WRITING IN ENGINEERING: TEACHING HIGHER-ORDER WRITING TECHNIQUES TO ENGINEERING STUDENTS IN AN EXTENDED DEGREE PROGRAMME

by

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Thesis submitted in partial fulfilment of the requirements
for the degree

Doctor Philosophiae

in the

Department of English

at the

UNIVERSITY OF PRETORIA

FACULTY OF HUMANITIES

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August 2023

UNIVERSITY OF PRETORIA

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ResPEthics Documentation **NE 46/04** 05/2004

ACKNOWLEDGEMENTS

This thesis is dedicated to my brother, Richard Norman Fouché, who never got to finish this journey with me, my husband, Neville Jansen, who stayed on this journey with me throughout, and my son, who will join me at the transition to a new phase of life.

I would like to take this opportunity to thank the people who have helped me through my research:

- My supervisor, Dr Patrick Lenahan, and my co-supervisor, Dr Erika Müller: your support, reassurance, reliability, and valuable feedback have helped me through the past four years. I thank you for all that you have done to guide me.
- My colleagues: you have been understanding and reassuring throughout this journey, and I look forward to many more years of working side-by-side.
- My friends and loved ones: thank you for your love and friendship, and for being there when you are needed.
- My brothers, sister-in-law, and nephew: you add tremendous colour to my life and I am grateful to have had you on this and so many other journeys.
- My parents: Mom and dad, I cannot thank you enough for the endless support and encouragement in the face of such challenges. I could not have asked for two better parents to be in my corner.
- My husband: you are the most amazing husband, who loves me and keeps me going when the going gets tough. I love you endlessly and I look forward to the next chapter and all the chapters to come.

ABSTRACT

This study investigates the ways in which a writing curriculum with an emphasis on higher-order skills improves student writing. This curriculum was developed for a module titled 'Professional Orientation', which is offered to students in the extended engineering degree programme at the University of Pretoria. One of the aims of Professional Orientation is to promote writing development as specified in the Engineering Council of South Africa's (ESCA's) Graduate Attribute 6. After a quality review in 2017, which indicated that the writing aspect of the module was too general and simplistic, and the lecturer/researcher's appointment in the module, it was decided that a PhD study would be conducted to establish the success or failure of a revised writing curriculum with an explicit emphasis on higher-order writing. This exploratory study investigates whether or not a curriculum with an emphasis on higher-order writing skills leads to improvements in student writing, to what extent these improvements are notable, and how these are relevant to students as they progress in the academic and professional environment.

This study adopts an action research framework, following Glanz's 1998 proposed research cycle. A literature review was done to investigate the cognitive, social, and education theories used as a lens to develop the revised curriculum. Thereafter, different international and local studies on academic literacy were reviewed to gather relevant information on the field. Finally, a framework for the lower- and higher-order skills developed and enforced in this study was investigated and finalised. This led to a revised curriculum in 2020 and a further revision of the curriculum for analysis in this study in 2021. The researcher conducted a quantitative analysis of student results, a qualitative analysis of select student writing samples, as well as an analysis of regular student writing reflections.

The results indicate that certain aspects of student writing improved, particularly in mid- or high-performing student work, but that low-performing students were not necessarily able to keep up with the writing demands and make significant improvements in their writing. However, students, whether low-, mid-, or high-performing, typically perceived an improvement or need for improvement in their own writing, suggesting that the interventions were successful at creating an awareness around the importance of writing in an academic setting.

Key terms

Academic Literacy
Curriculum development
Engineering Education
Extended degree programme
Higher-order writing
Lower-order writing

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CHAPTER 1:
INTRODUCTION

1.1. BACKGROUND

> It would be extremely naïve, of course, to imply that all our professional problems are capable of 'solution'. Some can only be investigated; some we might have to walk away from; others we might have to live with. However, it is the received wisdom of those working in caring professions that most problems benefit from being aired and discussed in some controlled or structured way; and this should also be true of professional problems (Wallace, 1998:15).

The idea for this study stems from the researcher's personal experiences as a lecturer in Professional Orientation (JPO 110 and JPO 120), a module presented to engineering students in the extended degree programme offered by the University of Pretoria (UP). UP implemented the Engineering Augmented Degree Programme (ENGAGE) in 2010 in order to "help students make the transition from high school to university" (Müller, 2020:1). Further, this programme is offered to students who have not achieved the minimum entry requirements for the four-year degree programme, but have achieved an Admission Point Score (APS) of 30 to 35, with sub-minimums of 60 to 69% for English, Mathematics, and Physical Science[1] (Jansen van Rensburg, 2019:s.p.). In this programme, additional modules are offered in conjunction with and parallel to mainstream modules, e.g., additional mathematics is offered in conjunction with and parallel to mainstream mathematics. Professional Orientation is a module that is only offered to students in ENGAGE and does not align with any of the prescribed mainstream modules in the UP syllabus.

Professional Orientation was established with the intent to "teach students relevant academic practices, Information Technology (IT) practices, and reading and writing practices, so that they can succeed academically within the school of engineering at UP" (Fouché, Müller & Naidoo, 2021a:3). This module is offered over the course of a year in the form of two semester modules: JPO 110 and JPO 120. The aim of JPO 110 is to "develop, refine and apply suitable academic, reading, writing and IT skills

[1] APS is used by South African universities to admit students into specific study programmes. Students calculate their APS by adding the points they earned per subject for their final Grade 12 results together. For example, an achievement of 50-59% = 4 point, 60-69% = 5 points, 70-79% = 6 points, and so on.

and practices" (Fouché, Müller & Naidoo, 2021a:3) to equip students with the soft skills[2] and 'tools' to complete their studies successfully; whereas the aim of JPO 120 is to consolidate these skills and practices in the form of projects that represent a microcosm of an engineering environment (Fouché, Müller & Naidoo, 2021b:1).

Initially, a reading development program and writing tasks were incorporated in the Professional Orientation syllabus and introduced as supportive aspects to the Academic Practices component of the module. However, because the aim of Professional Orientation is to develop the skills and practices necessary to succeed academically and professionally, and because the perception and understanding of these are constantly evolving, there have been a number of changes to the curriculum over the years. One of these was the removal of the reading program due to funding and compatibility issues and the other was making academic reading and writing a stand-alone module component, separate from Academic Practices. Thus, adaptions to the balance of time and depth of focus on reading and writing have been made.

In 2017 the Engineering Council of South Africa (ECSA) conducted an audit of all of UP's engineering modules, in which Professional Orientation was declared a good and suitable module. However, an independent quality review by Dr Karen Wolff and Ms Ina Pretorius (2017)[3] reported that "at curricular level [although] the reading, writing and project texts have engineering themes, their appearance suggests 'language' exercises (which is supported by student interviews)" (p.11), highlighting that there was not enough of an emphasis on language development in the module and pointing to the need for a separate reading and writing course component that focuses on both higher- and lower-order skills development. Subsequent to the ECSA audit and independent quality review, various changes to the lecturing staff were made, including the appointment of the researcher as module coordinator and Engineering Reading and Writing (ERW) lecturer, and this has led to further re-curriculation within the module and the development of a more in-depth reading and writing component. Thus, this study contributes to this initiative by first distinguishing between lower-order

2 Soft skills refer to the skills that allow one to "conform one's attitude and behavior to established standards of conduct — in order to engage and work together effectively with others in a shared enterprise" (Tulgan, 2015:16). This includes "social aptitudes, language and communication capability, friendliness and ability of working in team and other personality traits that characterize relationships between people" (Cimatti, 2016:97).

3 Ms Ina Pretorius is a quality coordinator at the University of Johannesburg and Dr Karin Wolff is an engineering educator and Higher Education (HE) Academic Development (AD) practitioner.

and higher-order writing skills and then experimenting with a curriculum that prioritises higher-order skills, such as subject-focus, source integration, structure, and coherence, without neglecting lower-order skills, such as grammatical structure[4]. The purpose of which is to teach writing to students and to improve students' written communication in an extended engineering programme of this nature.

1.2. PROBLEM STATEMENT

English is the primary language of instruction at tertiary institutions throughout South Africa. Although institutions such as the University of Pretoria have historically used Afrikaans as the medium of instruction, for many years evidence has suggested that

> the majority of universities and technikons use English as the sole medium of instruction or, as is the case in most historically Afrikaans medium institutions, offer parallel/dual instruction in English and Afrikaans (Ministry of Education (RSA), 2002:7).

In 2017 UP officially amended its language policy to make English the sole language of teaching and learning, and official communication and administration as of January 2019 (University of Pretoria, 2017:2). However, many people in South Africa have not been adequately exposed to mainstream English literacy and lack the proficiency to succeed academically. As stated in the Language Policy for Higher Education (Ministry of Education (RSA), 2002:4-5):

> Language has been and continues to be a barrier to access and success in higher education; both in the sense that African and other languages have not been developed as academic/scientific languages and in so far as the majority of students entering higher education are not fully proficient in English and Afrikaans.

Because of these barriers to entry, extended degree programmes similar to the EBIT ENGAGE programme at UP have been introduced at tertiary institutions throughout the country — these include the College of Science at Wits and the Commerce and Science extended programmes at the University of Cape Town (Scott, 2009:32) — to improve "the quality of teaching and learning" and to facilitate "equity of outcomes

4 Lower-order skills relate to the surface-level features of writing (syntax and grammar) and higher-order skills include coherence, structure, source integration, and overall development. The distinction between these sets of skills is discussed in detail in Section 3.5.

rather than only of access" (Scott, 2009:31). Foundational provision, designed to bridge the gap between secondary and tertiary education, is interwoven in innovative ways within the mainstream curriculum in these programmes to promote academic development amongst diverse student cohorts (Scott, 2009:32). Modules have been developed in these programmes that help students gain the relevant academic and IT literacies to progress through their studies — Professional Orientation is one such module.

Academic Literacy, the particular subject focus of this study, is still a developing field. Lillis and Scott's article on Academic Literacy (discussed in Section 3.3) in 2007 was pivotal in the discussion of Academic Literacy as a separate, independent field of study. In addition, South Africa has a unique history in terms of language which means that South Africa's approach to instruction within this field may differ to that found elsewhere.

The emphasis of the research study at hand is on developing a higher-order writing curriculum for students in an extended engineering degree programme that has the potential to be introduced into similar programmes, so that students can either acquire or build upon the writing skills needed to communicate in an academic or professional engineering environment. Historically, Professional Orientation's writing-education scope was limited and primarily focused on lower-order writing skills, such as basic grammar or vocabulary exercises and language feedback, which do not equip students to think critically about their writing so that they can produce texts that are well structured and developed enough to satisfy an academic and/or professional audience. This study explores the possibility that an explicit emphasis on higher-order writing skills, along with the implicit development of lower-order writing skills, may help students to think critically about what, why, and how they write so that they can communicate effectively in this form.

Although South African Academic Literacy scholars have conducted valuable research studies, there are gaps and avenues for exploration. By enhancing the curriculum to include "standardised academic writing methodologies" (Wolff & Pretorius, 2017:17) and focusing on higher-order writing skills that will help students obtain, or reinforce, the writing skills necessary for effective communication, this research study explores new avenues for further curriculum development in

Engineering Education, and attempts to make a useful contribution to Academic Literacy as an independent field of study.

1.3. AIM, OBJECTIVE, AND RESEARCH QUESTIONS

The aim of this study is to develop, implement, and evaluate a writing curriculum that broadens the scope of writing instruction in Professional Orientation by emphasizing higher-order writing skills development and framing lower-order writing skills as supportive of these. This has been achieved by

- developing a curriculum that includes interventions that aid students in improving their higher-order writing skills,
- trying-out methods and observing the results of these interventions through a qualitative analysis of select anonymous samples and student reflections, and a quantitative analysis of the students' results, and
- ascertaining the effectiveness of this emphasis for broader implementation into the Engineering curriculum and the field of Academic Literacy as a whole.

This is a project in curriculum development that has emerged out of the researcher's own teaching environment, and has been conducted there also. Its framing methodology is that of action research; and within that framework, the formalised procedures of Educational Research and Development (R and D) (discussed further in Section 2) are employed. The questions addressed in this research are:

- What is the current curriculum in Professional Orientation?
  - How does writing fit into this curriculum, and other first-year engineering modules?
  - What aspects of writing — lower- and higher-order — are covered in the curriculum?
- What problems are there with this approach, in terms of addressing student needs?
  - What are the students' writing needs?
  - Is there any evidence of problems in addressing these needs?
- What are higher-order writing skills?
  - Why are these skills important to students?
  - Why not focus on lower-order writing skills?
- What can be done to address these problems and skills in the curriculum?

- How can the literature, both theoretical and applied (i.e., reports of experiments), help to develop a new intervention?
- How can this be piloted?
- How can the process of formative evaluation involved in the try-out be used to develop and implement a new writing curriculum?

1.4. RATIONALE FOR THE STUDY

One of the goals of higher education is to "enable our students to achieve a rich operational understanding of and commitment to the relevant epistemic values. We are trying to teach our students how to become participants in disciplined inquiry" (Morrow, 2009:38). The goal of higher education is both to teach through the curriculum, but also to teach students how to engage with knowledge in a meaningful way that promotes inquiry. This is the type of inquiry that is encouraged when the emphasis shifts from lower- to higher-order skills.

Higher-order writing refers to one's ability to construct and develop an argument or judgement, and express it in written form. This is a skill that does not function in isolation, but in conjunction with thinking skills, an understanding of basic grammar and language, and reading comprehension. In acknowledging these connections, the focus is on how writing can be taught so that students produce written content that is applicable to their needs and communicates their understanding and knowledge of relevant content.

'Writing skills' are divided into two skill sets: lower-order skills, which include grammar, sentence construction, punctuation, and vocabulary (Purdue University, 1996:s.p.), and higher-order skills, which include issues of focus, audience or purpose, organization, and the development of argument (Purdue University, 1996:s.p.). However, this is a superficial breakdown that will be expanded upon in Section 3.5.

In their research on the topic of writing, du Toit, Heese and Orr (1999:233) note that

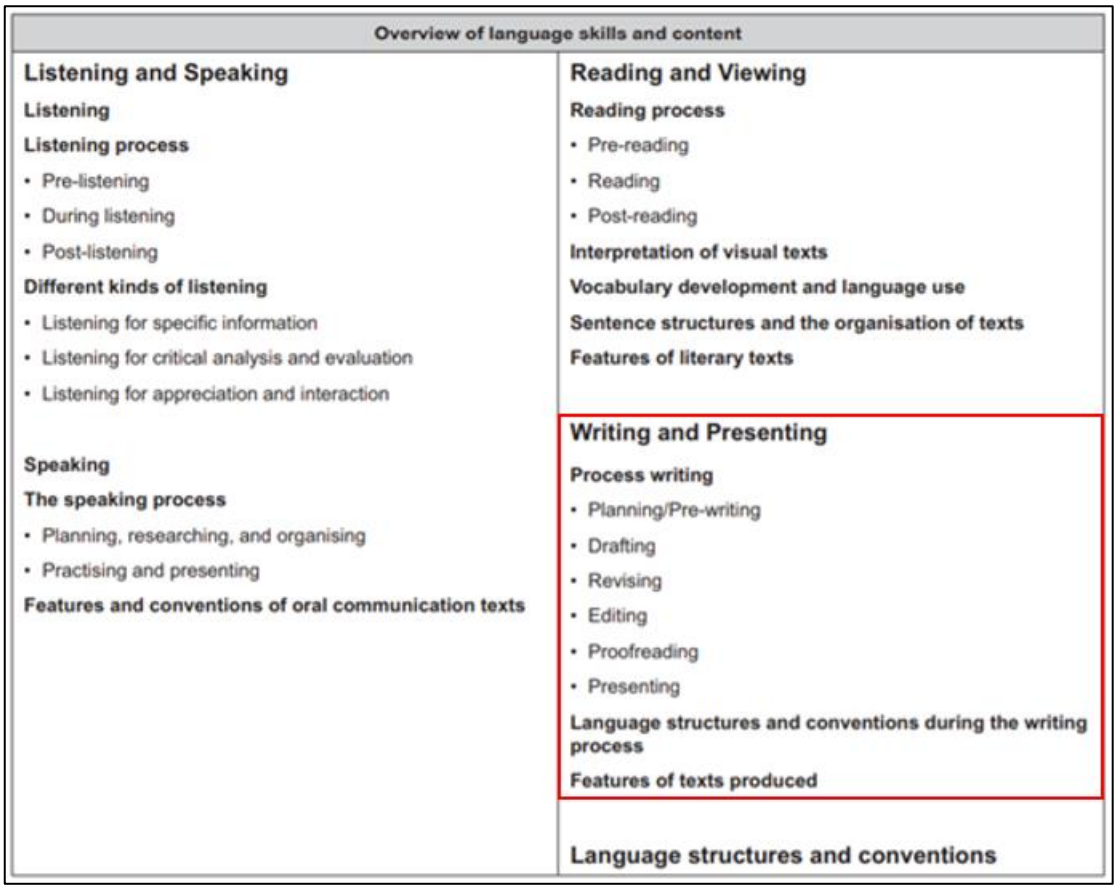
> many students think that as long as their writing is grammatically correct, has no spelling mistakes, and is neatly presented, it is good writing. Good writing is far more than that… In a survey of the teaching staff at UNISA, about 60% indicated that good writing was writing that was clear, concise, and to the point (i.e., depending on the ability to communicate content effectively). About 15% said that good writing was writing that demonstrated logically developed argument and had some literary grace

> or spark (i.e., depending on critical and creative ability), while about another 15% emphasized grammatical correctness and systematic organization (i.e., depending on mechanical ability). Lecturers in the Department of English tended to attach more importance to grammatical correctness than did lecturers in other departments[5].

Thus, while it is essential for students to have good lower-order language foundations (and these should not be ignored), it is just as important for our students to be able to develop logically and structurally sound texts within their field of study. These are texts that focus on specific subject matter, incorporate information from various sources while maintaining the author's 'voice', and follow structural writing conventions from within a specific field. The complexity of this cannot be overlooked as communicative practices are intrinsically embedded in higher education institutions and the professional working environment, and are challenging for students to attain "within a culturally, linguistically and socio-economically diverse student body" (Scott, 2018:9).

However, given that students are required to achieve specific results in order to participate in the EBIT ENGAGE programme, certain assumptions can and need to be made regarding students' writing competencies. The first assumption is that the students arrive at university having already worked on the development of their lower-order writing skills, as they had to achieve between 60-69% for English in Grade 12 in order to be permitted entry into the programme. The second assumption is that the students have had exposure to writing tasks before and understand how the writing process works — this assumption is supported by the home language English curriculum presented in Figure 1 (Department of Education, 2011b:10).

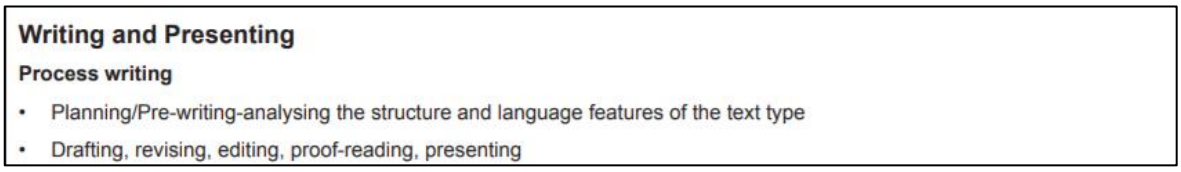
[5] From 'In a survey…' comes from the following research: Van Zyl, M.H. 1993. *Essay Writing Across the Curriculum: An Interdisciplinary Approach.* Unpublished doctoral dissertation. University of South Africa.



Overview of language skills and content	
Listening and Speaking	**Reading and Viewing**
Listening	**Reading process**
Listening process	• Pre-reading
• Pre-listening	• Reading
• During listening	• Post-reading
• Post-listening	**Interpretation of visual texts**
Different kinds of listening	**Vocabulary development and language use**
• Listening for specific information	**Sentence structures and the organisation of texts**
• Listening for critical analysis and evaluation	**Features of literary texts**
• Listening for appreciation and interaction	**Writing and Presenting**
Speaking	**Process writing**
The speaking process	• Planning/Pre-writing
• Planning, researching, and organising	• Drafting
• Practising and presenting	• Revising
Features and conventions of oral communication texts	• Editing
	• Proofreading
	• Presenting
	Language structures and conventions during the writing process
	Features of texts produced
	Language structures and conventions

Figure 1: Home Language English Curriculum

Exposure to the writing process is also represented in the first additional language English curriculum, as seen in Figure 2 (Department of Education, 2011a:10).



Writing and Presenting

Process writing

- Planning/Pre-writing-analysing the structure and language features of the text type
- Drafting, revising, editing, proof-reading, presenting

Figure 2: First Additional Language English Curriculum

The final assumption is that students will have to write documents with different intentions and for different audiences in their professional engineering careers. This assumption is represented in ECSA's graduate attributes as Graduate Attribute 6: Professional and Technical Communication. This is outlined in the Qualification Standard for Bachelor of Science in Engineering (ECSA, 2019:12).

> Graduate Attribute 6: Professional and technical communication
>
> Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large.

> Range Statement: Material to be communicated is in an academic or simulated professional context. i) Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. ii) Written reports range from short (300-1000 words plus tables diagrams) to long (10 000 to 15 000 words plus tables, diagrams and appendices), covering material at exit-level. iii) Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

These three assumptions about the students' background, as well as their future needs, all point to the necessity of shifting the focus away from lower- to higher-order writing skills. The students will need to regularly develop documents for different purposes, and evaluate and analyse information in order to justify their opinions, arguments, discussions, and feedback as they continue through their studies and advance into professional engineers.

As du Toit, Heese and Orr remind such students (1999:231), "you have only your written voice with which to convince them [your lecturers] that you deserve to pass their courses, that you are worthy of a degree." A focus on higher-order writing skills for first-year engineering students in Professional Orientation will aid them in refining this written voice for successful application in their other modules, because the reality is that "students who write well earn higher marks than students who write poorly" (du Toit, Heese & Orr, 1999:232).

On this issue, a psychology professor makes the following observation from his personal experience of student writing:

> I discovered that whereas it is usually easy to distinguish well-presented good ideas from well-presented bad ideas, it is often impossible to distinguish poorly presented good ideas from poorly presented bad ideas. *The problem is that the professor's comprehension of what the student says is solely through the student's way of saying it*. Professors can't read minds better than anyone else" (du Toit, Heese & Orr, 1999:232; authors' emphasis).

Subjective and anecdotal observations of UP students' written work prior to this study in 2018 indicated that the majority of students are able to produce coherent informal texts but still need to learn how to construct an *academic* text that includes and incorporates sourced material, is coherent and well structured, maintains the subject-focus, and synthesises the writer's voice and multiple sources of information together to create a cohesive discussion. For lecturers responsible for supporting students

through the writing process it is important to ensure, as far as possible, that written communication does not lead to the undoing of the students' academic careers but rather aids them in delivering content as seamlessly as possible. Therefore, the hypothesis is that a writing curriculum that prioritizes the higher-order writing skills will serve students' best interests going forward.

1.5. OUTLINE OF THE STUDY

The framing and results of this study are divided into six chapters each discussing different aspects of the research project. After the introduction, the methodology used to conduct the research project is outlined. This includes the following sub-sections:

1. Introduction
2. Research Design and Process
3. Educational Context and Framework
4. Research Setting and Participants
5. Methods and Procedure of Data Collection
6. Methods and Procedure of Data Analysis
7. Selection of Lower- and Higher-Order Skills Criteria
8. Selection of Assessments for Review
9. Ethical Considerations

All of these details need to be in place prior to conducting a study of this nature to ensure that the process that is followed is rigorous and results in legitimate and valid findings.

Thereafter, in Chapter 3, the theory, influences, and writing model used to frame the higher-order writing intervention workshops is outlined. This shows the theoretical framework that is used to conduct the study, as well as the influence of different studies in Academic Literacy and developments in writing instruction on the researcher's intervention framework. Moreover, the lower- and higher-order skills identified and defined in this study are discussed and provided in this chapter. The outline for this chapter is as follows:

1. Introduction
2. Theoretical Underpinnings
3. Academic Literacy

4. Developments in Writing Instruction
5. Writing Skills and Practices
6. Conclusion

Following this, a detailed overview of the curriculum developments and framework for the module is included and discussed in detail in Chapter 4. This offers insight into the origins of the module and the ways in which writing and writing instruction have developed over the years. This section includes:

1. Introduction
2. Curriculum Developments
3. Curriculum Outline
4. Discussion on Curriculum Developments
5. Conclusion

This section provides the necessary context for the interventions and results discussed in the penultimate chapter. Chapter 5 includes an analysis of the results and reflections on the higher-order interventions developed for the study. The following sections are included:

1. Grade 12 Results and English Language Proficiency
2. First Writing Intervention
3. Second Writing Intervention
4. Third Writing Intervention
5. Final Writing Intervention
6. Final Assessment of Interventions

In this, it is hoped that the successes and failures in the interventions are apparent. Finally, a conclusion on the findings of the research study is offered. This includes:

1. Introduction
2. Summary of the Findings
3. Reflections on the Study
4. Concluding Remarks

Through these detailed chapters and sub-sections, it is hoped that the value of the study and its key findings is evident.

CHAPTER 2:
METHODOLOGY

2.1. INTRODUCTION

The methodology used to complete the study is outlined in this chapter. This aspect of the study ensured that research was conducted using formalised research procedures.

This research is exploratory as it evaluates the development of a writing curriculum within a pre-existing university module that prioritises higher-order rather than lower-order writing skills and looks at the different interventions developed to assess whether or not this focus has a positive impact on student writing. Additionally, it combines traditional English studies methods, such as detailed reading and an extensive literature review (in the preliminary and data application stages), with methods less commonly used in this field, namely action research applying a mixed-methods approach to data analysis.

Initially, a literature review was conducted to gather information on academic literacies and the theoretical underpinnings upon which writing instruction at a tertiary level is built. Based on this information, a preliminary writing curriculum was developed in 2020, revised, then tested in 2021 to ascertain the extent to which a revised curriculum that highlights higher-order writing skills improves the overall quality of student writing.

2.2. RESEARCH DESIGN AND PROCESS

This research project in curriculum development emerged out of the researcher's teaching environment in the Engineering Faculty at the University of Pretoria and was conducted in that same environment. The framing methodology was that of action research; and within that framework, the formalised procedures of Educational Research and Development were employed (Gall, Gall & Borg, 2003; Leedy & Ormrod, 2015). It is believed that an extensive literature review combined with the cyclical and reflective nature of action research situated the study well within the area of Academic Literacy and writing development, as many education practitioners believe that "priority should be given to applied research that addresses actual problems as perceived by practitioners" (Gall, Gall & Borg, 2003:11). An amendment

to Glanz's (1998:27) action research cycle was applied to the study as demonstrated in Figure 3.

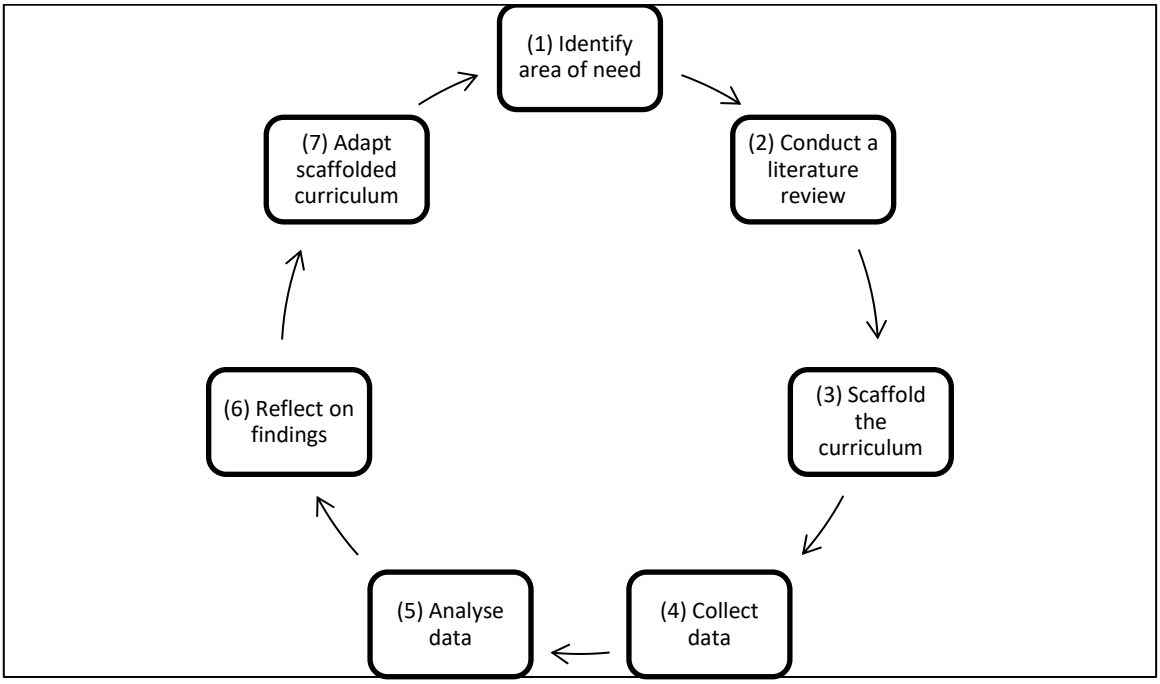


Figure 3: Research Cycle

This study took place over the course of two years (2020 and 2021) and was approached by introducing scaffolded intervention workshops and associated writing tasks to students throughout 2020, which were then revised and adjusted in 2021 for a final formal analysis of the results.

The aim of this study is to ascertain the extent to which interventions focused on higher-order writing skills improve the overall quality of student writing, specifically amongst first-year students in an extended engineering degree programme. This means that the students' results for the specified tasks were analysed quantitatively using Microsoft Excel to gain an overarching idea of the 2021 cohort's performance in the tasks completed after each intervention, particularly the aspects related to higher- and lower-order writing skills. The details of these tasks were further analysed qualitatively using criteria identified on the marking rubric for each assessment to establish whether or not there are improvements in the higher-order and lower-order aspects of student writing and, if so, what these improvements are and to what extent they are apparent. Additionally, students' reflections on their writing were analysed against prompting questions to establish how students perceive their writing development. This mixed methods approach means that the success or failure of the revised curriculum is reviewed at different levels, both broadly and narrowly.

Figure 4 provides a broad overview of the number of interventions completed across both semesters of Professional Orientation in 2021. A brief description of the tasks completed to assess the effectiveness of each intervention is also included, along with an indication of when student reflections on their writing took place.

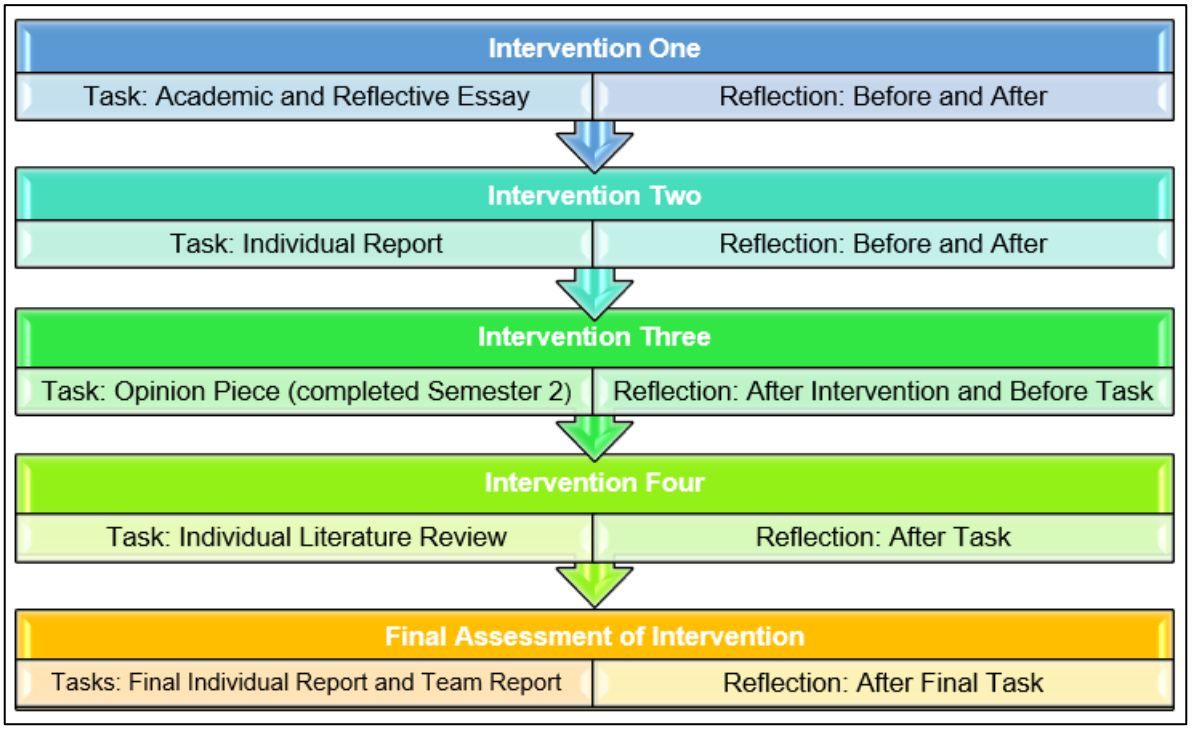


Figure 4: Scaffolded Writing Interventions

Professional Orientation is structured as a yearlong programme that is sub-divided into one module per semester: JPO 110 in Semester 1 and JPO 120 in Semester 2. The first semester serves as a prerequisite for the second semester. Thus, the writing tasks are scaffolded across the year as the assumption and intention is that students complete both modules in one year.

There were three interventions completed in the first semester that introduced students to different higher-order skills and two assessments linked to these interventions (the assessment for the third intervention took place in the second semester). The lecturer/researcher offered a high level of detailed instruction in these workshops and the students were required to reflect on their writing development before and after the first two interventions, and after the third intervention. The intention was to get students to comment on their perceptions of their writing skills and improvements or proposed areas for improvement in their writing.

Students completed a final intervention in the second semester. This intervention took place after the assessment for the third intervention and was followed by three additional writing assessments. Two of these assessments were used as a final gauge to assess the overall success or failure of the interventions as a whole. The first of these was a final individual report that was completed as a test and the second was a team report based on the results obtained in the capstone LEGO project (outlined in Chapter 4). The goal was for the students to complete these tasks independently to see whether or not they applied the skills and practices learnt and reinforced in the four interventions. By working as a team to complete the final writing task, the students could start to form a shared discourse community that would allow them to evolve and develop their communication for engineering studies.

2.3. EDUCATIONAL CONTEXT AND FRAMEWORK

The initial intention was for this study to take place in the in-person contact sessions hosted three times a week on campus. However, with the onset of the Covid-19 pandemic and its associated lockdown restrictions, the research project was moved to the virtual teaching and learning environment. By 2021, lecturers had been working online for approximately one year and felt better equipped to guide students in the use of online tools. Each week, a folder was released that contained a weekly schedule and the content for the week. Blackboard Collaborate, a virtual classroom, was used to host classes where attendance was generally good, although the extent to which students were engaged in each session was unclear. These classes were recorded and the recordings were made available to students.

Each session was designed to promote active learning by applying the strategies of guided practice and 'teaching in layers, not lumps'[6], as well as allowing some time for independent learning and some time for shared learning (Harmin & Toth, 2006:s.p.). These were encouraged by integrating the concept of writing as a social practice with process-writing and text analysis techniques. Continuous assessments and feedback through the use of standardised rubrics were used as assessment techniques, in

[6] 'Layers' refer to the scaffolding of learning from one level to the next; whereas 'lumps' refer to the introduction and discussion of the entire concept without scaffolding.

addition to regular pre-writing and post-writing reflections and freewriting exercises (Coffin *et al.*, 2003; Elbow, 1998).

2.4. RESEARCH SETTING AND PARTICIPANTS

The research was undertaken online using the University of Pretoria's Blackboard system, first amongst the 2020 EBIT ENGAGE student cohort as a trial run, and then across the 2021 EBIT ENGAGE student cohort as the final study cohort.

JPO 110, the first semester module, ran across 13 weeks from 15 March 2021 to 5 July 2021, and JPO 120, the second semester module, also ran across 13 weeks from 16 August 2021 to 26 November 2021. Initially, 120 students agreed to participate in the study, but 16 of these student participants dropped out of the study programme during the course of the year. This resulted in 104 study participants out of a final total of 167 students (62% of the group). All registered students completed the same tasks and received the same interventions so as not to disadvantage any of the students. Only the results of the 104 students who agreed to participate in the study and who remained in the programme throughout the year were evaluated so as to respect the wishes of the remaining students and to ensure that each of the participants had access to each of the interventions.

The writing development component of the Professional Orientation curriculum is just one aspect of the full curriculum, which focuses on academic and professional development skills and practices, and this aspect of the course was redeveloped to align with the study goal, the module outcomes, and overall student development in this skill-set. Each year, the students are broken up into two class groups. These groups were divided as follows in 2021:

- Group 1: Industrial, Chemical, Electrical, and Mechanical Engineering Students
- Group 2: Metallurgical, Mining, Computer, Civil, and Electronic Engineering Students

Six hours of class time are dedicated to each group per week and these hours are split across three class sessions of two hours each. Typically, the instructors start the session with a lecture, introduce an activity, and give students time to complete the activity, but this largely depends on the class. As previously mentioned, all classes were run online via Blackboard Collaborate in 2021 due to the ongoing lockdown

restrictions and a folder would open each week on the students' dashboard. Within this folder, students would have access to a class and assessment schedule for the week, the class PowerPoints and recordings (after the live session), class notes and sources, and submission links. The students would then join a Blackboard Collaborate session during their regular class times where the lecturer would present a PowerPoint or demonstration, introduce the activity or activities, and answer questions. If students needed further assistance, they were encouraged to arrange a consultation session with the lecturer, assistant lecturer, or module tutors via email.

2.5. METHODS AND PROCEDURE OF DATA COLLECTION

As indicated at the start of this chapter, this study was exploratory, applying an action research methodology. The methods of data collection that were used are outlined in Table 1.

Table 1: Data Collection Methods

Data collection method	Description
Literature Review	The purpose of this method was to: ➢ Identify the theoretical underpinnings of the study ➢ Identify approaches to writing development in international and local studies ➢ Verify the need for higher-order writing development amongst students in the extended engineering degree programme ➢ Define lower- and higher-order writing skills
Assessments and Reflections	The assessments were key in: ➢ Identifying the base level of students' writing ➢ Establishing criteria for evaluation ➢ Observing whether or not the revised curriculum improved the overall quality of student writing over time ➢ Establishing whether or not students perceived an improvement in their own writing
Curriculum Review	The intention of reviewing the curriculum was to: ➢ Identify areas for improvement in student writing ➢ Scaffold the writing interventions across the curriculum ➢ Establish an effective structure for higher-order writing development ➢ Find an effective structure for writing assessment

A mixed-methods design was used, combining an extensive literature review with qualitative and quantitative research methods. First the results of the students' assessments were analysed quantitatively to establish the baseline performance of each student and the class averages for the overall assessment and the specific lower- and higher-order skills assessed. These tasks were then analysed qualitatively to see if/how student writing improved and what the areas of need were. Additionally, the student writing reflections were analysed qualitatively to establish whether or not the students noted an evolution in their own development of the skills and practices.

As advised by Saldana, Leavy, and Beretvas (2011:68) a literature review was conducted at the outset of this study because this set the parameters for what were considered to be lower- and higher-order writing skills and outlined the gaps in academic literacies studies and writing instruction in tertiary education in particular. This review also established the theoretical framework for the study and assisted the researcher in forming an understanding of how writing fits into academic literacies development, why it is an essential skill, and what work is being conducted in writing development.

The process represented in Figure 5 was followed when it came to collecting student assessments.

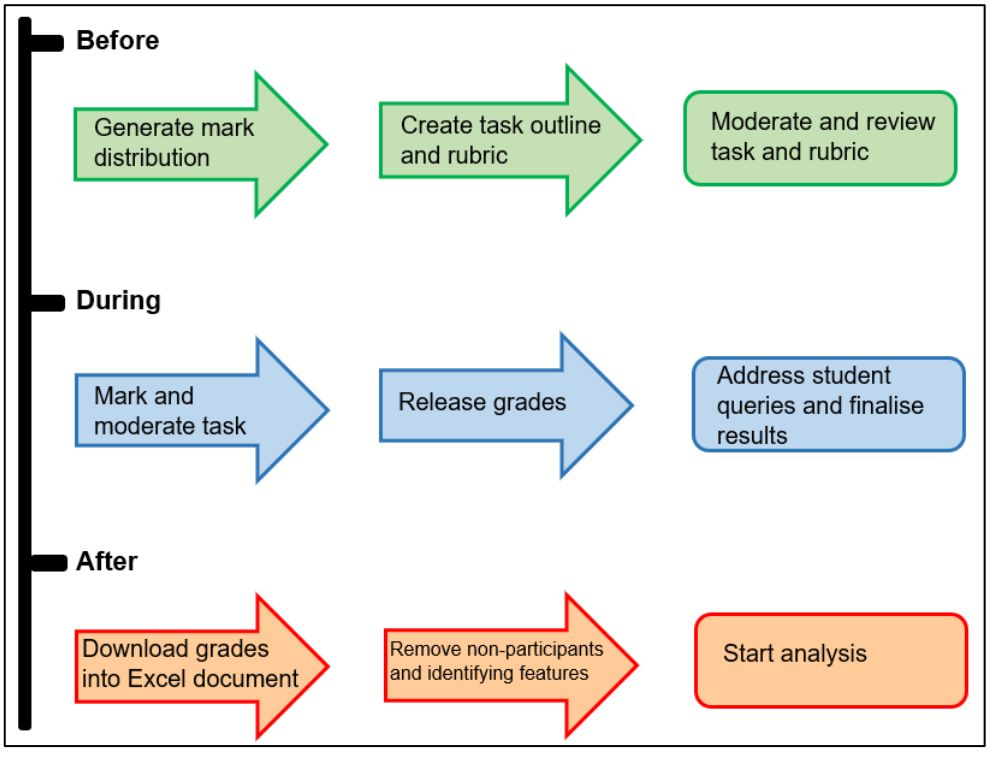


Figure 5: Collection of Student Assessments

Assessments were used to evaluate student progress after the interventions. The assessments were sub-divided and marked by either the researcher/facilitator, the assistant lecturer, or a fellow lecturer in the module. Each marker received a pre-assigned number of scripts and a marking breakdown. This was set up so that a student's work was not marked by the same marker each time. (These markers would in any case be marking the work, and their marking occurred independently of the study. Markers were employees in the module and they received no other financial benefit relating to this study, meaning that there was no additional cost involved for the study.) The marking was completed on a guided rubric that was developed by the researcher/facilitator and reviewed by a fellow lecturer. The marking for each task was moderated by the researcher/facilitator. The rubrics were used to ensure that higher- and lower-order skills were graded across tasks, to assess the skills focus of each intervention, and to identify possible areas for improvement. Additionally, marking bias was limited by having rubrics that focused on specific aspects of the assessments, and having three assessors with a similar background in language studies grade student work. These rubrics were also used to identify themes in student writing development. Finally, the markers had approximately one week to mark the scripts and capture the marks on a shared marksheet. After that, the students received their marked rubrics and assessments back. They then had five working days to query their results before the mark was considered final.

All assessments were marked using Turnitin[7] software embedded in the Blackboard package used by the University of Pretoria. Duplicates of the marked assessments were stored in a separate folder on the researcher's laptop computer, and all identifying features were removed and replaced with randomly assigned numbers for each student to ensure student anonymity. The marks were moved to a separate Microsoft Excel document that did not include any student details, so that each student's performance could be tracked against that in previous assessments and specific trends and averages could be identified. The results of this process in 2020 informed the interventions and teaching strategies that were used in 2021, where the same data collection methods and procedures were applied.

[7] Turnitin is a software that highlights areas in a paper that match outside sources so that students and educators can easily review work and establish if the matches are appropriate or indicative of plagiarism (Turnitin, 2021:s.p.).

The student reflections were downloaded to the researcher's computer and these were then transferred to a shared MS Word document stating the reflection question and each student's response to the question. Student names were removed from this document to maintain their anonymity. Including all of the responses in a shared document made it easy to code the data and identify themes in the student responses.

2.6. METHODS AND PROCEDURE OF DATA ANALYSIS

Data management was essential in conducting the data analysis effectively and accurately. To do this, the researcher had to stay up-to-date with sorting the data and labelling it effectively. The researcher ensured that each time an assessment was completed, it was filed and logged with anonymity structures in place. Figure 6 reflects the procedure that was followed to analyse the data effectively.

