. The criterion-referenced tests for the BSc students in the form of written laboratory reports were marked using a marking guideline and analysed by the first author in terms of the aims, approaches, methods and findings of the experiment (see Appendix A; see Appendix B; cf. Table 5). The author applied the above-mentioned commonly used measures of central tendency to analyse the quantitative data collected from the students' written laboratory reports (cf. Mackey & Gass, 2005: 254).

RESULTS

This section presents, analyses and interprets the results of the study, constituting the students' quantitative laboratory report-writing test scores.

Since this paper adopted the social constructivist approach, teaching and learning activities could lead to shared constructed meanings when students work collaboratively and cooperatively and participate reciprocally (Jones & Araje, 2002: 2; cf. Methodology). Communicating involved small group discussions, cooperative learning and so on (cf. Appendix A). This could enhance learning because it allowed the students to test their ideas and consider those of others (Eastwell, 2002: 83).

Laboratory Report-Writing Test

The laboratory report-writing test results comprise biodata and written laboratory report data.

Chokwe and Lephalala (2013) assert that insight into students' backgrounds is critical and forms the core of teaching and developing academic writing at a tertiary level. In the same vein, the years in which students matriculated, the English language scores obtained at NSC, the other languages they had passed, and the degrees for which they had registered at SMHSU provided vital background information for the development of academic writing.

Bio-data

Table 1: Years students matriculated

Year	Total No. = 153	%
2013	2	1
2014	1	0.7
2015	7	5
2016	9	6
2017	49	32
2018	84	55
2019	1	0.7

Table 1 presents the years in which the students had matriculated. The majority (55%) matriculated in 2018, a considerable number (32%) in 2017, lower numbers (6%) in 2016 and 2015 (5%), and much lower numbers in 2014 (0.7) and 2019 (0.7%).

In South Africa, when learners complete specific educational qualifications, they are awarded a National Qualification Framework (NQF) level. They must complete their programme of study to achieve this level. For example, learners who complete secondary school reach NQF Level 4 or Grade 12, implying they have passed their matric or Grade 12 examinations and earned the National Senior Certificate (NSC). This is referred to as the National Senior Certificate NQF. The matric NQF level requires learners to register for seven subjects, which carry 120 credit points in total. These subjects include one home language, another language,

mathematics or mathematics literacy, life orientation and three elective subjects. Most universities in SA require learners to have passed the NSC and earned NQF Level 4 to be eligible for undergraduate programmes (Jadhav, 2024).

Furthermore, the findings revealed that the majority of students (71%) sat for an EFAL examination paper, and most (88%) had attended government schools. This suggests that most students at the threshold of university study need substantive support in academic writing because they have unique schooling backgrounds characterised by a lack of laboratories and sufficiently qualified teachers (cf. Ngoepe, 2007; Ngoepe, 2020: 248).

Table 2: English symbol obtained at senior certificate level

Symbol	**Total No. = 153**	**%**
A	14	9
B	67	44
C	52	34
D	19	12
E	1	0.7

Table 2 presents the number of students per symbol achieved. The symbols obtained ranged between A and E. Most students (44%) attained a B symbol, followed by a C (34%). The lowest score was an E (0.7), attained by only one student. The symbols obtained imply that the students have the General English (GE) required as a foundation for studying an English Language Support Course (ELSP) in a science context (see Ngoepe, 2020: 234).

Matriculation symbols are essential for the grades candidates receive in their final results. These symbols are categorised in alphabetical order, the highest symbol being 'A' and the lowest being 'G' and sometimes FF. Symbol A represents an 80–100% score, translating into seven APS scores; B, 70–79%, translating into six; C, 60–69%, translating into five; D, 50–59%, translating into four; and E, 40–49, translating into three (Nethononda, 2022).

Table 3: Other languages students passed at the senior certificate level

Other languages	**Number**	**%**
Afrikaans	44	29
Tshivenda	6	4
IsiXhosa	6	4
IsiNdebele	1	0.7
Xitsonga	13	8
IsiZulu	13	8
Sepedi	36	24
Sesotho	5	3
Setswana	27	18
Siswati	3	2
Irrelevant	2	1

Table 3 depicts languages other than English that a specific number of students had passed at a senior certificate level: Afrikaans (29%), Sepedi (24%), Setswana (18%), Xitsonga (8%), Tshivenda (4%), IsiXhosa (4%), Sesotho (3%), IsiSwati (2%) and IsiNdebele (0.7%). However, 1% of the students gave irrelevant responses. Thus, the languages cited in Table 3 illustrate the multilingual learning environment most SA university students have experienced (see Lediga & Ngoepe, 2020: 110).