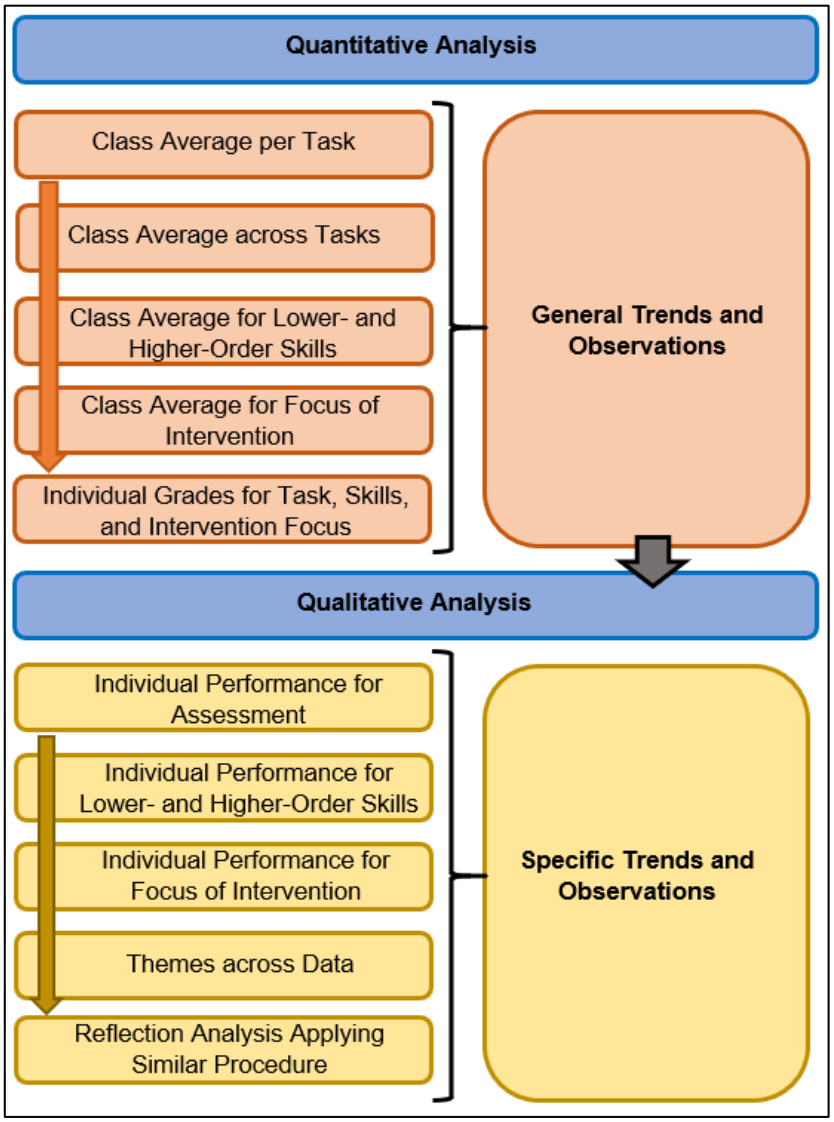


Figure 6: Method of Data Analysis

The mixed-methods approach highlighted above is effective in analysing findings in an action research project of this nature because of its complex and integrated nature (Ivankova & Wingo, 2018:978). By first looking at the quantitative aspects of the data and observing general trends on both a student cohort level and an individual level, the researcher was able to establish the overall effectiveness of the intervention in achieving the goal of enhancing higher-order skills development and, by association, writing for academic and professional purposes. The more specific analysis of the categories reflected on the rubric, which represent a type of higher- or lower-order skill and the focus areas of the interventions, allowed the researcher to see what the specific areas of improvement or need were and whether or not the interventions were effective at addressing the intended needs.

After each task, students were categorised as either low-performing, mid-performing, or high-performing based on whether or not their results fell below 50%, in the range of 51% to 74%, or above 75%. This was done with the overall task result, as well as the lower- and higher-order skills assessed. This allowed the lecturer to identify whether or not there was an improvement, consistency, or a decline in student performance from one intervention to the next. There were no significant findings based on these results and the researcher used this data to identify a low-performing, mid-performing, and high-performing student whose progress could be tracked for detailed qualitative analysis. These three students were selected at random from the categories within which they fell.

Writing reflections were used to ascertain the students' thinking around their own writing and to see if, as a group, they saw value in the interventions and improvements in their writing. The data for each of the students' writing reflections was captured on a Microsoft Word document. This data was coded to identify themes and patterns in the student responses (Saldana, Leavy & Beretvas, 2011:108). These themes were represented in a table format to identify how many positive, negative, or neutral responses there were to the different reflection questions. Different student responses to these questions are included in the results and these were selected to show the range of responses to each question.

Each task was observed in the ways reflected in Figure 6 at the end of the year, the tasks were compared across the board so that a clear response to the main research question and research sub-questions could be provided.

2.7. SELECTION OF LOWER- AND HIGHER-ORDER SKILLS CRITERIA

Scaffolding the writing curriculum so that higher- and lower-order writing skills were addressed meant that these skills needed to be defined in 2019 so that they could be implemented in 2020 and further refined for the final analysis in 2021. Thus, the researcher conducted an extensive review of the literature (discussed in detail in Chapter 3) on cognitive development, and academic reading and writing development so that a list of criteria could be identified. By looking at higher- and lower-order cognitive skills and academic reading and writing development, the researcher was able to create a framework for higher- and lower-order writing skills. An overview of the different skill categories is provided in Table 2 and this is discussed in detail in Section 3.5.

Table 2: Lower- and Higher-Order Skill Categories

Writing Skill and Practice Development	
Lower-Order	**Higher-Order**
General	
➢ Graphic features (letters, words) ➢ Phrases ➢ Sentences	➢ Local cohesion ➢ Global cohesion ➢ Inter-document cohesion ➢ Topic of discourse ➢ Synthesising ➢ World knowledge
Specific	
➢ Concord ➢ Parts of speech ➢ Punctuation ➢ Sentence structure ➢ Spelling and choice of words ➢ Tense ➢ Vocabulary ➢ Voice	➢ Use of and contribution to the literature ➢ Paragraph development ➢ Sentence order ➢ Source integration ➢ Structural development ➢ Subject-focus

2.8. SELECTION OF ASSESSMENTS FOR REVIEW

Each assessment selected for review served a particular purpose in relation to the writing outcomes addressed in each intervention and the scaffolded curriculum. The structure of the curriculum is discussed in further detail in Chapter 4; however, a

general overview of the theme of each intervention and its associated writing task is provided in Table 3.

Table 3: Writing Theme and Associated Task

April	• Writing for different purposes • Academic essay and reflective essay
May and June	• Writing a report • Case study report
June and August	• Analytical reading and writing • Opinion piece (validating an opinion)
August and September	• Conducting research and writing a literature review • Individual section of a literature review
October	• Writing a report with a time limit (EBIT Test Week 4) • Individual case study report
November	• Constructing a detailed team report of findings • Team report

Each intervention and associated task focused on a particular writing skill and style suited to the engineering profession. These tasks built upon each other in terms of type and difficulty, ultimately culminating in a final individual report and lengthy team report. The assessments highlighted above are analysed in this study because they reveal the students' abilities to keep up with the writing expectations, interventions, and developments within the module.

Eight formal reflections were done in total and each focused on a different aspect of writing. Table 4 shows the dates, associated assessments, and reflection questions:

Table 4: Reflection Dates, Times, and Content

Intervention One		
March	Writing Task: Pre-Reflection	Does writing come naturally to you?
April	Writing Task: Post-Reflection	What is your preferred style of writing?
Intervention Two		
May	Report: Pre-Reflection	Have you read or written a report before?
June	Report: Post-Reflection	Are you starting to think more about what and how you write?
Intervention Three		
June	Analytical Reading and Writing: End of Semester One Reflection	Do you feel more competent when it comes to writing formal documents?
August	Opinion Piece: Pre-Reflection	Historically, have you used external sources to inform your opinions?
Intervention Four		
September	Individual Literature Review: Post-Reflection	Have you noticed any progress in your writing since the start of the first semester?
Final Assessment of Intervention		
November	End of Year Reflection	Have the writing interventions provided in JPO 110 and JPO 120 had a positive impact, negative impact, or no impact on your writing development?

Students were asked to respond to different questions on each occasion, based on the focus of the writing task. It was felt that this would encourage them to think about different aspects of their writing at different times.

At the beginning, the questions were focused on determining if writing was something that came naturally to students and what their preferred style of writing was. This was done to get a sense of their level of comfort with writing. Thereafter, the question became task specific, asking if students had read or written a report before because reports are common in engineering. This helped with determining the level of exposure and guidance students would need in developing these documents. Following the report, students were asked if they had started to think more about their writing and the way in which they convey their written message. This was useful in assessing

whether or not the higher-order emphasis on structure, source integration, and subject-focus were resonating with the students. Toward the end of the first semester, students were asked if they were starting to feel more competent in writing formal documents and if they had noticed progression in their writing.

Three formal reflections were completed in the second semester. In the first one, students reflected on whether or not they had used sources to inform their opinions. This was done to encourage students to think about informed opinion and to reflect on the higher-order competencies of 'use of and contribution to the literature' and 'source integration'. Then, after the final intervention students were asked if they had noticed any progress in their academic writing since the start of the first semester. This was asked to establish if students perceived any immediate benefit to the interventions. The final reflection posed the question of whether or not students felt that their writing had been positively or negatively impacted by the interventions, or if they felt that the interventions had no impact on their writing. This reflection served as a final indication of the students' perceptions on the success or failure of the interventions.

2.9. ETHICAL CONSIDERATIONS

The Research Ethics Committee of the Faculty of Humanities at the University of Pretoria considered the research proposal and samples of the letters of permission, and approved the ethics application on 12 June 2020 (reference number 28141840 (HUM013/0420)). The Faculty of Engineering at the University of Pretoria accepted the decision of the Research Ethics Committee of the Faculty of Humanities (signed by Prof. Jan Eloff, Deputy Dean of Research in June 2020). See Appendix A for the official documentation.

The first-year students in the 2020 and 2021 EBIT ENGAGE programme at the University of Pretoria were asked if they give their permission for their results and tasks to be analysed for the study (the original letter of permission was submitted with the Research Ethics application).

Every participant signed a letter of informed consent (see Appendix B) which stated who the researcher was and what the research entailed. The reason for the research study and a description of what the researcher would do with the results and tasks was offered. It was stressed that participation in the study is voluntary and that the anonymity of each participant is guaranteed. It was clarified that only the researcher,

the research supervisor, and the research co-supervisor would have access to the results and that the data would be stored on a private computer for safekeeping. Furthermore, the participants were informed that they were under no obligation to continue sharing their information if they were not comfortable doing so.

CHAPTER 3:
THEORY, INFLUENCES, AND WRITING SKILLS

3.1. INTRODUCTION

The development of students' academic literacy is encouraged and facilitated during the course of university studies, either through explicit teaching or through implicit practise. Many changes to higher-education have been made over the years as universities have had to adapt to accommodate students who come from diverse, non-traditional backgrounds, with different educational needs and expectations. This has led to different frameworks, models, and approaches being tried and tested to establish the most effective means of developing students' academic literacy in different programmes. While the research shows that certain approaches are preferable to others, there is still work to be done on refining the teaching of these key academic reading and writing skills from a marginalised position within university structures.

This section reviews the growth within the discipline of Academic Literacy, globally and within the South African context, and highlights the gap that is being explored in this study with reference to the theoretical underpinnings for the research project, influential research in the field of Academic Literacy, and developments in writing instruction and writing skills. This ultimately leads to the framework of higher-order and lower-order writing skills and practices used to carry out the research project.

3.2. THEORETICAL UNDERPINNINGS

Lillis and Scott's article, 'Defining Academic Literacies: Issues of Epistemology, Ideology and Strategy' (2007), provides an overview of research in Academic Literacy. In this paper, various theories are considered for their applicability to Academic Literacy, though the authors acknowledge the following:

> The teacher-researchers who drive much academic literacy/ies research are usually grappling with the worlds of academic knowledge making on the one hand, and pedagogy, course design and institutional policy making, on the other, and often from marginal institutional positions (Lillis & Scott, 2007:16).

The implication of the above is that Academic Literacy is still embedded within larger study areas. This means that while many Academic Literacy scholars apply different theories to this field of study, these are not specific to Academic Literacy studies and are rooted in sociology, psychology, education, and linguistics.

When looking broadly at writing in Academic Literacy, it is evident that the processes involved are various, complex, and multi-faceted. Furthermore, higher-order writing as a separate, specific practice and skill-set not only involves different aspects of writing but also the ability to comprehend and refine that which is written. Thus, it would be remiss to look at the topic at hand from a strictly writing perspective, rather than as a complex web of processes that include both comprehension and writing, and cognitive, social, and educational processes.

The human brain is an intricate tool. Neuroscientists acknowledge the challenges that come with deciphering the many neural connections responsible for thought and the elaborate series of operations involved in reading and writing (particularly at a higher level). In researching the topic of writing (generally) and higher-order writing (specifically) it became clear that to understand all of the processes, the following theories need to be considered as distinctive, if over-lapping, contributions to our understanding of the processes involved: cognitive theory, social theory, and educational theory. In reading this, one might be reminded that cognitive and social models generally differ fundamentally, as demonstrated in Table 5 (Street, 2006:1-2).

Table 5: Cognitive vs Social Models

Cognitive Model	Social Model
Autonomous model of literacy	**Ideological model of literacy**
➢ One literacy	➢ Multiple literacies
➢ Neutral and universal	➢ Culturally sensitive and diverse
➢ Technical skill	➢ Social practice
➢ Cognitive skill that will improve economic prospects	➢ Varies between contexts
➢ Favoured in education	➢ Ignored in education

However, Hayes (2009:12-13) clarifies the reason for taking both models into consideration by stating the following:

> Just as we would think a carpenter foolish who said, “Now that I have discovered the hammer, I am never going to use my saw again” so we should regard a literacy researcher who says, “Now that I have discovered social methods, I am never going to use cognitive ones again.” Our research problems are difficult. We need all available tools, both social and cognitive.

Cognitive theory is used to explain how cognition impacts one’s ability to write well and improve with practise. This is important as the foundations laid in the writing component of Professional Orientation need to be carried into the future, refined, and improved with time. These cognitive processes are ultimately the things that the students will need to have in place in the academic and professional environment, but they cannot be established without enforcing a writing curriculum built around the necessary cognitive skills.

Social theories regarding language use amongst different groups are also relevant to the students who are the subjects of this study. Helping them to develop the writing skills and literacies necessary for a long-term successful *engineering* career is the goal. This means that writing practices on both a macro and micro level should be introduced, advanced, and refined throughout the students’ studies, with Professional Orientation serving as the starting point.

Finally, the educational aspect of the study discusses Vygotsky’s theories of Internalization, the Zone of Proximal Development, and Activity Theory because these constitute the pedagogical lens applied to the study.

3.2.1. Cognitive Theory

There are many cognitive processes involved in the reading and writing of a text. Given that the focus of this study is writing, with some attention to reading (comprehension specifically) as a part of the writing process, the focus here will be on the mental procedures involved in both reading and writing. If one looks at images of the brain when engaged in these processes, it is clear that multiple areas are activated. Figure 7 (Mason & Just, 2006:767) highlights the different areas responsible for word processing, coherence, text integration, interpretation, and spatial imagery.

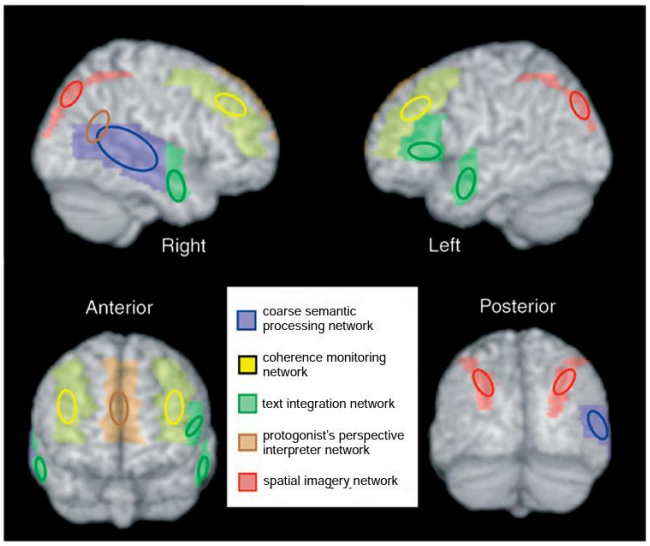


Figure 7: The Parallel Networks of Discourse

This demonstrates that writing draws from various parts of the brain and is not a basic function that involves regurgitating one's knowledge, but a *process* of developing, creating, and refining. According to Lyons (2020:s.p.)

> recognition of words, how they sound and what they look like are all part of the writing process. When writing, a person also engages in motor skills. This occurs in the dorsal parietal lobe and the premotor cortex in conjunction with the primary motor cortex. The dorsal parietal cortex is important because it contains the information about the movements that are necessary to form the written word.

It can be assumed that the students who enter a university class at any level have engaged in the mental processes, such as those mentioned above, necessary to produce a cohesive and coherent text. Additionally, according to Carlson (2012:s.p.), there are different processes involved in reading and these are strongly connected to the thought processes that are performed when one writes a text. It is said that "visual word recognition (lexical processing) provides the base for constructing meaning from text, as words are the primary meaning bearing element provided to the reader" (Morris, 2006:377). However, word selection also involves conceptualising, selecting a word from memory, processing it, and articulating it to the receiver. This process is shown in Figure 8 (Griffin & Ferreira, 2006:22).

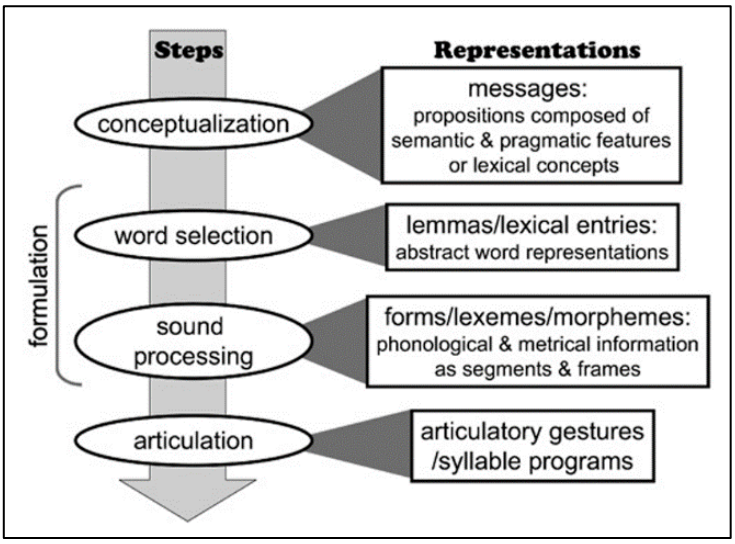


Figure 8: Sentence Formulation Process

These neurological aspects do not form a significant part of this study, but are acknowledged as foundations that are already in place. It is the *cognitive processes* that are important to delve into in this section as they are the tools students use to comprehend, analyse, and synthesise in the written form at a high level. Students should already understand the processes involved in developing a well-written, coherent, and considered text but they still need to learn how to use these to develop discipline-specific texts that can potentially contribute to the body of literature in their fields of study.

Historically, writing development has not received a lot of attention from cognitive researchers because “writing as a topic of research emerged from different disciplines from reading” (Purcell-Gates, Jacobson & Degener, 2004:45). Nevertheless, the writing researcher John R. Hayes has identified writing models that depict the different external and internal aspects involved in the writing process.

The original version of a writing model was published by Flower and Hayes (1981:370) and depicts their initial theory of the different broad cognitive processes that are involved in writing. This cognitive process model of writing is represented in Figure 9.

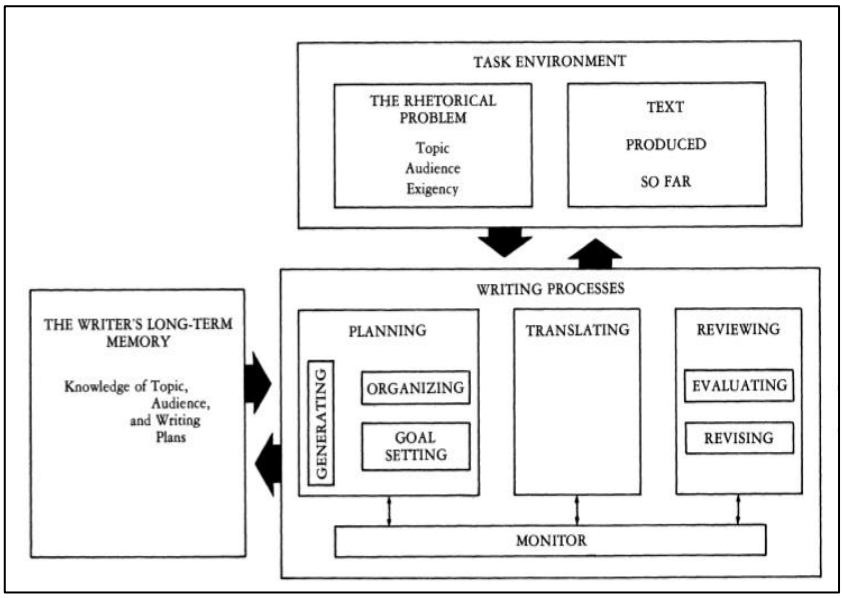


Figure 9: Cognitive Process Model of Writing

In a later discussion on the development of this model, Hayes (2009:4) identified three factors that were taken into consideration when producing it:

- The task environment: That is social and physical factors that occur outside of the writer's body.
- Cognitive writing processes: This includes planning, translating, and reviewing a text.
- Long-term memory: This involves the writer's knowledge of a topic, the audience, and the genre.

This model demonstrates the relationship between the writer's physical and social environment, cognition, and memory. The cognitive aspect is represented as the link between memory and environment. The assumption is that on receiving the task or topic and context for the written text, writers draw upon their knowledge of the topic or context from memory while generating the written text by means of the process of planning, translating, and reviewing. The arrows indicate that all of these processes are iterative as the writer refines the topic and context, pulls knowledge again from memory and undertakes the writing process of planning, translating, and reviewing until a final written product is formulated.

Hayes later found that the above model was too much a simplification of the process and has subsequently produced a more developed model termed the 'Individual-Environmental Model'. This model reflects a revised focus on the environment and the

individual as opposed to the original focus on the cognitive writing process. This model is depicted in Figure 10 (Hayes, 1996:5).

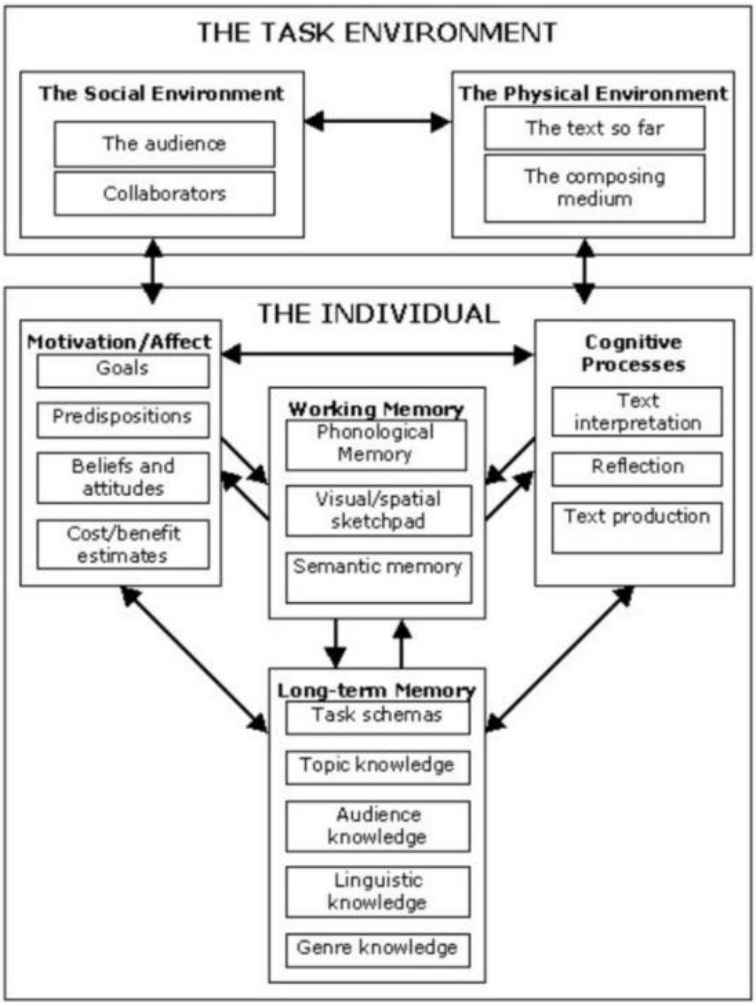


Figure 10: The Individual-Environmental Model

There are a number of revisions to Flower and Hayes' original model evident here, the clearest of which is the scaffolding of the different writing processes. The task environment is depicted as responsible for a third of the writing process, and the individual as responsible for the remaining two-thirds of the process, with one third distributed amongst motivation/affect, working memory, and cognitive processes, and another third dedicated to long-term memory. These different aspects were then further revised as demonstrated in Table 6.

Table 6: Original and Revised Model Differences

Cognitive Process Model	Individual-Environmental Model
The Task Environment	
Rhetorical Problem - Topic - Audience - Exigency	The Social Environment - Audience - Collaborators
Text produced so far	The Physical Environment - Text so far - Composing medium
Writing Process	**The Individual**
Planning - Generating (organising and goal setting) Translating Reviewing - Evaluating - Revising **Monitor**	Motivation / Affect - Goals - Predispositions - Beliefs and Attitudes - Cost / benefit estimates Cognitive Processes - Text interpretation - Reflection - Text production
Long-term Memory	**Central Role of Memory** Working Memory - Phonological memory - Visual / spatial sketchpad - Semantic memory Long-term Memory - Task schemas - Topic knowledge - Audience knowledge - Linguistic knowledge - Genre knowledge
Knowledge of topic Audience Writing plans	

Adapted
Adapted
Adapted
New
New

As indicated above, the task environment was originally inclusive of the rhetorical problem and the text produced so far. However, the task environment has been amended to represent the social environment and the physical environment in the revised model, and it includes the processes identified in the original model. These revised environments are an important addition, because they point to the differences between the physical and social environments and their individual and unique impact on the task environment.

A further significant revision is depicted in the new categorization of the individual and his/her internal processes. This is noteworthy as it creates a clear division between that which occurs within the individual and that which occurs external to the individual.

It still recognises the influence that external and internal processes have on one another, but there is no ambiguity between that which is internal and that which is external to the writer.

The internal processes are sub-categorised differently in the original and revised models, with some additions. Motivation/affect is now recognised by Hayes as an influential factor that includes goals, predispositions, beliefs and attitudes, and cost/benefit estimates. While goal setting was recognised in the original model, the larger impact of these motivational aspects on that which is produced through writing is now recognised. Additionally, the central role of memory has been considered and amended to include working memory in the revised model. This is added to acknowledge that this limited resource is absolutely essential for both storing information and carrying out cognitive processes, based on Baddeley and Hitch's model of working memory (Baddeley & Hitch, 1974). It is a vital addition, because it reminds us of the mechanical factors that play an important role in putting pen to paper (or finger to keyboard).

This revised model reveals that writing cannot take place without any of the necessary external and internal processes in place. Later, Hayes (2009:5) states that

> … writing depends on an appropriate combination of cognitive, affective, social, and physical conditions if it is to happen at all. Writing is a communicative act that requires social context and a medium. It is a generative activity requiring motivation, and it is an intellectual activity requiring cognitive processes and memory. No theory can be complete that does not include all these processes.

Both the original 'Cognitive Process Model of Writing' (1981) and the revised 'Individual-Environmental Model' (1996) reveal that the writer is confronted with an external writing environment (for Professional Orientation students, this will be a new writing environment for them), while at the same time undergoing various internal writing processes, and recalling information and ideas from memory. Furthermore, these events and processes do not occur in isolation, but iteratively throughout the writing process.

It is Hayes' (1996) revised 'Individual-Environmental Model' that will provide the cognitive framework for this study as it represents the holistic nature of writing and draws attention to the cognitive aspects of text interpretation, reflection, and text production, three core procedures that are consistently brought to the fore in

Professional Orientation. These aspects are unpacked further in Table 7 (Hayes, 2009:13).

Table 7: Text Interpretation, Reflection, and Production

Process	Function	Cognitive Inputs
Text interpretation	Creates internal representations ***From*** Linguistic and graphical inputs	• Reading • Listening • Scanning graphics
Reflection	Creates revised internal representations ***From*** Other internal representations	• Problem-solving • Decision-making • Inferencing
Text production	Creates written, spoken, or graphical output ***From*** Revised internal representations	• Writing

Likewise, it shows that the higher-order aspects of writing require complex and demanding thought processes and can be influenced by motivational/affective factors that are equally essential for writing success. It is necessary to consider both the internal, intricate thought processes undertaken by each student in the development of a logical and structured text, but this can be limiting and narrow if one does not also consider the external factors that impact writing (Purcell-Gates, Jacobson & Degener, 2004:77). These will be explored in the sub-section on social theory that follows.

3.2.2. Social Theory

In this section the focus shifts to the external or social factors that have a powerful influence on the discourses used in everyday life. While this, too, can be limiting because it tends to ignore individual cognition and point to problems rather than solutions, these theories attempt to explain the impact that the social world has on our literacy and ability to participate in the world (Purcell-Gates, Jacobson & Degener, 2004:66).

New Literacy Studies (NLS) is the predominant theoretical basis for social theory in language, with researchers such as Barton, Fairclough, Gee, Halliday, Hamilton, Heath, and Street providing the basis for concepts discussed and explored within this framework. In essence, the NLS posit literacy as a sociocultural event, rather than a mental event. Gee (2015:38) summarises this NLS belief as follows:

> … the NLS point not to the 'private mind' but to the world of experience — and that experience is almost always shared in social and cultural groups — as the core of human learning, thinking, problem solving, and literacy (where literacy is defined as getting and giving meanings using *written language*). (My emphasis)

This suggests that what defines 'literacy', and by extension 'academic literacy', is not so much a specific set of skills, but knowing how to communicate within specific sociocultural communities. To put it simply, individuals are involved in different cultural engagements on a daily basis: for example, interactions with family and friends in the community, different textbooks during the course of their studies, and peers and classmates on campus. Each of these domains involves a different form of literacy, and participation within these groups cannot take place without the relevant literacies intact. Similarly, the way in which this thesis is written differs markedly from the way in which a text message or email might be written. This is because "language varies according to its use, according to its functions it is made to serve; and there are many other variables — rhetorical mode, degree of 'openness' or unpredictability, level of technicality, conventionality, and so on" (Halliday, 2007:78) — that come into play.

The NLS are influenced by the understanding that literacy is always embedded within a social context and is "observable in events which are mediated by written texts" (Barton & Hamilton, 2000:9). Different contexts are defined as *discourse communities,* according to NLS, which are "held together by their characteristic ways of talking, acting, valuing, interpreting and using written languages" (Barton & Hamilton, 2000:11). If one considers this in the context of socialisation, members of different communities will have different literacy behaviours and practices.

Shirley Brice Heath, a significant early contributor to the NLS, conducted a study on literacy in several small towns in America, published as *Ways with Words: Language, Life and Work in Communities and Classrooms* (1983) — which is now recognized as a definitive text within the discipline. In this study, she found that sociocultural circumstances impact children and their ability to access and use language. Additionally, she found that schools are not good places to *acquire* the foundations of mainstream literacy, but are better for *practise* once these foundations have been acquired. According to Heath (1983:344), "the language socialisation process in all its complexity is more powerful than such single-factor explanations [formal language structures, parent-child interactions] in accounting for academic success." This means that prior acquisition of basic literacy through socialisation is crucial, and those

embarking on formal education programmes without it will be at a disadvantage. This has obvious bearings on the ENGAGE Programme which is the subject of the present study, since many students in Professional Orientation may lack mainstream literacy foundations, given that they come from different sociocultural and linguistic circumstances and often speak English as a second, third, or even fourth language.

Gee (2008), who has usefully expanded on these points with an important distinction, says that primary discourses — the discourses people develop in their primary residence or social group, which may be mainstream or not — are *acquired* in social groups without formal teaching, but dominant discourses — those that carry societal value — are *learnt* through formal teaching[8]. He goes on to say that "we are better at performing what we acquire but we consciously know more about what we have learned"[9] (2008:170). This indicates that the different discourses with which students come to university should not necessarily render them incapable of learning the dominant academic engineering discourse, if it is consciously being taught and adopted by those in the discipline. However, given that academic literacy is a secondary discourse, a lack of exposure in childhood would make it more challenging for some students to acquire than others.

Heath and Gee's arguments highlight that socialisation has a significant impact on literacy practices and academic success. The relevance of this in relation to the present project is that on the one hand, students in Professional Orientation might lack mainstream literacy foundations, which can lead to isolation and an inability to communicate or understand necessary content but, on the other hand, all of the students are new to the specific professional/academic environment and should therefore be open to developing a shared engineering identity that is developed by and aids in the development of the required academic literacy.

[8] Primary discourse is what we develop as our 'everyday' mode of expression at home. A secondary discourse is what we develop in areas outside of our primary environment, like the sports field. Dominant discourses bring about social status and social benefits, and non-dominant discourses bring about a sense of shared belonging, but do not carry social benefits (Gee, 2008).

[9] Gee views 'acquiring' and 'learning' as different. Acquisition happens in social groups, without formal teaching; whereas learning happens consciously, with formal teaching.

Various NLS scholars take the concept of 'literacy' further and differentiate between what they term 'literacy events' and 'literacy practices'. Definitions of these terms are provided in Table 8.

Table 8: Terms Defined

Literacy events	Any occasion in which a piece of writing is integral to the nature of the participants' interactions and their interpretive processes (Heath, 1983:93).
Literacy practices	Social rules which regulate the use and distribution of texts, prescribing who may produce and have access to them (Barton & Hamilton, 2000:8).

Literacy practices influence literacy events and the way in which one is able to manage such events. Literacy practices are embedded in power relations that can result in social exclusion — Brian Street and Norman Fairclough discuss this extensively in their works on language, power, and the intersection between the two. Social exclusion from literacy practices can result in an inability to adequately participate in literacy events. According to Fairclough (2000:54), social exclusion can be either a *process* or an *outcome* — a process is something that is done to one and an outcome is a condition that one is in.

Social exclusion is an *outcome* for many in the South African context. As stated previously, the majority of school and university students are not first language speakers of English (the language of higher education in South Africa) and come from communities that do not have the means to help children develop mainstream literacy practices, and from schools that do not have the tools to help mature the literacies that are in place. This prevents many prospective students from participating in the literacy practices that would allow them to adequately partake in literacy events at a later stage.

English carries social value and within the language itself, there are different dialects that hold more social value than others. At a university level, academic English is based on Western rhetorical norms and is the dominant discourse crucial to academic success and, ultimately, success in the workplace (Street, 2001:8). While this value system is framed as problematic by NLS theorists, the reality is that it is unlikely to change. Thus, the goal is to give students the opportunity to acquire the academic literacy practices they need to be successful by helping them to form a discourse

community or 'engineering literacy identity' that mirrors dominant academic literacy norms.

One of the ways to develop this shared 'engineering literacy identity' is to consider "the notion of team[s] working on projects rather than hierarchical forms of organisation that simply pass orders down a chain of command" (Street, 2001:5). This is supported by Gee (2012:90) who says that "one learns cultural models by being acculturated, by being open to and having experiences within a culture or social group, by practicing language and interaction in natural and meaningful contexts." This approach, which is currently used in Professional Orientation, may help to break down the barriers between students and aid them in developing a discourse community that can evolve and be carried through their studies and into the workplace. As Gee (2015:35-36) says "written language never sits all by itself and it is rarely if ever fully cut off from oral language and action." The NLS explain that written language is acquired through social and cultural practice involving the use of:

- Oral language
- Action and interaction
- Knowledge, value, and belief
- Various technologies and tools.

Although this list does not point to specific actions to aid the teaching of a shared literacy, it does indicate a broad list of criteria that can aid in its development. Inevitably, language will remain the vehicle for learning in an educational setting for the foreseeable future. Halliday (2007:269-270) captures the complexities of this as follows:

> … in talking of language education, we are asserting that there is a relationship between language as a *medium* of learning, in this sense of "language across the curriculum", and language as the *substance* of what is being learnt, in the teaching of foreign or second languages, of the mother tongue, of reading and writing, of grammar, composition, and so on. (author's emphasis)

There is always a verbal environment within which context is created. This can be concrete, abstract, or embedded within the surrounding text (Halliday, 2007:271). When it comes to education, particularly language education, one is simultaneously

learning a language, learning through a language, and learning about a language (Halliday, 2007:80).

By concentrating on writing as the product of academic literacy and, in particular, the higher-order skills of subject-focus, synthesis, source integration, and cohesion[10] students are exposed to the relevant nuances and complexities of language and literacy. At its core, language is made to serve as a means of interaction and much "secondary education consists in becoming sensitive to this kind of register variation and learning to control it" (Halliday, 2007:78). Thus, the next section on education theory will explore the theories that will provide a framework for the teaching of the higher-order writing skills and practices central to this study.

3.2.3. Education Theory

Theories of the cognitive processes involved in writing and the impact of the social environment on our ability to acquire literacies are fundamental to this study which focuses on Academic Literacy. However, the theory of education that frames the interventions and curriculum changes that have been developed is also important and requires some explicit attention. Vygotsky's work on Intervention, the Zone of Proximal Development, and Activity Theory provides the theoretical lens for this study by clarifying how the concepts discussed in the cognitive and social theory sections impact one's ability to acquire language. Because Vygotsky was prevented from developing many of his ideas by his early death, much of this discussion references notable scholars who have synthesised, critiqued, and elaborated on his ideas.

James V. Wertsch, in his book *Vygotsky and the Social Formation of the Mind* (1985), states that "in order to understand the individual, one must first understand the social relations in which the individual exists" (p. 58). In simple terms, he argues that in order to develop higher-order functions, one must first be exposed to the social event, then identify the relevant signs, and finally internalise the information (p. 62). Vygotsky does not believe that all external events result in internalisation but that internal mental processes emerge from 'mature cultural forms of behaviour' (p. 63).

[10] The Lower-Order and Higher-Order criteria applied to this study are discussed in more detail later in the chapter.

This suggests that, in the case of children (or those of developmental age), cognitive and language development occurs when they see a successful performance and internalise it. However, teachers' performances are often 'too polished' which makes them too far removed for children to be able to internalise and assimilate the behaviour (Shayer, 1997:47-48). Thus, the learning often has to come from someone who has been able to assimilate the behaviour, or what Vygotsky terms a 'capable peer', and express it in their own way.

Vygotsky's view on internalisation is closely linked to his theory on the Zone of Proximal Development (ZPD). The ZPD is the distance between a child's actual development and their higher level of potential development, or the "area within which the learner is able to complete a task with assistance" (Everson, 1991:11). Figure 11 (Janevski, 2013:23) is a simple representation of this concept.

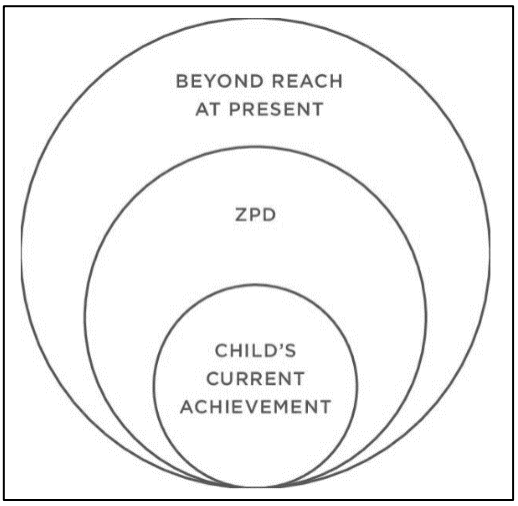


Figure 11: Zone of Proximal Development

Wertsch (1985:67) explains that the ZPD was also established in part to enhance instructional practices, indicating that tasks should be developed that fall within the students' ZPD rather than within their current achievement (not challenging enough) nor be beyond reach at present (too challenging). The revisions that are being considered for this study should fall within the students' ZPD as they have already achieved the necessary requirements for admission into the course and they have received writing instruction to a lesser or greater degree throughout their schooling.

Moreover, Vygotsky alleged that social events (inter-psychological functioning) could maximise individual internalisation (intra-psychological functioning) (Wertsch, 1985:71). He believed that this could lead to a rise in mental functioning because the focus would not be on 'specialised' skills but on 'all-round' development, implying that

advanced thinking can come from peer interaction and it can be more beneficial than individual skill development. Thus, even if students do not have adequate lower-order skills, they will still learn from their peers and boost their higher-order processes.

Many Vygotskian scholars have found that, regrettably, when it comes to communication and expression, the expectation that peers can assist each other in the learning process and that gaps can be bridged between actual knowledge and knowledge potential is often not fulfilled in the making of writing interventions. Curriculum Management Solutions Incorporated (2018:s.p.) recognizes that "[u]nfortunately, children from impoverished backgrounds and English Language Learners are often condemned to worksheet purgatory instead of being assisted to develop the language thinking skills they need to be successful in school."

Vygotsky was primarily concerned with thought processes, but many of the researchers who have studied his work have observed that his ideas also strongly relate to language development, specifically writing instruction. From this point of view, such instruction should move away from internalised, private structure, toward small group discussions and sharing of ideas that will allow the student to step away from "abbreviated inner speech" toward "external, social speech" that is more objective and subject to correction (Everson, 1991:10). Everson (1991:11) elaborates as follows:

> [Vygotsky's] work is represented throughout modern discourse theory, and his observations are reflected in solid instructional practices… Writing is a synthesis or pulling together of ideas, images, disarrayed facts, and fragments of experiences. It should be taught naturally. It should be necessary for something. And it should allow the time and space and cooperation necessary for the compositions to develop into a worthwhile product. Writing teachers must recogni[s]e this interplay of inner voices and social contexts that are ever combining to form written discourse. Only then will our student writers be free to experiment and mature as much as possible along the way.

To aid in insuring that the above is taken into consideration, Vygotsky's Activity Theory serves as another useful lens for this study. This theory proposes that "human activity is purposeful and carried out by sets of actions through the use of 'tools', which can be physical or psychological. The latter include language, the most significant tool for collaborative human activity" (Hassan & Kazlauskas, 2014:9). Moreover, Vygotsky proposed a distinction between 'elementary' and 'higher' mental functions, and stated that social or cultural development converts elementary mental functions into higher

mental processes. He identified four criteria to distinguish between elementary and higher mental functions, namely:

1. The shift of control from environment to the individual.
2. The emergence of a conscious realisation of mental processes.
3. The social origins and nature of higher mental functions.
4. The use of signs to mediate high mental functions. (Wertsch, 1985:25)

These ideas led to Engeström's version of Activity Theory which explains that the above process does not function in isolation, but through "interactions within the social world through artefacts, and specifically in situations where activities were being produced" (Wheeler, 2020:s.p.). In other words, people use both internal tools (e.g., language and thought processes) and external tools (e.g., computers and interactions) to carry out activities.

This adapted theory is beneficial to this study because it points to the influence of both internal and external factors in one's ability to successfully achieve a goal. This is relevant because it highlights the environment and the 'tools' available in the environment, as well as how one's thought processes and language capabilities influence one's ability to acquire higher mental processes (something the students are still developing).

Thus, in accordance with the theories discussed, a substantial curriculum for the development of higher-order writing processes that takes NLS, Cognitive Process-Writing Theory, and Activity Theory into consideration, will help lead to higher mental functioning in the students. As stated by Everson (1991:11), "writing teachers must recognise this interplay of inner voices and social contexts that are ever combining to form written discourse."

3.3. ACADEMIC LITERACY

Lea and Street's 1998 article titled 'Student Writing in Education: An Academic Literacies Approach', although based on British experience, has come to serve as the foundation for much of the Academic Literacy research that has followed in other contexts. In this paper, Lea and Street explore staff and student expectations and interpretations of written assignments by taking case studies from two universities in

England. To frame their discussion, Lea and Street outline what they deem to be the purpose of Academic Literacy by stating:

> Learning in higher education involves adapting to new ways of knowing: new ways of understanding, interpreting and organising knowledge. Academic literacy practices — reading and writing within disciplines — constitute central processes through which students learn new subjects and develop their knowledge about new areas of study (p. 158).

This brief explanation emphasises the importance of academic literacy for *all* students at university, as it explains in simple terms that the goal of programmes designed to promote academic literacy is to develop the reading and writing skills necessary for learning and developing knowledge *within a discipline*. This means that the objective is not to teach students how to read and write, but to teach students how to read and write for the learning and expression of knowledge within their field of study.

In this article, Lea and Street find that meaning is different for the various role-players at university, that is the institution itself, the teaching staff, and the students (p. 158). Thus, the aim is to aid each role-player in developing an understanding of what the expectations and interpretations of written assignments are within courses for each of these. For instance, the aim of the institution is to have students pass and complete all of the relevant courses within the minimum timeframe; the aim of teaching staff is to assess student understanding and knowledge of the specific subject area in order to justify a pass; and, the aim of students is to gear their written assignments to the relevant lecturer's expectations to achieve a pass mark. While the outcome for each of these is to achieve a pass mark, each group has a different agenda or understanding as to how to reach these expectations. For this reason, one of the most important areas for improvement identified by Lea and Street is feedback:

> [Lecturers spent a lot of time] concentrating on issues of surface form: grammar, punctuation and spelling… They rarely dealt with the issues that students reported they had most difficulty grasping — for example, how to write specific, course-based knowledge for a particular tutor or field of study (p. 164).

This points to a lack of emphasis on the higher-order thinking skills that demonstrate understanding and knowledge within a field of study. These higher-order abilities relate to the deeper aspects of writing such as structure, argumentation and development (discussed in further detail later in Section 3.5), which students reported

as being dealt with inconsistently within each department, and sometimes from one writing tutor to another. Additionally, the researchers report that "[a]lthough students frequently had guidelines, either from individual tutors or as departmental documents on essay writing, they found that these often did not help them very much with this level of writing" (Lea & Street, 1998:164), demonstrating that this aspect is often left open to student interpretation at the risk of student success. The reasons for this are varied but are thought to be related to a lack of uniformity amongst the writing instructors themselves, open-ended feedback that leads to open-ended interpretation, and feedback that critiques writing as opposed to offering epistemological feedback on how to convey knowledge within a particular discipline (Lea & Street, 1998:165-167) — all of which are issues the current study aims to address under the umbrella of 'higher-order writing skills and practices'.

The final important observation that is made by Lea and Street[11] concerns three main models appearing in educational research on student writing. The identifying features of each of these models are represented in Table 9.

Table 9: Student Writing Models

	Study Skills	Academic Socialisation	Academic Literacies
Literacy is / Literacies are…	a set of atomised skills.	inducting students into a new culture.	social practices.
Students are encouraged to…	transfer these skills to different contexts.	interpret knowledge within this new cultural framework.	develop their epistemological knowledge.
Lecturers emphasise…	fixing the surface features / technical aspects of writing.	the distinction between deep, surface, and strategic approaches to learning.	different communicative practices, including genres, fields, and disciplines.

Although each of these models has different goals and ideals, they do not function in isolation and are transferable between one another (p. 158). Lea and Street view these

[11] These models were originally introduced in a paper Lea and Street presented at the Higher Education Funding Council for England, Social Anthropology Teaching and Learning Network workshop in 1997 titled 'Models of student writing in higher education'.

models as hierarchical and privilege the Academic Literacies approach[12] (p. 158). In this study they are viewed as inseparable from each other and of equal importance because attention to each of these aspects needs to be given when teaching academic writing as they relate to the spectrum of lower- and higher-order writing development. If the surface-level aspects of writing are ignored, students will not be able to develop or convey their epistemological knowledge; if the field or genre within which students are working is not considered, the strategic aspects of writing will be left unfulfilled. Thus, the final writing curriculum will ensure that each of the identifying features indicated above is addressed.

Another formative research study in the field of Academic Literacy is Lillis and Scott's 2007 article, 'Defining Academic Literacies Research: Issues of Epistemology, Ideology and Strategy'. In this article, Lillis and Scott claim that Academic Literacy should be a field of study on its own, with a shared ontology. Clarence and McKenna (2017:38) remark that this study has been crucial to Academic Literacy scholars because it outlines Academic Literacy as a "critical field of inquiry, [that has] both a recognizable epistemology — that of literacy as a social practice — and an ideology — that of transformation."

In support of their stance on the importance of Academic Literacy in higher education in the UK and in other national contexts (including South Africa), Lillis and Scott (2007) outline the broadening of participation by students from different social contexts within universities in the UK from the 1980s to the 1990s and into the early 2000s (p. 8) and they go on to mention the political transformation, and subsequent education transformation, that took place in South Africa in the 1990s (p. 9). The opening up of higher education to more students globally has led to linguistic, cultural, and social diversity in these systems and falling standards in written language, and, given that writing is the primary form of assessment at university, this has resulted in higher failure rates within these institutions (pp. 8-9). Therefore, Lillis and Scott argue that Academic Literacy scholars internationally need to focus on writing "as long as [it] continues to be at the heart of assessment in higher education" (p. 17).

Additionally, the researchers outline the complex dimensions that influence student writing (pp. 10-12), namely: power relations, academic writing conventions, identity

[12] Lea later acknowledges and addresses criticism for this model's lack of attention to pedagogy (Lea, 2004:741)

and identification in academic writing, ideologically inscribed knowledge construction, and generic academic writing vs. disciplinary specific writing practices. By bringing these factors to the fore, they emphasise the challenges that writing researchers and university students face at an institutional, social, and cognitive level. Because writing is such a complex process involving various factors, exploratory studies (such as the one at the heart of this thesis) can only serve to enhance the field of Academic Literacy and writing education.

More recently, Wingate (2015) published *Academic Literacy and Student Diversity: The Case for Inclusive Practice* in which she draws on studies that have been conducted internationally and in South Africa to establish trends in Academic Literacy education and areas for development.

Wingate identifies two common misconceptions in Academic Literacy education (pp. 10-11):

1. That academic literacy is equal to linguistic competence.
2. That problems in academic literacy are only applicable to those preconceived as disadvantaged or deficient.

Students at many institutions, both in South Africa and internationally, often complete English proficiency tests to assess their competency in overall language, grammar, and the use of cohesive devices — surface-level forms — and not on the deeper forms related to structure, argumentation and development. However, these tests have been shown to have "little predictive value of students' ability to use language in academic contexts" (p. 10). While these are difficulties that one faces when learning a secondary dominant discourse, the issues go far beyond these surface-level weaknesses. Wingate expands on this as follows:

> The assumption that literacy instruction and support is only needed by certain student groups is, of course, closely linked to the misconception that academic literacy is the same as language proficiency. However, once academic literacy is understood as communicative competence in an academic discourse community, the conclusion that all students have to gain this competence and will therefore benefit from support and instruction is obvious (p. 11).

At the root of Wingate's observation is the idea of 'communicative competence', which is defined by Hymes (1972) as a grammatical competence that one is able to apply to

various social situations involving communication[13]. Subsequently, various models have been developed relating to communicative competence (Canale & Swain, 1980; Canale, 1983; Bachman & Palmer, 1996; Bagarić, 2007), all of which highlight the relationship between our grammatical toolbox and our sociolinguistic competence, and the way in which the two come together to form our communicative discourses.

The idea that academic literacy relates to communicative competence presupposes that the emphasis of academic literacy instruction not only needs to deviate from writing to other forms of communication (e.g., oral presentations) in an academic setting, but also that writing instruction needs to move away from primarily surface-level (lower-order) form instruction to higher-order forms that display discipline-specific writing competencies.

For this reason, the student subjects of this study are not sub-categorised as first- or second-language English speakers, nor are they identified according to their English language proficiency. However, given that many South African students lack English language proficiency, this aspect of writing cannot be ignored. Surface-level forms must still be addressed, but they must be viewed as distinct from and supportive to the higher-level academic literacy competencies required of engineering students. Wingate acknowledges that the history of racial segregation in South Africa has made the literacy challenge an even greater obstacle to be overcome than that in other Anglophone countries (Wingate, 2015:65).

Wingate also contends that “the integration of literacy instruction into the curriculum, as well as its quality, is greatly facilitated by the collaboration between academics in the disciplines and writing experts” (p. 57). The stronger the collaboration between the English for Academic Purposes (EAP) practitioner and the discipline expert, the more effective the academic intervention will be. One of the primary reasons for this, according to Wingate, is that

> the marginalisation of writing experts would considerably decrease when language and literacy are given attention in the subject curriculum and when writing experts teach alongside academics in the department. The exclusive targeting of specific learner groups disappears when writing

[13] Dell Hymes established the idea of ‘communicative competence’ in reaction to Noam Chomsky’s theory on ‘linguistic competence’, which highlights one’s knowledge of language forms and not one’s ability to apply these broadly to different communicative practices.

> instruction becomes part of a study programme and thus inclusive of all students on that programme (pp. 58-59).

Jacobs (2007) expands on this in her research study on discipline-specific academic literacies which highlights the important relationship that exists between language lecturers and disciplinary specialists. Jacobs finds that language lecturers help to make tacit knowledge of literacy and discourse patterns more explicit (p. 59), which further suggests that such collaboration is beneficial for discipline-specific academic literacy teaching.

Professional Orientation is embedded within the EBIT ENGAGE programme, which offers various support modules to students completing the extended engineering degree at UP. This means that only students in the extended degree are offered academic literacy development and, as a result, many students in the programme do not view academic literacy as relevant to their engineering studies. Moreover, this programme is positioned as separate from the four-year engineering degree programme, meaning that the overlap with engineering is lacking. Given this separation, there is a lack of input from discipline experts and much of the content is developed from the EAP lecturers' research into the field.

Dison and Moore (2019) also stress that entry-level students need help and support with the academic discourses that are unfamiliar to them and that so long as Academic Literacy modules are offered as 'student support' modules, the students to whom such modules cater will feel alienated and excluded (pp. 1-2). This stems from the lack of emphasis on the applicability of academic literacy and the benefits it holds for *all* students within higher education institutes.

All universities in South Africa are faced with similar sociocultural and literacy concerns and several local EAP practitioners from across a broad institutional spectrum have for some decades been researching ways in which to equip South African students with the academic literacies necessary to make progress at university and beyond.

Chrissie Boughey, a renowned South African EAP researcher at Rhodes University, has published many research studies on higher-education in South Africa and Academic Literacy. In her 2018 short paper titled 'Using the Curriculum to Enhance Teaching and Learning', Boughey reiterates the marginalised positions of EAP and Academic Development practitioners by acknowledging that "curriculum reform is

neglected at the expense of ad hoc initiatives which take place outside of mainstream learning" (p. 5). This is despite the continuous curriculum reform that South African universities and institutions of higher learning have undergone for over two decades and the push for vocational-specific courses that will allow for "participation in the global economy by dominant discourses" (Boughey, 2018:5).

In the case of engineering, the vocational-specific course model is followed by all universities (including the University of Pretoria) conforming to the Washington accord, as specific graduate attributes are required in order for students to be awarded their degrees. ECSA includes effective communication as one of its Graduate Attributes (ECSA, 2019:12) and this is dealt with in Professional Orientation for entry-level extended degree programme students and in discipline-specific communication courses offered to all students (four- and five-year programme) later in the degree programme.

3.4. DEVELOPMENTS IN WRITING INSTRUCTION

Writing at a school level has seen many changes over the years and as tertiary institutions have evolved to afford more people access, writing instruction and academic literacy have become more important. This has contributed to the study at hand on developing higher-order writing in engineering students in an extended degree programme. This brief history of the evolution of writing curricula at a secondary and tertiary education and on writing curriculum developments in the South African context serves to highlight why this study is of value.

3.4.1. History of Writing Curriculum Development

David R. Russell provides a history of how writing instruction and writing curricula have developed from the post-war era through to the early 2000s in America and Britain in *Writing in the Academic Disciplines: A Curricular History* (2002)[14]. By documenting this history, he identifies different trends and factors that are/should be taken into consideration when designing a writing curriculum.

[14] South Africa was part of the British commonwealth until 1961, but remains heavily influenced by British language and educational trends.

In the 1960s, the Writing Across the Curriculum (WAC) movement was set in motion. This movement led to Britain's National Association of Teachers of English (NATE) challenging traditional writing norms and taking into consideration the "linguistic, social, and personal development of the student" (p. 273). This change in thinking was adopted in America as well, and both Britain and America implemented the following teaching approach:

> Loosely structured classroom "talk," dramatic improvisation, and personal response to literature took precedence over disciplinary knowledge embodied in literary classics and rhetorical or grammatical principles. Students' own creations were valued as literature and treated as texts worthy of analysis (p. 273).

This adaptation to English instruction at a school level resulted in more teachers and researchers seeking to understand and investigate the role of writing in learning, particularly in the 1970s (p. 272). Paralleling these advances, were 'changing patterns of employment and higher education… "making more widespread demands on reading and writing skill and therefore exposing deficiencies that ha[d] escaped attention in the past"[15]' (p. 277). This meant that American and British media began accusing the education system of "spawning a generation of semi-literates" (p. 276). Consequently, schools started to revert to mechanical drill and language and grammar exercises, and writing practise became about filling in the blanks — extended writing was only done to assess students' performance and not to make improvements (p. 281).

However, in the 1980s, school teachers and researchers began to see this as problematic and began to "investigate the underlying principles that give structure to a subject through writing" (p. 272). As a result, teacher training programs began to be developed, and curriculum and material development came to the fore (p. 281).

In the 1990s and early 2000s these educational changes started to become prevalent in higher education as well – Russell (2002:309) termed this the "age of accountability in higher education". As improvements were being made to teaching and writing programmes, so too did Writing in the Disciplines (WID) come to the fore as an

15 The quote comes from a report published by the British educational commission, headed by Margaret Thatcher, in 1975.

initiative separate from WAC (p. 310). The differences between the WAC and WID movements are represented in Table 10 (Russell, 2002:310-311).

Table 10: WAC vs WID

WAC	WID
Writing Across the Curriculum	Writing in the Disciplines
General	Specific
Writing to learn	Learning to write
Developing cognitive performance	Developing professional discourse

Even though the WAC movement originally grew out of higher education, specialists started to realise that writing needed to be more professional and discipline-specific. Still, this meant that students rarely learnt the kinds of writing they would need when they left university, because they were still writing to an instructor for the purposes of examination. Consequently, Writing Intensive (WI) courses grew out of the WAC/WID dichotomy and it was realised that WID is an aspect of WAC (i.e., writing across the curriculum should be applied broadly, with consideration for writing in the disciplines as well) (p. 313).

Over the years, the WAC model has evolved further to Communication Across the Curriculum (CAC) as visual modes of communication have become more prevalent, but the overarching dominant framework remains writing across the curriculum with writing intensive courses or discipline-specific writing courses (p. 313) being on offer.

This summarises the history of how writing curricula have developed in the United States and Britain, but it is applicable to South Africa as well. South Africa's education system has traditionally been modelled on the British system so our approach to teaching and learning tends to mirror theirs. Additionally, the world is becoming far more global and institutes that have internationally accredited courses tend to follow similar models and approaches.

Reflecting international trends, South Africa's Academic Literacy courses tend to either be writing intensive courses or discipline-specific writing courses. Professional Orientation is a discipline-specific writing course that incorporates academic and IT skills, since its aim is to prepare students for their engineering studies and engineering careers using a combination of academic, IT, and reading and writing skills. However, the designers of the module also face the dilemma that students tend to write for the

purposes of examination and forget that the intention is to be more reflective of one's writing and learn how to write in the dominant discourse for different audiences and purposes. Moreover, many of the students are not first language English speakers, which presents its own challenges, even though most students (even those who are first-language English speakers) still need to develop an academic English discourse. All of this often results in written texts that lack coherence, cogency, and clear intentionality. The goal is thus to shift the emphasis away from surface-level features related to grammar and to focus on the higher-order so that students in the programme become more *conscious* of the delivery and intention of their writing, and start producing texts that are coherent, well-considered, and relevant to the engineering context.

3.4.2. Curricula in the South African Context

A number of local practitioners have conducted important research in writing instruction and curriculum development within Academic Literacy, which has improved the discipline both nationally and internationally. These studies highlight the current trends in writing instruction and curriculum or pedagogical development, and were taken into consideration when the curriculum that scaffolds the higher-order writing process was developed for this research project.

Boughey's 1997 research study on groupwork in writing points to the pertinent connection that exists between writing and thought, a connection that is essential for higher-order communication:

> The claim for a relationship between writing and learning is, by now, well documented… and tends to rest on the function of writing as a tool for *clarifying* and *extending thought* (p. 126; my emphasis).

In other words, if writing and writing conventions are not valued by mainstream practitioners, students will miss out on key opportunities to refine their practice and explore the learning and thinking opportunities that come with it. Although this point does not relate directly to the study at hand, it underlines further potential benefits of writing with an emphasis on higher-order forms, as these aid in both communication and learning.

In their 2005 study, Granville and Dison evaluate self-reflection in an extended degree option in the Humanities Faculty at the University of the Witwatersrand. This study is

relevant, as this course is a discipline-specific course, much like Professional Orientation, with a specific Academic Literacy focus. Moreover, it is applicable because self-reflection is a Learning Outcome in Professional Orientation. The researchers propose that "[b]y reflecting on classroom tasks using their own voices, students can more easily make the transition from their everyday vernacular languages to the specialist languages required by the University" (p. 100). They claim that self-reflection aids in the development of academic social languages, higher-order thinking (meta-cognition), and effective learning. After concluding the study, the researchers observe that "once the habit of reflection is refined and developed [in students], it has the potential to build a range of more complex understandings required in academia" (p. 114), and that reflections help students to "remain anchored in their secure identities while they reach out towards new understandings and new identities" (p. 114). This is significant because self-reflection has always been considered as separate to the writing component in Professional Orientation, but it can be a useful tool to use in scaffolding the students' higher-order writing development — that is, the manner in which they present their argumentation and the complex thought processes that are required of them.

Arlene Archer, a South African researcher in the field of academic literacies in engineering, conducted her 2005 PhD study on multimodalities in an engineering communication course. In two articles based on the PhD findings, Archer explains that she approached her research from the perspective of the NLS and explored the use of different 'modes' in aiding student expression and boosting student competency in order to address student access issues. (Modes refer to visual, written, and oral communication). In her first article, Archer (2006a) argues against logocentrism and asserts that technology is changing the way people communicate. She states that 'multimodality' is emerging as a communication theory and a particular approach to pedagogy, and that there is a clear intertwinement between language, power, and modalities. In a second article, Archer (2006b) argues for less regulated spaces (open tasks, with no strict, generic guidelines), with less of a focus on assessment to suspend teacherly judgement and the use of tasks as a springboard for students to develop their writing skills. She states that there has been a societal shift from the verbal to the visual, and that needs to be reflected in the curriculum. "Less regulated curriculum spaces", she argues, "are able to draw on and experiment with a range of

genres and modes in a way that is not always possible in highly regulated genres such as the written report" (p. 191).

The writing focus in Professional Orientation has historically been on working toward the production of a written report, with a strong assessment focus. There are writing tasks that lead to this goal, though the curriculum tends to be regulated. However, there generally is a parallel between the approach taken by Archer and Professional Orientation in the use of different modes of expression in the projects introduced in the second semester that afford the students the opportunity to express themselves in the visual, oral, and written form. What Archer's study suggests is that there should be more attention to the writing development *process*, rather than the writing development *outcome*, and that the use of different modes of expression may ultimately help the students to develop the thought processes necessary for logically sound writing and higher-order development. Although the emphasis is on writing development in this study, the researcher uses different modes of expression to encourage discourse development throughout the year.

Cecilia Jacobs' 2013 conceptual paper, 'Academic Literacies and the Question of Knowledge', maps academic literacies work in the South African context across 20 years. In this paper, Jacobs argues for a shared ontology within which to frame academic literacies in the South African context, given our unique and diverse higher educational context. This is reminiscent of the views of Lillis and Scott (2007) and shows that there is considerable work being done in the field in the South African context but, as with the global context, there is still a long way to go before we can achieve this shared ontology and move out of the marginal position in which academic literacies scholars often find themselves.

In Moragh Paxton and Vera Frith's 2013 study of the implications of academic literacies research for knowledge creation and curriculum design, an argument is made for making language and literacy an integral aspect of all curriculum design so that students can develop texts that will help them to create new identities. Furthermore, it is argued that this will help students to link theory and real-world application through writing. Paxton and Frith contend (2013:172) that subject-specific disciplines need to take reading and writing seriously in their curricula.

> What is so often overlooked in the higher education literature is that reading and writing are central to the process of learning in any discipline.

> The importance of writing for shaping students' cognitive processes is now well established after extensive research in this area over the last four decades.

In spite of the above, writing is often overlooked or an after-thought in curriculum design. Thus, the development of a curriculum with a specific focus on higher-order writing concerns will encourage the development of these essential cognitive processes, particularly if engineering-based content is used that is relatable and relevant to the students. As Paxton and Frith acknowledge, the focus should not simply be on the text but on the text as a social practice — and perhaps a multi-layered combination of cognitive skills and social and educational practices.

The nature of Paxton and Frith's research aligns with the NLS and they state that "Academic literacies research has built on these theoretical frameworks to develop a field of research which seeks to understand language and literacy as social practices within higher education" (2013:173). This demonstrates that this aspect of the theoretical underpinnings chosen for the study is one that is accepted by many South African researchers, and has led to positive results in the field of Academic Literacy.

Clarence and Mckenna (2017), two researchers from Rhodes University, contend that academic literacies develop through disciplinary knowledge. What they mean by this is that there is connection between what students learn about and how it is organized, sequenced, expressed, addressed, and valued. They claim that there are two broad goals in academic literacies work:

1. To orientate students and lecturers toward sociohistorical and sociocultural informed literacies and practices, that are influenced by disciplinary and broader contexts within universities. (I.e., Literacy practices are never neutral and there should be sensitivity toward this.)
2. To orientate students and lecturers overtly to the structure of knowledge in the disciplines from which the norms, values, and textual practices emanate.

Clarence and McKenna (2017) state that these two goals are important, but the different types of Academic Literacy courses in South African universities make it a challenge to achieve the latter goal. The types of Academic Literacy courses in South Africa are:

- Writing-intensive courses

- Embedded modules
- Stand-alone courses

Ultimately, they believe that

> [a]cademic development practitioners need to adapt their practice and research to work effectively with students who are creating varied disciplinary texts, reading within specific disciplinary 'canons' or bodies of knowledge, and learning to think using methods that differ from one discipline to another (Clarence & McKenna, 2017:39).

Through their research, this belief is validated in the following response:

> Connecting the knowledge that students need to engage with, think, read, and write about, with the disciplinary conventions that they need to follow makes these conventions seem less arbitrary (Clarence & McKenna, 2017:46).

Professional Orientation is an embedded academic literacy and computer literacy course, so it does not function in isolation from either of the goals mentioned above. Furthermore, the study suggests that the focus on higher-order writing concerns should make students more reflective of their writing within their discipline, which may help to solidify the connections between what the students engage with, and what they think, read, and write about.

3.5. WRITING SKILLS AND PRACTICES

Writing skills are often not clearly defined by writing instructors or their students, with many confusing good grammar with good writing. Good grammar is an aspect of good writing, but good writing is a combination of skills related to language, style, and subject knowledge. Figure 12 (Tribble, 1999:18) provides a broad breakdown of the factors at play when one writes.

content knowledge	knowledge of the concepts involved in the subject area
writing process knowledge	knowledge of the most appropriate way of preparing for a specific writing task
context knowledge	knowledge of the social context in which the text will be read, and co-texts related to the writing task in hand
language knowledge	knowledge of those aspects of the language system necessary for the completion of the task

Figure 12: What Writers Need to Know

Writing instructors tend to emphasise the language knowledge component of writing, presumably because it is the feature that is easiest to distinguish or quantify. In this study, the goal is to shift the emphasis away from language alone, toward content knowledge, writing process knowledge, and context knowledge as well.

As stated previously, the areas of the brain that are activated when one reads are the same areas that are activated when one writes. Additionally, writing is often a step in the reading process at it reveals content knowledge and the ability to synthesise information. Byrne (1979:10) states that "[reading plays] an important part in a writing programme. Reading may of course be a goal in itself… But the two skills *can* and *should* be developed in close collaboration" (author's emphasis). If one considers this in conjunction with Hayes's cognitive model, reading allows one to access topic knowledge, linguistic knowledge, and genre knowledge, to be able to understand tasks and produce a written text based on key mental constructs (Delaney, 2008:141). All of these skills ultimately distinguish *any* reader or writer as having high or low literacy. Thus, writing should not be seen as separate from thinking and reading. For this reason, a range of seminal texts have been drawn on, including reading and writing development, Grabe's reading levels, Bloom's taxonomy, and Ivanić's discourse framework to define the lower-order and higher-order writing criteria referred to and applied in this study.

3.5.1. Understanding Academic Reading for Writing

Before exploring this aspect of the literature, it must be clarified that this research project is *not* a reading study. It is a writing study where it is understood that "writers are all readers during the writing process" (Grabe, 1988:65) and that reading and writing are not separable because reading comprehension is essential for good, cohesive writing. Furthermore, the higher- and lower-order reading skills discussed in

this section inform the higher and lower-order writing skills and practices discussed in the sections that follow.

Eskey (1986) theorises that people *cannot be taught* to read, but they *can learn* to read, meaning that

> "[h]uman beings are preprogramed to perform language acts, like listening, speaking, reading, and writing, and if provided with real opportunities and a minimum of guidance, in a stimulating, non-threatening context, they can learn to do things with relative ease" (p. 5).

This implies that the EAP practitioner's role is to give students the environment and the information necessary to develop these 'preprogramed' skills. This assumption is applied in this study as the broad emphasis of the ERW curriculum in Professional Orientation is on creating opportunities to develop students' listening, speaking, reading, and writing abilities for the effective development of their academic literacy. To create the right environment for this, the cognitive and social factors that stimulate these capabilities must be considered.

When it comes to reading, two levels are commonly understood: identification (low order) and interpretation (high order). Good readers are proficient on both levels when reading a text. As Pikulski and Chard (2005:511) acknowledge

> [i]f attention is drained by decoding words, little or no capacity is available for the attention-demanding process of comprehending. Therefore, automaticity of decoding — a critical component of fluency — is essential for high levels of reading achievement.

This springs from the research of Goodman (1967) and Smith (1982) who theorised that reading is an *interactive process*. Goodman notes that meaning develops from receptive language (reading and listening) but also from the context of which the reading takes place. Goodman depicted the reading cycle as follows in Figure 13 (Goodman, 1975:15).

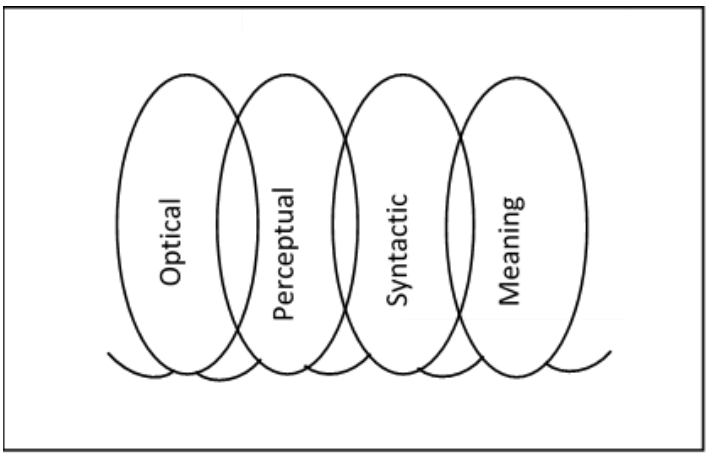


Figure 13: Reading Cycle

Goodman perceives meaning as the final objective and something that is ever changing based on interaction between thought and language and, by extension, between individual and text. This includes reading, understanding, writing, background knowledge, and conceptual abilities. In other words, "[t]he interactive model predicts that good readers will not become progressively less concerned with identification, but rather progressively more efficient at it as they develop their interpretive skills" (Eskey,1986:14). This has remained the dominant perspective on reading development. Consequently, it is argued that genre knowledge is important, because this allows one to recognise a text's communicative purpose, rhetorical organisation and formal features, and it aids in the comprehension and production of similar texts (Wingate, 2015:80).

Discipline-specific texts that improve genre knowledge and one's recognition of textual expectations will help to improve both reading and writing within a discipline — in this case, engineering. Once this recognition is achieved, students can start to develop texts that fit with the expectations of industry and that are well-considered and informed. For this reason, the emphasis on lower-order skills needs to shift to an emphasis on higher-order skills and practices with lower-order skills and practices serving as supportive to these.

In 1991, Grabe enhanced reading theory by introducing the idea that there are six reading skills:

1. Automatic recognition skills
2. Vocabulary and structural knowledge
3. Formal discourse structure knowledge

4. Content / world background knowledge
5. Synthesis and evaluation skills / strategies
6. Metacognitive knowledge and skills monitoring (p. 379)

These skills work from the top to bottom (1 to 6) in beginner readers but as readers become more skilled, these start to function in reverse and one is able to move between different levels at different paces. However, if a proficient reader lacks knowledge of academic genres, his/her reading might be reduced to basic comprehension. A claim that reiterates the importance of genre-specific knowledge in the academic reading materials, continual reading development, and exposure to a shared discipline and discourse community.

Students from underprivileged backgrounds, who lack linguistic capital and English language proficiency, often become used to information being spoon-fed because reading instruction is limited to existing knowledge-bases and writing instruction is limited to transactional instruction (van Pletzen, 2006:106). This results in students developing neither the relevant reading nor the relevant writing skills and practices necessary for adequate academic literacy development.

It must be understood, however, that in an academic environment one is reading with the objective of producing something, generally in the written form. When one reads to write, one is reading to comprehend and reading to shape one's ideas, to shape one's opinion, and/or to support one's opinion. Reading activities that apply this understanding "must be closely guided by the writing activity" (Wingate, 2015:92), which is why the elected focus of this study is writing as the final step in this process. The types of reading strategies that might be employed in order to achieve this objective are (Wingate, 2015:93):

1. Reading for the selection of sources (compiling and sifting)
2. Critical and analytical reading (metacognitive)
3. Integrating information (synthesis)

These types of reading are crucial if one is looking to compile a written text at an academic level. And, if it is understood that "the writer encodes thought as language and the reader decodes language to thought" (Goodman, 1975:12), then it is understood that the different processes that impact good reading can only help to develop good writing practices and vice versa.

3.5.2. Differentiating Lower- and Higher-Order Skills

In Bereiter and Scardamalia's 1987 article titled 'An Attainable Version of High Literacy: Approaches to Teaching Higher-Order Skills in Reading and Writing' they outline the cognitive skills that distinguish more or less competent readers and writers from one another. These are:

1. Problem-solving, fix-up, or back-up strategies

   This refers to the ability to navigate challenges faced when interpreting information or constructing a text.

2. Self-regulatory procedures

   These include strategies for maintaining good mental housekeeping, such as checking, planning, monitoring, testing, revising, and evaluating.

3. Executive strategies

   This is the ability to control the way in which information is transformed to achieve a particular goal. Scaffolding is a technique that can aid in achieving a high-mental process such as this.

4. Intentional learning procedures

   This takes place when one invests effort into learning, over and above simply completing a task.

These cognitive abilities have an impact on comprehension in reading and the ability to produce a successful written text. While these are thinking skills that come into play when one writes, they do not in themselves define lower- or higher-order writing; these are simply aspects that impact the production of a high-quality text.

Bloom's taxonomy (well-known in education for categorising human cognition) is a tool that can be used to distinguish where the features mentioned above can be categorised in terms of thinking ability, as well as how the scales of cognition can be viewed in reading and writing. Figure 14 (Brande, s.a.:s.p.) is a representation of Bloom's taxonomy and the tiers of higher-order thinking skills.

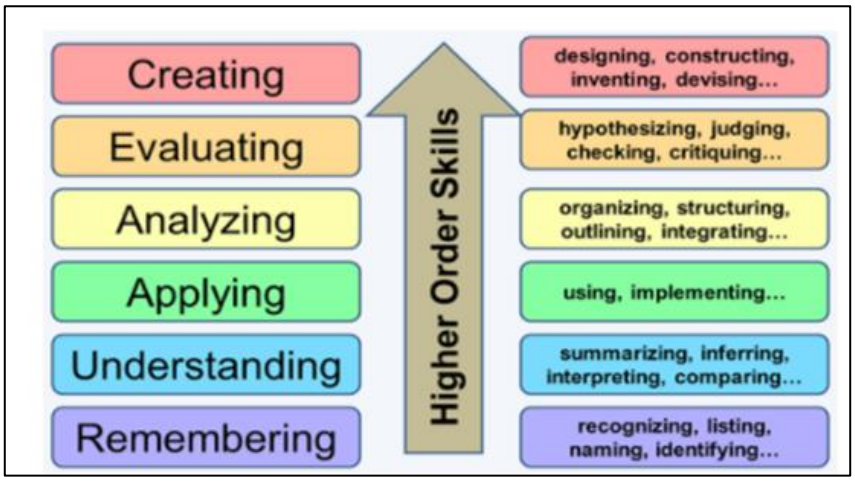


Figure 14: Bloom's Taxonomy

Bloom's taxonomy is commonly used in education because it aids educators in categorising the cognitive skills at play when producing a lesson or assessment. Anderson and Krathwohl (2001:67-68) expand on Brande's description of these tiers:

1. Remembering: Retrieving, recognising, and recalling information from long-term memory
2. Understanding: Constructing meaning from oral, written, and graphic messages, through interpreting, exemplifying, classifying, summarising, inferring, comparing, and explaining
3. Applying: Carrying out or using a procedure through executing or implementing
4. Analysing: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organising, and attributing
5. Evaluating: Making judgements based on criteria and standards through checking and critiquing
6. Creating: Putting elements together to form a coherent or functional whole; reorganising elements into a new pattern or structure through generating, planning, or producing

These skills are tiered as it is assumed that they build upon each other. That is, remembering leads to understanding, which allows one to apply, then analyse, evaluate, and finally create. If this is compared to the cognitive skills outlined by Bereiter and Scardamalia (1987), it is evident that tiers 4, 5, and 6 relate to problem-solving, self-regulating, executive functioning, and intentional learning, signifying that

the cognitive abilities that make for competent reading and writing align with the high-level cognitive skills identified in Bloom's taxonomy.

While it is still unclear exactly which skills and practices are involved when one refers to lower- or higher-order writing, Bloom's taxonomy more clearly categorises the thinking skills at play, which can be cross-transferred to reading and writing as well.

Grabe's 1988 (p. 59) reading model (Figure 15) clearly compartmentalises reading into low-level and high-level abilities.

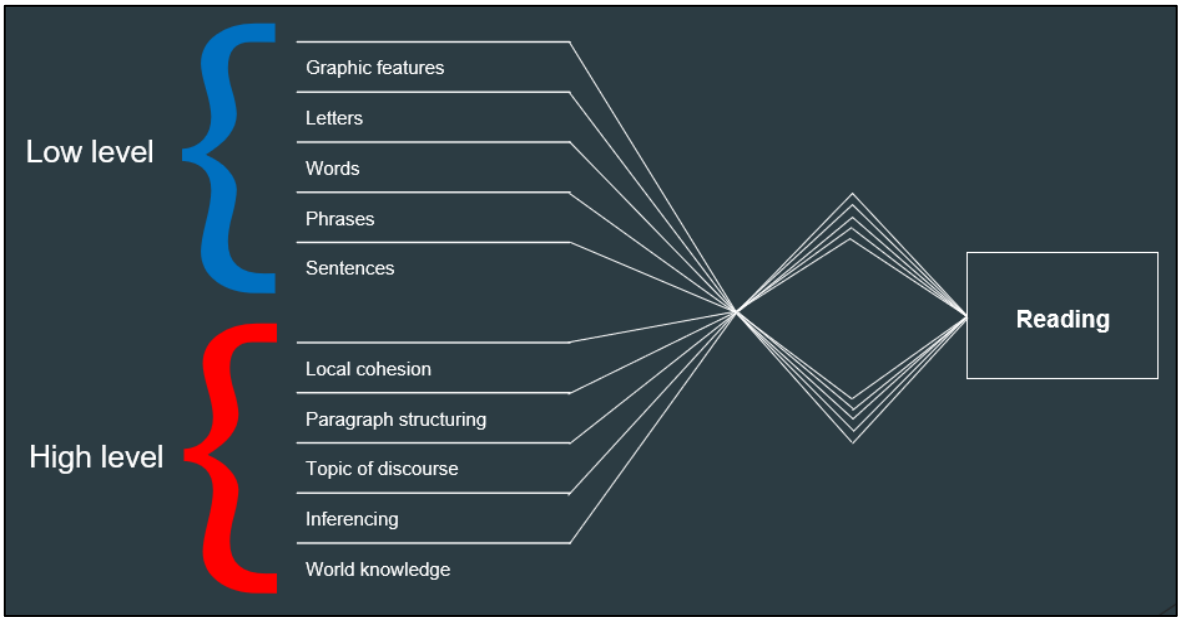


Figure 15: Grabe's Reading Model

When reviewing this model, it became apparent that these tiers also align with the lower- and higher-order cognitive skills defined previously. By considering the alignment in the factors at play when one thinks, reads, and writes at any level, a general model for writing, based on the models presented above, could be developed for application in this study. This model is presented in Table 11.

Table 11: Lower- and Higher-Order Skills

Category	Cognitive	Reading	Writing
Lower-order	➢ Remembering ➢ Understanding ➢ Applying	➢ Graphic features (letters, words) ➢ Phrases ➢ Sentences	➢ Graphic features (letters, words) ➢ Phrases ➢ Sentences
Higher-order	➢ Analysing / problem-solving ➢ Self-regulating ➢ Evaluating / executive functioning ➢ Creating / intentional learning	➢ Inferencing ➢ Local cohesion ➢ Paragraph structuring ➢ Topic of discourse ➢ World knowledge	➢ Local cohesion ➢ Global cohesion ➢ Inter-document cohesion ➢ Topic of discourse ➢ Synthesising ➢ World knowledge

In this model, the factors involved when it comes to reading and writing are reflected as similar. Lower-order thinking is classified as the three initial phases on the Bloom's taxonomy. That is, remembering, understanding, and applying, and these are reflected as aligning with the reading skills of identifying graphic features, sentences, and phrases. This, too, takes place in writing as grammatical and syntactical rules and norms are used to produce a text. These are all categorised as 'lower-order' because these thinking, reading, and writing factors are not linked to greater textual understanding or interpretation. These reflect the foundations of thinking, reading, and writing outside of the aspects at play when one seeks to understand, comprehend, and develop or convey meaning.

In the higher-order category of thinking, the skills of analysing / problem-solving, self-regulating, evaluating / executive functioning, and creating / intentional learning are reflected. These all take the complexity of thinking to a higher-level because they draw on the ability to break information into its constituent parts, adapt the approach to a problem, critique and evaluate, and finally create new meaning from various fragments of understanding. This links with the higher-order abilities applied to reading, which are to understand how the graphic elements and sentences converge to generate meaning within the relevant context, how paragraphs are formed and connect to one another, what the topic of discourse is, what inferences can be made based on what is read, and how this links to and is informed by world knowledge. This takes reading from a visual / verbal exercise to an exercise involving comprehension, thought, and background knowledge.

A similar outline can be applied to writing, as it requires an understanding of how to generate cohesion out of the graphic components of language, formulate paragraphs in a meaningful and appropriate way, communicate an understanding of the topic in question, and rather than infer meaning (as in reading), demonstrate understanding by synthesising knowledge on the topic. This is ultimately informed by and contributes to 'world knowledge' on a particular subject. However, the term used to define 'paragraph structuring' has been extended to incorporate the different layers of cohesion in texts as highlighted in Crossley (2020:425): "Text cohesion can occur at the sentence level (i.e.,, local cohesion) or across larger segment gaps such as paragraph, chapters (i.e.,, global cohesion), or even texts (e.g.,, inter-document cohesion)."

3.5.3. Surface-Level and Discourse-Level Writing Features

Typically, writing skills are defined in categories of surface-level features or discourse-level features. Surface-level features are those related to word use, parts of speech, and sentence formation; whereas discourse-level features are those aspects related to coherence, text cohesion[16], and inferencing (Allen, McNamara & Perret, 2016:2484). Trained linguists would generally measure the successful use of surface-level features using indices such as the Gunning Fog Index, Flesch-Kincaid Ease Score, or Linsear Write Formula. These tests ascertain "the average sentence length and the average number of syllables or characters (depending on the test) per word, applying these results to a formula and establishing the reading level of the text" (Fouché, 2018:60). These tools are computer-based and automatically assess the readability of a text based on its syntactic features. These features are not related to the actual meaning portrayed within a text and simply relate to grammatical and syntactic features (Enghels & Sol Sansiñena, 2021:9). Discourse-level features are, however, more challenging to distinguish and quantify.

In 2004 Ivanić developed a map of the different writing discourses. This framework was developed "over a number of years by working to and fro between evidence of

[16] 'Cohesion' refers to the use of linking devices and logical connectors in order to create a logical flow of ideas in writing; whereas, 'coherence' refers to the unity, togetherness, and readability of a text as a whole. Effective cohesion often leads to good coherence (Kies, 2020:s.p.).

pedagogic practices, evidence of beliefs, and theories of language and literacy" (Ivanic, 2004:224). Figure 16 (Ivanic, 2004:225) outlines this framework.

Discourses	*Layer in the comprehsive view of language*	*Beliefs about writing*	*Beliefs about learning to write*	*Approaches to the teaching of writing*	*Assessment criteria*
1. A SKILLS DISCOURSE	THE WRITTEN TEXT	Writing consists of applying knowledge of sound–symbol relationships and syntactic patterns to construct a text.	Learning to write involves learning sound–symbol relationships and syntactic patterns.	SKILLS APPROACHES *Explicit teaching* 'phonics'	accuracy
2. A CREATIVITY DISCOURSE	THE MENTAL PROCESSES OF WRITING	Writing is the product of the author's creativity.	You learn to write by writing on topics which interest you.	CREATIVE SELF-EXPRESSION *Implicit teaching* 'whole language' 'language experience'	interesting content and style
3. A PROCESS DISCOURSE		Writing consists of composing processes in the writer's mind, and their practical realization.	Learning to write includes learning both the mental processes and the practical processes involved in composing a text.	THE PROCESS APPROACH *Explicit teaching*	?
4. A GENRE DISCOURSE	THE WRITING EVENT	Writing is a set of text-types, shaped by social context.	Learning to write involves learning the characteristics of different types of writing which serve specific purposes in specific contexts.	THE GENRE APPROACH *Explicit teaching*	appropriacy
5. A SOCIAL PRACTICES DISCOURSE		Writing is purpose-driven communication in a social context.	You learn to write by writing in real-life contexts, with real purposes for writing.	FUNCTIONAL APPROACHES *Explicit teaching* PURPOSEFUL COMMUNICATION *Implicit teaching* 'communicative language teaching' LEARNERS AS ETHNOGRAPHERS *Learning from research*	effectiveness for purpose
6. A SOCIOPOLITICAL DISCOURSE	THE SOCIOCULTURAL AND POLITICAL CONTEXT OF WRITING	Writing is a sociopolitically constructed practice, has consequences for identity, and is open to contestation and change.	Learning to write includes understanding why different types of writing are the way they are, and taking a position among alternatives.	CRITICAL LITERACY *Explicit teaching* 'Critical Language Awareness'	social responsibility?

Figure 16: Ivanić Writing Discourses

The discourse-features of a text largely depend on what is understood by 'writing' — this includes the belief that discourse can include the surface-levels of writing. This framework divides writing discourses into six categories: skills (linked to surface-level features), creativity, process, genre, social practices, and socio-political factors. Some of these discourses assume overlapping beliefs about writing, either working on concrete assumptions or blurring the lines between the written text, the mental processes of writing, the writing event, or the sociocultural or political context of writing. These blurred lines imply that writing need not be understood as one discourse, but can be seen as a combination of various discourses and beliefs about writing, learning to writing, teaching to write, and assessing that which is written. This is explained by Witte (1992:249):

> … any conceptualisation of writing must be able to accommodate not only the production and use of extensive alphabetic texts but also the production and use of minor (e.g., lists, labels, notes) forms of "writing" and texts such as engineering proposals, guidebooks to indigenous plants, and scholarly articles, all of which typically employ more than one symbol system. Second, […] any conceptualisation must be able to account for both the meaning constructive and social-constructive

> dimensions of writing regardless of whether writing be viewed as a process or a product and regardless of whether the writer traffics in linguistic or nonlinguistic symbols. Third, […] any conceptualisation must be able to account for both the protracted and the collaborative nature of composing regardless of the symbol system the "writer" might employ at a given time.

It is these facets that are taken into consideration as a curriculum is designed, to ensure that students leave with an understanding of writing not just as a syntactic skill, but as a practice involving layers of mental processes and contexts.

3.5.4. Lower- and Higher-Order Writing Skills Applied to this Study

The specific writing skills outlined in this sub-section stem from the theory and general outline provided in the preceding pages, as well as the discussion of surface-level and discourse-level writing features. The student participants in the study are first-year engineering students whose knowledge of their particular field of study and the writing norms that accompany this are more than likely not in place.

At the outset of this sub-section, it must be clarified that the lower-order skills outlined here are no less important than higher-order skills. These are simply categorised as such because they are elements related to language and grammar[17], while the higher-order elements relate to structure, knowledge, and form. Together, all of these features contribute to the successful composition of a text and "connect discourse and an underlying logic of organisation" (Grabe & Kaplan, 1996:4). The aim is to help students to become better writers of texts that conform to discipline-specific language, context, and content norms, by following the correct writing processes. Thus, writing cannot and should not be taught in the form of grammatical exercises or with a pure emphasis on language features, but should encourage students to draw on a series of skills and practices that together make for successful writing. Table 12 presents the researcher's outline of the specific division in lower-order and higher-order skills and practices and the level of student understanding they suggest.

[17] Language refers to a body of words (vocabulary) within a language, as well as the formulation of these words into meaningful phrases and clauses, and grammar refers to the rules governing the use and expression of words to form sequences that are understood (Yule, 2009:74).

Table 12: Writing Skills Defined

Writing Skills			
	General	**Specific**	**Suggest**
Lower-Order	➢ Graphic features (letters, words) ➢ Phrases ➢ Sentences	➢ Concord ➢ Parts of speech ➢ Punctuation ➢ Sentence structure ➢ Spelling and choice of words ➢ Tense ➢ Vocabulary ➢ Voice	➢ Grammatical understanding ➢ Syntactical understanding
AND			
Higher-Order	➢ Local cohesion ➢ Global cohesion ➢ Inter-document cohesion ➢ Topic of discourse ➢ Synthesising ➢ World knowledge	➢ Use of and contribution to the literature ➢ Paragraph development ➢ Sentence order ➢ Source integration ➢ Structural development ➢ Subject-focus	➢ Discourse knowledge

This outline has been developed by drawing together the different theoretical and influential factors discussed in this chapter. By considering the general framework mentioned previously, which aligns with Bloom's taxonomy of cognitive abilities and Grabe's reading levels, specific writing criteria were established. These specific criteria have been devised as such because they are measurable to some degree. This is important for writing instructors who grade student work based on various criteria.

The lower-order features were comparatively easy to establish and specify as these relate to the surface-level features of writing. These are the grammatical and syntactical features — syntax refers to "the structure of a sentence whereas grammar is a set of structural rules that dictates the construction of sentences, clauses, phrases and words in a language" (Hasa, 2016:s.p.). These are the elements that can be measured by computerised systems and those who are knowledgeable in the field of linguistics or applied language studies, because certain rules are applied when working with these aspects of language. It is also often these elements that become the focus area for those who teach writing, but while they are important, they only form

one part of the puzzle. It is the higher-order skills and practices that require further clarification and discussion.