Moreover, 150 students had passed. physical science, life sciences (139) and mathematical sciences (138).; geography (79), life orientation (72), agricultural science (18), accountancy (15), business studies (9), computer applied technology (8), biology (4), economics (3) and information technology (3). Negligible numbers passed civil technology (1), graphics and design (1), history (1), religious studies (1), tourism (1) and visual arts (1). One student did not respond to the question, 15 responses were not applicable, and 42 were irrelevant.

The above implies that all the students had passed the Senior Certificate English, and their scores ranged from symbols A to E. This also indicates that the students have a good foundation in GE, which is essential for learning a specific language such as ESP.

None of the students had ever failed matric; nearly all (97%) registered for other degrees, while only 3% registered for BEd, health sciences, electrical engineering and industrial physics, collectively. Other degrees enrolled in were electrical engineering and health sciences.

The multilingual student sample was from a diverse language background and is representative of the majority of SA's student population (cf, Lediga & Ngoepe, 2020: 110). Students had a science background, which enabled them to qualify for admission at SMHSU. Although most had attended public schools, they attained the top rung of the Senior Certificate passes. Furthermore, the low number of students registered for a basic BSc degree illustrates that these students had passed matric with higher marks, which ensured meeting the required Admission Point Score (APS) for admission to health sciences requiring a higher APS score than a basic BSc degree (Veldtman, 2021: 62).

Table 4: Degrees registered for by students

Degree	**Total No. = 153**	**%**
BSc LS	41	27
BSc MS	36	24
BSc	8	5
BSc Ps	33	22
BSc Occupational/Environmental	35	23

Table 4 captures the degrees the students had registered for. A relatively high number of students (27%) registered for BSc LS. This is followed by BSc MS (24%), BSc Occupational/Environmental (23%) and BSc Ps (22%). The number of students registered for basic BSc (5%) was the lowest. On the whole, the test takers had registered for a BSc degree that can lead to a health science qualification (cf. Methodology; Appendix A).

To this end, the distinct feature of SMHSU that it is a comprehensive health and allied sciences university which caters for a distinctive academic model and a range of health professional programmes as well as training for both undergraduate and postgraduate qualifications. These programmes fall under a classified Programme Qualification Mix (PQM) (cf. Veldtman, 2021).

The written laboratory report

Criterion-referenced assessments verify whether or not students have acquired the expected knowledge and skills. It also highlights if they have any learning gaps or academic deficits that need recourse. Therefore, these assessments can evaluate the effectiveness of a course, academic programme or learning experience in the use of pre-assessments and post-assessments to measure the learning progress over the duration of an instructional period (Muthaiyan & Ananthi, 2020: 611: cf. Figure 1).

Institutions of learning should engage in collaborative analysis of achievement data to identify starting points, monitor progress and inform institution-based decision-making (Teachers' Guide to Assessment, 2016: 5). SMHSU BSc students' content and language lecturers collaborated in assessing their laboratory reports.