In general terms, higher-order writing is defined by the cohesion and coherence of a document (this occurs at different levels), the focus or topic of discourse, the ability to synthesise information, and a demonstration of 'world knowledge'. While all of these facets make sense as aspects of writing, they are more challenging to measure. For this reason, specific and measurable criteria have been identified that suggest that these factors are present in student writing. These are discussed below:

Use of and contribution to the literature	This relates to the use of sources in a text and whether or not these are legitimate, relevant, and valid to the topic of discourse. At a first-year level, students are not likely to be making contributions to their particular field, but will need to start developing their knowledge around the field. For this reason, the students should be drawing from literature to develop a discussion or argument. By defining the specific criteria around the use and type of sources used in assignments, this can be measured in a fair manner.
Paragraph development	The topic of each paragraph should be clear and the rest of the paragraph should support this topic. As the paragraph draws to a close, it should naturally lead into the next paragraph, which will either be an extension on the discussion or a new facet of the discussion. The successful formulation of a paragraph is evident if the topic is clear and the remaining information supports the topic.
Sentence order	The sequencing of information within a paragraph is somewhat individual, but a logical flow of ideas should be present. While there are no set criteria for this, there should be a clear pattern or logic to the presentation of information.
Source integration	Integrating external sources of information into a discussion is a requirement for any academic. This information should form part of the author's discussion. Integration can be difficult to achieve as students lack confidence in their written voices and rely on external sources to formulate the discussion. The success of this can be measured by assessing if a student is relying on sources to form the argument or using them to inform the argument, and by assessing if the source integrates (in both topic

	and structure) into the sentence and paragraph structure or not.
Structural development	Written texts in academic circles, particularly in the pure and applied sciences, tend to follow set patterns. At a basic level, the structure is introduction, body, and conclusion. For many students, the structure may be familiar but the level of detail required will not necessarily be something they are familiar with. The students can be taught this layout, the information generally included in the different sections can be outlined, and their ability to apply these to their own work can be measured.
Subject-focus	One of the greatest challenges in academic writing is retaining a focus on the *specific* subject of a task. This is because interesting facts related to the field often come to light in the research that are brought into the discussion, but are actually unrelated to the topic at hand. By being clear on the writing objectives, research topic, and research questions, the writing focus can be retained and measured.

By identifying specific criteria that indicate the application of higher-order thinking, reading, and writing skills and practices at play when one produces a written text, the ability (or inability) for students to produce texts that can lead to academic or professional success can be measured. These criteria may be challenging for students to achieve and develop all at once, so a writing curriculum was designed that scaffolds these skills, the practices required to apply these skills successfully, and the assessment thereof.

3.6. CONCLUSION

Various theories and influences impacted this practical study on higher-order writing development. Applying a research framework that considered aspects of cognitive, social, and education theories resulted in a well-rounded approach to curriculum development that paid heed to the various factors that contribute to written communication.

Furthermore, drawing from specific studies in Academic Literacy and writing curriculum development, as well as understanding the history behind these fields (internationally and locally), allowed for the inclusion of ideas that could contribute to

the overall success of this study so that a meaningful contribution to the growing field of Academic Literacy could be made.

Finally, drawing specifically from cognitive, reading, and writing studies and models allowed for a clearly defined set of criteria for the assessment of the writing skills that are at the heart of this study.

Table 13 consolidates the context of the curriculum reviewed for this study by pulling together the different theories and writing skills and practices discussed in this chapter:

Table 13: Curriculum Context

Module Structure			
Module	**Objectives**	**Student Numbers**	**English Language Background**
Professional Orientation	➢ develop, refine, apply academic, reading, writing and IT skills and practices ➢ consolidate skills and practices in engineering-based projects	Approximately 200	Home language and non-home language speakers
Theoretical Framework			
Framework	**Influence**	**Emphasis**	**Teaching Model**
Cognitive theory	Individual Environmental Model	• Text production • Reflection • Text interpretation	• Process-writing
Social theory	New Literacies Studies	• Discourse development • Literacy identity • Teamwork	• Social process • Text-analysis
Education theory	Intervention Activity Theory Zone of Proximal Development	• Effective tools • Peer learning • Social events • Well-pitched tasks	• Process-writing • Social process
Writing Skill and Practice Development			
Lower-Order		**Higher-Order**	
General			
➢ Graphic features (letters, words)		➢ Local cohesion	

➢ Phrases ➢ Sentences	➢ Global cohesion ➢ Inter-document cohesion ➢ Topic of discourse ➢ Synthesising ➢ World knowledge
Specific	
➢ Concord ➢ Parts of speech ➢ Punctuation ➢ Sentence structure ➢ Spelling and choice of words ➢ Tense ➢ Vocabulary ➢ Voice	➢ Use of and contribution to the literature ➢ Paragraph development ➢ Sentence order ➢ Source integration ➢ Structural development ➢ Subject-focus

The curriculum developments discussed in the section that follows are based on the above outline. A rubric was created for each assessment that highlighted the elements referred to above so that the students were graded based on their overall writing proficiency. This is discussed in further detail in the chapters that follow.

CHAPTER 4:
DEVELOPING A CURRICULUM FOR TEACHING HIGHER-ORDER WRITING SKILLS

4.1. INTRODUCTION

> Curriculum planning, which involves the design and development of programmes and modules or courses, is an endeavour for broad-based thinking on teaching, learning and intended learning outcomes before teaching is done. In planning a course or a module, a lecturer has to reflect on how the planned course or module fits into the whole degree programme and its significance thereof (Maphosa, Mudzielwana & Netshifhefhe, 2014:355-356).

Curriculum development is an aspect of education that focuses on the macro-elements of programme and course design, as well as the micro-elements of module outcomes and plans (Connelly, He & Phillion, 2008). Both of these are significant because of their influence on the teaching and learning environment and on student development. This study focuses specifically on higher-order writing as an outcome and aspect of the writing curriculum, and as a factor that influences students' participation in their studies.

Teaching higher-order writing techniques to students in the extended engineering degree programme requires a module curriculum that is well-planned and structured, and that addresses specific student needs. Thus, the researcher experimented with different approaches and curricula plans across two-years so that a final curriculum could be formed for the module.

This chapter includes the developments that were made to the module's curriculum, as well as a detailed explanation of the final writing curriculum. This is followed by an evaluation of the results of the curriculum interventions in Chapter 5.

4.2. CURRICULUM DEVELOPMENTS

Professional Orientation is the core module offered in the University of Pretoria's EBIT ENGAGE Programme and, over the years, this module and its outcomes have changed so as to address different student needs. In 2016, the lecturers and an EBIT educational specialist met to review and revise the module outcomes and associated

learning tasks, so that a more streamlined and focused module could be offered from 2017 onwards. The curriculum developments that took place over the period between 2017 and 2021 (and that impacted this study) are discussed below in sub-sections: Learning Outcomes, Teaching and Course Design, and Assessment.

4.2.1. Learning Outcomes

The revised outcomes from the 2016 discussion are stipulated as follows — aspects related to the Academic Literacy component of the module have been emphasised (Fouché, Müller & Naidoo, 2021a:12; Fouché, Müller & Naidoo, 2021b:12-13):

JPO 110 Outcomes

These outcomes are addressed in the first semester that runs from February to June each year.

Learning Outcome 1:

The student will organise and manage himself/herself, with regard to IT and academic demands, responsibly and effectively within the context of the UP School of Engineering.

Learning Outcome 2:

The student will demonstrate academic prowess by using *accurate and coherent* mathematical and *language practices in written format*.

Learning Outcome 3:

The student will be able to construct a mental model of key terms and basic concepts of IT and Academic Practices, to implement these comprehensively within the UP School of Engineering.

JPO 120 Outcomes

These outcomes are addressed in the second semester that runs from July to November each year.

Learning Outcome 1:

A student will work effectively with others as a member of a team in the GoGreen and LEGO projects.

Learning Outcome 2:

A student will *collect, analyse, organise, and critically evaluate and communicate information in the GoGreen and LEGO projects through individual submissions. A final team report* and PowerPoint presentation and peer feedback on team participation will be completed at the end of each project.

Learning Outcome 3:

A student will utilise science and technology effectively.

Learning Outcome 4:

A student will be able to reflect on his/her journey in Professional Orientation, re-organise what he/she has learnt and develop an executable plan for his/her future within the UP School of Engineering.

Each of the Learning Outcomes listed above relates to one of the three course components offered by the specialist lecturers in the module. Academic Practices is addressed in JPO 110 and JPO 120 Learning Outcomes 1; Engineering Reading and Writing (ERW) is addressed in JPO 110 and JPO 120 Learning Outcomes 2, and; IT Practices is addressed in JPO 110 and JPO 120 Learning Outcomes 3. JPO 120's Learning Outcome 4 is an overarching outcome related to reflection across all components of the module.

Using this framework, the lecturers involved removed aspects that were no longer relevant to the outcomes. Over the course of three years following these changes, three of the five lecturers involved left the module and the researcher joined the remaining members of the team, eventually taking over the role of module coordinator.

The move to three lecturers streamlined the module by allowing each of them to take responsibility for their specialist subject.

The researcher's goal became to analyse the outcomes and gear the module toward addressing these specific areas in equal measure. The researcher took responsibility for the curriculum plan and division of responsibilities across the module, as well as for the ERW course component specifically. Thus, the focus was on JPO 110's Learning Outcome 2 and the emphasis on *coherence* in writing. This is expanded on in JPO 120 Learning Outcome 2 which, in simple terms, indicates that students must conduct research and *communicate the findings* through a written report. This aligns with the initial goal of coherence and highlights the basic principle of higher-order writing. It was also noted that JPO 120 included Learning Outcome 4, which emphasises the role of reflection across all module components, meaning that reflection was introduced as an aspect of the ERW curriculum in the form of writing reflections.

With these in mind, the researcher developed Learning Outcomes related to the ERW course component, so that none of the critical aspects of academic reading and writing was overlooked when re-developing this component of the module. These outcomes are:

Learning Outcome 1:

The student will deepen his/her knowledge of engineering by reading discipline-specific texts, expressing his/her comprehension thereof, and building his/her textual understanding.

The disciplinary socialisation of students was taken into consideration when developing this outcome. This approach can help students build their disciplinary knowledge, aiding in the formation of a literacy identity. Furthermore, the disciplinary models that students are exposed to are then stored in their working memory, which can later be transferred to their long-term memory.

Learning Outcome 2:

The student will practise applying techniques to improve his/her decoding, fluency, and comprehension. These techniques will include skimming, scanning, critical reading and reading against time.

This relates to the previous outcome and focuses on the development and implementation of appropriate skills and practices to create and build textual understanding and disciplinary discourse knowledge. This draws on the idea of developing the cognitive processes necessary for text interpretation and the idea of using internal tools to carry out activities and develop higher mental processes within the ZPD.

Learning Outcome 3:

The student will develop writing practices relevant to the discipline by composing different text types and applying a combined process-writing and text-analysis approach.

This outcome combines aspects of the different theories by again emphasising the formation of different disciplinary models to help formulate the discourses necessary for socialisation within the discipline. As with the previous outcome, these internal tools help to form the necessary higher mental processes for discourse development.

Learning Outcome 4:

The student will learn the importance of knowing, understanding and synthesising work within the discipline and apply the Harvard referencing technique to avoid plagiarism.

This outcome was developed to promote the motivation/affect needed to transfer that which is learned to working memory, for potential long-term storage. This is also necessary for acceptance within the social environment, as certain behaviours are expected, such as appropriate referencing.

Because of the reciprocal role of reading and writing, both are addressed in the above outcomes. They emphasise the development of textual understanding (in both reading and writing), reading speed and comprehension, synthesis in writing, and referencing. Each of these outcomes is intended to align with the broader module outcomes and to the development and reinforcement of higher-order skills and practices. This meant that teaching and course design needed to be revisited to ensure that all of these factors were addressed at the required level (taking the ZPD into account), and that they would align with the pre-existing module content and framework.

4.2.2. Teaching and Course Design

Lea (2004:740) states that "focus[ing] on pedagogy—the science of teaching—brings to the fore the relationship between the institutional practices of teaching and course design". This meant that the teaching approach and course design had to work hand-in-hand with each other and were reviewed in terms of the module plan, underlying pedagogical tenets, and approaches to writing instruction. All of these had to fit together to ensure that the students had the context for meaningful learning to take place.

4.2.2.1. Module Plan

Historically, workshops take place in computer laboratories three times a week for two hours at a time in the first semester. However, the Covid-19 pandemic led to remote online teaching and learning in 2020 and 2021. The module structure remained the same, but classes were offered via Blackboard Collaborate, a Learning Management System (LMS) offered to all UP students[18].

The group was divided into two smaller groups of approximately 100 students, meaning that each workshop was presented twice. In previous years, the workshop schedule was such that the different module components were addressed each week: Academic Practices, ERW, and IT Practices. Thus, a different lecturer was responsible for each of the three weekly sessions, but it was found that students were often confused and struggled to make the shift between the three sub-disciplines or to see the connections between the subject-matter, outcomes, and module requirements.

In 2020, it was decided that the workshop schedule in the first semester would be adjusted into teaching blocks that dealt with a particular sub-discipline and associated theme. This increased the demands on particular lecturers for a period of time, but allowed each to take a turn introducing their subject-matter and theme, and working with the students to complete the relevant requirements before moving onto the next module requirement. This allowed the students to focus on one sub-discipline at a time

[18] Although there was a shift to online teaching and learning during the course of the study, this is not a study on remote teaching methods as it is believed that the structure and techniques developed can be delivered with similar effectiveness both online and in person.

and make the mental connections between the subject-matter, outcomes, and module requirements.

Projects are used as learning tools in the second semester, with each of the four Conceive-Design-Implement-Operate (CDIO) phases serving as a platform for different tasks related to the skills and practices taught in the first semester to take place — the CDIO project framework is frequently applied to engineering-based projects, with each phase serving as a stepping stone toward the completion of a project (CDIO Office, s.a.:s.p.). The students start with the GoGreen Project, which includes introductory workshops on research. Once the students get to the Implementation Phase of the project (this is completed in their own time), they start with the capstone LEGO project. The researcher serves as the facilitator of the LEGO project, where no new workshops are offered and each phase reinforces the skills and practices introduced previously. Students work in teams to complete these projects and each team member takes responsibility for a particular project phase, where either a team submission or individual submissions from all team members are required.

Prior to 2020, the students were given the opportunity to select their own teams for GoGreen and were put into pre-selected teams for LEGO. When the module moved online in 2020, the students were put into pre-selected teams for both GoGreen and LEGO (different teams for each project) because of the concern that some students would be more isolated than others and would not be able to find teammates to work with. It was also felt that pre-selecting both teams would allow the lecturers to pair students up with ‘capable peers’ who could assist in reinforcing the relevant skills and practices. The scaffolding of the two projects has remained consistent since 2017, with changes only to the project requirements and not to the scheduling, approach, or overall intention.

4.2.2.2. Underlying Pedagogy

Pre-existing modes of teaching and learning continued to be used in both semesters. This involved workshop-style classes and team-teaching in the first semester and project-based learning and teamwork in the second semester, as well as continuous assessment and feedback as learning tools throughout. The process-writing and text-analysis techniques trialled in the writing component of the module were adopted into this framework.

The workshops offered in the first semester generally start with an introduction to the theme for the session or workshop series, a theoretical discussion on underlying principles, and examples in the first hour. During this time, students are invited to ask questions at certain points during the presentation. An assessment of (and for) learning is then presented to the students for completion in the second hour. In this time, tutors who are second, third, or fourth year ENGAGE students approach the students to see if they have questions or would like to discuss their work, and lecturers and assistant lecturers are available in the room if further assistance is required. Many of the completed activities are graded and used for the next scaffolded session on the particular skill or practice in question, but some are completed purely for practise.

A project-based learning framework in the form of two engineering-based projects is followed in the second semester. These two projects are used to reinforce the skills and practices introduced in the first semester — and to elaborate on some of these — and to introduce students to teamwork and a microcosm of the engineering environment. It is widely understood that project-based learning both deepens content knowledge and can lead to skills mastery (Boss & Larmer, 2018:1), which is why this model was selected early in the development of the module. This model also reinforces the sociocultural underpinnings for secondary discourse induction, which supports the theoretical framing of the study. Furthermore, inter-psychological functioning gives rise to higher mental functioning, meaning that students stand to benefit in various ways by learning through peer interaction.

This combination of workshops in the first semester and project-based learning in the second semester has proven to work well in laying the foundations for skills development and reinforcement, creating the platform for healthy academic and professional habits to form, including written communication.

4.2.2.3. Approaches to Writing Instruction

The local studies discussed in the previous chapter provided some insight into the techniques and approaches others have found effective in developing writing curricula. These included:

- Process-writing
- Self-reflections
- Teamwork

- Textual analysis

The revised writing curriculum outline thus incorporated these aspects as they have been found to be effective by local researchers in the South African context (Boughey, 1997; Granville & Dison, 2005). Teamwork had been addressed in the module in previous years through projects in the second semester, but the remaining aspects had not been introduced previously. The workshops in the first semester were altered in their entirety to incorporate the above techniques and approaches.

By combining the lower-order and higher-order criteria that needed to be addressed, and theory on the individual-environmental model, new literacies studies, Vygotsky's education theories, and the relationship between reading and writing, a revised process-writing outline (including reflection and freewriting[19]) combined with text-analysis was set up for trial. According to Coffin *et al.* (2003:43), text-analysis and process-writing can effectively be merged into a writing curriculum by completing the following processes:

1. Building the context: Raising awareness of the topic and pre-writing techniques
2. Modelling and deconstruction: Examining example target texts
3. Joint construction: Collaborating with the lecturer and playing the role of scaffolding students' writing
4. Independent construction: Writing alone in groups and participating in peer reviews

This draws attention to the analysis and development of specific text types that serve the purpose of sharing knowledge within the discipline and developing knowledge of the discourses relevant to the discipline, the intention of the writing course component in Professional Orientation. Murray and Moore (2006:55 and 133) also encourage this approach to academic writing because disciplinarity is constructed by published writing in the discipline and writing is a process in which knowledge can be developed.

[19] Freewriting is the practice of writing for a stipulated amount of time without stopping or editing oneself. It emphasizes what is said over how it is said, breaks the habit of editing oneself prior to writing rather than after the fact, and encourages the development of one's own academic 'voice'. This writing preparatory exercise is encouraged by writing researchers, including Elbow (1998), Coffin *et al.* (2003), and Murray and Moore (2006).

The practice of developing the context, deconstructing ('pulling apart' a text to review style, tone, audience, and intention), modelling, and constructing encourages students to build the dominant discourse for writing in engineering studies. This together with the teamwork in projects in the second semester and the use of engineering-specific texts as preparation and reference material in writing tasks meant that many of the techniques other researchers have trialled could be brought together in this study.

The final approach taken to produce the Professional Orientation writing curriculum is outlined in Figure 17:

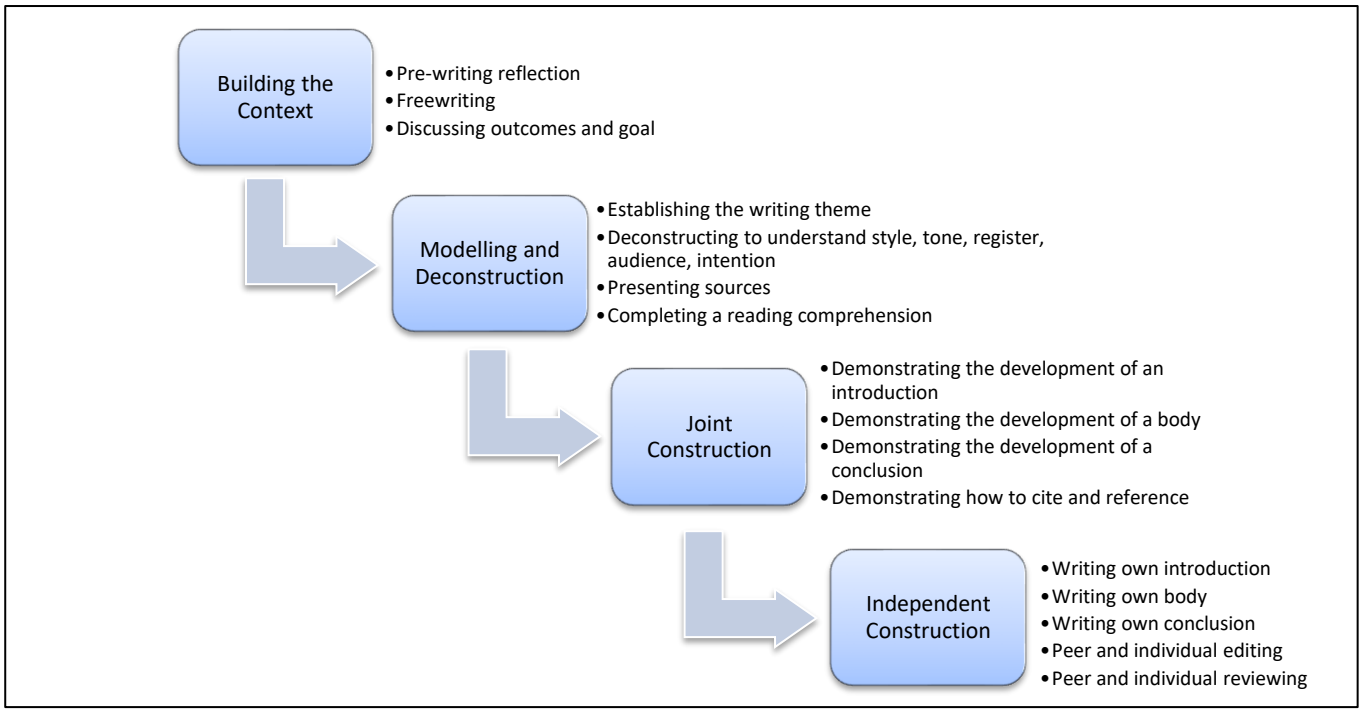


Figure 17: Writing Process in Professional Orientation

This process draws on the study skills, academic socialisation, and academic literacies models identified by Lea and Street (1998). Because these are treated as inseparable from each other in this study, the different aspects of each needed to be addressed in the process plan. Academic literacies are formed by building the context and modelling and deconstructing texts as these activities expose students to different communicative practices and allow students to develop their epistemological knowledge. Study skills come to the fore when joint construction takes place because the emphasis is on the technical and surface-level aspects of writing. Finally, academic socialisation takes place when independent construction starts because knowledge needs to be interpreted and applied within the new cultural framework, allowing deeper learning to take place.

The scaffolded approach to writing instruction within the writing sessions was applied to a greater or lesser extent in each of the intervention workshops so that students could form the writing practices beneficial to writing skills development. These techniques could also help students in becoming more confident in their writing and lead to "more 'self-directed' learning environments that higher and further education contexts are pursuing" (Murray & Moore, 2006:133). Coffin *et al.* (2003) developed the general framework and this was combined with the influences and theories outlined previously to allow for the delivery and development of lower- and higher-order writing skills through ongoing assessments for learning in the interventions.

4.2.3. Assessment

In Professional Orientation, the final grade is calculated by awarding 60% of the final mark to performance in the Continuous Assessment (CASS) tasks and the remaining 40% to student performance in quarterly semester tests. Both the CASS and semester tests include three sections: Academic Practices, ERW, and IT Practices.

The CASS component is weighted more heavily because these assessments are used to get students to continually develop the required skills and practices and to use feedback as a learning tool. CASS is an approach that can benefit both the instructor and the student because learning is monitored so that students can use the practise to enhance their abilities and to learn from, and it can aid the instructor in identifying knowledge-gaps so that these can be addressed (Poza Méndez & Bas Sarmiento, 2011:4809). However, CASS is only effective if feedback is provided. Given the large module group of up to 270 students and the limited staff complement, innovative (but effective) means of feedback needed to be considered.

The first consideration was to have students peer edit and review each other's work. Checklists were drawn up by the researcher so that students would not neglect certain aspects of the work. The editing checklist focused on lower-order criteria and served as a form of 'proofreading', and the reviewing checklist focused on higher-order criteria as a form of structure and content critiquing. These checklists were slightly adapted for each assignment. This served as the first line of feedback in the students' writing development and had to be completed prior to final submission. Students are also encouraged to use the tutors as 'writing mentors' who they can share ideas with and who can help to develop their writing (Murray & Moore, 2006:138). Students then used Turnitin for all writing submissions, because this software serves as a grammar

checker and a similarity index by highlighting text that appears to have been lifted from external sources and grammatical errors identified in the writing. Students can use this feedback to edit their drafts and resubmit once they are satisfied. This feedback draws attention to the writing process because it allows students to look at writing as an iterative process and in a more critical manner.

After students make their final submissions, the work is then graded by a combination of lecturers and assistant lecturers in the module. Rubrics are used to grade the students' assessments, with the same sets of criteria (specific details are altered to align with the subject-matter and text type) being assessed across each assignment[20]. The rubrics are detailed so that they serve as a form of feedback, and individual comments, along with an overall comment, are offered as well. Students have access to this feedback for the duration of the semester. Rubrics ensure that each marker grades toward a specific set of criteria that focus on higher- and lower-order features, and they serve as a form of progress monitoring (Philippakos & FitzPatrick, 2018:154). These rubrics are generally released to students prior to the assessment so that they are aware of how they will be graded.

The pre-writing and post-writing reflections give the students the platform to think about their own development within the area of academic writing, which is a higher-order thinking practice that can help students to become more conscious of their learning and application of relevant skills and practices (Granville & Dison, 2005:100). These are not assessed and are purely a means of encouraging deeper thinking to take place.

4.3. CURRICULUM OUTLINE

This section provides the Engineering Reading and Writing (ERW) curriculum outline for 2017, 2018, and 2019 (prior to any interventions), 2020 (after first round of interventions), and 2021 (after the final round of interventions) along with explanations of the approach and assessment for learning. This section emphasises the way in which higher-order skills and practices were addressed, extended, or reinforced across this timeline.

[20] The details of the rubrics that are used to assess the writing tasks are discussed in more detail in Chapter 5.

4.3.1. ERW Curriculum Outline: 2017, 2018, and 2019

At this stage in the module's development, the emphasis was on academic reading as writing was seen as a supportive skill that was addressed in communication modules[21] offered in year three of the ENGAGE programme. Students had access to an online reading program called ReadON until 2017 (this was discontinued in 2018 and will be discussed in further detail following the curriculum outline) and this was the primary mode of academic literacy development in the module up until this point. Table 14 represents the ERW curriculum outline for JPO 110 in 2017, 2018, and 2019. There were slight changes to the curriculum in 2018 and 2019, and these are reflected in red.

[21] These communication courses are still offered to students in the engineering programme, but they take place in year two for mainstream students and year three for extended degree students. This means that extended degree students only receive this exposure later in their studies.

Table 14: JPO 110 ERW Writing Curriculum 2017, 2018, and 2019

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
23 February 2017 **22 February 2018** **26 February 2019**	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Introduction to Engineering News magazine - ReadON Orientation, screening, and placement - No ReadON Orientation in 2018 and 2019	- Placement test - Engineering News activity	- Engineering News magazine - ReadON program
1 March 2017 **28 February 2018** **5 March 2019**	Individual	*JPO 110: 2* *ERW: 3*	**Writing Skills** - Reflective essay	- Reflective essay draft	- Essay instructions
2 March 2017 **1 March 2018** **6 March 2019**	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Introduction to reading and comprehension - Four common reading mistakes - Reading speed - Skimming, scanning, and critical reading	- Engineering News activity	- Engineering News magazine - Activity instructions
9 March 2017 **8 March 2018** **7 March 2019**	Pair	*JPO 110: 2* *ERW: 3*	**Writing Skills** - Essay buddy check training	- Final reflective essay	- Essay feedback
Test Week 1	Individual	*JPO 110: 2* *ERW: 2*	**Semester 1 Test 1** - Comprehension skills	- Comprehension	- Comprehension sources - Comprehension questions
19 April 2017 **20 March 2018** **10 April 2019**	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Skimming and scanning - Critical and analytical reading - Interactive reading: Improving comprehension	- Mind map - Comprehension	- Mind map instructions - Comprehension sources - Comprehension questions
22 May 2017 **25 April 2018** **23 April 2019**	Individual	*JPO 110: 2* *ERW: 1, 2*	**Reading Skills** - Interactive reading: Unpacking / Text mapping	- Text map	- Text mapping instructions
Test Week 2	Individual	*JPO 110: 2* *ERW: 2*	**Semester 1 Test 2** - Comprehension skills	- Comprehension	- Comprehension sources - Comprehension questions
22 May 2018 **21 May 2019**	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Unpacking and synthesising	- Worksheet on synthesis	- Comprehension sources - Worksheet
22 May 2019	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Class test on reading skills	- Online class test	- Sources - Student dashboard

In the first session of the semester, students were introduced to the *Engineering News* magazine, given to the students on a weekly basis, offering them insight into the world of engineering. The majority of the reading assessments following the introduction of the *Engineering News* were based on articles from the magazine, encouraging students to keep up with news on the industry.

The students were also required to complete the ReadON placement test in the first ERW session so that their reading level could be established and subsequent tasks could be pitched at the required level in 2017. After the placement test, students completed the program in their own time and were given tasks in class that reinforced their reading development. This became problematic as the notional hours[22] for the module were being exceeded and the operational system for the ReadON program was no longer offered by the University, making the newer version too expensive for the module to incorporate in subsequent years. This had little impact on the 2018 and 2019 curricula, however, and only resulted in minor changes to the class schedule. One of these was the development of an '*Engineering News* Activity' in 2018 and 2019 where students were required to apply different reading strategies, such as skimming and scanning[23], to articles from the magazine — this stood in the stead of the ReadON placement test.

A strong emphasis on IT and reading development within the module severely limited time dedicated to writing instruction in these years, and meant that there was only time for one writing specific task: the reflective essay. This task encourages students to think about why they have chosen to pursue a career in engineering (a higher-order thinking skill), but the language, style, and structure of this assessment is not academic in nature because students are not required to draw from external sources of information to develop a discussion or argument. This task was used to introduce students to the practice of peer editing and review, which is an important part of process-writing, and this exposed students to the higher-order skills of structural

[22] 'Notional hours' refers to "the time that the average student would need to attend all classes, study for tests and do assignments and homework. Each credit equals 10 notional hours" (Byles, 2022:s.p.). JPO 110 is an 8-credit module, meaning that students are required to commit 80 hours to the completion of the module.

[23] Skimming is a technique in which rapid eye movements are used to establish the overall context of a text, and scanning is a technique in which key words are identified to find certain facts within the text (Ngo, 2018:s.p.).

development and subject-focus. This task serves as a good starting point, but should not serve as the primary assessment of academic writing.

It is worth noting that students also completed a project entitled BuildUP in the first semester, where they had to produce a final individual report. In this project, students were required to estimate and measure the heights of buildings on campus, and then use this information to populate a report. The emphasis of this project was on the IT aspects of formatting and populating the document with figures and tables; however, the comparisons students were required to make in this document were useful in promoting subject-focus, coherence, cohesion, and synthesis. The students were given a standard introduction and linking sentences and paragraphs, and were assessed on their ability to follow formatting protocols. While this is also a valuable activity, academic writing development was a secondary focus and was not assessed or promoted enough to consider this a 'writing specific' task.

One additional session was added to the ERW class schedule in 2018 and this was used to complete an additional reading activity to make up for the loss of ReadON. In 2019, another session was added where students completed a class test (online multiple choice-based test) based on the reading skills they had learnt throughout the semester.

Formal semester tests took place in the first and second quarters of the year. In these, students completed reading comprehensions[24] based on themes and articles from the *Engineering News, National Geographic,* and *Popular Mechanics* publications. The reading comprehensions in the first test drew questions from one longer source and the second test drew questions from two sources to allow students to make a comparison. Questions that required writing synthesis and source integration were included as part of the scaffolding of Bloom's taxonomy.

Historically, the first semester is taught in the form of workshops that are hosted by the relevant module lecturer. These are used as opportunities to first conduct a lecture and then assess the students on the topic, prior to grading it and offering feedback. This remains the mode of teaching. Opportunities for writing development and the

[24] Reading comprehensions are question and answer-based assessments frequently used in the schooling system to assess students' comprehension of the texts. These questions are generated using Bloom's taxonomy as a guide, and range from simple to more challenging questions.

enhancement of higher-order skills were limited in these workshops in the first semester and were not supportive to the writing requirements and teaching style in the second semester. This had to be revised in subsequent years.

The ERW curriculum outline for JPO 120 in 2017, 2018, and 2019 appears in Table 15. Again, differences are indicated in red.

Table 15: JPO 120 ERW Writing Curriculum 2017, 2018, and 2019

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
21 July 2017 **20 July 2018** **19 July 2019**	Individual	*JPO 120: 2* *ERW: 4*	**Reading Skills** - Library training	- Research	- UP library website
24 July 2017 **24 July 2018** **23 July 2019**	Individual	*JPO 120: 4* *ERW: 1, 3, 4*	**Reading and Writing Skills** - Opinion piece: Is Google making us stupid?	- Opinion piece	- Sources - Essay instructions
28 July 2017 **27 July 2018** **25 July 2019**	Individual	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing a literature review: Writing an introduction, paraphrasing, referencing	- GoGreen literature review	- UP library website - Google
1 August 2017 **31 July 2018** **30 July 2019**	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Conducting research	- GoGreen literature review	- UP library website - Google
1 August 2019	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Writing Skills** - Peer editing and reviewing	- GoGreen literature review	- Draft review - Grammarly
8 August 2017 **8 August 2019**	Individual Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading Skills** - Interactive reading and text mapping **Writing Skills** - Combining research	- Comprehension - Text map - GoGreen literature review	- Comprehension questions - Text mapping instructions - Individual reviews
11 August 2017 **14 August 2018** **15 August 2019**	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing and literature review - Conducting research	- LEGO literature review	- UP library website - Google
Test Week 3	Individual	*JPO 120: 4* *ERW: 2*	**Semester 2 Test 1** - Comprehension skills	- Comprehension	- Comprehension sources - Comprehension questions
27 and 29 August 2019	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing and literature review - Conducting research	- LEGO literature review	- UP library website - Google
22 Sept 2017 **25 Sept 2018** **3 Sept 2019**	Individual	*JPO 120: 4* *ERW: 3*	**Writing Skills** - Reflective essay	- Reflective essay draft	- Essay instructions
26 Sept 2017	Individual	*JPO 120: 4* *ERW: 1, 2*	**Reading Skills** - Interactive reading and text mapping	- Comprehension - Text map	- Comprehension questions - Text mapping instructions
Test Week 4	Individual	*JPO 120: 4* *ERW: 1, 2, 3, 4*	**Semester 2 Test 2** - Comprehension skills - Writing a report	- Comprehension - Report	- Sources - Guiding questions
17 October 2017	Individual	*JPO 120: 4* *ERW: 1, 2*	**Reading Skills** - Engineering News: Comprehension	- Comprehension	- Engineering News - Comprehension questions

In the second semester, lecturers served primarily as facilitators who guided the students through projects and associated tasks. Strong emphasis was placed on research and application as students applied the CDIO framework to their projects. In 2017, two additional reading tasks were included in the class schedule to reinforce the reading skills taught through ReadON in the first semester. These were removed from the schedule in 2018 and replaced with IT related tasks, but in 2019 additional research and writing time was allocated in these time slots[25]. Apart from these differences, the subject-matter and framework remained similar across the three years.

The semester started with the EBIT librarian introducing students to the UP-library website and its functionality. Students were shown how to use different databases and relevant search terms to conduct research, a practice that is still applied at the start of the second semester. This training served as a stepping stone for having students draw from literature in order to develop a cohesive, coherent, and considered discussion, all of which are higher-order skills.

An assignment entitled ‘Is Google making us stupid?’ was then given to the students soon after the research training. This topic was selected to show students that not all information on Google is relevant or legitimate, and that different sources can also be used to gather material. Additionally, the polarising subject-matter made for a good point of comparison and discussion. To complete this assignment, students received three sources on the topic and were told to write an opinion piece in which they respond to the question of whether or not Google is “making us stupid”. Students had to cite and reference the sources in Harvard style and were encouraged to use the online referencing tool ‘Cite This for Me’. At this stage, students had not been introduced to or trained in academic writing and formulating an argument using sourced material, and were not yet familiar with Harvard referencing conventions. This initial exposure to these higher-order skills was scaffolded for further development and reinforcement from this point and this type of assessment remains in the curriculum.

Following this, the students had to complete an individual literature review based on their chosen research perspective in the GoGreen project — the idea being that each team member conducts research on an aspect of the project that is then combined to

[25] This is when the researcher took over as module coordinator and ERW lecturer.

form a complete literature review in the GoGreen document. Prior to completing the individual literature review, there was a brief training session on writing an introduction, and quoting, paraphrasing, and referencing information. Thereafter, the students were given time to complete the task in class — the time allocation was extended in 2019 to allow for more feedback in class and better information synthesis. Again, higher-order skills (using sources, integrating them, and maintaining the subject-focus in particular) were applied to this assessment and this remains in the curriculum.

In between the completion of the GoGreen individual literature review and the LEGO individual literature review in 2017 (where the same principles were applied), there was a session dedicated to interactive reading and inferencing to reinforce the reading skills developed in the first semester but this session was not included in the 2018 or 2019 class schedule. This was followed by a semester test where the students had to complete a reading comprehension for the ERW module component that included questions from different sources on a topic and was structured similarly to the second semester test in the first semester.

In the final quarter of the year, students were required to complete a second reflective essay on their first-year experience and goals (academic, professional, and personal). This concluded the writing specific component of the semester. Like the reflective essay in the first semester, this is a valuable task that encourages higher-order thinking skills, but it is not an academic writing assessment and does not serve to further develop the higher-order skills promoted in the previous tasks. Around the time of the final semester test, two further reading activities were completed for reinforcement in class time in 2017 but these were not offered in 2018 and 2019.

Students completed a guided report in the final semester test. The students were assessed on their ability to format a document, include figures and tables by applying the correct formatting protocols, and use the sources to generate an introduction, body, and conclusion using guiding questions. The writing rubric assessed higher-order writing competencies by having students draw from literature, develop paragraphs and a coherent structure, and integrate sources, but students were not adequately equipped with the skills to complete this assessment and could not be graded fairly on their higher-order competencies. This limitation was addressed in later years when higher-order skills development interventions were incorporated into the writing curriculum.

Two additional written documents were completed during the semester and these were a GoGreen document and a LEGO report. Both of these tasks were completed as teams and the emphasis was on formatting, with generic lower-order writing conventions applied and a limited higher-order focus.

The writing tasks offered in the second semester had the potential to bolster, develop, and refine higher-order writing skills, but the lack of grounding and emphasis in the first semester meant that not all of these opportunities could be realised. For these reasons, writing development opportunities were enhanced in the first semester and early parts of the second semester from 2020 onwards.

4.3.2. ERW Curriculum Outline: 2020

The ERW curriculum for 2020 was developed in accordance with the face-to-face and team-teaching, workshop-style approach ordinarily implemented in the module. However, the onset of the Covid-19 pandemic and associated lockdown restrictions in March 2020 led to a shift in the manner in which content was delivered after the first quarter of the year. Furthermore, the curriculum outline was adjusted for revised dates and deadlines, and module content was amended to accommodate student access to resources.

This meant that the same outcomes could still be addressed and content delivery could be scaffolded to ensure that students were exposed to lower- and higher-order writing concerns and the development thereof. The ERW curriculum outline for 2020 appears in Table 16.

Table 16: JPO 110 ERW Writing Curriculum 2020

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
6 February	Individual	*JPO 110: 2, 3* *ERW: 1, 3*	**Writing Skills** - Constructing a professional email - Writing directions	- Email formatting - Directions	- Student email - Task instructions
19 February	Individual and Pair	*JPO 110: 2* *ERW: 1, 3, 4*	**Writing Skills** - Logical reasoning - Peer reviewing	- Tangram instructions	- Task instructions - Tangram information
20 February	Individual	*JPO 110: 2* *ERW: 1, 3, 4*	**Writing Skills** - Writing a formal essay - Writing an informal essay	- Academic essay - Reflective essay - Class test on informal vs formal writing	- Task instructions - Harvard referencing instructions
24 February	Individual and Pair	*JPO 110: 2* *ERW: 3, 4*	**Writing Skills** - Individual and peer editing	- Checklists: editing and reviewing - -Class test on editing errors	- Checklists - MS Word track changes - MS Word grammar checker
25 February	Pair	*JPO 110: 2* *ERW: 1, 2, 4*	**Reading Skills** - Introduction to reading for different purposes	- Reading activities: skimming, scanning, critical and analytical reading	- Engineering News - Online sources - Task instructions
Test Week 1	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Skimming and scanning - Critical and analytical reading - Formulating a discussion	- Comprehension - Discussion paragraph	- Comprehension sources - Comprehension questions - Paragraph instructions
6 May	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Four common reading mistakes - Reading speed - Skimming, scanning, and critical reading	- Reading activities: skimming, scanning, reading speed, comprehension	- Sources - Task instructions
19 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Conducting research: formulating a problem statement and research questions	- Final individual report	- Various sources - Task instructions - Report layout
20 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Writing an introduction: background, objectives, and overview	- Final individual report	- Various sources - Task instructions - Report layout
21 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Developing a discussion: populating report content	- Final individual report	- Various sources - Task instructions - Report layout
26 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Writing a conclusion: problem revisited, synthesis of key ideas, relevance, recommendations	- Final individual report	- Various sources - Task instructions - Report layout
27 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Inserting citations and references using Harvard	- Final individual report	- Word referencing tool

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
28 May	Individual and Pair	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Using Turnitin as a reviewing tool - Using checklists to edit and review document	- Final individual report - Completed checklists	- Turnitin - Final report
2 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Analytical Reading and Writing** - Identifying theme, research focus, and research questions - Planning	- Final discussion	- Various sources - Task instructions
3 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Analytical Reading and Writing** - Writing a draft discussion - Citing and referencing sources	- Final discussion	- Various sources - Research question and planning examples - Task instructions
4 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Analytical Reading and Writing** - Synthesising information - Using checklists to edit and review document	- Final discussion	- Various sources - Synthesis examples - Task instructions
Test Week 2	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Skimming and scanning - Critical and analytical reading - Formulating a discussion	- Essay planning - Final essay - Reference list - Readability, language, grammar	- Sources - Task instructions - Marking rubric
24 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading Skills** - Completing a comprehension using skimming, scanning and critical reading	- Comprehension	- Various sources - Comprehension questions

The first two ERW workshops and related assessments focused on both lower- and higher-order writing skills. The email assignment developed out of an email formatting task from prior years. In this session, students were taught how to construct a professional email by incorporating language and formatting conventions, and how to include an attachment. In this attachment, students were required to include systematic campus directions, which served as a formative assessment for lecturers to gauge student writing foundations. This systematic thinking was then applied to a subsequent logical reasoning workshop and activity on instruction writing. Limited writing instruction was given at this point and the tasks were used to gauge lower-order aspects related to language and higher-order aspects related to coherence and synthesis. By reviewing this work, the lecturer could design tools that catered to the diverse student cohort.

Attention then shifted to a comparison of formal and informal writing conventions and a discussion of the lower-order skills related to academic language and colloquial language, as well as the higher-order skills related to the use of sources and structure. Students were required to complete a short academic paragraph comparing their chosen discipline of study to an alternative field, followed by their personal reflective essay on career ambitions and goals. The academic essay was the students' first exposure to academic writing in the module and was used as the foundation for further development in this area. This part of the assignment incorporated higher-order skills (paragraph development, source integration, and subject-focus), but the marking rubric used for assessment prioritised the reflective essay and lower-order language concerns. Individual and peer editing was workshopped in class and students were required to use checklists to edit (focus on language and grammar) and review (focus on structure and content) their own work and a peer's work. These checklists were used at the end of each writing assignment.

Following these workshops, reading became a priority. First, there was a workshop in which students worked in pairs to complete different reading tasks based on different types of sources, followed by a discussion of the strategies that were used to complete the tasks. With introductory reading and writing in place, the first semester test included a reading comprehension based on an article from the *Engineering News* magazine and a short discussion paragraph on the topic in order to promote written synthesis. Thereafter, the reading- and writing-specific workshops concluded with a workshop on four common reading mistakes, reading speed, and reading strategies.

These individual workshops in the first quarter of the semester served as opportunities to introduce students to the specific details around discussion, argumentation, and reading skills. Reading and writing were then combined into activities that involved the guided application of both.

The mode of teaching and learning changed at this stage and students were taught in the form of narrated PowerPoints, instruction sheets, and online question and answer sessions with assistant lecturers and tutors. Two full weeks were dedicated to the completion of a report on the Covid-19 pandemic. In this time, students were given different sources on the Covid-19 pandemic (web-based sources, newspaper, and magazine articles) and taught how to construct a formal report using formatting features, and guidance in how to write an introduction, the content in the body of the report, and a conclusion. This guidance prioritised paragraph and structural development, source integration and relevance, and subject-focus, all of which are higher-order skills. Lower-order skills were not dealt with in detail in these sessions but were revisited in the editing and reviewing workshop.

Context was provided and an example was used to show what a report looks like, what it includes, what language conventions were applied, and how the document is structured. Thereafter, a process-writing approach was used to scaffold the reading and writing skills applied to the assignment. This meant that students had to identify their research focus, plan their writing, draft each section, include supporting information such as tables and figures, cite and reference their sources, and review and edit their work. Finally, individual and peer editing and reviewing took place to check both the lower-order aspects of the document and to determine whether or not the document adequately responded to the higher-order aspects scaffolded throughout the workshops. The scaffolded approach to writing, reading, and then combining the two more slowly socialised students into the engineering discourse.

In the final set of workshop sessions on analytical reading and writing, a similar process was followed with slightly less guidance. Students were given sources on a topic and were then required to write a one-page essay discussion on the subject, without being told the specific research focus. Again, the process-writing approach was used and students were required to establish their research questions prior to planning, drafting, and finalising their discussion. This essay was not graded but simply served as preparation for the second semester test where students had to

follow the process-writing approach to write a short essay on a particular theme, and as preparation for a comprehension test based on the theme. Again, higher-order skills were prioritised.

The goal this semester was to scaffold the writing process and highlight higher-order skills so that the tasks in the second semester could be used to strengthen these foundations. It was thought that this would introduce students to discipline-specific discourses and associated practices within the ZPD. However, some of these tasks did not cover engineering themes, which was an improvement that could be made in 2021. The ‘Building the Context’ aspect of the writing process was also not included in these workshops. The ERW curriculum outline for JPO 120 in 2020 appears in Table 17.

Table 17: JPO 120 ERW Writing Curriculum 2020

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
7 August	Individual	*JPO 120: 2* *ERW: 2*	**Reading Skills** - Library training	- Research	- UP library website
11 August	Individual	*JPO 120: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Opinion piece: What is better for the environment?	- Opinion piece	- Sources - Essay instructions
14 August	Individual	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing a literature review: Writing an introduction, paraphrasing, referencing	- GoGreen literature review	- UP library website - Google
18 August	Individual	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Conducting research	- GoGreen literature review	- UP library website - Google
20 August	Pair and individual	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills** - Editing and reviewing individual and team submissions	- GoGreen literature review - Completed checklists	- Checklists
24 August	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: GoGreen proposal** - Constructing a proposal - Planning the document - Combining the literature review	- GoGreen proposal	- Guiding information - Task instructions
27 August	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: GoGreen proposal** - Populating the proposed method	- GoGreen proposal	- Guiding information - Task instructions
28 August	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: GoGreen proposal** - Citing and referencing - Editing and reviewing the document	- GoGreen proposal - Completed checklists	- Checklists - Task instructions
Test Week 3	Individual	*JPO 120: 2* *ERW: 1, 2, 3, 4*	**Semester 2 Test 1** - Completing a comprehension - Process-writing	- Comprehension - Plan - Essay	- Sources - Comprehension questions - Planning and essay instructions
11 September	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing a combined literature review: Research	- Combined LEGO literature review	- UP library website - Google
15 September	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** Constructing a combined literature review: Introduction and development	- Combined LEGO literature review	- UP library website - Google
17 September	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** Constructing a combined literature review: Editing and reviewing	- Combined LEGO literature review	- UP library website - Google
2 October	Individual	*JPO 120: 4* *ERW: 3*	**Writing Skills** - Reflective essay	- Reflective essay draft	- Essay instructions
Test Week 4	Individual	*JPO 120: 4* *ERW: 1, 2, 3, 4*	**Semester 2 Test 2** - Comprehension skills - Writing a report	- Comprehension - Report	- Sources - Guiding questions
27 October	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: LEGO report** - Constructing a report	- LEGO report	- Guiding information - Task instructions

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
			- Planning the document - Reviewing literature review feedback		
30 October	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: LEGO report** - Populating the method - Populating results and discussion	- LEGO report	- Guiding information - Task instructions
3 November	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: LEGO report** - Writing a conclusion - Citing and referencing - Editing and reviewing	- LEGO report	- Guiding information - Task instructions

The second semester curriculum was designed to build upon the skills and practices taught in the first semester, and further accustom students to the disciplinary discourse practices. The semester started with a session on library training and using the library website to conduct research, because students needed to conduct research in both of their projects. The EBIT librarian created a set of narrated PowerPoints and activities to guide the students through the use of this platform. In the first semester, the sources that were cited and referenced had been provided, so this served as a good starting point for students to find relevant and legitimate sources of information for their research.

This session was then followed by a reading and writing activity in which students were expected to formulate a written argument based on the sources provided. However, the theme was changed from ‘Is Google making us stupid?’ to ‘What is better for the environment? An electric motor or internal combustion engine?’. Students were given different sources and perspectives on the topic but were also encouraged to find their own sources, and these aided in the development of their arguments. The change in theme was made so that it was more closely related to the theme of global warming in the GoGreen project, making for a smooth transition between the different writing activities. Additionally, the theme is more closely related to engineering and engineering related concepts, encouraging discipline-specific discourse development. This assignment also drew from the reading and writing processes discussed and completed in the ‘Analytical Reading and Writing’ sessions at the end of the first semester. By reinforcing this process and the higher-order skills emphasis in a similar activity to that practised in semester one, the students could better apply these to the writing activities embedded in the two projects.

Following this, the GoGreen literature review was introduced. The same procedure of having students complete their own individual literature review before combining them in teams at a later stage was followed. This allowed students to use feedback from peers and markers to make improvements prior to submitting the full literature review for final assessment in the GoGreen document. The GoGreen document became more formalised in 2020 and was turned into a proposal. This meant that students could have exposure to structuring a written proposal and a written report, both of which are used in industry. Three sessions were dedicated to the formatting, construction, and development of the proposal so that the team could apply all the relevant writing processes and address their coherence, structural development,

synthesis, source integration, and subject-focus, as well as their use of language and grammar. By working in diverse teams, students could challenge each other and promote higher-order thinking processes through socialisation.

In the third test week of the year, the students were expected to follow the process-writing approach to complete a written discussion. This process included skimming, scanning, and critically reading different sources and source types, which was assessed through a reading comprehension test, followed by planning and drafting an essay based on the sourced content and the research question provided. This consolidated the higher-order skills taught previously and served as scaffolding for tasks involving more extensive written documents, such as the combined LEGO literature review, individual report, and LEGO report.

The first of these was the combined LEGO literature review. In previous years, students completed this task in the same fashion as the GoGreen individual literature review, but it was felt that students might benefit from the addition of combining their research perspectives as a team prior to submission. This would allow the students to consolidate and synthesise information prior to submission and then apply the marking feedback to the complete review prior to submission in the final LEGO report. This additional step in the writing process further extends the idea of peer learning and disciplinary discourse socialisation. Following this, the final reflective essay task was completed.

In the final test of the year, students completed a guided individual report based on the variety of sources and the topic provided. Like the previous test, students first completed a reading comprehension test in preparation for the report, and used their understanding to produce a report that included an introduction, content in the body of the report, a conclusion, a reference list, and supporting figures and tables. These aspects could now be graded for use of literature and source integration, subject-focus, and sentence, paragraph and structural development because these skills had been developed and reinforced throughout the year. This final assessment was used to establish whether or not the revised curriculum led to improvements in the students' higher-order writing skills.

This was followed by the final writing assessment for the year: the LEGO report. Using appropriate vocabulary and applying the rules of grammar, as well as cohesion,

synthesis, and world knowledge, each LEGO team was required to produce a report on the entire project lifecycle.

The reading and writing tasks throughout JPO 110 and 120 in 2020 were scaffolded to ensure that students were first introduced to the individual skills and practices required to complete academic reading and writing activities, and then reinforced these skills in gradually more extensive and intensive written forms. On each occasion, the reading expectation grew along with the writing expectation. This served as an enhancement of the 2017, 2018, and 2019 curriculum that did not scaffold the development of key higher-order writing skills and did not make use of the opportunities to offer feedback and enhancement in these areas.

Given that this was the first iteration of the previous curriculum, there were areas for improvement. Firstly, there were limited opportunities for the lecturers and students to engage with each other to respond to questions, offer support, or offer interventions in 2020 (due to the Covid-19 pandemic) and better opportunities for engagement online were needed. Additionally, the first phase of the process-writing approach was not applied, which meant that context was not being built before constructing texts, possibly impacting the higher-order aspects of writing. For these reasons, the final ERW curriculum in 2021 addressed these deficiencies.

4.3.3. ERW Curriculum Outline: 2021

The final revisions to the ERW curriculum were introduced in 2021. While this curriculum was scaffolded in a similar way to the 2020 curriculum, the full process-writing approach that includes building the context was introduced by adding pre- and post-writing reflection, freewriting, and outcome and goal discussions. Moreover, each task was designed and themed to have an engineering focus. Lectures also took place via an interactive platform online and the writing sessions were repositioned within the curriculum framework to allow time for feedback. These changes were introduced so as to enhance the writing curriculum as much as possible in the pursuit of developing higher-order writing competencies. The JPO 110 curriculum outline in 2021 appears in Table 18.

Table 18: JPO 110 ERW Writing Curriculum 2021

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
18 March	Individual	*JPO 110: 2, 3* *ERW: 1, 3*	**Writing Skills** - Constructing a professional email - Writing directions	- Email formatting - Directions	- Student email - Task instructions
7 April	Team	*JPO 110: 2* *ERW: 1, 2, 4*	**Reading Skills** - Introduction to reading for different purposes	- Reading activities: skimming, scanning, critical and analytical reading	- Various sources - Task instructions
8 April	Individual and Pair	*JPO 110: 2* *ERW: 1, 3, 4*	**Writing Skills** - Logical reasoning - Peer reviewing - Freewriting - Pre-writing reflection - Post-writing reflection	- Tangram instructions - Freewriting - Writing reflections	- Task instructions - Tangram information
13 April	Individual	*JPO 110: 2* *ERW: 1, 3, 4*	**Writing Skills** - Writing a formal essay - Writing an informal essay - Freewriting - Pre-writing reflection - Post-writing reflection	- Academic essay - Reflective essay - Freewriting - Writing reflections	- Task instructions - Harvard referencing instructions
14 April	Individual and Pair	*JPO 110: 2* *ERW: 3, 4*	**Writing Skills** - Individual and peer editing - Completing a reference list	- Checklists: editing and reviewing - Class test on editing errors	- Checklists - MS Word track changes - MS Word grammar checker - Referencing information
15 April	Individual	*JPO 110: 2* *ERW: 2*	**Reading Skills** - Four common reading mistakes - Reading speed - Skimming, scanning, and critical reading	- Reading activities: skimming, scanning, reading speed, comprehension	- Sources - Task instructions
Test Week 1	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Skimming and scanning - Critical and analytical reading - Formulating a discussion	- Comprehension - Discussion paragraph	- Comprehension sources - Comprehension questions - Paragraph instructions
25 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Conducting research: providing context, formulating a problem statement and research questions	- Final individual report	- Various sources - Task instructions - Report layout
26 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Writing an introduction: background, objectives, and overview - Freewriting - Pre-writing reflections	- Final individual report - Freewriting - Writing reflection	- Various sources - Task instructions - Report layout

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
27 May	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Developing a discussion: populating report content	- Final individual report	- Various sources - Task instructions - Report layout
Test Week 2	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Skimming and scanning - Critical and analytical reading - Formulating a discussion	- Comprehension - Discussion paragraph	- Comprehension sources - Comprehension questions - Paragraph instructions
15 June	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Writing a conclusion: problem revisited, synthesis of key ideas, relevance, recommendations	- Final individual report	- Various sources - Task instructions - Report layout
17 June	Individual	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Inserting citations and references using Harvard	- Final individual report	- Word referencing tool
22 June	Individual and Pair	*JPO 110: 1, 2, 3* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Individual Report** - Using Turnitin as a reviewing tool - Using checklists to edit and review document - Post-writing reflection	- Final individual report - Completed checklists - Writing reflection	- Turnitin - Final report
24 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Analytical Reading and Writing** - Identifying theme, research focus, and research questions - Planning	- Final discussion	- Various sources - Task instructions
29 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Analytical Reading and Writing** - Writing a draft discussion - Citing and referencing sources - Freewriting	- Final discussion - Freewriting	- Various sources - Research question and planning examples - Task instructions
30 June	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills: Analytical Reading and Writing** - Synthesising information - Using checklists to edit and review document	- Final discussion	- Various sources - Synthesis examples - Task instructions
1 July	Individual	*JPO 110: 2* *ERW: 1, 2, 3, 4*	**Reading Skills** - Completing a comprehension using skimming, scanning and critical reading - Post-writing reflection	- Comprehension - Writing reflection	- Various sources - Comprehension questions

The first session remained the same as before, with the professional email and attachment task being completed for the purposes of formative assessment. In both 2020 and 2021, the students corresponded with lecturers via email so an understanding of the voice and structure of professional communication needed to be shared early on. Instead of going directly from this session into the logical reasoning activity, it was thought that allowing time for feedback on the email directions and introducing reading skills would be a more effective form of scaffolding. This meant that the interactive reading activity in which teams of students completed tasks that required different types of reading strategies came next, and allowed students to get to know each other from afar while they considered and discussed the different reading strategies necessary for academic development. This approach was used on different occasions in the semester to address the issue of academic isolation and ensure that students contacted peers for the purposes of socialisation.

The students then completed the logical reasoning activity after feedback on the email directions was provided. Prior to completing the activity, students were required to do their first freewriting activity[26] and their first writing reflection[27] in order to build the context. Students then completed the activity by first watching a video on poor instruction-writing, and then editing and reviewing each other's work. This was the students' first guided writing activity and was again closely followed by the formal and informal essay writing task, where the full process-writing model was implemented. These sessions followed a similar format as that followed in 2020 and guided students in the writing, reviewing, editing, and referencing process, with the additional phase of planning included. As in 2020, the full range of lower-order and higher-order skills were applied to this task.

The reading skills workshop on reading errors, reading speed, and reading strategies followed on from this. This workshop was used to prepare students for the semester test, making it better positioned in 2021. The semester test included a reading comprehension based on different sources of information and concluded with a discussion paragraph in which students had to synthesise information to formulate an

[26] In addition to the benefits stated previously, freewriting helps students to overcome writer's block, to engage with content without worrying about outside influences, and to develop voice and confidence (Writes, 2017:s.p.).
[27] Reflection encourages higher-order thinking around learning experiences and allows one to think about how to make sense of and grow from these learning experiences (Nobel, 2014:s.p.).

opinion on the topic from the sources provided. This revised scaffolding was included in order to cater further to the diverse needs of the student cohort.

The individual report was introduced in the second quarter of the year. The same framework that was applied in 2020 was followed, but the topic was adapted to 'Construction Failures'. It was felt that this topic was more appropriate and relevant for engineering students and that case studies would be a good form of exposure to real-world engineering scenarios. Additionally, the topic introduced disciplinary discourses to which students may not have been previously exposed. In the second session on writing an introduction, students completed a third freewriting exercise and a pre-writing reflection. The first three report-writing sessions, including conducting research, writing an introduction, and developing a discussion, were completed prior to the second test, and the last three report-writing sessions were completed in the week following the test. This was also better scaffolding because the test required students to focus on the process of reading and comprehending to writing and expressing an understanding of the topic. Students completed their post-writing reflection in the final report-writing session. Throughout this task, the emphasis was on higher-order skills such as use of or contribution to literature, paragraph and structural development, source integration, and subject-focus.

The semester then concluded with the three analytical reading and writing sessions, which laid the final foundations for the writing tasks in semester two. This task was structured in a similar way to the final task in the first semester of 2020, which highlighted the same higher-order processes covered in the report. The theme was 'Unusual Building Designs', aligning well with the report content. This time, students had the opportunity to generate their own style of essay and research questions, which were not provided to them. To end off, an online test was completed based on the content of these workshops, and a writing reflection for the semester was done as an overarching reflection on the semester.

The scaffolded structure followed in the first semester of 2020 was very similar to that followed in 2021, with differences related to time between each task, the subject-matter, and the extended writing process.

The ERW curriculum for JPO 120 in 2021 appears in Table 19.

Table 19: JPO 120 ERW Writing Curriculum 2021

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
20 August	Individual	*JPO 120: 2* *ERW: 2*	**Reading Skills** - Library training	- Research	- UP library website
24 August	Individual	*JPO 120: 2* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Opinion Piece: What is better for the environment? - Process-writing: Freewriting, pre-writing reflection, comprehension, planning, drafting, referencing, editing, and reviewing	- Opinion piece - Class test - Freewriting - Writing reflection - Completed checklists	- Sources - Guided writing instructions
27 August	Individual	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing a literature review: Writing an introduction, paraphrasing, referencing	- GoGreen literature review	- UP library website - Google
31 August	Individual	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Conducting research	- GoGreen literature review	- UP library website - Google
2 September	Pair and individual	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills** - Editing and reviewing individual and team submissions	- GoGreen literature review - Completed checklists	- Checklists
7 September	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: GoGreen proposal** - Constructing a proposal - Planning the document - Combining the literature review	- GoGreen proposal	- Guiding information - Task instructions
9 September	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: GoGreen proposal** - Populating the proposed method	- GoGreen proposal	- Guiding information - Task instructions
10 September	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: GoGreen proposal** - Citing and referencing - Editing and reviewing the document	- GoGreen proposal - Completed checklists	- Checklists - Task instructions
Test Week 3	Individual	*JPO 120: 2* *ERW: 1, 2, 3, 4*	**Semester 2 Test 1** - Completing a comprehension - Process-writing: planning, drafting, and finalizing essay	- Comprehension - Plan - Essay	- Sources - Comprehension questions - Planning and essay instructions
28 September	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** - Constructing a combined literature review: Research	- Combined LEGO literature review	- UP library website - Google
30 September	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** Constructing a combined literature review: Introduction and development	- Combined LEGO literature review	- UP library website - Google
1 October	Team	*JPO 120: 1, 2, 4* *ERW: 1, 2, 3, 4*	**Reading and Writing Skills** Constructing a combined literature review: Referencing, editing and reviewing	- Combined LEGO literature review	- UP library website - Google
15 October	Individual	*JPO 120: 4* *ERW: 3*	**Writing Skills** - Reflective essay	- Reflective essay draft	- Essay instructions
Test Week 4	Individual	*JPO 120: 4*	**Semester 2 Test 2**	- Comprehension	- Sources

Week	Individual / Team	Learning Outcome	Content	Assessment	Resources
		ERW: 1, 2, 3, 4	- Comprehension skills - Writing a report	- Report	- Guiding questions
9 November	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: LEGO report** - Constructing a report - Planning the document - Reviewing literature review feedback	- LEGO report	- Guiding information - Task instructions
12 November	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: LEGO report** - Populating the method - Populating results and discussion	- LEGO report	- Guiding information - Task instructions
16 November	Team	*JPO 120: 1, 2* *ERW: 3, 4*	**Writing Skills: LEGO report** - Writing a conclusion - Citing and referencing - Editing and reviewing - Post-writing reflection	- LEGO report - Writing reflection	- Guiding information - Task instructions

It was felt that the structure of the JPO 120 ERW curriculum in 2020 adequately scaffolded the development of higher-order writing competencies. Thus, the curriculum outline remained the same with students being exposed to a mix of individual and team writing tasks. The only difference was the addition of the first phase of the freewriting and reflection tasks, but this was not done as formally as those in the first semester.

Freewriting was formally completed before the opinion piece toward the start of the semester. A pre-writing reflection was completed in the same session, and a final writing reflection was completed at the end of the semester. The freewriting and reflection exercises were no longer formalised because the intention was to facilitate rather than instruct. Students were still encouraged to apply the process-writing taught and reinforced in semester one. The writing reflections were less frequent because the writing foundations were laid in the first semester and given further practise in the second semester. It was felt that a formalised, longer reflection at key points in the semester would result in fuller reflections, as students would have had more time to develop and progress in the areas of writing and reflection through their individual practise.

4.4. DISCUSSION OF CURRICULUM DEVELOPMENTS

In the first semester of 2017, lecturers applied a workshop style approach to the class sessions. The topic was introduced, followed by an overview of the task, and opportunity for students to ask questions; whereas, the second semester was geared toward the application of the individual skills taught in the first semester. For this reason, lecturers served as facilitators who guided the students through the completion of the projects and associated tasks.

The emphasis on reading in semester one of 2017 encouraged students to develop the speed and comprehension needed for academic reading and writing in semester two. But, the limited exposure to academic texts and academic writing may not have allowed for adequate development in the area of writing. The individual report is a place where students could have been introduced to higher-order thinking, reading and writing as a practice that could be reinforced in the projects in the second semester; however, these were not used to the full extent.

While the students had good opportunities for academic writing exposure in the second semester of 2017, there was limited guidance and instruction on how to write for academic purposes and apply higher-order skills to an argument or discussion. Students were not introduced to the writing process nor were they introduced to textual analysis, which helps to develop the mental models necessary for the application of higher-order writing in the discipline. Additionally, while there were many reading assessments, the sources came primarily from the *Engineering News* magazine. Although this is a good source for general knowledge and industry exposure, it is not academic in nature and does not show students how literature reviews or reports are constructed. Finally, many of the documents that students were required to complete for the IT component of the course were graded for content, which may have been unfair to the students due to the lack of instruction and guidance in lower- and higher-order writing development. For these reasons, it was felt that the module framework, while adequate in certain respects, required further writing instruction, particularly in the higher-order aspects of writing. In 2018 and 2019, minor adjustments were made to the ERW curriculum, but when the researcher began to work full time in the module and on the module curriculum toward the end of 2019, more significant changes were introduced. This led to the first revised curriculum in 2020.

The ERW curriculum in 2020 was more extensive than that offered in 2017 because fewer contact sessions were dedicated to IT skills specifically. The introduction of an IT Skills Assessment Manager (SAM), which offers training in Microsoft Office, meant that less time needed to be dedicated to reinforcing IT proficiency and practise in class. This opened the schedule up to accommodate further writing practise and reinforcement, and many of the tasks that were initially considered IT assessments were redeveloped to incorporate an ERW component.

Moreover, the BuildUP project, a campus orientation and estimation task that was first introduced when Professional Orientation included a mathematics component, was removed from the schedule and replaced with a guided individual report. Initially, it was felt that the project no longer aligned with the module aims and the lecturing team were discussing the introduction of a more detailed individual report, but the fact that students had to work in pairs and be active on campus meant that the project could not be completed with lockdown restrictions in place. This led to a report based on information about the Covid-19 pandemic. At the time, this was a prevalent topic and new information was coming to the fore on a daily basis, but it was recognised that the

topic would have to change in subsequent years so that engineering would be the focus.

Another major shift in the module was in the time that was dedicated to reading *and* writing. Because ReadON was not available after 2017, tasks had to be introduced that encouraged reading development and that ensured students were comprehending the content at a higher level. This resulted in a scaffolded curriculum with more writing tasks that emphasised the higher-order skills of using or contributing to literature, developing sentences, paragraphs, and overall structure, integrating sources, and focusing the subject-matter. This led to workshops entitled 'Analytical Reading and Writing'.

The ERW curriculum in 2020 was created to address the deficiencies in the previous writing curriculum, but the transition to remote teaching and learning meant that it took time to establish the most effective mode of teaching and learning in the new environment. Lecturers and students had first to adjust to the new situation and only then could they experiment with the different resources available before being able to fulfil the teaching and learning cycle. Furthermore, many students mentioned that they did not have access to peers who could edit and review their work, resulting in academic isolation which was not addressed by the lecturers in the module.

The revised mode of teaching and learning was used to deliver content throughout the second semester of 2020 as well, which meant that narrated PowerPoints continued to be the delivery vehicles for content discussion, detailed instructions were provided, and students could attend the remote question and answer sessions with assistant lecturers and tutors. For this reason, students could not self-select their teams for either the GoGreen or LEGO projects and were assigned teammates who could be contacted via the students' dashboards. This allowed the lecturers to create teams that were not disadvantaged by limited access to resources, but the distance between the lecturers and the students made it difficult to establish whether or not teams were working together effectively or if students were viewing the relevant PowerPoints or understanding what was expected of them in terms of their writing development.

Classes remained online for the duration of 2021. The exposure to online teaching and learning in 2020 allowed the lecturers to identify which platforms could be used to ensure that students received adequate academic support, which was lacking in 2020. All classes took place via Blackboard Collaborate (a video conferencing tool available

to all students) in 2021. These classes were compulsory and student attendance was satisfactory due to monitoring by the system and the assistant lecturer, and follow-ups with students who did not attend class regularly. Each session was recorded and the recordings remained available to students for the duration of the semester so that they could practise and reinforce the skills taught in the workshops; however, it is unclear how many recordings were accessed by the students and how successful this was in promoting teaching and learning.

First, the lecturer would present the session and then students were given the opportunity to speak with lecturers, assistant lecturers, tutors, or peers if they had any questions. This led to a more supportive learning environment in the remote setting and closely emulated the team teaching and workshop style class structure followed in the first semester of 2017. If a student requested a consultation, this would be done via Blackboard Collaborate as well.

The same ERW sessions offered in JPO 110 in 2020 were again offered in 2021, and no new sessions needed to be added. However, the sequence of the classes changed, the subject-matter became more engineering-focused, and freewriting and writing-reflection exercises were added to enhance the process-writing approach. It was felt that the freewriting tasks would help students to think more deeply about the content of their written assessments and the higher-order aspects of writing, and that the reflections would encourage students to think about why writing is important and how it can be improved. The inclusion of planning in the process-writing approach also further enhanced the higher-order thinking skills required for higher-order writing development.

The second semester of 2021 was structured the same way as semester two of 2020, but the Blackboard Collaborate class sessions and guided facilitation again more closely emulated the class structure in JPO 120 in 2017.

4.5. CONCLUSION

This section has outlined the ways in which the ERW curriculum evolved during the course of this study. Through the introduction of the revised learning outcomes in 2017, staff changes over the years, and changes to the teaching environment in 2020 and 2021, a curriculum has emerged that scaffolds student writing in such a way that higher-order skills are prioritised. This, in turn, implicitly promotes reading

development as comprehension is required to be able to develop a coherent, well-structured, and considered written assessment. The outlines provided offer insight into how much time has been afforded to Academic Literacy, without compromising other aspects of the curriculum.

The quantitative and qualitative results of the writing interventions and associated assessments offered in 2021 are discussed in the chapter that follows to further emphasise the ways in which writing instruction and higher-order writing skills were addressed in the new curriculum.

CHAPTER 5:
RESULTS AND DISCUSSION OF THE HIGHER-ORDER INTERVENTIONS

> Data demand interpretation. But no rule, formula, or algorithm can lead the researcher unerringly to a correct interpretation. Interpretation is inevitably a somewhat subjective process that depends on the researcher's hypotheses, assumptions, and logical reasoning processes (Leedy & Ormrod, 2015:24).

This chapter discusses the particulars of the writing tasks that were completed in 2021, as well as the results of these assessments and whether or not they show an overall improvement in student writing, with special attention to their higher-order skills. First, a brief overview of the students' Grade 12 results is presented to offer insight into their levels of English proficiency prior to the start of the module. This is followed by details of the writing interventions and an overview of the assignments completed to assess the success or failure of the intervention. Then, the researcher's impressions on the success or failure of the intervention are provided along with qualitative and quantitative results as support.

Six assignments were used to track the success or failure of the writing interventions offered throughout the year: two in the first semester and four in the second semester. Each assignment was used as scaffolding for the next, until the end of the second semester when both individual and team reports had to be completed with limited support. These assessments are: writing task (academic and reflective essays), individual report, opinion piece, individual literature review, final individual report, and final team report.

5.1. GRADE 12 RESULTS AND ENGLISH LANGUAGE PROFICIENCY

As per the minimum entry requirement for the ENGAGE Programme, students were required to achieve a sub-minimum of 60% for English in Grade 12 and this could either be as a home language or as a first additional language. Both of these require the ability to speak, read, and write competently in English using formal and informal language. In total, 63 of the 104 student participants in the study took English as a home language in Grade 12, 39 took English as a first additional language, and two

were international students who took English as a subject in Grade 12 (it is unclear whether this was taken as a first, second, or third language).

Table 20 shows the results the 104 students who participated in this study obtained for English in Grade 12.

Table 20: Grade 12 English Results

Percentage Bracket	Number of Students
50 – 59%	1
60 – 69%	41
70 – 79%	49
80 – 89%	13

This indicates that 62 of the students achieved a grade of 70% or above for English in Grade 12, showing strong abilities to speak, read, and write in the language. The 41 students who obtained results within the realm of 60 – 69% also showed that they have the ability to speak, read, and write competently in English. One student was permitted into the programme without having achieved the sub-minimum of 60%, which is likely due to them having performed well in their other prerequisites and only falling short by one or two percentage points in English.

Based on these results, it was assumed that all of the students were capable of writing texts in English and that the lower-order skills required for this were fairly well developed. Additionally, based on the National Curriculum outline, these students had written essays in English throughout their schooling careers and had an idea of how to structure an essay and develop an argument. Thus, it is reasonable to assume that none of the students had weak English language foundations and that emphasis could be placed on the higher-order skills that needed to be streamlined for academic success.

5.2. FIRST WRITING INTERVENTION

The first intervention was used to reaffirm the process-writing model with students who were required to follow this approach in Grade 12 (see Figure 1 and Figure 2), closely guide them through the application of this model, introduce the idea of textual analysis as a modelling tool, and highlight the distinction between informal and formal writing and lower-order and higher-order skills. The idea was to outline the general

requirements for good writing to take place in these sessions and then to focus on specific skills and practices that improve higher-order writing in the interventions that followed.

This intervention took place across four sessions offered in weeks one, four, and five of the first semester. The level of lecturer involvement and guidance was high and the workshops concluded with two types of essays: academic and reflective.

The first session took place in the first week of the semester where textual analysis of a well-written email from a student to a lecturer was used to demonstrate the types of style, tone, and structure required when addressing and contacting a lecturer or person of seniority in an academic institution. By doing this, students also had to consider the differences in formal and informal writing and the range of different styles of writing. This was a straightforward session where the intention was not to challenge the students, but to create an awareness of the differences in language use and to have them apply these.

The intention of the second session was to go through the process-writing model so that students were reminded to use this practice in their writing assessments at university. Students would have followed this approach at school, based on the curriculum outline, so they were familiar with the practice. However, the freewriting and reflection stages were introduced to the students to help them to become more confident in their writing and more reflective of the areas of need or successful areas in their writing. The following stages were completed:

1. A writing reflection
2. A freewriting exercise
3. A video on poor instruction writing
4. A discussion on what logical reasoning means
5. A discussion on the importance of clear communication
6. A logical reasoning activity
7. The reviewing and editing process
8. A post-workshop reflection

Additionally, each student was required to produce logically written instructions by the end of the session that would help a peer to complete a task. This was done to challenge students in the use of appropriate structure and subject-focus in their written

communication and to have students inform and assist each other in their writing development. The students only had time in class to complete the short activity.

The task that would be used to assess the success or failure of the first intervention was completed in the third and fourth sessions. First, the steps involved in the writing process were reiterated and there was a discussion and examples of formal and informal writing in the third session. Students were then given time to complete a reflection and freewriting exercise and to plan and draft each of the essays they were required to complete by using mind maps. The lecturer, assistant lecturer, and tutors were available to assist and pace the students through these stages.

In the final session the students received information on editing, which focuses on lower-order skills, and reviewing, which focuses on higher-order skills. A clear distinction was made here so that students would focus on both sets of skills, and different tools were introduced to help them work on these aspects of their writing. The tools that were introduced to help with the editing process were a checklist, MS Word, Google Docs, and Grammarly, which are software packages that all students have access to and that identify spelling and grammatical errors. When it came to reviewing, there were two tools that were introduced: a checklist and Turnitin. As stated previously, Turnitin is a software that identifies the percentage of similarity in one's work. This helps students to rectify their quote incorporation, referencing, and paragraph structure. After being introduced to the different skills they would be assessed on and the tools they could use to check their writing, the students completed a short test on editing and reviewing and were sent to breakout rooms to edit and review their work in pairs, with tutors joining each room.

In each of these sessions, a structured approach was used that scaffolded the writing process and incorporated textual analysis. Students could ask tutors, assistant lecturers, or lecturers for assistance, and consultation sessions were offered to those who had difficulty with the task. Furthermore, students were given access to a rubric (see Appendix C) that assessed higher-order competencies such as use of or contribution to the literature, source integration, structure (sentence, paragraph, and overall), and subject-focus, and lower-order competencies such as language, grammar, and voice.

At this stage, students were still new to academic writing and had different levels of exposure to using or contributing to literature, integrating sources, structuring their

work for different audiences, and focusing on a particular subject area. Thus, subject-matter that was familiar and personal to the students was used to assess the application of both sets of skills. In this task, lower-order skills were assessed in the same level of detail as the higher-order skills to check whether or not the researcher's assumption that lower-order skills were fairly well developed and that more emphasis needed to be placed on higher-order skills was correct.

5.2.1. Academic and Reflective Essay Instructions

In the academic essay, each student was required to use two sources to compare their chosen field of study to their alternative choice of study. These sources were not provided but recommendations were made to help the students. Students had to remain objective, share the facts presented in sourced material, and not display bias or make generalisations. This exposed students to an academic task that was formal in style and tone, objective in voice, focused in subject, and that used sources to inform knowledge. The instructions for the academic essay are included in Figure 18:

> Construct a **short**, **formal** essay (it must include an introduction, body and conclusion) of approximately **250 words**. In this essay you are required to **compare** your chosen study field with another study field or career path that you considered pursuing. You are required to find information that describes exactly what your chosen field entails, and what the other field entails. You must use a **minimum** of two sources. A good starting point is available for you on clickUP, under 'Important Documents' and is titled *Library link to Studying Engineering (R.B. Landis)*. However, you may use any two sources to get the information you need for your short essay.

Figure 18: Academic Essay Instructions

Following this, a reflective essay on the students' personal reasons for selecting their chosen degree programme and their goals for the future was completed. This assignment was used to encourage students to contemplate *why* they chose their degree scheme and *what* they aimed to get out of it, which is meaningful in getting students to 'buy-into' the skills and practices being developed. It was also used to highlight the differences in formal and informal writing in terms of voice, style, and intention. Figure 19 includes the task instructions:

Use your prior knowledge and the previous section's comparison to compile a reflective essay of **350 - 450 words** (approximately one and a half **A4** pages) in which you respond to the following questions:

- Which doors do you believe your chosen field of study will open for you?
- What potential opportunities did your alternative field of study present?
- What do you hope to be doing in 15 years' time?
- How will your short-term and long-term goals help you get there?
- Why did you elect to study engineering?

Figure 19: Reflective Essay Instructions

5.2.2. Findings of the Intervention

The first set of intervention workshops and accompanying assessments were general and introductory. The style, tone, and writing expectations required in the reflective essay would have been familiar and comfortable for students based on the school curriculum. However, the style, tone, and expectations required in the short academic essay were either new or not well established for many, judging from the researcher's observations of the email and logical reasoning activities. Thus, it was thought that including a short task with a simple outcome would have helped students to experiment with the writing process, the use of voice, structure, style, and tone, and the higher-order skills related to structure and cohesion, subject-focus, synthesis, source integration, and resulting coherence without it having too negative an impact on student results.

In the pre-writing reflection, students were asked the following question:

Does writing come naturally to you?

This question was asked to get a sense of the students' perceived level of confidence and competence in writing. By indicating whether or not they felt writing came naturally to them, they were demonstrating their level of comfort with writing as a concept and the writing expectations of an engineer. Table 21 includes a table showing the spectrum of responses to this question. (The process of determining these results is discussed in Section 2.6)

Table 21: First Reflection

Definitely not	Not really	Somewhat	Very much	No answer	Total
42	2	17	31	12	104

These results are interesting because 46% of the students who completed the reflection felt strongly that writing does not come naturally to them. One of the students stated “No, I don’t enjoy writing because I can’t always write what I’m actually thinking and [I] sometimes [even] confuse myself.” Another student said no but offered a different explanation, stating that it does not come naturally to them[28] because it is a “skill that [they] have developed over the years and continue to develop.” 21% of the students who completed the reflection had mixed feelings, either feeling that it comes somewhat naturally or naturally to a limited extent, and stated the following: “For the most part writing comes naturally and my imagination goes wild, but [sometimes] certain specific topics take more effort” and “I do feel that it comes naturally to me, especially when I do it on my own account and no one tells me that I need to do it.” This is reflective of polarised views of writing competencies and is potentially reflective of their language and writing backgrounds, and exposure to different forms of writing. This highlights the diverse levels of exposure to different discourses within the cohort, emphasising a potential lack of prior socialisation into academic literacy practices for many of the students. Although this may be hard to recover, given that primary and secondary discourse induction is crucial in childhood, reaffirming the practices required for good writing would be useful to those who evidently felt ill-equipped for writing.

The researcher observed that in the workshops, those who participated appeared to be comfortable with the subject-matter and seemed to have a good understanding of what was expected of them. They were easily able to distinguish between formal and informal language and, when prompted, provided accurate information on the differences between the two styles. This observation highlights the problems that exist in the context of South African higher education where many students lack the primary discourses necessary for induction into secondary discourses. This would make the scaffolding of tasks that fall within the ZPD (and the reinforcement of key skills and practices) essential for all students in order to develop their mastery of the discipline-specific discourse.

The freewriting and reflection components of the writing process appeared to be new to many, but students took the time to respond to both. The planning, drafting, editing,

[28] The gender-neutral terms ‘they’ and ‘them’ are used when referring directly to a student, so as to ensure that there are no identifying features associated with the student respondents.

and reviewing aspects of the process were not new to students with a number electing not to take the time to complete these properly (it was felt that this key part of the process was often neglected by students). For most, referencing and the use of sources in general seemed to be something they would need to work on because they were not comfortable with these and were unfamiliar with referencing, possibly experiencing difficulty in learning referencing procedures due to a lack of motivation

Overall, it was expected that this writing task would not be a major writing challenge for students, certainly not when it came to lower-order skills, but that the academic essay would include higher-order requirements that students would need to develop further, such as structure and cohesion, synthesis, subject-focus, source integration, and overall coherence.

In the post-writing reflection students were asked the following:

What is your preferred style of writing?

A total of 63% of the students who responded to this reflection indicated that they preferred informal writing. This is likely due to familiarity with this style and the creative freedom that comes with it. Table 22 includes the results for this reflection.

Table 22: Second Reflection

Informal	Formal	Both	Neither	No answer	Total
62	27	8	1	6	104

Significantly fewer students (28%) indicated that they preferred formal writing, and these could be students who prefer the rules around academic writing. Perhaps preferring to use writing as a means of communicating with others in similar fields and not as a means of emotional or creative expression. One student stated that they prefer formal writing because “it feels more professional and once a piece of writing is done [it] allows [them] to feel more accomplished.” Another student said “I prefer to use formal writing as it is more structured which helps my ideas to flow better.”

8% of the student respondents stated that they enjoyed both styles for different reasons, and these were likely students who were comfortable with writing and felt that it was something that came naturally to them. Only one student stated that they did not prefer either style, and it is probable that this was someone who did not feel that writing was a natural competency. Overall, the responses showed that they

generally preferred informal writing because it “requires less thought” and “is just easier”, which may have resulted in challenges in the formal writing task.

Students generally performed well in the lower-order aspects assessed in the task and obtained a class average of 71% for these skills; whereas the class average for the higher-order skills assessed was 62% (see Appendix D). The lower-order skills that were assessed included sentence structure, use of conjunctions and prepositions, spelling and choice of words, pronouns and UK/US English, concord and tense, and punctuation. However, it was found that 74% students who completed the task obtained a result of 50% or below for sentence structure, suggesting that the assumption that *all* lower-order skills were well-established in the students was incorrect (see Appendix D).

The higher-order skills assessed in the academic essay included source integration, content development, comparison, structure, focus and audience, and coherence. As anticipated, source integration was a challenge for most students with only 34% of the students who completed the task obtaining a pass mark for this criterion. This is possibly linked to sentence structure because students may have had difficulty with their quote incorporation or use of sources in general. As a result, 82% of the students also did not perform well in the coherence aspect of the academic essay rubric, likely due to disjointed discussions as a result of poor quote incorporation. This supports the theory that long-term memory, and the different forms of knowledge that are stored in memory, has a dramatic impact on one’s ability to produce a text. The students are still being introduced to the discourse and would still need to develop their task schemas and linguistic knowledge. However, the assumption that all higher-order skills need development and improvement was also incorrect as 93% of the students who completed the task performed well in the content development, comparison, structure, and focus and audience rubric criteria in both essays — see Appendix D. This may have been impacted by the familiar content, again supporting the importance of long-term memory in writing.

These general observations indicate that lower-order skills should not be neglected, especially as students are being introduced to source integration and the impact this has on grammar, and that source integration and coherence would need to form the focus of the interventions going forward.

5.2.2.1. Analysis of Student Work

Qualitative analyses of three students' work: a low-performing, mid-performing, and high-performing student, are included in the 'Analysis of Student Work' for each intervention. These are included to show the differences in student writing competencies after the first set of interventions. The same three students' work is analysed across each of the interventions (as stated in Chapter 2) to show how typically low-, mid-, and high performing students responded to the interventions. To demonstrate that Grade 12 results had no bearing on performance, it is worth noting that the low-performing student obtained 76% for English as a Home Language, the mid-performing student obtained 63% for English as a Home Language, and the high-performing student obtained 67% for English as an Additional Language in Grade 12.

A sample of the comparison required in the body of the academic essay has been included in Figure 20 to demonstrate a low-performing student's application of lower- and higher-order competencies after the first set of intervention workshops. Comments on lower-order competencies are included on the right and comments of higher-order competencies are included on the left.

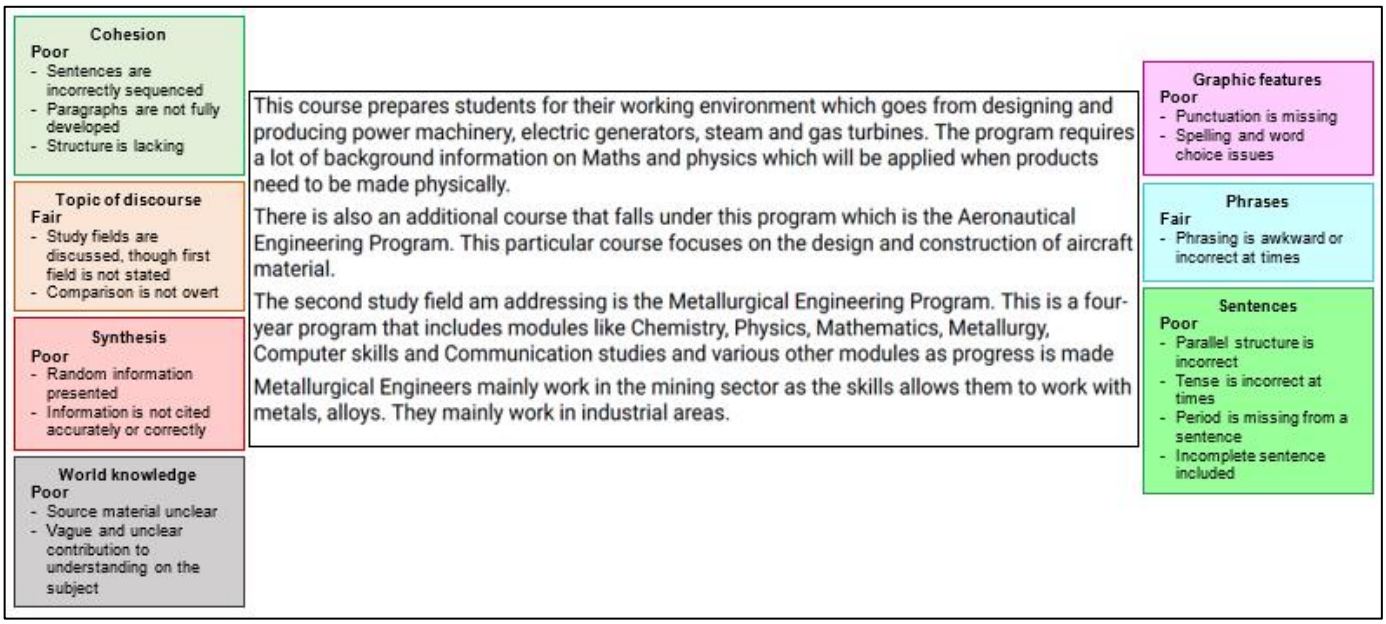


Figure 20: Low-performing Student Writing Task

Students were asked to compare their chosen field of study to the alternative field they had considered. In the sample above, the student compares Mechanical Engineering (although this is not stated explicitly) with Metallurgical Engineering.

In the first paragraph, the student does not state which degree programme they are referring to and inferences are made based on the points within the discussion. Thus, the topic sentence in the first paragraph does not provide the necessary context for the remainder of the discussion. Additionally, the sentences within each paragraph do not present a logical flow of ideas. The student discusses what the Mechanical Engineering course prepares students for, then the requirements for getting into the course, and in a separate paragraph, one of the sub-disciplines within Mechanical Engineering. A more logical flow of ideas would have been to define Mechanical Engineering, to discuss the requirements for getting into the course, and then to share the kinds of work and industries a Mechanical Engineering degree prepares one for.

The third paragraph discusses different aspects of Metallurgical Engineering studies, leading to limited points of comparison. This disordered construction of the sentences, paragraphs, and the essay negatively impacts cohesion. This indicates that the student either neglected to apply the process-writing model to help with the formulation of their essay, that they lacked the language foundations necessary for this model to be applied effectively, or that they did not have a conceptual understanding of what the task required.

The first engineering discipline is not stated directly, making the topic of discourse only partially clear. Furthermore, the comparison is not explicit and the points made do not show the differences or similarities between the two engineering disciplines, due to unclear relationships between the different pieces of information. The information shared by the student is also general and random and it is difficult to tell if the information comes from source material or from the student's own understanding. Ultimately, this leads to an unclear topic of discourse, poor information synthesis, and a poor display of world knowledge.

When it comes to lower-order competencies, the student makes various construction errors. For example, a full stop is not included at the end of the last sentence in the third paragraph: "… as progress is made". The student also makes minor spelling and choice of word errors. Phrasing is awkward at times and this is seen when the student writes "… when products need to be made physically." This is ambiguous because it is unclear if the student is referring to physical products or physical labour. The assumption is the former and a clearer statement would be: "… when physical products need to be made." Finally, the sentences are poorly constructed and this is

visible in the lack of parallel structure when information is listed, the use of the incorrect tenses, and incomplete sentences. This is not linked to the assumption that source integration negatively impacts sentence structure, because these errors occur across the board.

The student is unable to show a clear understanding of the study skills discussed, suggesting a possible comprehension issue, and the student's ability to present information in a coherent and structured manner is also lacking, suggesting inadequate writing foundations. These deficiencies in the student's lower- and higher-order skills indicate that both the reading and writing skills assumed from a school level are not evident.