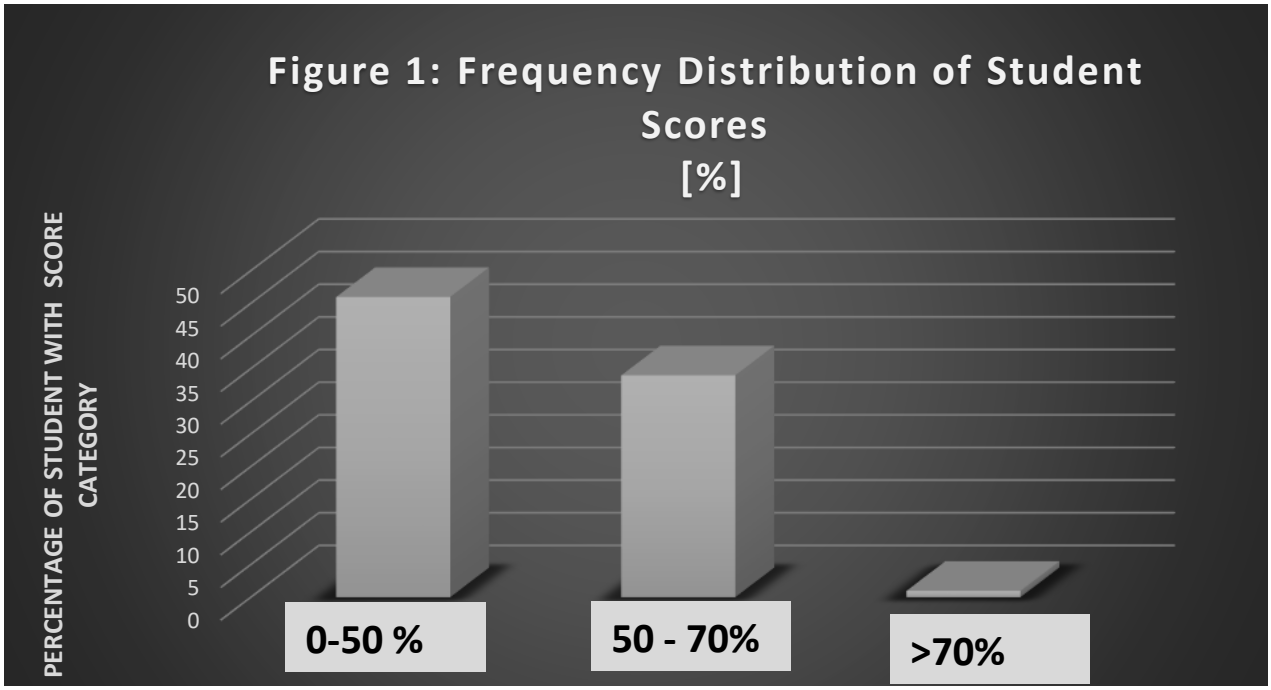

Figure 1: Laboratory report-writing students' scores

Figure 1 depicts the students' laboratory report-writing scores in percentage categories: 0–50%, 50–70% and >70%. The scores varied widely, ranging from 0 to 76%. The highest score was 76%, while the mean and median scores were 30.5% and 28%, respectively. The scores were thus heavily weighted in the <50% range (>93% of the cohort), and only 7% scored 50% and above.

Jackson et al. (2006: 261) aver that science communities characteristically share common cultures and values. Thus, the SMHSU BSc students are, by extension, access seekers to a science discourse community and need support with laboratory report-writing. Furthermore, the highest number of students who scored between 0 and 50% suggests a need to integrate laboratory report-writing into the DLP course.

Table 5: Students' average scores per item tested

Aim = 5	**Apparatus = 10**	**Method = 5**	**Findings = 10**	**Total Score = 40**
3.7	2.5	1.7	1	8.9

Table 5 depicts the average scores per item of the report writing test. Students scored relatively high (3.7) in the aim section, lower in the apparatus section (2.5) and by far the lowest in the method (1.7) and findings (1) sections, respectively. The overall average score was 8.9.

The average scores presented in Table 5 suggest that the DLP intervention strategy should prioritise the main structure of a laboratory report when teaching BSc students.

Writing is an integral part of science at every stage. However, when students are trained to become scientists, academics often focus on the scientific method and the data collection work. The equally important topic of writing about science is rarely addressed (Grogan, 2020).

Furthermore, the process of understanding and overcoming obstacles in scientists' academic writing at all career levels can increase scholarly output, boost career prospects and, in the long term, advance scientific knowledge (Grogan, 2020).

Supporting the findings above, Carstens (2008:82) asserts that undergraduate students struggle with academic writing because of new demands placed on them in the disciplinary cultures within which they find themselves. The underlying assumption is that they should comply with the minimum writing requirements expected of them in the various disciplines.

CONCLUSION AND RECOMMENDATIONS

SA university students, including science students, learn in a multilingual setting. This experience tends to compound the students' learning environment, especially that of the science students learning science in an L2. English language lecturers who can integrate science content and language should strategically employ confirmative assessment to identify and redress the needs of BSc students first commencing university study. The exercise could help lecturers secure students a place in a specific science discourse community.

Furthermore, the students had passed other SA languages at the matriculation level. The linguistic demography of the student cohort is exemplified by the number of languages they had passed (other than English) and corroborates the multilingual nature of the South African higher education setting (see Table 3). This suggests that the application of this phenomenal

science writing genre, LRW, could further be compounded by these circumstances. This paper's findings can be used by language lecturers to enhance laboratory report-writing skills of SMHSU BSc students first entering university with genre-specific writing deficiencies. They can also foster guidelines for curriculum development among content subject and language lecturers regarding laboratory report-writing skills for such students. Since the sampled students had never failed an NSC examination and had the potential to succeed in the sciences, the anticipated LRW support provided by the language and science content lecturers in concert can be used to teach and allow students to practise laboratory report-writing skills. Such support could also help prepare students to engage with the science discourse vagaries experienced in the higher education environment.

Since the DLP does not have a language policy, it is anticipated that the recommendations would inform guidelines which might help shape an essential language policy for the department (see Veldtman, 2021: 20). The envisaged policy would address specific writing needs of students such as laboratory report writing skills in line with an identified ESP learner-centred approach (cf Ngoepe, 2020: 235). English language support courses aimed at specific disciplines, such as English for science students, English for medicine, and so on, are not taught by the DLP. These language courses would be conducive to opportunities to assess ways in which students could implement and improve their laboratory report-writing abilities within the functional context of the sciences at the tertiary level. However, the report writing foundation laid at a school level in a science context places an even higher premium on laboratory report writing skills of BSc students first entering SMHSU since most of them are second language (L2) students whose first language (L1) is not English. Therefore, laboratory report-writing skills are essential academic skills which would help phase students into tertiary-level disciplinary writing with prescribed academic requirements.

In the long term, the findings could help bring about fundamental changes in this regard, including the teaching of relevant ELSCs specific to the needs of the students.

The DLP should teach and afford science students the opportunity to practise LRW after conducting experiments. The reports should be assessed by both language and science content lecturers, allowing the students to make inroads into the science academic community.

Ideally, English language support departments such as the DLP should provide a fertile ground for students to practise specific writing skills. Both English language and science content lecturers need to collaborate proactively to scaffold students settling into an identified community by securing them a place in a relevant science discourse community.

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APPENDIX A

A Laboratory Report Writing Test

Duration: one hour and 45 minutes

Venue:_____

_____

Section A

1.1 Give the symbol that you obtained in English in your Matriculation/Senior Certificate examination:

_____

1.2 What was the type of English language examination that you sat for (EFAL or EHL)?

_____

1.3 Was the school you attended: a government or private one?

_____

1.4 In which year did you pass matric?

_____

1.5 What are the other language(s) that you passed in matric?

_____

1.6 List the content subjects that you passed:

_____

_____

_____

_____

1.7 Have you ever failed matric?

_____

1.8 If you answered 'yes' in 1.7, in which year?

_____

1.9 What is the university degree that you are currently registered for?

_____

1.10 Is this your first degree?

_____

1.11 If not, what was your first degree?

_____

1.12 Mention other degree(s) that you hold.

_____

Section B

Write a report on an experiment that you performed in Grade 12 investigating the absorption and transportation of water and mineral salts by plants. Your report should have the following four subheadings:

1.13 Aim of experiment (5)
1.14 Apparatus (10)
1.15 Method (15)
1.16 Findings (10)

APPENDIX B

Marking guide on the experiment investigating absorption and transportation of water by plants

Examining water absorption by the stem

Aim

To examine/investigate water absorption and transportation by the stem. **(5)**

Apparatus

- water
- food colouring dye (available at supermarket)
- white flower on a stem, e.g., Impatiens, carnation or chrysanthemum
- scissors
- two jars, cups or measuring cylinders
- plastic tray
- sticky tape **(10**)

Method

1. Fill one jar with plain water, and one with water containing several drops of food colouring dye.

2. Take the flower and carefully cut the stem lengthwise, either part way up the stem or right up to the base of the flower (try both, the results will be different!).

3. Put one half of the stem into the jar containing plain water and one half of the stem into the jar containing food colouring dye. To make it easier to insert the stalks without breaking them, it helps to wedge paper underneath the jars so that you can tilt them towards each other. Tape the jars or cylinders down onto a tray so that they do not fall over.

4. Observe the flowers after a few hours and the next day, and note where the dye ends up in the flower head. You can leave the flowers up to a week but make sure that they have enough water. **(15)**

Results/Findings

Most volume of water entering plants is by means of passive absorption. The water will enter the plant through the root cells that can be found in the roots where mainly passive absorption occurs. With the absorption of water, minerals and nutrients are also absorbed. **(10)**