A sample of the comparison in the academic essay completed for the writing task for the mid-performing student is included in Figure 21. In this sample, the student compares Mechanical Engineering to Civil Engineering by discussing the skill and job requirements of both fields.

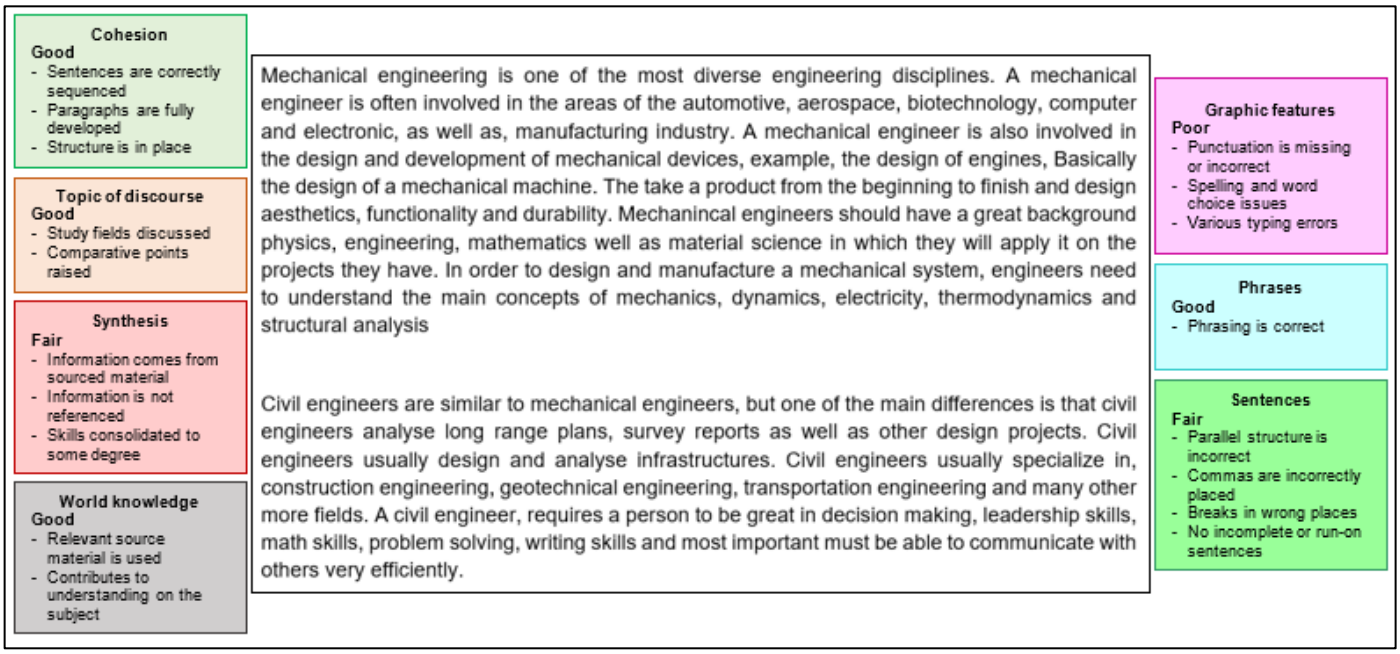


Figure 21: Mid-performing Student Writing Task

The student discusses Mechanical Engineering and specifies the industries in which mechanical engineers work, the types of jobs they do, and the skills and knowledge needed to complete these jobs. This is a logical flow of ideas and shows good sentence sequencing within the paragraph. The second paragraph then starts by stating that civil engineers are like mechanical engineers in many ways, and then goes

into the differences between the two. This shows good cohesion within the paragraph as comparison is required. Overall, the comparison is well structured and logical.

This good cohesion translates to a clear topic of discourse and world knowledge, because there is a strong subject-focus and sourced material is used to share an understanding of the two fields. However, the student loses some of the strength of their discussion when it comes to synthesising information. It is evident that the student uses sources to develop their comparison, but the discussion lacks integration. The student lists information on the two disciplines without making connections between different pieces of information. For example, the student indicates that they will discuss the differences between civil engineers and mechanical engineers, but then lists what civil engineers do. This leaves the comparison to be made by the reader, rather than the writer, resulting in a lack of synthesis and consideration for the audience.

The student's lower-order skills are weaker than their higher-order skills, and this is particularly evident in the graphic features and sentence structure. The student makes various punctuation errors, spelling errors, and choice of word errors, which disrupt the flow of the discussion.

This assessment indicates that the student had higher-order competencies in place prior to the interventions, but that they needed to work on their synthesis and lower-order skills.

In the final sample, the high-performing student compares Chemical Engineering to Biochemistry. Figure 22 includes a sample of this comparison for the high-performing student.

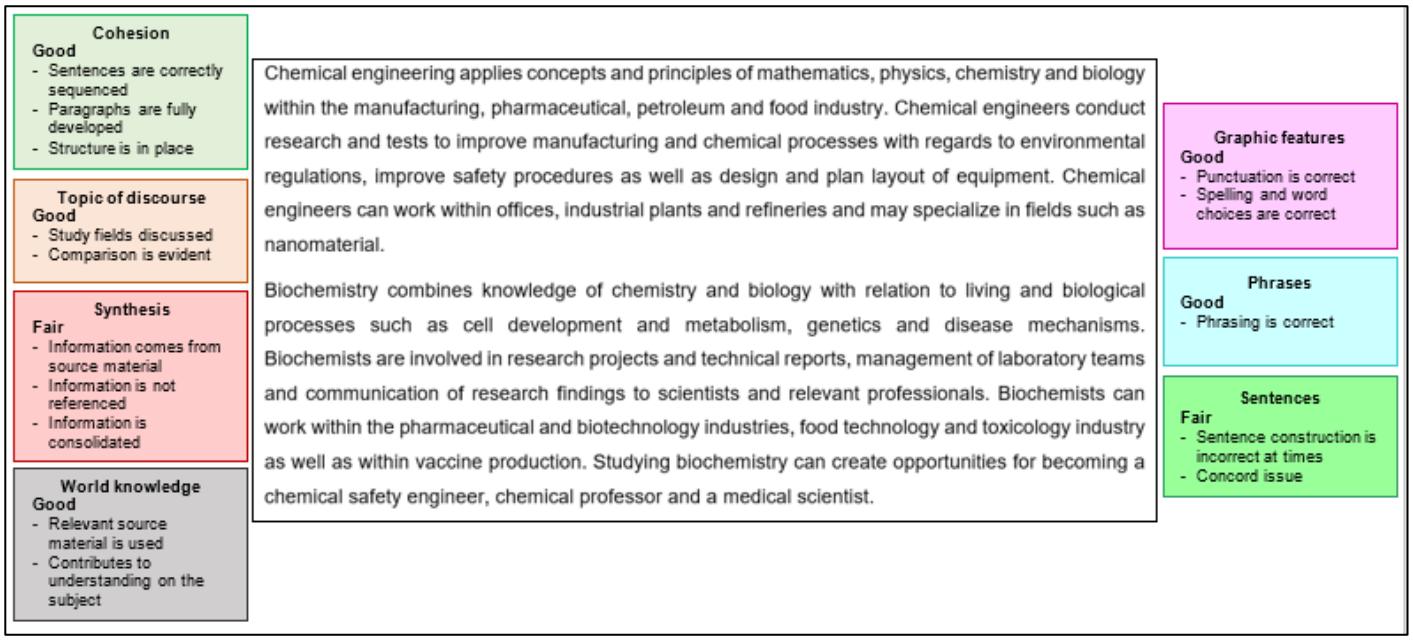


Figure 22: High-performing Student Writing Task

The student starts their comparison with a description of Chemical Engineering. They first describe the subject areas involved and the industries in which chemical engineers are needed, then they outline the types of jobs performed by chemical engineers, and the environments within which they work. The student follows this same structure in the next paragraph on Biochemistry. This displays a good level of cohesion and coherence, because sentences within each paragraph are sequenced in a logical manner and the paragraphs are ordered correctly. By sequencing information similarly within each paragraph, the reader is able to identify the similarities and differences within the fields.

Both paragraphs are focused in terms of the topic of discourse and showcase the student's world knowledge and understanding of the two fields. Resource material is used to inform the discussion and this information is synthesised within each paragraph to create a full comparison.

An area for improvement is subject-focus. Although the topic is clearly addressed, the student does not overtly state the similarities and differences between the two fields. This is inferred based on the detailed information provided, but a clear statement of these factors would have made for a better and fuller comparison.

The student's lower-order skills are well presented in the sample, with the correct use of punctuation, spelling and choice of words, and phrasing. Sentence structure requires some improvement, however. For example, the student says "Biochemists

can work within the pharmaceutical and biotechnology industries, food technology and toxicology industry as well as within vaccine production." The parallel structure in the list would have been correct if stated as: "Biochemists work in various industries, such as the pharmaceutical and biotechnology industry, the food technology and toxicology industry, or the vaccine production industry." This supports the claim that sentence structure may have been negatively impacted by source integration.

The student evidently has strong reading and writing foundations in place from school and these can be moulded for good academic writing through the course of the year. The higher-order emphasis in the interventions could help with minor synthesis, subject-focus, and sentence construction errors.

These samples show that the assumption that higher-order interventions are more necessary than lower-order interventions is incorrect. The low-performing student evidently lacks skills in both areas and this impacts their ability to formulate a logical discussion, and the mid- and high-performing students were better equipped to respond to the higher-order aspects of the task than the lower-order. This could be due to the subject-matter or it could be due to the emphasis placed on process-writing, which favours higher-order skills development, at a school level. The increasing intensity of the tasks and the emphasis on academic writing and the skills required for this may re-challenge this initial discovery but suggests that attention should be given to both sets of skills.

5.3. SECOND WRITING INTERVENTION

The second intervention took place across six sessions over three weeks in the first semester. These were weeks nine, ten, and eleven. The lecturer/researcher was heavily involved in the class sessions and offered guidance throughout the three-week period. The sessions culminated in an individual report based on three case studies (see Appendix E for the report overview).

The goal of the second intervention was to repeat the practices of process-writing and textual analysis while placing an emphasis on the development of higher-order skills, specifically: paragraph and overall structural development, use of or contribution to the literature, source integration, and subject-focus. It was hoped that this emphasis would address problems identified with sentence structure, source integration, and

overall coherence by focusing on the higher-order factors that influence these elements in academic writing.

Paragraph and structural development were addressed by introducing students to research questions and the idea of a problem statement. These are generally not presented at a first-year level, but are valuable tools in developing and maintaining structure in writing and subject-focus within that structure. Additionally, students were guided in formatting their reports using clearly defined headings to frame the report in order to promote structure, cohesion, coherence, and focus in their writing.

Textual analysis was first used to show students how reports, specifically case studies, are structured, what the style, tone, and register of the report is, and how direction is provided through a clear statement of the problem that is being investigated and through guiding questions. This was then followed by going through examples with students and having them formulate their own research questions and associated problem-statements to an example and then to the topic provided.

The use and integration of sources was addressed by giving students access to resources that would help with referencing, such as the Harvard referencing guide and the referencing database in MS Word, and demonstrating how to use these to cite and reference work. Examples of paraphrasing and quote incorporation were also provided and discussed in class for students to gain an understanding of how to do these things effectively.

Students had to achieve different milestones in the report-writing workshops over the course of three weeks and the next section goes into these milestones and the guided steps leading to their completion.

5.3.1. Individual Report Instructions

In the first session, students were given the task instructions and the content they would use to complete the assignment such as an example report, six texts on the case studies, and various figures. This session was used as a planning session that went through an example of a case study report, the task objectives, and explanations and demonstrations on how to identify a problem statement and research questions. At the end of the session, students completed the activity in Figure 23.

Activity

1. Download, save, and read the sources provided
2. Review the report guidelines
3. Think about your construction failure report and in a blank Word document identify:
    a) The issue you are addressing (i.e. the topic)
    b) Your problem statement
    c) Your main research question
    d) Your research sub-questions (5 Ws)

Figure 23: Session One Instructions

An example of a case study was used to show students how to plan their writing and ensure that they stay consistent and on topic throughout the report. The '5 Ws'[29] were introduced to help students identify the research questions they could use to inform the content of the report and maintain the subject-focus.

The students brought and shared their answers in the second session, which focused on drafting an introduction. A collective understanding of the objectives and focus going forward was formed by having students share these responses verbally in the session. The students had the opportunity to understand not only how to formulate a writing framework but why it is important to do so, by engaging in a social event that promotes inter-psychological functioning in order to maximise intra-psychological functioning for the purposes of secondary discourse development.

With the context and a shared objective in mind, the students could now formulate a draft introduction. It was explained that framing the report through a cohesive, coherent, and complete introduction is an important step in developing a logical and structured document. To do this, three key features of an introduction were identified: background, objectives, and overview, and these were aligned with the '5 Ws' identified previously. An introduction using the previous example helped to explain how key features are identified and drawn together in a logical and structured manner. Figure 24 is the activity that was completed at the end of the session.

[29] The '5 Ws' refer to who, what, when, where, and why, and can be used in reading and writing to formulate questions that assist with the gathering of relevant information (Denomme, 2021:s.p.).

Activity

1. In your planning document, identify your…
    a) Background
    b) Objectives
    c) Overview

3. Once you are satisfied that you have included all the relevant information, draft your introduction. Remember that there will be some overlaps in your planning and that you need to get rid of any repetitive information.

4. Then, read the article titled 'Construction Failures' and draft Section Two: Reasons for Construction Failures of your report based on the guidelines provided in the 'Report Guideline' document.

Figure 24: Session Two Instructions

Students also wrote the first paragraph of the report body in this session so that they had a complete contextual framework in place prior to drafting the case studies for the report.

The students started working on the case studies in the third session and continued with this in the fourth session. The research questions for each of these sections were given to the students to help them maintain the subject-focus and find relevant information in the sources provided. They were asked to include tables and figures in certain sections to enhance this content. The primary aim of these sessions was to have students find relevant information in the sources provided and to formulate this information into a well-integrated and cohesive discussion. In this case, the session started with examples of good and bad quote-incorporation and examples of relevant and irrelevant information, which were discussed with the students. An overview of the tasks completed in this session is included in Figure 25.

Activity

1. Use the sources provided to draft the case studies section of your report in your planning document:
    - Foreshore Freeway
    - Grayston Bridge
    - Injaka Bridge

2. Once you are satisfied that you have responded adequately to this section and are happy with your draft, submit it to the submission link available under 'Assignment Submissions' by Friday, 28 May at 17h00.

Figure 25: Session Three and Four Instructions

Students made their first submission of the document after this session to ensure that they had stayed on track with the writing process.

The conclusion and recommendations were completed in the fifth session, along with guidelines on citing and referencing the sources. The steps on writing a cohesive, coherent, and complete conclusion with recommendations were provided by going through an example with the students. They then had time to complete this. Thereafter, the relevance of referencing was discussed and a demonstration of citing and referencing sources was provided; a recording of this class was released to the students for later reference as well. Figure 26 shows the activity completed in this session:

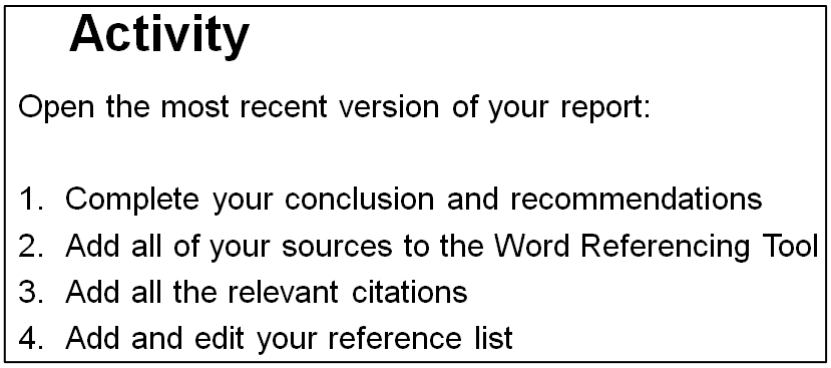


Figure 26: Session Five Instructions

By the end of session five, students had a complete draft of the report and this was brought to session six, which was dedicated to editing and reviewing the document. Here, the students completed a short online test on editing and reviewing. Then, they were given checklists to assist with the editing and reviewing process and had to work in pairs to edit and review their own and each other's work. Completed checklists were submitted with the final draft of the report. Along with these checklists, the students were required to run their drafts through Turnitin as a form of final review. Figure 27 is the activity completed in this session:

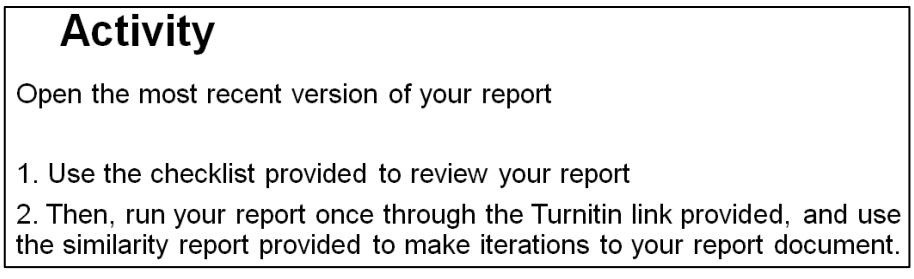


Figure 27: Session Six Instructions

This concluded the report writing intervention workshops, which focused on developing skills and practices that would help with structure, subject-focus, use and integration of sources, and overall coherence in particular. These skills were also

assessed within various different criteria on the grading rubric (see Appendix F), which was released to the students prior to their final submission. Lower-order skills were assessed under the criteria of 'composition' and this was included in each of the rubrics that followed. Extensive feedback was given and used as a springboard for continued development in these skill areas in the interventions offered in the second semester.

5.3.2. Findings of the Intervention

This set of workshops focused on the development of all higher-order skills and scaffolded these through activities that were interactive and that allowed students to learn, practise, apply, and refine the skills and practices that formed the particular focus of each session.

Based on the results of the previous writing assessment, particularly in relation to source integration and overall coherence, the assumption was that most students would not have been familiar with the style, structure, or writing requirements of a report. To confirm this, students were asked to comment on the following in their pre-writing reflection:

Have you read or written a report before?

Table 23 includes the spectrum of responses to this question:

Table 23: Third Reflection

Neither	Read	Written	Both	No answer	Total
73	5	6	9	11	104

As anticipated, a large number of the students (79%) who responded to the question had neither read nor written a report before. This indicates that most students were not familiar with this style of writing, especially within the engineering environment, and likely did not know what was expected from a document of this nature. One student commented that they "had not read an engineering report before" and that it is "not something [they] really knew about." Only 5% and 6% respectively had either read or written a report before, suggesting that their exposure was limited up until this point. A student commented that they had read parts of reports but that they did not "feel comfortable with writing a report of this nature" because they did not have "enough background in [the] specific discipline." This means that 90% of the students

who responded to the question would probably not know how to write a report with an engineering focus without some level of guidance and would benefit from the higher-order emphasis of the task. Just 10% of the students had both read and written reports before, but not all of these students felt proficient in their abilities with one commenting that although they had read and written reports before, they were “not fully confident in [their] reports yet.”

The sense of uncertainty in the task was apparent in the initial intervention workshops, as the students gave the impression that they were overwhelmed by the task. By pacing the expectations across six sessions, it was hoped that students would become more comfortable with what was expected of them.

In the first workshop, students found it difficult to articulate the problem statement and associated research questions. The few who offered responses to the activity questions were unsure and fairly general in their research questions and statements but after suggestions were offered, appeared to have a better understanding of the concept. This impression was called into question in the second workshop, however, when students were reluctant to respond to queries about the introduction. After both sessions, the lecturer/researcher wondered whether or not the approach that had been taken was effective in laying the foundations for focused, cohesive, and coherent writing.

The sessions that followed were more promising as students were guided in populating the case studies and incorporating figures and tables into their documents. There were few questions about these aspects and most students appeared comfortable completing the task. Later, students had several questions about citing and referencing in their work, but these were related to the technical aspects of referencing and not the purpose of referencing. In the final workshop, roughly half of the students left the session early indicating that they were either not yet ready to edit and review their work, wanted to do this in their own time, or were not interested in this aspect of the writing process.

After completing the report, the students were asked the following:

> Are you starting to think more about what and how you write?

Exactly half of the class failed to complete this reflection, but the responses for those who did are included in Table 24:

Table 24: Fourth Reflection

Definitely not	Not really	Somewhat	Very much	No answer	Total
2	0	0	50	52	104

Of those who responded to the reflection, 96% indicated that they had started to think more about what and how they write. Some students responded with one-word answers such as “definitely” and others wrote that they are more conscious about identifying “what is relevant and what [is] not” in their writing. This shows that approximately half of the class were becoming more critical and reflective of their writing. The remaining 4% of students indicated that they did not think more about what and how they wrote, with one stating that “they’ve always enjoyed writing and doing research.”

However, 50% of the students did not respond to the question. This might either be because they were already critical and reflective of their writing or it may indicate that these students were not critical and reflective of their writing and were reluctant to engage with the question. Irrespective of this, half of the cohort were becoming more conscious and reflective of their writing, and the other half either already felt that they were conscious and reflective of their writing or were uninterested in developing this skill further.

Students’ performance in the higher-order aspects targeted in the interventions was mixed (see Appendix G). The results for subject-focus and cohesion in the objectives aspect of the introduction supported the impression that students struggled to articulate these and identify appropriate research questions with 59% of the students performing poorly in this aspect of the task. However, the impression that students were comfortable developing their case studies was incorrect as approximately 55% of the students performed only moderately well in this aspect of the task.

The use and integration of sources and overall coherence improved from the previous task, with 60% of the students obtaining a good result for source integration and 76% of the students performing well in overall coherence. This suggests that the aim of addressing their use and integration of sources and structural development was achieved, but that the intervention was not successful at addressing subject-focus and the complexities that come with this.

The lower-order aspects of writing were neglected in this task and student results reflected this, with the class obtaining an average of 51% (see Appendix G). This is likely due to the fact that lower-order skills were not assessed individually, but were grouped into a category titled ‘composition’. This suggests that sentence structure remained a challenge for many and that other grammatical issues may have become more apparent in the longer and more formalised document.

These results indicate that the intervention was successful at addressing source integration and the structural development that impacts coherence and cohesion. However, subject-focus in a challenging and lengthy document, like a report, was difficult for the students to maintain and the intervention was unsuccessful at addressing this. Additionally, the results for lower-order skills indicated that the overall grammatical structure of the student reports was poor and was not adequately addressed.

5.3.2.1. Analysis of Student Work

This section includes the report samples for the low-performing, mid-performing, and high-performing students discussed in the previous task analysis. Figure 28 shows the report introduction written by the low-performing student.

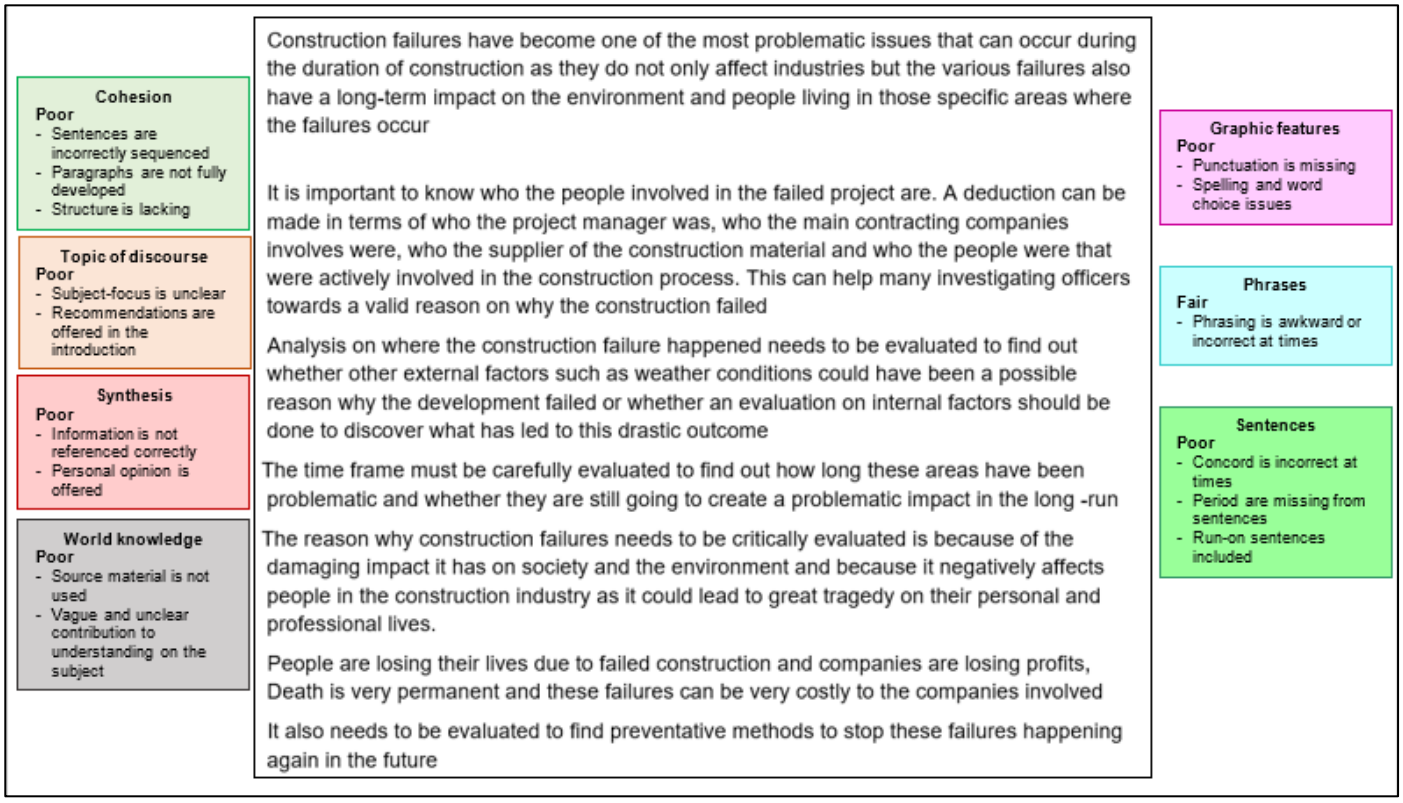


Figure 28: Low-performing Student Individual Report

In the intervention workshops it was stressed that an introduction should include background on the topic at hand, research objectives, and an overview of the details included in the document. Examples were provided and discussed in class, and students were given time to complete each section of the introduction and ask for feedback from the lecturer, assistant lecturers, or tutors.

This part of the intervention did not immediately benefit the low-performing student because they do not provide context for the report and instead makes generalisations regarding the topic of construction failures. The student also mistakes objectives for recommendations and offers suggestions as to how to resolve the issue of construction failures rather than a clear statement of the objectives of the report. Lastly, an overview is not provided. A cohesive and coherent introduction is not presented, in which the sentences follow a logical sequence, where the paragraphs are fully developed, or where the correct structure is applied.

Overall, the poor structure and cohesion in the introduction impact the remaining aspects of higher-order writing, because the subject-focus is unclear, there is no synthesis of information from the sources, and the student's knowledge on the subject matter is shown to be lacking. It is evident from this that a higher-order emphasis is not beneficial when a student does not have the vocabulary, context, or comprehension necessary to frame a written document. Even though the student attempts to respond to the 5 Ws, they do not have the schemas and discourse knowledge to do this effectively. This highlights a limitation of the process-writing approach, which does not address inadequacies in these aspects of discourse development.

In addition, problems with the lower-order competencies are reflected in this document, with poor punctuation, spelling, and choice of words throughout. Moreover, phrasing such as "… whether they are still going to create a problematic impact in the long-run" is also vague and ambiguous. A statement like this should be qualified as follows: "… whether problems could occur as a result of project halts in future." Sentence structure is also poor, subject-verb concord is often incorrect, and various run-on sentences are included.

This analysis indicates that the student showed little improvement in their lower- or higher-order competencies after the first two interventions. The student's writing indicates that this might be because they do not have the reading comprehension and

vocabulary necessary to understand how to provide context to the report, why this is necessary, or what it includes.

Figure 29 shows the introduction to the mid-performing student's individual report.

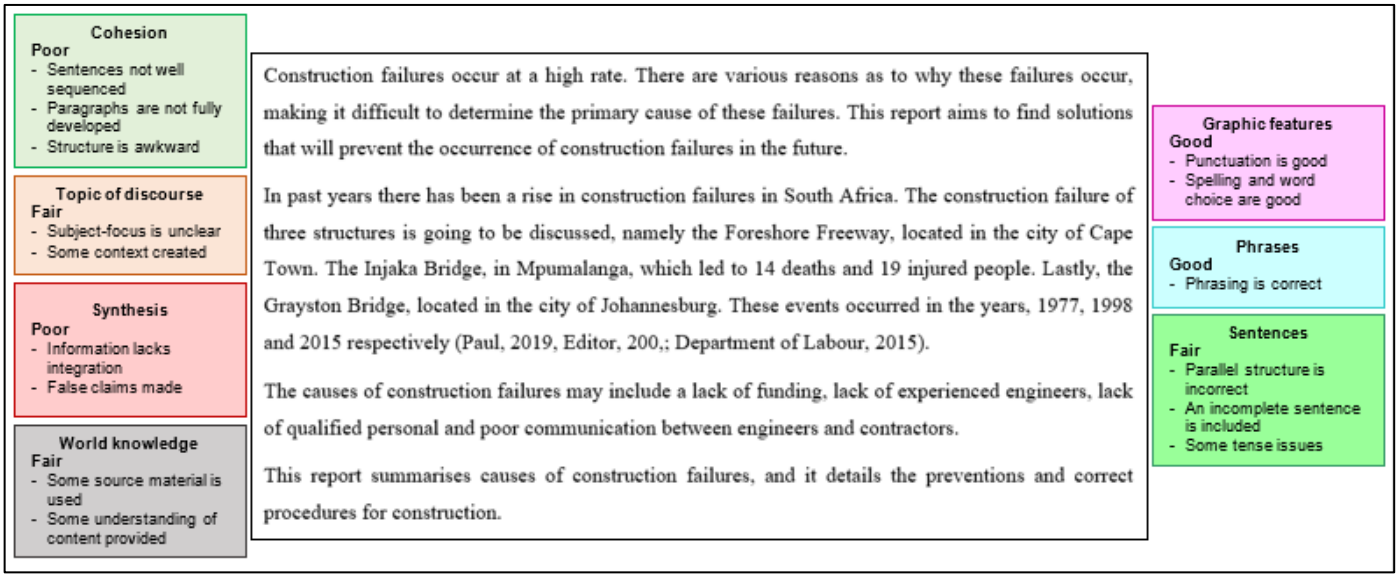


Figure 29: Mid-performing Student Individual Report

In the first paragraph, the student makes generalisations regarding the occurrence of construction failures and these are then followed by the aim, which is the incorrect structural formulation for an introduction. The student then includes some background, without qualifying the emphasis of the report. Further unnecessary information is included in the third paragraph, leading to an awkward paragraph layout. The lack of cohesion and coherence results in an unclear direction for the report, caused by poor information synthesis.

The student includes some relevant information but appears to be unsure of how to synthesise and filter it for a logical and structured introduction, possibly due to a misunderstanding of the report's aims. This is seen when the student refers to a rise in construction failures in general and follows this with mention of different aspects of the three case studies. The student does not clarify that the emphasis of the report is the three case studies and the causes and consequences of these failures. The student shifts between general (and false) information and specific (but confused) information, evidently uncertain of the intention of the information in the report. This may indicate that students were unclear about the subject-focus of the report.

The source integration aspect of the student's writing is well done, because some source material is used to introduce the case studies and this is cited. Nevertheless,

the student struggles with the cohesion, coherence, and synthesis of this information. This shows that the student did not make an improvement in the coherence and synthesis aspects of higher-order skills development despite the intervention and that this lack of improvement impacts other skill areas when writing tasks become more challenging. This may be related to insufficient textual models and guidance in the higher-order intervention workshops.

The student's lower-order skills show an improvement from the previous task. The student generally uses punctuation correctly, except when listing information, and their spelling and choice of words are correct. Sentences are also constructed correctly, except when information is listed. This could mean that the student used the workshops dedicated to editing and reviewing as intended and used the support structures available to make these corrections.

Overall, the interventions appeared to be unsuccessful at helping the student to improve their coherence and synthesis, which led to further writing issues. This could be addressed through practise and by providing better guidance in establishing the report aims and objectives, opportunities for textual analysis, and a clear structural outline that students can follow.

The high-performing student's introduction to the Individual Report is included in Figure 30.

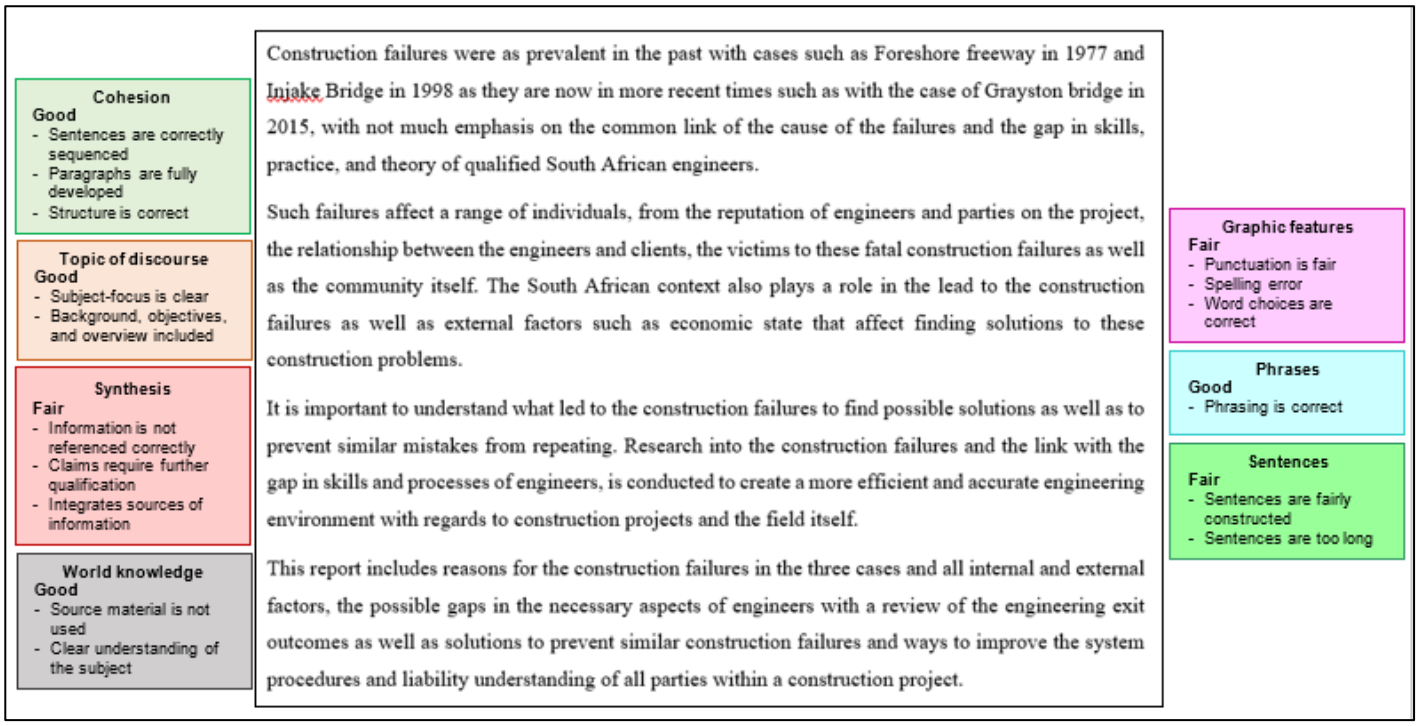


Figure 30: High-performing Student Individual Report

The student presents a coherent introduction by starting with the background and context, moving to the objectives, and concluding with the overview. Each paragraph flows into the next, creating a framework for the remainder of the document. The topic of discourse is clear from the outset and each of the three case studies are mentioned early on to maintain the subject-focus. Furthermore, source material is used to inform the introduction and the student displays a clear understanding of the topic. However, the student does not cite their information, which is flagged for plagiarism, and makes claims that are general and require further qualification and support. For example, the student says “Construction failures were as prevalent in the past… as they are now…”. This claim and others are not supported by the literature. Many students make similar claims and it appears as if they still need to learn to focus on the topic and not to inflate their claims in academic writing.

Lower-order skills are well presented in this task. However, the student makes a spelling error early on with “Injake” rather than “Injaka”, and includes multiple paragraph-long sentences. These errors may be linked to coherence, but do not disrupt the flow of the discussion and do not alter its meaning.

The student presents a good introduction that shows that they have understood what is required and that they can present it in a cohesive, logical, and focused manner. The student still needs to learn how to cite information correctly and to break the habit

of exaggerating information and making generalisations, but maintains good writing competencies for the most part.

The samples indicate that the low-performing student did not benefit from the interventions, presenting an unstructured and confused introduction. However, the mid-performing and high-performing students were able to present more informed introductions, but demonstrated the same issue with subject-focus prevalent in the findings.

5.4. THIRD WRITING INTERVENTION

At the end of the first semester, the lecturer/researcher presented three intervention workshops titled ‘Analytical Reading and Writing’. These workshops were designed to focus on higher-order reading and writing skills, so that students had a clear understanding of the relationship between the different sets of skills. After the previous intervention, it was decided that the aim would be to help students to use and integrate sources of information in order to develop a discussion or argument that had a clear subject-focus. This meant that four higher-order skills formed the focus of the intervention: use of and contribution to the literature, structural development, subject-focus, and source integration.

In these sessions, process-writing was used as a tool to encourage students to focus on different aspects of their writing. Each session was designed to look at a specific part of the process, so that the relevance of each phase would be clear and students would have time to think about each step. The goal was to get students to produce an essay on the topic provided, but this was used for practise and not for assessment purposes.

In the first session, the lecturer/researcher revised the relevance of research questions and introduced the theme of ‘Unusual Building Design’. Thereafter, the students were given four sources and time to skim and scan these sources in order to formulate research questions for themselves. Students were encouraged to share their research questions and some examples were provided. The lecturer/researcher encouraged students to restrict themselves to their own research questions and not to use the examples provided. This was done to allow students to be more independent in their learning and to be creative in their approach to the problem. Once this was done, text

mapping[30] was introduced as a reading technique that could help students to find and establish relevant information for their practise essays. At the end of the session, students were asked to develop a detailed mind map or writing plan, and were given time to do this.

The second session focused on using the detailed planning to form an essay structure and first draft. At the start of the session, discussion was prompted by asking students to share their research questions and to give an indication of the information that could be used to develop responses to these questions. A limited number of students responded to this, but those who did presented interesting questions and offered useful and valid support for their essay discussions. After this, there was time to go through an example of a research question and an example of an appropriate plan for an essay with that focus. Finally, an outline of an appropriate essay structure was provided and explained, and students were then given time to draft their own essays using a similar structure. Prior to starting their drafts, the students completed a freewriting exercise so that they were prepared for the writing stage of the assessment.

The final intervention workshop looked at the differences between summarised and synthesised essays, and detailed examples were used to demonstrate this discrepancy. Then, the students were told to look at their drafts and establish if they thought they required better information synthesis. A checklist of questions related to the structure and content of their essays was given and students were divided into groups to review each other's work. The remainder of the session was dedicated to this task and to completing a final writing reflection.

The assessment for this series of workshops was done at the start of the second semester when the approach changed from individual workshops that focused on specific content to facilitated learning through projects. This was done to give students time in class to complete the activity, with the lecturer offering guidelines regarding the amount of time that should be dedicated to each phase of the writing process, and to assess whether or not the students applied the skills and practices outlined in the 'Analytical Reading and Writing' workshops.

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[30] 'Text mapping' is a visualization technique used in reading comprehension to help students to remember salient features of a text (Lapp, Fisher & Johnson, 2010:424).

5.4.1. Opinion Piece Instructions

The class started with a summary of the skills covered in the 'Analytical Reading and Writing' workshops. This then led to the topic introduction and factors that should be taken into consideration when formulating an educated opinion. Following this, the students were given the question 'What is better for the environment? An internal combustion engine or an electric motor?' together with six sources that they could use to formulate their arguments. They were also given time to skim and scan these sources. Thereafter, they completed a short online reading comprehension test on these sources to ensure that they had a grasp of the subject-matter. Time was then dedicated to having students prepare for the written component of the assignment by carrying out a reflection and a freewriting task. This was followed by the planning phase, the drafting phase, and the editing and reviewing phase.

Once students started with the planning, drafting, and reviewing, they received the instructions in Figure 31.

Activity:

1. Open a Word document (JPO styles menu) and insert a table that you will use to unpack information from **three of the sources provided**. These sources will assist you with formulating an argument as to what is better for the environment. You need to refine the scope of the topic by posing research questions. Use a table to map your sources and draw a **comparison** between the claims made in the three sources you elect to use. The table will function as your planning for this exercise.

2. Once you have completed the first step, write a short essay (**300 - 400 words/two-thirds of a page to a full page**) in which you express your educated opinion. You must provide at least **two** references that support and/or refute (challenge) your perspective — remember to cite your sources and make a list of your references.

Figure 31: Opinion Piece Instructions

Limited class time was dedicated to this activity and students were required to work under pressure to complete the different phases of the writing process, but this was done deliberately in order to instil the practice of dedicating time to the writing process and not neglecting important phases under pressure.

Once the process was underway, students prioritised the higher-order aspects of their writing by paying attention to sentence, paragraph, and essay structure, using and integrating sources of information, and maintaining the subject-focus. This was done through the assignment instructions that emphasised planning and the use of sources

(both of which impact sentence, paragraph, and essay structure), and source incorporation. As with the individual report, the rubric was also provided beforehand and this prioritised higher-order writing skills (see Appendix H).

5.4.2. Findings of the Intervention

After the 'Analytical Reading and Writing' workshops, the students were asked to complete a reflection on their writing development in the first semester. In this reflection, students were asked:

> Do you feel more competent when it comes to writing formal documents?

This was asked to give students a chance to think about the skills and practices they had learnt throughout the semester. Table 25 includes the results for this reflection:

Table 25: Fifth Reflection

Definitely not	Not really	Somewhat	Very much	No answer	Total
1	3	6	44	50	104

In this case, 48% of the class failed to respond to the question, possibly as a result of poor class attendance at the end of the semester and a lack of involvement in the final series of workshops. This is representative of the negative impact of fully online teaching and learning during the Covid-19 pandemic where many students could not (or did not) participate in their studies for various reasons, including access to technology, socioeconomic factors, home environment, or psychological and emotional factors (Mthethwa & Luthuli, 2021:96-97). Of those who did respond to the question, 93% indicated that they either felt much more or somewhat more competent in their formal writing. One student stated that they were "somewhat [more] aware of what a formal piece entails and this makes [them] feel more competent." Another mentioned that they "feel a bit more competent and that [they] will improve as [they] do more formal writing pieces."

The remaining 7% of respondents did not feel that they were more competent in their formal writing development, because "there is still room for improvement" and they "need to work on [their] writing skills". None of the responses indicated that the students felt as if the interventions were inadequate or unhelpful, but rather that they felt as if their writing skills needed to improve and that they needed more practise in

this regard. This indicates that 52% of the class felt that they had learnt from the writing interventions and were thinking more about their development in this regard.

The opinion piece was completed after the library training, toward the beginning of the second semester, discussed in the previous chapter (4.3.2.), and was used to assess the skills taught in the 'Analytical Reading and Writing' workshops. Class attendance and student involvement were generally poor in the intervention workshops, with the result that some did not have this background in place prior to completing the assessment. However, those who did participate in the workshops applied the process and had a good grasp of the intention of the intervention. When it came to the assignment, 91% of the class completed the task, but the results were not very good and the class average was 53%, which is possibly a direct result of poor class attendance in the intervention workshops.

Before writing the opinion piece, students were asked to reflect on the following:

Historically, have you used external sources to inform your opinions?

This was asked to gauge whether or not students were becoming more comfortable with the use of sources, or if they had developed the habit of reviewing multiple sources prior to making a claim. This was the first time that students were required to contribute to the literature on a particular subject, so they may not yet have understood that an opinion needs to be well-informed by literature on the subject. Table 26 includes the responses to this question:

Table 26: Sixth Reflection

Definitely not	Not really	Somewhat	Very much	No answer	Total
13	1	3	64	23	104

A total of 79% of the students who responded to the question indicated that they typically used sources to inform their opinions, meaning that this was not a new habit that they felt they needed to form. A few students commented that they did this to have "wider insight o[n] the topic at hand" and to develop "context in [their] studies". Of the remaining students, 16% stated that they did not use sources to inform their opinions. None of these students offered a reason as to why. In total, 22% of the class did not respond to the question and it is unclear how these students would have responded to the question.

These responses suggest that most students would not have found the 'use of and contribution to the literature' aspect of the task too challenging and that those who did not typically use sources to inform their opinions would benefit from this exposure and practice.

Subject-focus was the area in which students had performed most poorly in the previous assessment and, as a result, emphasis was placed on this in the intervention. In this case, 43% of the class did well in this category, maintaining a strong subject-focus, and a further 40% performed moderately well. This shows that students had a better grasp of research questions and the intention thereof and used these to guide their writing. However, the source integration and 'use of and contribution to the literature' aspects of the task showed a decline in results, with just 49% of the class performing moderately well or well in this category. This could suggest that the process outlined in the intervention did not adequately address these skills, that continued reinforcement was required, and that students found it difficult to contribute meaningfully to literature on a particular topic. However, it is difficult to establish exact reasons for this due to poor attendance in the intervention workshops.

The emphasis on structural development resulted in an average grade consistent with that of the previous task with 75% of the class presenting coherent essays that followed a logical and cohesive structure. This shows that the continued reinforcement of structural development may have had a positive impact on student writing. This also seemed to have a good impact on the argumentation aspect of the task, with 83% of the class performing moderately well or well in this category. See Appendix I for an overview of these results.

While the intervention was not designed to address lower-order skills directly, it was hoped that the editing and reviewing aspect of the process would lead to improvements in this category. In total, 76% of the class obtained a grade of 60% or higher for this component (see Appendix I). This shows that there was some improvement in the students' composition, which may be attributable to either the intervention or to continued writing practise and feedback.

Overall, it was difficult to establish with much precision how strong the link was between the results and the interventions, but it was evident that continued reinforcement of each of the different higher-order skills was required for there to be improvements in these aspects of the students' writing. Additionally, further

enhancements within the process-writing approach, such as exposure to different modes of expression, may help to develop conceptual and discourse understanding and ultimately improve higher-order writing skills.

5.4.2.1. Analysis of Student Work

Students were asked to formulate an argument as to whether or not internal combustion engines or electric motors are better for the environment, and to base this argument on contextual factors, such as local power supply issues. Figure 32 shows the low-performing student's conclusion to their opinion piece.

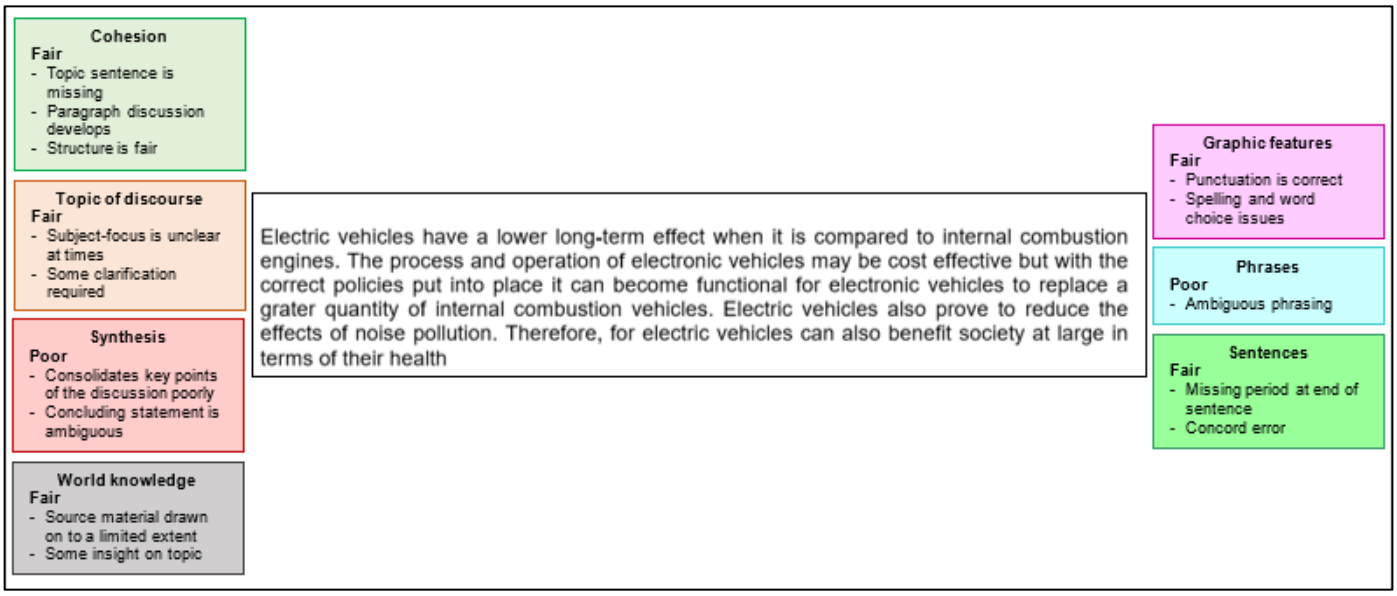

Figure 32: Low-performing Student Opinion Piece

In the conclusion, key points in the discussion need to be reiterated and a clear statement in response to the research question needs to be made. By this time, students had received feedback on the report and had completed an example essay.

In this sample, the paragraph develops as the student states the less problematic long-term effect of electric motors on the environment and explains why this is the case. The student also concludes with a final claim that shows their position on the topic. However, the subject-focus is not always clear and some of the claims contradict one another, suggesting errors in synthesis. An example of this is "… electronic vehicles may be cost effective but with the correct policies put in place it can become functional for electronic vehicles to replace a gr[e]ater quantity of internal combustion vehicles." The student states that electric vehicles are more cost effective but the context of this statement suggests that electric vehicles are more costly than internal combustion

engines. This error could, however, be related to persisting productive vocabulary problems which may also be linked to receptive vocabulary problems in reading.

Although there are errors in formulation, the student draws from sources of information to formulate their opinion and develops insight on the topic. This is an improvement from the previous submission where the student was unable to develop a cohesive and focused introduction.

The student's lower-order competencies remain a problem, particularly in relation to their choice of words and phrasing. Choice of word errors, such as the example mentioned previously, impact the discussion, and phrasing like "lower long-term effect" creates the impression of uncertainty regarding the material.

Generally, the student shows that they have comprehended the topic of discourse and expresses an opinion on the subject-matter, which is an improvement on the previous task. This could be linked to the regular writing practise and emphasis on the higher-order aspects of writing. However, persisting lower-order writing issues indicate that some attention needs to be placed on these aspects of the writing for more consistent improvements.

A sample of the mid-performing student's conclusion is included in Figure 33.

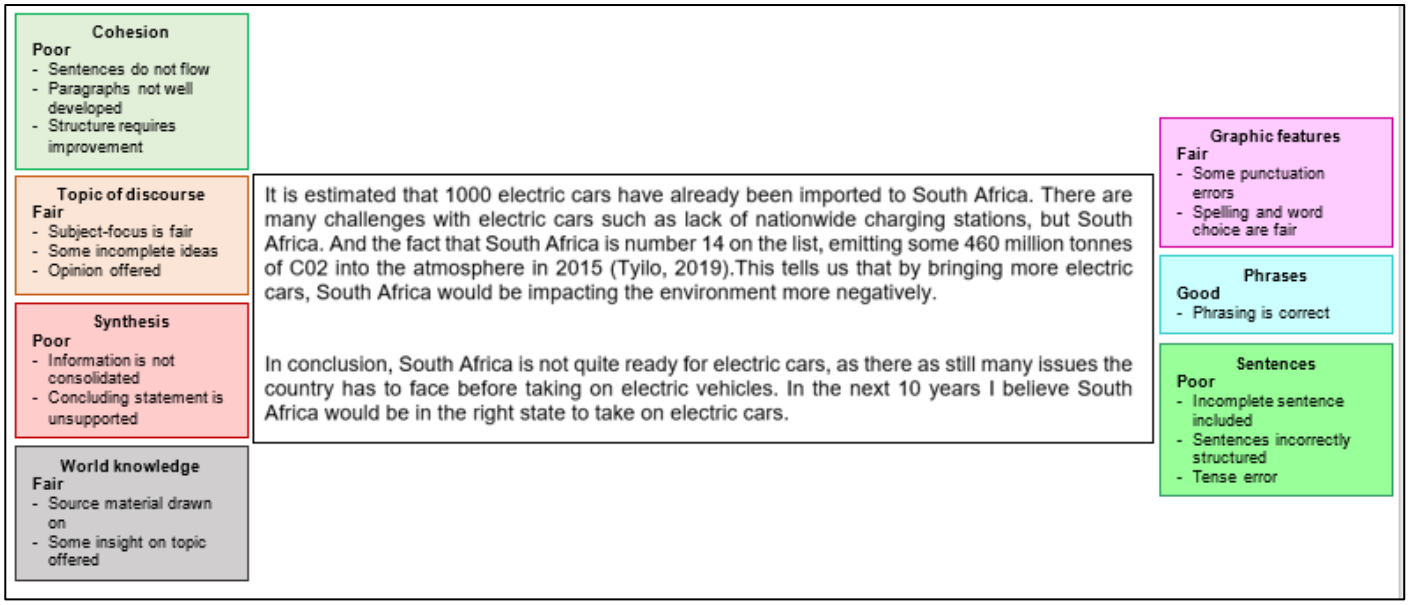

Figure 33: Mid-performing Student Opinion Piece

The student has difficulty with the cohesion, coherence, and synthesis of information, suggesting that the interventions have not yet been successful at addressing these areas of need. In the first paragraph, the student's discussion lacks focus. The student

discusses electric vehicles in South Africa, but includes information without synthesising it and showing its interconnectedness. The student then starts their conclusion and states that they do not think South Africa is ready for electric vehicles. This is a fair statement based on inferences from the first paragraph, but the student does not present an explicit enough argument to justify their opinion.

The topic of discourse and world knowledge aspects of higher-order writing are portrayed satisfactorily. The student focuses on electric vehicles but does not mention internal combustion engines in the conclusion; however, they offer a clear opinion which indicates some level of subject-focus. Additionally, the student draws on resources to inform their discussion and shows a level of understanding of the subject matter, but the lack of cohesion, coherence, and synthesis negatively impacts the overall impression of the student's understanding of the information.

Lower-order skills are inconsistently applied to this task, with typing errors, sentence construction errors, and tense errors apparent in the student's work. This indicates that inadequate time was provided for editing and reviewing, or that the student did not take the time to do this.

The writing errors apparent in the previous task were the same errors that came to the fore in this task, indicating that there was insufficient emphasis on cohesion, coherence and synthesis in the workshops and that more support in this area is required.

The higher performing student's conclusion to the opinion piece appears in Figure 34.

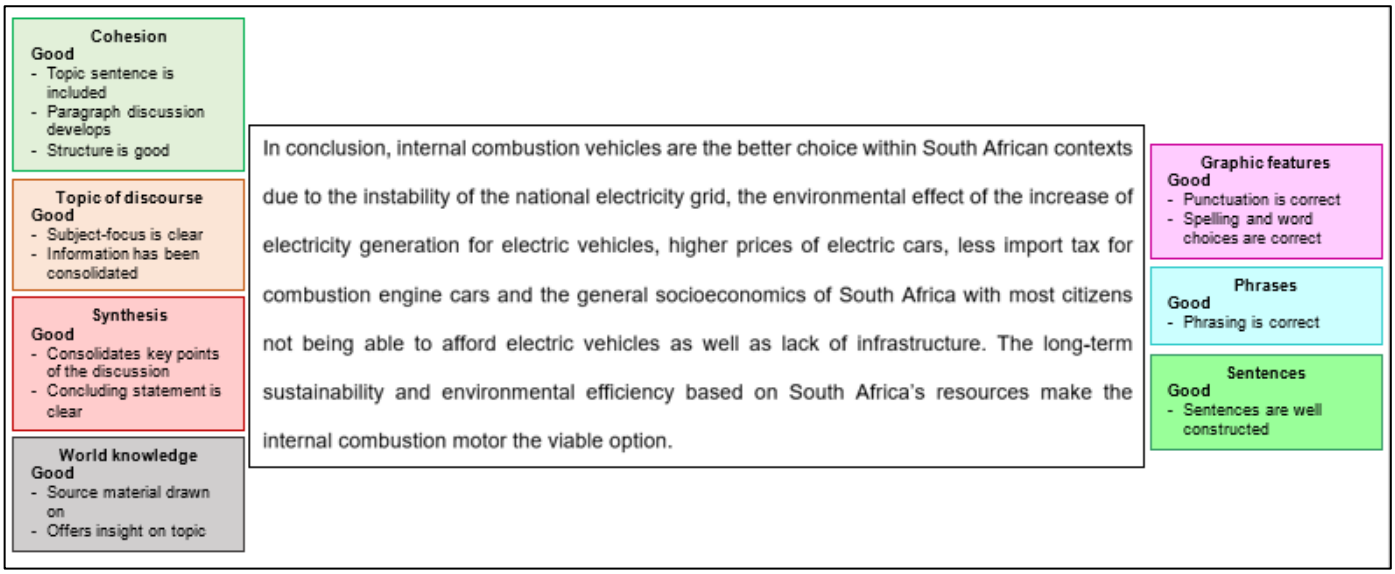

Figure 34: High-performing Student Opinion Piece

The student presents a very good conclusion to the opinion piece, performing well in all aspects of their higher- and lower-order skills. The student starts with a clear topic sentence listing the key findings from the body of the argument, and concludes their discussion with a final statement of their opinion. This shows good cohesion and development, resulting in a coherent overall discussion.

The student also maintains the topic of discourse and does not deviate from the proposed research question. This positively impacts synthesis, as the student sticks to the key findings and presents a firm statement on which motor they feel is better for the environment given the current South African context. On this occasion, the student does not inflate the information or generalise; they stick to the information presented and formulate an opinion based on this. This demonstrates maturity in this regard. Moreover, the student draws on sources to formulate their opinion and offers good insight on the topic.

The student's lower-order skills also improve. The student applies graphic features effectively, phrases their work correctly, and includes well-constructed sentences. Some aspects of their construction can improve by having them simplify their sentences, but this generally comes with time and as students grow more comfortable with and confident in their academic voices.

Improvements to lower- and higher-order competencies are evident in this submission. This is possibly due to the feedback provided in previous assignments and the student

having become more comfortable with the writing expectations outlined in the intervention workshops.

The intervention appeared to be reasonably successful at showing the students how to get and maintain their subject-focus and the continued writing practise led to some improvements in the application of lower-order skills. Students performed well in the structural development aspect of their writing, but source integration and the association of using literature to contribute to a subject remained areas for improvement. These results are not as clear-cut in the writing samples, as the low-performing student continued to obtain poor standards in all aspects of the writing and the mid-performing student performed inconsistently across the different higher-order skill areas.

5.5. FINAL WRITING INTERVENTION

The individual literature review workshops concluded the higher-order interventions for the year. A literature review is typically a report where higher-order skills come to the fore because it describes, synthesises, evaluates, and clarifies information on a particular subject (Creswell, 2012:80). This means that all higher-order skills formed the focus of this intervention because students were guided in conducting research, using and contributing to a body of literature, developing a logical and structured literature review, and focusing on a particular subject-area. By the end of these sessions, students were required to have completed a section of a literature review for their team's GoGreen project[31].

The library training that took place at the start of the semester served as a reference point for these interventions. In this training, the students received guidance on how to navigate the university's library website and online databases. This was a useful starting point because students were required to conduct their own research for the first time in order to complete the required writing task. Both textual analysis and process-writing were used as the teaching strategies that guided the intervention.

The first session was used to introduce students to the concept of a literature review and to the research question they were required to respond to. After looking at the

[31] The GoGreen project took place in the third quarter of the year and required students to work in teams of four to produce a product or game using a recyclable material.

research question, some keywords were identified and used to ensure that the scope of the review was clear to each student. Thereafter, the lecturer/researcher discussed what constitutes legitimate, valid, and relevant sources of information and provided a list of ‘dos and don’ts’ when writing a literature review. Finally, the session concluded with a reminder of how to write an introduction, body, and conclusion, as well as how to use the Harvard referencing system. This allowed for students to conduct their research and plan their writing in the remaining class time.

In the second session, students were given time to plan and draft their literature reviews. It was important to give them the chance to discuss their research findings and progress with their teammates to ensure that the team maintained their subject-focus and writing objectives. At different stages in the workshop, the lecturer/researcher gave students an indication of where they should be in terms of the writing process.

The final session was used to focus on the structural aspects of writing. Here, the funnelling approach to constructing a focused literature review was discussed and the structure of the review was reinforced. Textual analysis of an example of a literature review was then done to bring attention to the voice, tone, subject-focus, research integration, and structure of a successful literature review. Finally, students were given time to edit and review their documents with their teammates.

These sessions consolidated the skills and practices that were introduced in previous intervention workshops and was used to demonstrate how these are applicable to writing tasks that differ in expectation.

5.5.1. Individual Literature Review Instructions

Each member of a team of four completed a section of a literature review in this task. To help with this process, the review was scaffolded into four categories for each member to address. That is, the review focused on the impact of the team’s chosen product on global warming internationally, in Africa, in South Africa, and in the local community, and each member was responsible for one of these perspectives. Figure 35 includes the instructions that were given to students:

Activity:

1. Identify the perspective you will be researching for your team (global warming, international, African, or national).
2. Find five reputable and varied sources (one must come from Knovel) to inform your individual literature review.
3. Complete your individual literature review in a JPO styles menu (include the relevant header and footer). Your individual literature review should be approximately 500-600 words.
4. Include figures and tables if they enhance your discussion (optional).

Figure 35: Literature Review Instructions

Each section of the literature review was then combined into a full literature review in a proposal document. This gave teammates incentive to assist each other as they worked through the writing process, ultimately assisting with the formation of a discourse community. See Appendix J for the rubric that was used to assess the students.

5.5.2. Findings of the Intervention

Student participation in the workshops improved in this intervention, possibly due to the teamwork component of the assignment. This meant that the lecturer/researcher found the students to be more responsive and involved in the classes. Additionally, the assistant lecturer and tutors commented that more students had approached them for guidance in completing this assessment. This positive impression was supported by the results which indicated that the students' application of the higher-order skills required to complete the assessment was generally good, resulting in a class average of 64% for their higher-order skills (see Appendix K).

After completing the assignment, students were asked to reflect on the following:

> Have you noticed any progress in your academic writing since the start of the first semester?

This question was asked to get an idea of how the students perceived their writing development through the course of the interventions. The results for this reflection question are included in Table 27:

Table 27: Seventh Reflection

Definitely not	Not really	Somewhat	Very much	No answer	Total
0	0	1	74	39	104

Of the 75 who responded to the question, 99% indicated that they felt that they had progressed a lot in their writing. One student stated that they "thought that [their] writing skills were pretty good until [they] started this class" and now they feel that their writing skills "are better" and a "reflection [their] of intelligence." Another stated that they "have made impressive progress in regards to [their] academic writing" and that they "have a better understanding of what it means to summarise, synthesise, analyse, and critique [their] essays and those of [their] peers." A third student indicated that they felt their writing pieces were "much more organised." These responses are all indicative of an improved awareness of the skills and practices required for good academic writing. This shows that the cognitive processes reinforced in the process-writing model were being moved from working memory into long-term memory, and that the motivation and affective factors required for this to happen were in place for these students.

The remaining 1% noticed a fair amount of progress in their writing, but still felt that they had a lot to learn. This student stated that they "were not really looking forward to JPO 110 as [they] did not realise the importance of being able to write academic reports, etc." They felt that "there was some progress in [their] writing, although [they] still need a lot of work." While this student does not express that they have made a lot of progress, they acknowledge the skill and effort required for good academic writing to take place. This indicates that the scaffolded curriculum falls appropriately within the ZPD for the majority of students within the class, providing adequate developmental opportunities.

A total of 28% of the class failed to respond to the question. There are various possible reasons for this, which could be linked to the limitations on teaching and learning during the Covid-19 pandemic noted previously, or to the reluctance of students to note progress in their writing. This might be because they already felt well equipped to complete the required writing tasks or that they felt they had made no progress and were having difficulty in this regard.

The positive response by 72% of the class to the reflection was represented across all of aspects of the higher-order results in the assessment. Source integration and

'use of and contribution to the literature', in which student performance had been inconsistent throughout the year, saw 50% of the class performing well and a remaining 24% performing moderately even though this was the first time that students were required to conduct their own research. This improvement from the Opinion Piece could be linked to the intervention, feedback, or teamwork aspect of the task.

Student performance was consistent with the performance in the Opinion Piece in each of the remaining categories: subject-focus, structure, and coherence, showing a 1% to 2% discrepancy in each result. Students generally did not seem to have major problems in these areas previously and the final intervention did not appear to have had any impact on these results. See Appendix K for an overview of these results.

Student performance in lower-order skills was 12% lower than the performance for higher-order skills, showing that lower-order skills remained consistent with the average result of 54% obtained in the Opinion Piece – see Appendix K. This indicates that the editing phase of the writing process was insufficient to result in improvements in these skills and that not enough attention had been given to this aspect of student writing.

5.5.2.1. Analysis of Student Work

In the literature review the students needed to discuss the impact of their chosen material, e.g., plastic, on the environment within their particular context, e.g., South Africa. Figure 36 is a sample of the body of the literature review for the low-performing student.

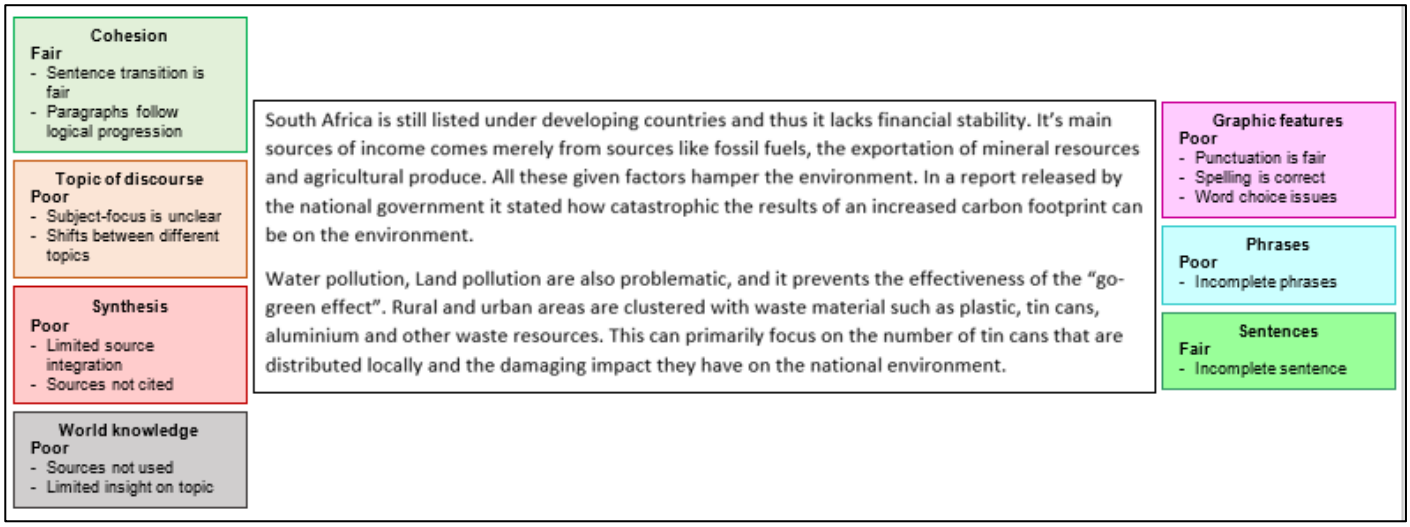

Figure 36: Low-performing Student Individual Literature Review

The student makes it clear that the context they are focusing on is South Africa, but does not clarify which material is being discussed. This results in an unfocused review from the outset. In the first paragraph, the student discusses South Africa's economy and its primary sources of income, but this is unrelated to the intended subject-focus. The second paragraph focuses on waste materials but, again, this is general and unrelated to the topic at hand.

The development from one paragraph to the next shows a level of cohesion and coherence as the paragraphs become more focused, but the topic of discussion is unclear and the student shifts between many different perspectives to get to their subject area. The student does not show that they have synthesised information from different sources to formulate the literature review, which also reflects a limited understanding of the intension of the review. This lack of focus indicates that the student either did not use the research question to help them generate the review or did not understand what was expected of them. This is related to previous deficiencies noted in the student's reading and writing.

Lower-order skills have improved from the previous assessments with there being fewer punctuation and sentence errors and no spelling mistakes. This could be due to peer involvement in reviewing the task. This improvement is not seen in their choice of words, which was frequently inappropriate in the discussion. Some phrases are also left incomplete, leading to incomplete ideas and discussion points.

The problems noted in the student's writing are still related to vocabulary, context creation, and comprehension. Although the student showed an improvement in their higher-order skills in the previous assignment, the expectation that students find their own sources of information may have led to overwhelming content and challenges in filtering information for the review. This indicates that closer guidance on how to filter information for the purposes of a review is required.

The mid-performing student was required to focus on the environmental impact of plastic in Africa in their individual literature review. A sample of the body of the literature review is included in Figure 37.

Figure 37: Mid-performing Student Individual Literature Review

The student shows an improvement in their cohesion and synthesis in this task, possibly indicating that the interventions and feedback on prior tasks were starting to have a positive impact on the student's writing. The student comments first on plastic recycling in Africa and then looks at a more specific example related to the Democratic Republic of Congo. Within each of these paragraphs, the student maintains the focus of the discussion and ensures that each has a specific intention. Sentence order within the paragraphs lacks cohesion and coherence at times, but the student keeps their focus despite this.

In both paragraphs, the student makes inferences based on their sourced information, such as "Approximately 1 million children pick bottles up every single day for recycling in Africa. Therefore approximately 2 billion plastic bottles are recycled every single day…". The student makes the second claim based on the information in the first sentence, which leads to a more powerful statement on recycling. This shows that there is a fair amount of synthesis; however, the inclusion of only one source per paragraph results in a relatively unsupported discussion.

Throughout the body of the literature review, the student maintains a clear subject-focus, uses sources to inform their discussion, and offers insight on the topic. This demonstrates an overall improvement in the higher-order aspects of the student's writing, which could be due to the interventions that focus on these aspects of writing and feedback offered throughout the year.

Lower-order skills improve slightly in this task. Punctuation and spelling are fair for the most part, but there are small errors around the use of commas. Phrasing is still good,

but sentence construction and the use of conjunctions is problematic at times. Generally, however, the student shows an improvement in most aspects of their writing, indicating that they participated in the workshops and followed the writing process outlined.

Figure 38 includes the high-performing student's individual literature review.

Figure 38: High-performing Student Individual Literature Review

The higher-order aspects of the student's individual literature review are well presented in this submission. The student maintains coherence in their writing by presenting a logical and clear discussion on the initiatives taking place to recycle plastic in the South African context to curb the negative environmental impact. The strong focus on the topic of discourse results in a clear and concise review of the initiatives, without deviating from the context. Additionally, sources are integrated and offer good insight into the subject-matter. The student focuses on a different topic per paragraph and draws different sources on the topic together to formulate each discussion point. This shows a good level of insight and understanding of the topic.

The student presents their information similarly to how they had previously, which means that some sentences are awkwardly constructed, particularly where sources are cited. This could be due to a lack of familiarity with citing in text and incorporating information.

Overall, the student presents a very good review that displays strong application of higher- and lower-order skills. The student still needs to learn how to cite sources correctly, which indicates that this is an area that requires further improvement.

The results in these samples show that the low-performing student made limited progress in their writing in the final intervention. This is possibly linked to the poor reading and writing foundations noted at the start of the year. The mid-performing student shows an improvement in their higher-order skills and the high-performing student shows consistently good application of these skills. This, along with the findings noted previously, suggests that the final intervention resulted in improved source integration but that there were few other notable improvements.

5.6. FINAL ASSESSMENT OF INTERVENTIONS

Two writing assessments were given to the students after the interventions at the end of the second semester. These were a final individual report and a team report. The application of higher-order skills after the series of interventions was assessed to see if students applied the skills and practices they had been taught throughout the year to these tasks without outside assistance. These assessments are discussed in further detail in the sub-sections that follow.

5.6.1. Final Individual Report

The final individual report was completed in a three-and-a-half-hour test session toward the end of the second semester. Each student completed the test on a computer at home, under strict time constraints in order to restrict external involvement as much as possible. By this stage, students had completed all four interventions, along with the associated assessments, and they had received feedback on these assessments. Each intervention had focused on one or more higher-order skills and the feedback on these assessments was used to help students improve in the areas in which they experienced the most challenges. The assessments that had been completed in the interventions were diverse and included academic and reflective essays, an individual report, an opinion piece, and a literature review. Outside of the interventions, students had also completed a proposal and a combined team literature review.

The final individual report was closely guided and sources were provided, even though students had received training on how to complete the required steps and research processes independently. This was because students were assessed on their ability to structure a formal report, use sources to support their discussion and consolidate

information, and maintain the subject-focus, which could not be done in the limited time available if research still needed to be conducted.

5.6.2. Final Individual Report Instructions

The test started with a reading comprehension exercise, based on the three reading pieces provided. This was done to encourage students to skim and scan the documents (as defined in the previous chapter, under 4.3.1.) and to start gathering information for the report writing section of the test.

Once students had completed this, and had gathered the necessary information, they were given written guidelines for setting up the report and incorporating information into it. The following details were given to them. (See Appendix L for a copy of the test paper):

- Topic and main research question
- Breakdown of the required structure
- Research sub-questions
- Images that could be used as figures

These parameters were measured in different categories on a rubric like those used in previous assessments (see Appendix M). Students were not given access to this rubric beforehand as a result of the test writing conditions. All the higher-order skills taught and reinforced throughout the year were assessed, that is: cohesion and resulting coherence, structural development, using and sourcing information, and maintaining subject-focus. A lower-order rubric criterion was included as ‘composition’, which matched that of previous assessments.

To prepare for this test, students had been given detailed feedback on all writing assessments thus far and had access to class recordings. Students could also arrange a consultation session if they had specific questions or areas of need.

5.6.3. Findings of the Assessment

This assessment was completed as a test, which meant that time was limited. This led to a class average of 46%, which was a significant drop from the averages recorded previously — see Appendix N. This drop was most notable in the higher-order components of the task.

When reviewing the results for the different higher-order components, it became clear that many students achieved moderate grades across these categories. This might be a consequence of the time restriction which did not allow for the iterative back-and-forth required for the successful application of the process for academic writing.

Subject-focus was measured across six different rubric criteria, each focused on a different section of the report. These were: introduction, case study one, case study two, comparison, supporting figures and tables, and conclusion. Student performance within each of the first three sections (introduction, case study one, and case study two) was consistent with approximately 74% of students achieving moderate to good results. This suggests that students worked on the document from top to bottom resulting in more time to complete these sections. It also suggests that the writing expectations were fair and matched those of previous assessments. However, performance deteriorated in the second three sections (comparison, supporting figures and tables, and conclusion) as 68% of the class obtained results that were poor in these sections. These results can be attributed to the challenge of consolidating information in a limited amount of time as these sections were largely incomplete and showed poor information synthesis.

Student performance in the structure, coherence, and source integration components was inconsistent, with the results spread unevenly across the rubric categories. Structure and coherence saw 77% of the class obtaining moderate results and the rest of the class falling on either side of this, and source integration saw 58% of the class obtaining moderate results, with the rest of the class falling primarily below this. (see Appendix N for more information). This is also likely a consequence of the time pressure experienced and an inability to finalise each of the required writing components.

In reviewing the results, it became clear that students could not be fairly assessed on their higher-order writing skills in such limited time.

Students' lower-order skills performance was consistent with that of previous tasks as the class average was 51%. This suggests that the interventions and time restrictions had very little impact on these skills (see Appendix N), and that students probably did not make the effort to edit their work in either this or previous tasks.

5.6.3.1. Analysis of Student Work

One of the sections in the final individual report asked students to compare two aircraft to show why one was more successful than the other. Students could use a table to make the comparison but if they did so, they were asked to insert a paragraph beneath to explain why the information in the table was significant. Figure 39 shows the low-performing student's comparison.

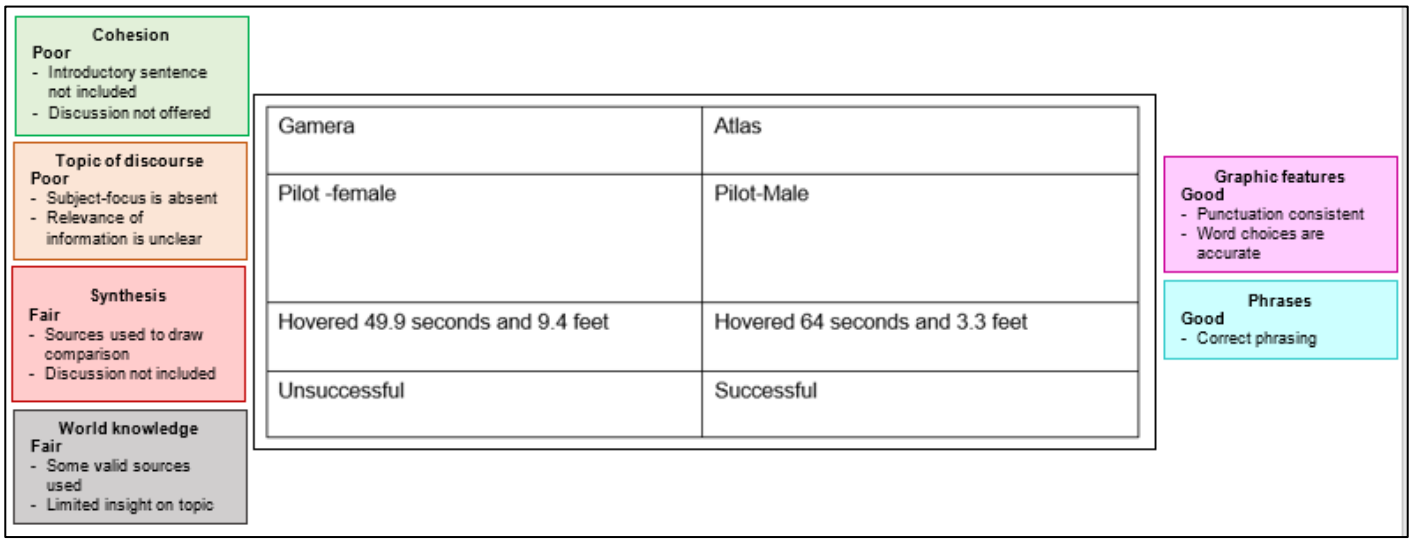

Figure 39: Low-performing Student Final Individual Report

The student presents clear points of comparison within the table and keeps it focused and neat. However, there is no context for the table. An introductory sentence is not included and a discussion on the relevance of the information is absent. This results in poor cohesion and coherence, and a vague topic of discourse. Synthesis and world knowledge are fair because information from different sources is used to draw the comparison and the table offers some insight into the student's understanding of the topic.

It is difficult to establish how well lower-order competencies are displayed in this sample. From the information included, the student remains consistent in their formatting, phrasing, and word choices, which shows positive application of lower-order skills. However, the limited language use makes it difficult to establish whether this is indicative of improvements in this area.

The information in this sample is limited, making it difficult to establish if the higher-order emphasis of the interventions was beneficial to the student's writing development in this instance.

The final individual report was the most challenging writing task for most students. In the section that required a comparison, most students inserted a table to make a direct comparison, like the low and mid-performing students sampled. Figure 40 shows the comparison made by the mid-performing student.

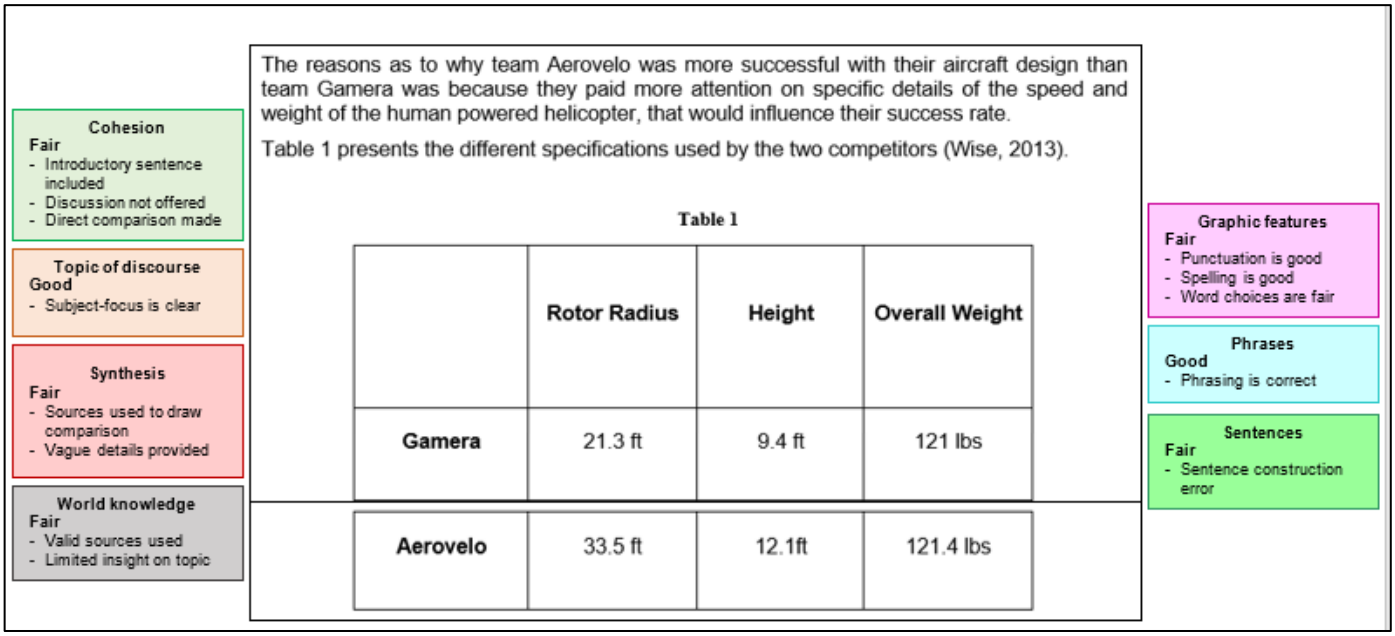

Figure 40: Mid-performing Student Final Individual Report

For the most part, the student presented a fair comparison. The information included reads well and is formatted effectively, but the discussion is thin. The subject-focus of the comparison is clear throughout, but a paragraph explaining the relevance of the factors mentioned in the table is not included, resulting in inadequate cohesion, synthesis, and world knowledge. The inclusion of an introductory paragraph does, however, provide context to the table.

The lower-order factors are presented effectively, but the introductory sentence is poorly constructed.

Overall, the student shows that they were able to synthesise information in a limited amount of time, but the level of detail provided is insufficient to make a judgement on lower-order and higher-order skills development.

Figure 41 shows the high-performing student's task and how they coped with the limited time available for completion.

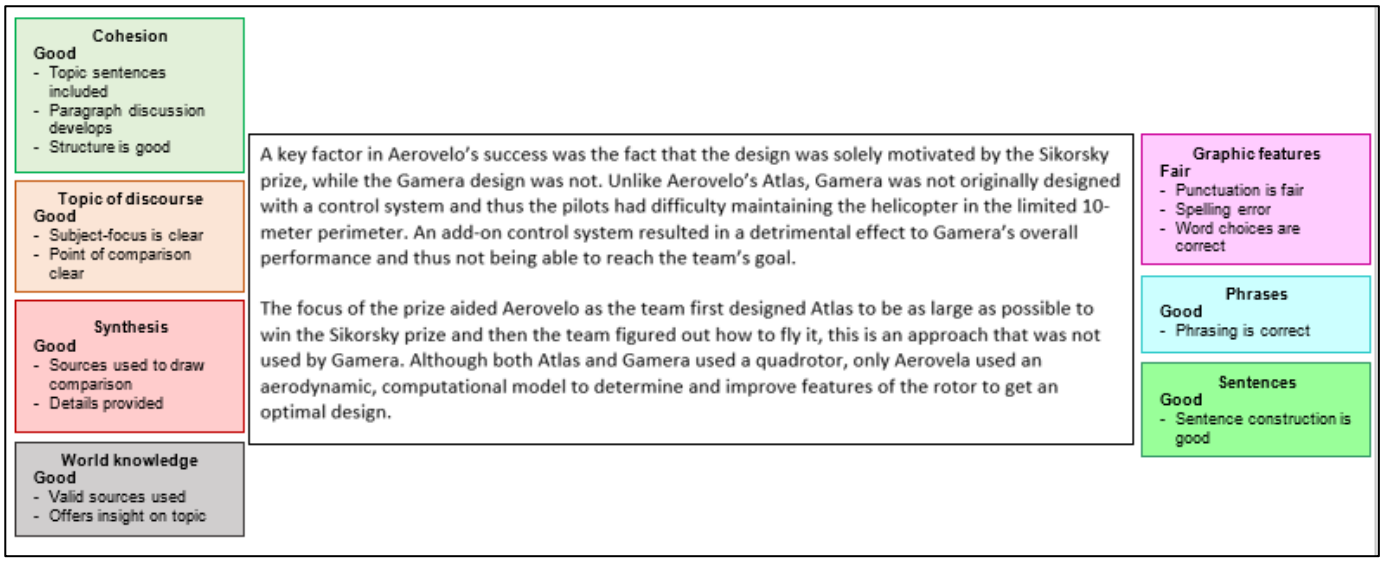

Figure 41: High-performing Student Final Individual Report

By this stage, the student's higher-order skills were established and they were able to formulate a cohesive, focused, synthesised, and knowledgeable discussion fairly easily. This ability is showcased in the sample.

The student includes their comparison in the form of paragraphs that describe why one aircraft is more successful than the other. The first paragraph presents a comparison of the intention of the two designs and how the outcome differs as a result of this, and the second paragraph goes into the different design features of each aircraft. This shows good cohesion and coherence, a clear focus on the topic of discourse, as well as synthesis. The student has read and understood the information provided on a high level and is able to identify and integrate key pieces of information together, displaying good insight on the topic.

The student maintains their lower-order competencies, with minor exception to American versus United Kingdom spelling in the use of 'meter' instead of 'metre'. Generally, the graphic features, phrasing, and sentence structure are well done, however.

The student presents an impressive writing effort in this task, showing that they were able to read, comprehend, formulate, and compare information effectively in a limited amount of time.

Although the results for this assessment were generally poor and perhaps not a wholly reliable reflection of the students' abilities to apply higher-order skills in their writing, the samples indicate that differences in the application of higher-order competencies

are still clear in the low-, mid-, and high-performing students' work. The low-performing student is unable to complete the report and apply higher-order skills, the mid-performing student completes the report with limited information synthesis, and the high-performing student completes the report with a good display of higher-order skills. This shows that the weaknesses previously noted in the low- and mid-performing students' work come to the fore when there is limited time available for completion.

5.6.4. Team Report

The team report was the final writing assessment that consolidated all of the skills that were taught and reinforced throughout the year. Students were required to follow the writing process, focusing on higher-order competencies, and provide a detailed report on the LEGO project. This was a lengthy document that was completed in teams of four. The literature review component of this document had been completed and assessed previously, and students were required to apply the feedback to the literature included in the report. They were given report instructions (see Appendix O) and time to complete the task across three double sessions. No lecturing took place during this time, but students had access to tutors, assistant lecturers, and lecturers during the class sessions. If the same question or type of question came up frequently, a response was provided to the entire class.

5.6.5. Team Report Instructions

The final submission was completed by 43 teams of four, that had been working together on the capstone LEGO project[32]. This meant that the workload could be distributed amongst all of the team members and each could focus on a particular section or aspect of the document. The following sections had to be included in the final report:

- Introduction
- Literature Review
- Method (planning, apparatus, final design, and final design comparison)
- Results
- Discussion (results and teamwork)

[32] The LEGO project took place in the final quarter of the year and required students to research, design, and report on a LEGO crane that was able to lift a minimum of 2.5 kg 15 cm in 90 seconds.

- Conclusion and Recommendations
- References
- Appendices

Teams had been working on the LEGO project throughout the final quarter and had gathered information and results in each of the project phases that they needed to include in the final report. To complete this document, students were encouraged to divide the workload up amongst individual team members and then use the available time to review and edit the document to ensure completeness and overall readability.

The students completed a compulsory freewriting task as reinforcement of this skill at the start of the first session. Thereafter, the teams were given time to plan the report and each member's responsibility in completing it. Students were also advised to review the feedback on the combined literature review, which had been completed earlier in the quarter, to make improvements prior to including it in the final report.

The body of the report formed the focus of the second session, where students compiled the method and results sections of the document. A lot of information was needed here, so each teammate was encouraged to focus on their aspect of these sections (e.g., inserting the figures and tables or writing the supporting paragraphs). In the final session, the teams were given time to draft the conclusion, complete the reference list, and edit and review their reports; following the final submission, each student was asked to complete the final writing reflection for the year.

This class breakdown was not compulsory and students were only advised to follow this sequence if they were unsure of how to approach the task. The written report instructions indicated what needed to be included in each of the sections and students could access the rubric online (see Appendix P). The final submission was assessed on all higher-order criteria and overall composition and readability.

5.6.6. Findings of the Assessment

It was difficult to know whether all team members contributed equally to the overall report, so these results could not be measured against individual students' overall writing progress. However, they were useful in gauging whether or not teams applied the higher-order skills focus to their writing, even when they were not explicitly guided and encouraged to do so, and to what extent they were able to do this. The rationale

behind this was to promote inter-psychological functioning and expose students to peer-to-peer learning for discourse development and socialisation. The formation of a shared discourse community is one of the proposed outcomes of the research and it was felt a team submission would help students to achieve this.

Although this was a teamwork assignment, the final writing reflection was completed individually and students were asked to respond to the following:

> Have the writing interventions provided in JPO 110 and JPO 120 had a positive impact, negative impact, or no impact on your writing development?

This was asked in order to get a sense of whether or not the students felt that they had benefited from the writing interventions after having completed all of the writing requirements for the year. Table 28 includes the responses to this question:

Table 28: Eighth Reflection

Positive	Negative	No Impact	No answer	Total
69	1	2	32	104

In total, 96% of the students who responded specified that they felt that the writing interventions had a positive impact on their writing development. One of the students stated that a positive aspect of the writing interventions was that it allowed students to "strive to improve [their] writing… as [they] now see the standard expected at a university level." Another stated that the interventions had taught them "how to approach writing in a logical manner instead of all at once without a clear thought process." Even though lower-order skills were not at the forefront of the interventions, one student highlighted that they "now understand the importance of editing [their] work and checking [their] audience so that [they] know the form of language to use." Finally, one student stated that the writing interventions had taken their writing from "0 to 100. Okay, maybe not a 100, but it's better than 0." These responses, and other similar responses, indicate that a considerable number of students were positively impacted in different ways and to varying degrees by the interventions, and that they recognised that the skills and practices promoted in the module could be further applied and further improved in the years to come.

Two students noted that the interventions had no impact on their writing development. One of these students did not provide a reason for their response but the other stated that it was because "research has always been in [their] schooling career." In total,

31% of the class failed to respond to the question. This might mean that they did not perceive a benefit from the interventions, possibly for a similar reason to the one stated above. Although these students did not perceive the interventions as beneficial, it is possible that they may not have perceived them as detrimental either and may tacitly have benefited from the practise.

One student indicated that the writing interventions had negatively impacted their writing development because they "lowered [their] confidence in [their] writing." This suggests that the writing interventions can be counter-productive in creating feelings of inadequacy in students who are unable to keep up with different expectations because the tasks fell outside of their individual ZPDs. The responses, however, indicate that the positive impact of the interventions was more widely felt than the negative or neutral impact.

The results for the final team report showed an improvement from the previous assessment and were similar to those obtained in the individual literature review (see Appendix Q). However, in this case the grading categories were more extensive, resulting in a more multifaceted analysis of the results.

Subject-focus was a difficult category to measure because it was assessed in six sections of the report: introduction, method, design, results, discussion, and conclusion, and the discrepancy in marks within these categories was significant. Student teams generally performed well in the introduction and method sections, with 62% of the teams achieving good or excellent results. This performance dips in the design and results categories where just 33% of the teams obtained good or excellent results, and further in the discussion and conclusion sections where 21% of the teams obtained good or excellent results. Overall, however, just 1% of the teams obtained poor results within these categories, indicating that subject-focus was not difficult to establish but that the level of detail required may have been insufficient, incomplete, or inconsistent leading to primarily moderate results.

Source integration was again the category to see the widest discrepancy in results. The mark distribution indicates that 44% of the teams did a good or excellent job of integrating their sources and just 21% of the teams performed poorly. This indicates that almost half of the teams had a good grasp of source integration at this stage, and that the poor result could be linked to inadequate development of this skill or to poor teamwork and a breakdown in communication. The 'use of and contribution to the

literature' result demonstrated that teams experienced challenges in this regard, with all teams receiving moderate results. This is possibly due to limited resource use and integration, which is something that students still needed to practise and develop further as they learnt to conduct research.

Structure and coherence were categories in which performance remained good, with none of the teams performing poorly and 26% performing well. The remaining teams performed moderately.

The reasons for these results are varied and could be linked to higher-order writing skills development, or to teamwork and communication amongst members of the team. However, it is clear that categories in which teams performed best and worst matched those from previous task analyses, suggesting that skills related to source integration and 'use of and contribution to the literature' required the most practise and development (see Appendix Q).

The teams were consistent in their performance in the lower-order aspect of the assessment, receiving neither poor nor good results and obtaining a class average of 52%. 93% teams obtained a mediocre score and this may be due to the lack of emphasis on these skills in the instructions and inconsistencies within the team in voice and language use. The team reports did not appear to have been edited and none of the teams obtained a high mark for composition, with each section reading as a separate entity. This highlights the lack of improvement in lower-order skills development throughout the year (see Appendix Q).

5.6.6.1. Analysis of Student Work

Each of the students completed the task in a team, so it is not possible to link these results to the low-, mid-, and high-performing students whose work has been analysed up to this point. However, as members of the team, they contributed to the project and each can be evaluated to see if the patterns identified previously had an impact on the team as a whole.

The team report was an extensive document and one of the required sections was 'Results'. In this section, teams were asked to indicate the proposed lifting capacity of each team's crane and then to discuss the significance of the results in relation to their

team's performance. This section of the low-performing student's team report is included in Figure 42:

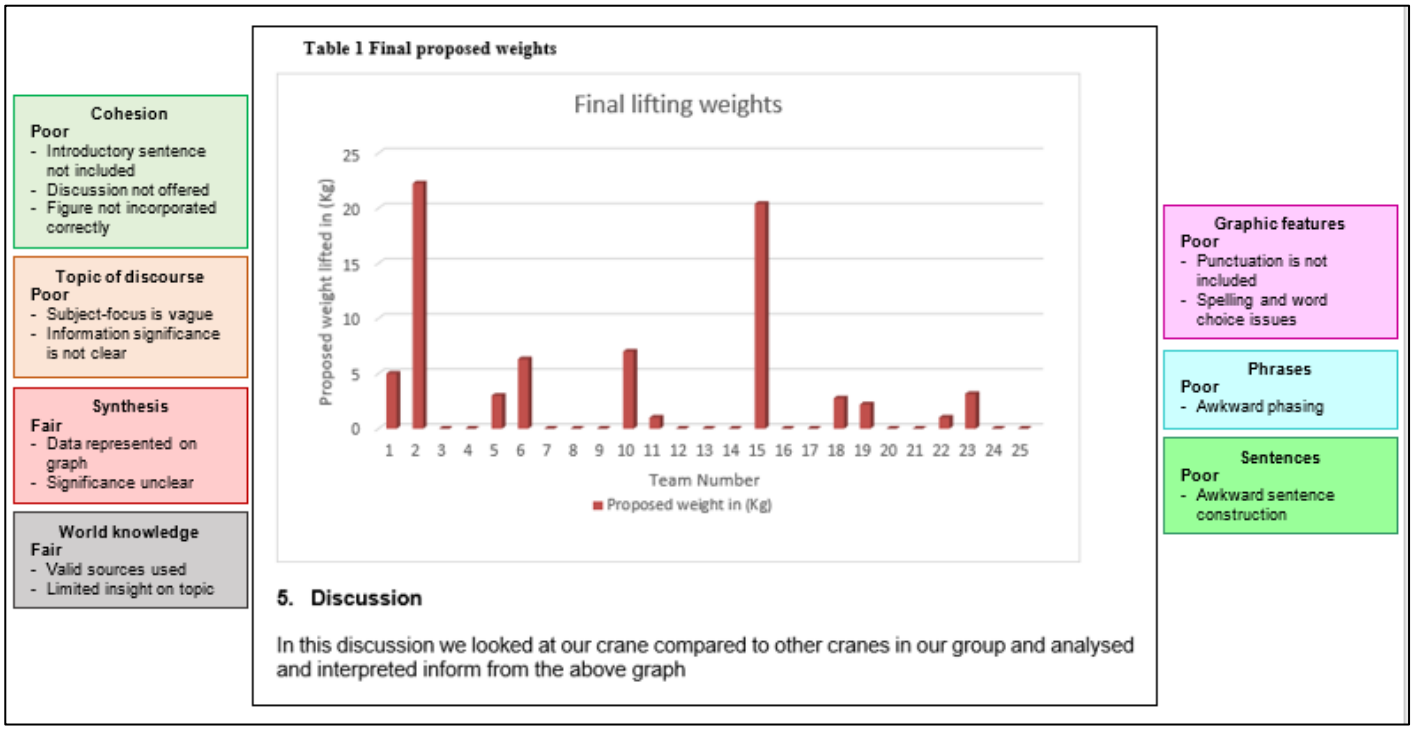

Figure 42: Low-performing Student Team Report

As with the previous sample, the student and their team do not provide a context for the figure. The introductory sentence is not included, a discussion is not offered, and the figure is not incorporated correctly. This leads to poor cohesion and coherence, and an unclear topic of discourse.

Synthesis and world knowledge are fair because the data represented in the figure is drawn from external sources of information, but insight into the significance of this data is not provided.

In the sentence following the graph, the student's team provide some context to the graph (this is included in the incorrect place) but the lower-order aspects of this sentence are poor. The student's team do not include punctuation at the end of the sentence and there are typing errors. This sentence is also awkwardly constructed, offering a conclusion to a non-existent discussion.

The patterns identified in the sample correlate with the patterns in the low-performing student's previous submissions, only showing moderate improvements. This is likely a result of poor communication within the team as a whole.

The low-performing student does not show much improvement from one task to the next, which is possibly due to the higher-order interventions inadequately addressing problems in reading and writing that have their origins at school-level and insufficient conceptual framing through the use of different modes of expression. The tasks grew in expectation and intensity, leaving little room for the development of skills that were not already in place. It was hoped that the emphasis on higher-order aspects would allow for an emphasis on content rather than expression but if a student did not have adequate reading or writing skills, then the content would pose as much of a challenge as the expression, which appears to be the case with this student. This indicates that the interventions were not substantial enough in terms of their scaffolding or lower-order skills development (falling outside of their ZPD) to lead to improvements in the writing of generally low-performing students.

The 'Results' section of the mid-performing student's team report is included in this section. Figure 43 shows this information.

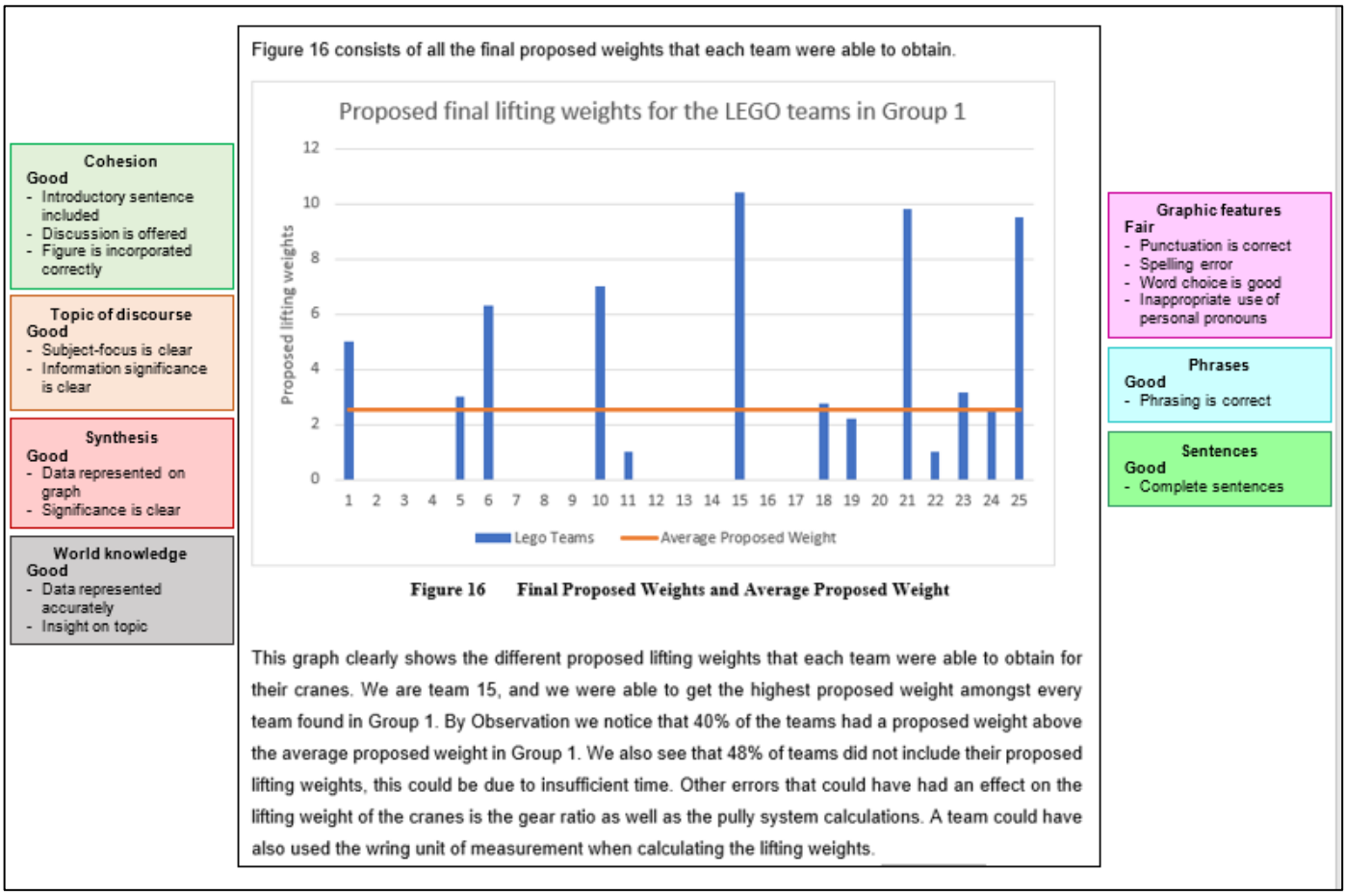

Figure 43: Mid-performing Student Team Report

The team does a good job of including and discussing the results in this section. In terms of cohesion, the team starts with an introductory sentence, then includes a table with the results, and finishes off with a discussion of the information in the table. This is an effective demonstration of how cohesion and structure can lead to good coherence, making it easy to read and absorb information. In the paragraph itself, the discussion is logical and easy to follow.

This coherent presentation of information positively impacts the other three higher-order factors: topic of discourse, synthesis, and world knowledge. This is because focus is maintained, data is interpreted and inferences are made based on this information, and insight on the topic is provided. Overall, this is a positive display of higher-order skills and suggests that this focus can lead to good cohesion, structure, synthesis, subject-focus, and a positive display of world knowledge.

Lower-order skills are also presented effectively in this task, except for a spelling error — ‘pully’ instead of ‘pulley’ — and the incorrect use of voice — students were required to write in the objective third person. But, the general construction of the section is well done.

It is not clear if this section was written by the sample student or a teammate, but throughout the tasks discussed, it is evident that over time the student made an improvement in terms of cohesion and synthesis in their writing. This indicates that the interventions had a positive impact on the student’s higher-order skills development over time. Additionally, the student made small improvements in the lower-order aspects of their writing, taking time to edit and review some of their tasks. This shows that lower-order aspects were not neglected. Although there are still some areas that require further development and some gaps in the interventions have been identified, the student kept up with the expectations of the interventions and applied higher-order and lower-order competencies to increasingly challenging writing tasks.

Figure 44 includes a sample of the ‘Results’ section of the high-performing student’s team report.

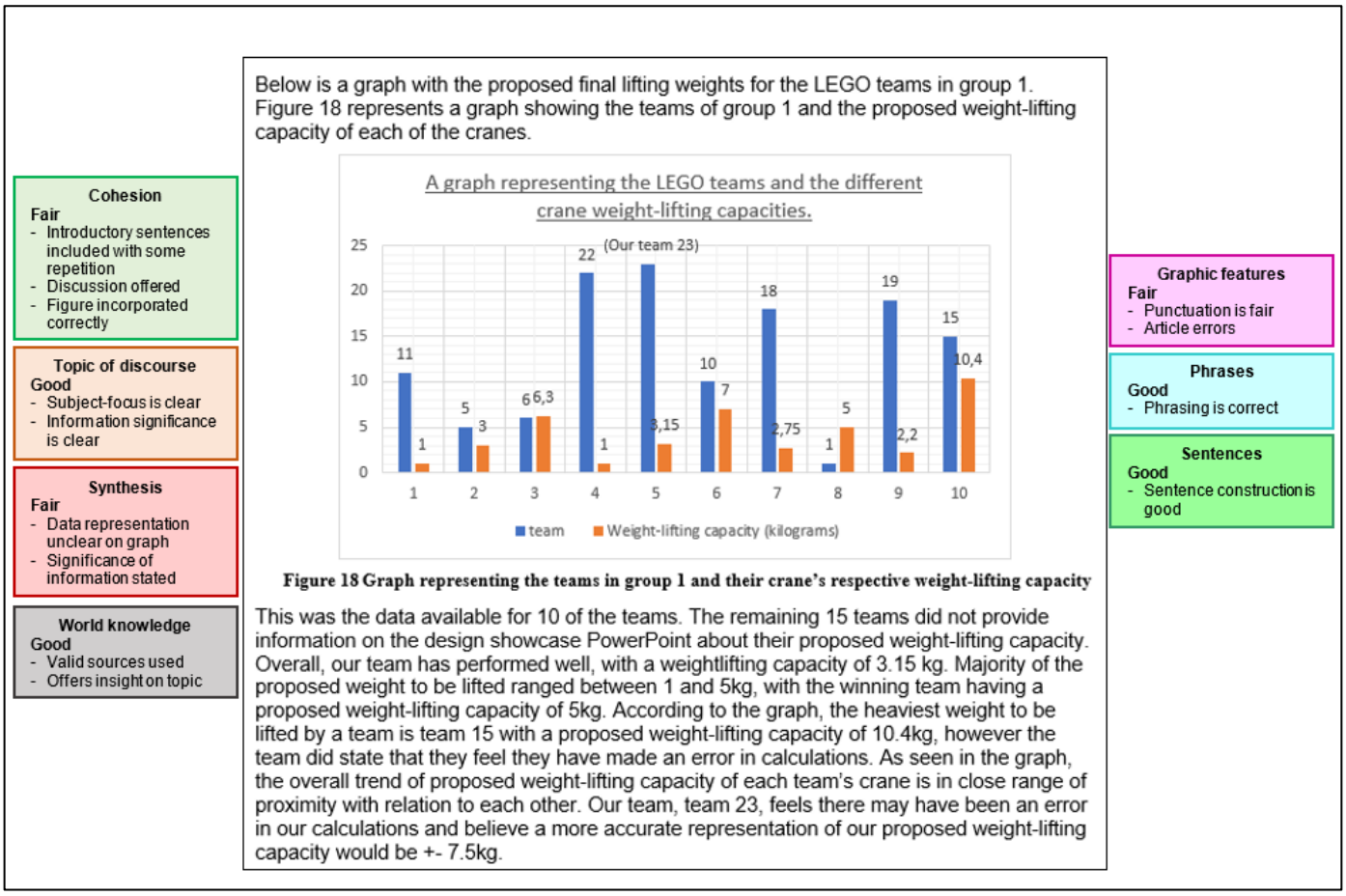

Figure 44: High-performing Student Team Report

In this sample, the cohesion, synthesis, and construction style typically associated with the student is not evident. This suggests that a different team member completed this section of the report or that the student did not put as much effort into this submission as they did in previous submissions. Nevertheless, the high-performing student formed part of the team responsible for the submission.

The higher-order features of cohesion and synthesis are not showcased as effectively as usual in this submission. The team includes two sentences introducing the figure in the opening paragraph, which results in unnecessary repetition and detracts from the focus required in academic writing. The information in the figure is also presented in a confusing manner, making it difficult to interpret. The discussion paragraph is fair and the team are able to offer an interpretation of the results. This indicates that the topic of discourse, world knowledge, and aspects of synthesis are applied to the task, but that the team needs to consider cohesion and the visual representation of information in future.

The team's punctuation and use of articles are incorrect at times in the submission. For example, the team writes "… a proposed weight-lifting capacity of 10.4kg, however the team did state…". This should be formulated as: "… a proposed lifting capacity of 10.4kg; however, the team stated…". They also neglect to add an article in front of "Majority of the…". Errors such as these do not occur frequently.

While this submission was not completed according to the student's usual standards of writing, the general presentation of information and discussion of results is fair and displays many of the higher- and lower-order competencies required of students.

Looking at the six samples provided, the high-performing student shows an improvement in their higher- and lower-order competencies from the start of the year until the end, particularly in synthesis. This may not have been as prevalent in the final sample because it was a team submission, but the general impression is that the student's writing improved with the interventions. The student is able to read, comprehend, synthesise, and formulate a discussion that shows maturity and insight for academic purposes, and this corresponds with the higher-order emphasis of the writing curriculum.

Through each of the interventions and the subsequent assignment submissions, the low-performing student showed little improvement and was unable to make up for inadequate writing foundations, and may have benefitted from multimodalities in order to promote better conceptual understanding. These multimodalities could have been embedded in the process-writing approach taken to discourse development. The mid- and high-performing students displayed an improvement in their use and synthesis of information, indicating that the interventions primarily had a positive effect on developing higher-order skills in the sample students. This is mirrored in the overall discussion of results.

CHAPTER 6:
CONCLUSION

6.1. INTRODUCTION

The primary aim of this study was to introduce different interventions into a writing curriculum for students in an extended engineering degree programme that emphasised the explicit development of higher-order writing skills. In so doing, the researcher tried out different methods and observed the results of the interventions through a quantitative analysis of student results and a qualitative analysis of select student writing samples. This was done to ascertain the effectiveness of the interventions for broader implementation into the engineering curriculum.

The research cycle was completed in 2020 for an initial evaluation, changes were made to the curriculum based on these results, and the cycle was completed again in 2021 for a final evaluation. The results of the 2021 research cycle are included, analysed, and discussed in this study.

The curriculum developed for this study is specifically geared for writing in engineering and is embedded into a university module that focuses on professional development. Thus, the context for the study is region- and discipline-specific with broader implications for Engineering Education and Academic Literacy studies.

This section provides a summary of the research findings, an outline of the contributions made to the fields of Academic Literacy and Engineering Education by the study, reflections on these contributions, limitations and recommendations of the study, and concluding remarks.

6.2. SUMMARY OF FINDINGS

Several steps were involved in developing the curriculum interventions for this study, all of which yielded findings. These included establishing the theories that would form the lens for the study, defining lower- and higher-order writing skills, and developing and assessing the effectiveness of the scaffolded interventions. These steps led to a number of findings.

6.2.1. Theoretical Findings

Aspects of cognitive, social, and education theories formed the lens for this study. Cognitive and social theories are typically perceived as fundamentally oppositional, making this an unusual theoretical position.

Hayes' Individual-Environmental Model was used as a framework to draw attention to different aspects of text interpretation, reflection, and text production. Cognitive, affective, social, and physical conditions are all recognised in this model as influential to the writing process as it is viewed as a communicative act, a generative activity, and an intellectual activity. This model was used to highlight the external and internal processes involved in writing and the complex and demanding thought processes necessary for higher-order writing to take place.

Social theory, specifically New Literacies Studies (NLS), draws attention to the idea of discourse communities and the development of a dominant discourse. This framework highlights that schools are not good places for *acquiring* literacy, but are good for *practising* literacy. This means that the idea is not to teach students language from the ground up, but to teach them how to develop the dominant secondary discourse for their particular discipline through good practice. This theory was used to draw attention to the role of community and the idea of creating a curriculum for the specific development of an engineering discourse in the academic environment.

Finally, Vygotsky's concepts of the Zone of Proximal Development (ZPD) and inter- and intra-psychological functioning, as well as Engeström's concept of internal and external 'tools' for promoting high mental functioning, were used to scaffold tasks for this study. The goal was to ensure that 'tools' were used to help students develop their writing and that peer interactions were encouraged to challenge students to engage in higher mental processes.

By using these theories, the higher-order writing interventions could be scaffolded at various levels. Firstly, the interventions were scaffolded to ensure that the activities remained in the ZPD of the students involved and were neither too simplistic nor too sophisticated in terms of their requirements. In line with this, external tools such as computers, writing software, and checklists were used to help students refine what they had developed using their internal language and thought processes. Secondly, peer interactions were encouraged so that students could learn from each other and

develop alongside each other. Finally, the process-writing model and textual analysis were used to reinforce the cognitive processes necessary for higher-order writing to take place.

This study thus found that different aspects of these theories could be used to develop a curriculum with higher-order interventions that appealed to the range of internal and external processes undertaken when one produces a text. It was also found that this curriculum could be used in practice without compromising these processes.

6.2.2. Categories of Lower- and Higher-Order Writing Skills

The researcher was guided by principles related to thinking, reading, and writing to develop the skill categories applied to and assessed in this study. Writing skills are typically defined in terms of surface- and discourse-level features, but the researcher opted to categorise these skills similarly to those applied to thinking and reading, so that the inseparable nature of the three in an academic context was apparent. Additionally, 'discourses' are difficult to quantify and measure, making the application and assessment of these features a challenge.

By using the thinking processes outlined in Bloom's Taxonomy, Grabe's reading model, and Ivanić's map of writing discourses, an outline of lower- and higher-order writing skills was created (see Table 11). This outline and the descriptions therein formed the framework of skills applied in the study, allowing for the consistent assessment and reinforcement of higher-order writing skills that would help students to develop their engineering discourse.

6.2.3. Effectiveness of the Higher-Order Writing Interventions

The success or failure of the four higher-order writing interventions introduced in this study are difficult to quantify and measure with certainty. This is because different aspects of each intervention were successful and unsuccessful, and these successes and failures were also linked to whether or not the student could be categorised as typically low-, mid-, or high-performing, as well as to the pedagogical approach that was used to scaffold the curriculum and to present curriculum content. The process-writing approach was successful at helping to develop relevant schemas and discourse knowledge for storage into long-term memory for those students within whose ZPDs the tasks fell, but less successful for those students whose ZPDs were not yet sufficient. This highlighted the potential benefit of multimodalities (and lack

thereof in the scaffolded curriculum developed for this study), as well as practical deficiencies as a result of the Covid-19 pandemic.

Although the aim was to shift the writing emphasis away from lower-order skills development toward higher-order skills development, the idea was not to neglect lower-order skills in their entirety. The process-writing model was used to implicitly encourage the development of these skills, but the results indicate that lower-order writing skills continue to be a problem area, and one with serious implications, as skilled writers (like readers) are good at both sets of skills and are more easily able to move between these categories. Initially, the assumption was that these skills were already in place from school but the findings indicate that this was perhaps over-optimistic and that there remain problems with many students' lower-order skills that interventions need to address in a more direct and focussed way than was attempted in this project.

The curriculum addressed higher-order skills development in different ways throughout the process. Four sets of higher-order skills were targeted in the interventions. These were: use of and contribution to the literature, sentence, paragraph, and structural development (coherence), source integration, and subject-focus.

After the first intervention, which was general and introductory, source integration and coherence were shown to be areas of need with most students displaying difficulty synthesising their information. This was attributed to the fact that many students had not used reference material previously.

These skills were addressed and targeted in the second intervention, which led to some improvement in source integration and 'use of and contribution to the literature', with more limited success in developing coherence and subject-focus. This intervention more successfully addressed the use of sources but was less successful at improving coherence and maintaining subject-focus.

As a result, coherence and subject-focus were addressed in the third intervention and this led to some improvement in both skill-sets. In this assessment, student results indicated that many still had difficulty using and contributing to the literature and integrating sources of information. Given that this was the first-time the students were

expected to contribute to literature and to form an educated opinion in the module, this was anticipated.

In the final intervention, all higher-order skills were addressed and targeted, which led to improved source integration and a consistent performance from the previous intervention in the remaining three skill-sets. This indicates that there was some improvement in each of the higher-order skills from the first set of intervention workshops to the last.

Two additional assessments were completed after the interventions: a final individual report and a team report. Time to complete the final individual report was limited and this brought certain weaknesses in student writing to the fore, particularly in regard to source integration and synthesis in low- and mid-performing student work. This may be because it takes time to integrate information effectively and to synthesise a discussion. Performance in the final report was fairly consistent, with teams primarily falling into the moderate to good skills categories. This result points to the partial development of discourse communities for most students as, when working together, teams performed fairly well. However, there were some teams that performed poorly, possibly suggesting a breakdown in communication at some level. In the analysis of student work, the low-performing student's team did not do well, suggesting that a low-performing team member may have a negative impact on the team as a whole.

These results indicate that the interventions adequately addressed the different higher-order skills categories and that when emphasis was placed on a skill, there was some improvement in the corresponding assessment. However, an analysis of low-, mid-, and high-performing student work showed that the mid- and high-performing students generally improved in their writing from the start of the year and that the low-performing student did not show as great of an improvement. This is linked to the initial claim that there is limited development of academic literacy at the secondary level where adequate literacy foundations are not acquired. This finding suggests that low-performing students may be unable to familiarise themselves with the dominant discourse or fit into dominant discourse communities because of inadequate literacy foundations, possibly resulting in feelings of academic isolation.

In their reflections, 96% of the student respondents indicated that the interventions had had a positive impact on their writing. Many of these students also indicated that they realised that they still had a long way to go in terms of this development. This

shows that the perception of the interventions was positive and that students recognise that writing is a combination of many different skills that come together in order to be successful. Furthermore, it is possible that the reflections themselves may also have had a positive impact on student writing, given Granville and Dison's (2005) finding that self-reflection boosts metacognition and higher-order thinking, as well as the development of academic social languages. It may be that the students who actively engaged in reflection as part of the process-writing approach experienced the benefits of this practice and that this led to positive reflection results.

Given that this was the first-year of engineering studies for the students and that there was limited time to address these skills, the expectation was that the writing improvement would be gradual. The idea was to instil practices that would encourage students to further develop their lower-order and higher-order writing skills in the coming years. The student results and reflections indicate that the interventions were relatively successful at laying the foundations for higher-order writing development in the majority of the student participants, that many students recognised that there was value to the writing activities, that there was still room for improvement in this area, and that the practices learnt in the intervention workshops would be useful to the students in subsequent years.

From a teaching practice perspective, these results show that consistent and explicit emphasis on a particular skill-area is necessary for there to be improvement amongst students. The curriculum developed for this study required a high-level of engagement and effort from both the lecturer and the students, and this led to a marginal improvement in the development and application of higher-order skills. Without this kind of engagement and scaffolding of tasks, it is possible that students' writing development will plateau. The large class sizes make it difficult to offer personalised interventions, but general trends in performance tend to indicate what the areas of need are for the majority of students. Continuous assessment with feedback also helped students to target weaknesses in their writing, suggesting that continuous reinforcement is required for improved skill and practice development.

Many lecturers in the South African context are confronted with conditions similar to, and often more challenging than, the circumstances in which this research was carried out — large class sizes, limited time, a lack of resources, and the marginalised position of Academic Development within the university. However, this study has shown that

curricula can be scaffolded to address skills at different levels, challenging a range of students in the class; students can be encouraged to think, read, and write at a high-level and tasks can be set to develop the higher-order skills that make students academically literate. Lecturers can also look at their modules as a space for reinforcing the practices that will encourage students to approach their writing from a higher-order thinking perspective, while still promoting reading and writing development in various skill areas.

6.3. REFLECTIONS ON THE STUDY

This section offers a reflection on the different limitations noted in the research project, the ways in which the study contributes to the fields of Academic Literacy and Engineering Education, and recommendations for further research.

6.3.1. Limitations to the Research Project

The programme and module used and investigated in this study is intended to support students in their academic development and promote professional competencies. The large class sizes of up to 270 students make it difficult to assist students on a one-on-one basis or to offer additional time and resources to those who might need it. This leads to a curriculum that is pitched at the development of mid- and high-performing student needs, leaving behind low-performing students. The lecturers, assistant lecturers, and tutors are unable to offer additional support to these students resulting in little chance of their succeeding in the degree programme. A consequence of this practical limitation is that the impact of the study is not as far-reaching as initially hoped, as there were few opportunities for peer-to-peer learning and discourse development through tutors who were already equipped with the knowledge.

Furthermore, this study took place while classes were hosted online during the Covid-19 pandemic, which highlighted inequality in all its forms — vital, resource, and existential (Czerniewicz *et al*., 2020:947) —, and it is not possible to tell to what extent students were able to engage in classes in this environment. In addition to various access issues, students were also required to login to the sessions but not to share audio or video, meaning that presence, involvement, and engagement may have been lacking. Feelings of alienation and disengagement from their studies amongst engineering students in the South African higher education context (Case, 2007:124) may have also made it difficult to develop a discourse community and to ensure that

peer support was taking place. At the end of each intervention session, students were given time to complete their work and to ask questions. Some students used this time to ask questions but it is unclear if the remaining time was used to complete the tasks or if the work that was completed was their own. In the team assessments and peer support aspects of the tasks, engagement could not be monitored. This also led to uncertainty regarding student involvement. If students felt overwhelmed, they may have chosen to leave the sessions and not receive support, resulting in isolation and difficulty in forming a discourse community.

In terms of the research design, the researcher was not able to make use of control and research groups. This would have had the ethical implication of disadvantaging students who did not participate in the interventions. Thus, it was difficult to measure the success or failure of the interventions with certainty. However, this study was intended to be exploratory and certain assumptions could be made by triangulating the findings through analyses of student results, student work, and student reflections.

In addition to the above, the study would have been enhanced if it were possible to measure whether or not the students who received the interventions applied what they had learnt to writing tasks in subsequent modules and how this compared to the mainstream students who had not received the interventions. This would be difficult to measure because students are absorbed into the mainstream programme and further sub-divided into their disciplines from year three onward.

The final limitation relates to the recent introduction of generative Artificial Intelligence (AI), such as ChatGPT, which is freely available online. These tools were not readily available when the study took place, but can be now used by students to consolidate, synthesise, and edit information. This takes away a lot of the higher-order thinking and application required in research. Although AI-detectors have been implemented into software grading packages, like Turnitin, these are still new and do not pick up on all instances of its use. These services have the potential to be useful to students in their post-graduate studies, but are detrimental to entry-level students who have not yet developed their academic literacy. This technology could limit the long-term benefits of this study, because it will be difficult to monitor higher-order skills development and this may prevent students from developing and applying their higher-order thinking, reading, and writing skills to the fullest extent.

Since the end of the Covid-19 pandemic, classes have resumed face-to-face making participation more evident. However, the class sizes have increased to approximately 350 students in recent years, resulting in a lack of individual support.

6.3.2. Contribution to the Fields of Academic Literacy and Engineering Education

This study has attempted to contribute to both the fields of Engineering Education and Academic Literacy by exploring the development of a writing curriculum that promotes higher-order skills. Although the students involved in it are specifically those who have been accepted into an extended engineering degree programme at the University of Pretoria, these students are representative of most entry-level engineering students who have not had exposure to Academic Literacy. This means that the curriculum developed for this study could have broader implications for Engineering Education at South African institutions.

Studies on the development of student literacy tend to focus on reading development, with very little emphasis on writing development. When reviewing the literature for this study, it became evident that writing-specific studies in Academic Literacy are uncommon in the engineering context. Indeed, it was, partly, this very gap that led the researcher to focus on the teaching of writing in an engineering degree programme, and more specifically, to explore the ways in which higher-order writing skills can be developed so that the students who come from diverse backgrounds can participate in dominant engineering discourse communities. The aim was to lay the foundations for further development as the students' progress through their studies and in so doing, prepare them for both the academic and professional environment. While it was found that low-performing students may not benefit from this emphasis, the majority of student participants (including low-performing students) indicated that they had become more reflective of their own writing development, saw the benefit to the interventions, and intended to further develop their higher-order writing skills by applying the practices reinforced in the module.

The Graduate Attributes stipulated in the Engineering Council of South Africa's engineering qualification standard highlight both technical and professional competencies. These include Graduate Attribute 6 on professional and technical communication and Graduate Attribute 8 on individual, team and multidisciplinary working. However, little time is meaningfully dedicated to the development of these

attributes due to the range of technical competencies that need to be promoted. By producing a curriculum that emphasises higher-order writing development and combining this with teamwork in engineering-based projects, it is hoped that the broader implementation of this into technical modules will be possible. At the moment, these are viewed as separate entities that will become inseparable in the professional environment. Thus, there should be consideration for how these can be grouped together in a module or across the curriculum for all engineering students, so as to promote both technical and professional enhancement. The researcher used engineering-specific tasks and examples to encourage higher-order writing development in this study and in so doing, introduced students to the discourses and thinking skills required in an engineering environment. Different variations of this initiative might be meaningfully applied within the broader engineering curriculum by having students produce reports and proposals with an emphasis on the coherence, cohesion, source integration, and subject-focus that indicates a deep understanding of technical knowledge.

Academic Literacy is still a developing field of study and one that is becoming increasingly relevant as more and more people are granted access into higher education institutions with inadequate secondary-level preparation. This means that there are still a number of gaps in the students' knowledge of the field and that research such as this, contributes to an understanding of what it means to be literate in an academic environment and how this literacy can be developed. In the South African context, Academic Literacy courses are often used to address language deficiencies in entry-level students and are limited to language exercises. This approach is both ineffective at aiding students to acquire basic language skills and at producing students who are equipped for the academic literacy demands of their course. This curriculum recognises that certain basic literacies need to be in place prior to the commencement of a degree programme and that academic literacy needs to be scaffolded to develop discipline-specific discourses that students can apply to their studies as they progress.

6.3.3. Recommendations for Further Research

In reflecting on the study, it became evident that the revised curriculum placed too strong an emphasis on higher-order skills development and not enough of an emphasis on lower-order skills development. It is recommended that adapting the

curriculum to include a combination of explicit lower-order and higher-order writing interventions be considered. This may enhance the writing development in low-, mid-, and high-performing students, rather than alienating those whose language foundations may be weak. Furthermore, the resumption of face-to-face classes will make it easier to monitor student participation and involvement, and ensure that social learning is taking place. Peer learning and the formation of a discourse community is vital to secondary discourse development and this aspect of the course design could improve higher-order writing skills in low-performing students in particular. This could lead to more effective scaffolding as observations and adaptations can be made in real-time based on student needs.

One of the limitations noted in the study was in the ability to assess the success or failure of the interventions with certainty. By potentially narrowing the scope of the research and focusing on the development of certain skills, it would be easier to implement research and control groups and to assess the effectiveness of each intervention. This would be a long-term study, involving different student cohorts, but the implications for Academic Literacy and lower- and higher-order skills development could be more far-reaching than they currently are.

Furthermore, by collaborating with the lecturers involved in the communication modules offered to all engineering students in their third-year of study, it may be possible to measure whether or not the student-participants benefited from the interventions. This would allow the researcher to determine the long-term success or failure of the interventions, as well as areas for further academic literacy development. This could be done by conducting interviews with the students who participated in the study and reviewing their subsequent writing assessments.

Finally, the ways in which generative-AI can be used to promote, rather than hinder, higher-order writing development might profitably be explored. As stated previously, this is new technology that was not available when the study was conducted, but some attention should be given to how it can be used as a tool for enhancement in student writing in the future.

6.4. CONCLUDING REMARKS

The intention of this study was to develop a writing curriculum that prioritised higher-order skills. In so doing, the researcher found that Academic Literacy is still a young

field of study where further exploration involving processes of trial and error is required. The project resulted in some findings that were different from what was anticipated. The researcher found that there is no one theory that can be applied to Academic Literacy education and that different, and oppositional, theories can be used in conjunction with one another to develop curricula that scaffold learning at different levels. Moreover, it was found that thinking, reading, and writing skills work together to form successful written communication and it is not possible to develop higher-order writing skills in students who did not have sufficient language foundations in place.

While the researcher aimed to develop a curriculum that supported writing development in all students in the module, this was not possible given the time and resource constraints, and deficiencies in some students' language foundations. However, it was notable that the higher-order aspects of mid- and high-performing student writing improved over the course of the interventions and, importantly, that the majority of the students noted an improvement or need for improvement in their own writing.

There is still considerable room for enhancement in the writing curriculum and no initiatives are ever likely to suit everyone's needs nor address every aspect of writing sufficiently. But, the changes in the EBIT ENGAGE Programme that have been recorded in this study seemed to have a positive impact on the students even while they were participating in classes online. As Leedy and Ormrod (2015:25) state, "Every researcher soon learns that genuine research is likely to yield as many problems as it resolves. Such is the nature of the acquisition of knowledge." This study has illustrated the truth of this assertion, and illuminated the challenges and complexities educators face in developing students at any level.

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Appendix A: Ethics Approval Letter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Humanities 100. Since 1919

12 June 2020

Dear Miss LS Fouche

Project Title:	Higher-Order Writing Skills at the Tertiary Level: Developing a Writing Curriculum for Engineering Students
Researcher:	Miss LS Fouche
Supervisor:	Dr PC Lenahan
Department:	English
Reference number:	28141840 (HUM013/0420)
Degree:	Doctoral

I have pleasure in informing you that the above application was **approved** by the Research Ethics Committee on 12 June 2020. Data collection may therefore commence.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. Should the actual research depart significantly from the proposed research, it will be necessary to apply for a new research approval and ethical clearance.

We wish you success with the project.

Sincerely,

Prof Innocent Pikirayi
Deputy Dean: Postgraduate Studies and Research Ethics
Faculty of Humanities
UNIVERSITY OF PRETORIA
e-mail: PGHumanities@up.ac.za

Fakulteit Geesteswetenskappe
Lefapha la Bomotho

Research Ethics Committee Members: Prof I Pikirayi (Deputy Dean); Prof KL Harris; Mr A Bizos; Dr A-M de Beer; Dr A dos Santos; Ms KT Govinder Andrew; Dr P Gutura; Dr E Johnson; Prof D Maree; Mr A Mohamed; Dr I Noomè; Dr C Puttergill; Prof D Reyburn; Prof M Soer; Prof E Taljard; Prof V Thebe; Ms B Tsehe; Ms D Mokalapa

Appendix B: Letter of Informed Consent

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Department of English
University of Pretoria
Pretoria 0002, South Africa
072 117 5166

Participant Consent Form

Dear Prospective Participant

I, Lauren Senna Fouché, would like to invite you to take part in my PhD study titled "Higher-Order Writing Skills at the Tertiary Level: Developing a Writing Curriculum for Engineering Students".

The aim of this study is to improve the writing skills of engineering students as engineers in training, so I will be testing different writing approaches on you in some of your Professional Orientation (JPO 110 and 120) sessions. This writing practice will take place in your JPO 110 and 120 lecture times, and **will not require any extra-curricular activities or additional time commitments from you as the participant.**

You will complete writing tasks in these writing workshops that will count toward the continuous assessment portion of your final mark for Professional Orientation. I would like your consent to allow me to use your results for these assessments and your written work to see how effective these writing approaches are.

Your participation in this study is voluntary. If you choose not to participate in this study, you will not be penalised and will still receive the writing workshop and related assessment. You have the right to withdraw from this study at any time. Your results will be kept completely anonymous throughout the study and all of your personal information will be removed and replaced with pseudonyms on the written submissions and results sheet that I will use to analyse the data. Only myself (the researcher), my supervisor, and my co-supervisor will have access to this data, and it will only be used for the abovementioned PhD study, journal articles, conference presentations, and future related studies.

The data collected will be stored on a laptop computer provided by the University of Pretoria for safekeeping and shared in a Google Drive folder that only myself (the researcher), my supervisor, and my co-supervisor have access to. Additionally, this data will also be stored in a password-encrypted format for 15 years in the English Department.

The purpose of this study is to improve upon an existing course, so there are no foreseeable risks to your taking part in this study. One of the benefits of participating in this study is that you will get guidance in writing for academic and professional success, and help to improve the way that writing is taught to engineers in training. The results of the study will be made available to you upon request after the completion of the examining of the thesis

This study is being done through the Department of English. You may contact via email for further information: lauren.fouche@up.ac.za.

Consent form:

I ……., student number, ……..have read the informed consent form provided above. I voluntarily agree to participate in this study and give permission for an analysis of my writing assessments in Professional Orientation to take place for the purposes of this study and its related publications. I have the right to a copy of this consent form for my personal information.

Participant…… Date……

Witness…… Date……

Researcher: Lauren Fouché (signed) Date: 18/06/2020

Natural Sciences 2 4-14
University of Pretoria
PRETORIA 0002
Republic of South Africa

Tel number: 012 420 4222
Fax number: 012 420 5191
Cell +27 72 117 5166

E-mail address: lauren.fouche@up.ac.za
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Appendix C: Writing Task Rubric

Name Writing Task

Description

Rubric Detail

Levels of Achievement

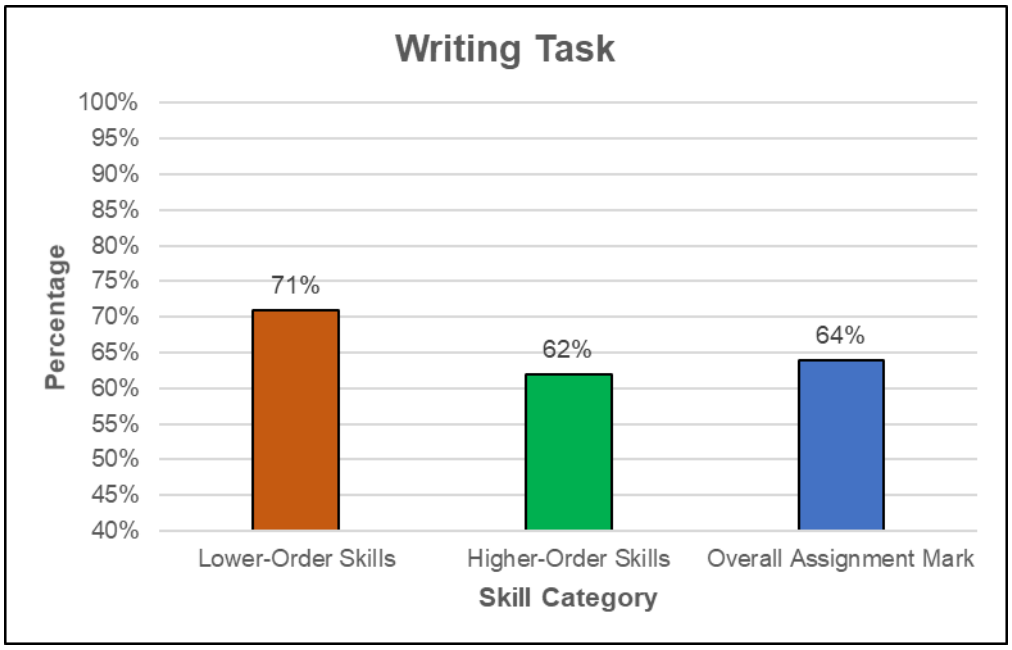
Criteria	Poor	Satisfactory	Good	Very good	Excellent
Formatting	**0 Points** JPO styles menu not applied	**1 Points** JPO styles menu applied, but missing some formatting details	**2 Points** JPO styles menu applied appropriately throughout (header, footer, heading, body text)	**0 Points** N/A	**0 Points** N/A
Document Length	**0 Points** One or both essays are far too long / too short	**1 Points** One or both essays are a bit too long / too short	**2 Points** Both essays are the correct length (Academic essay +/- 250 words; Reflective essay +/- 400 words)	**0 Points** N/A	**0 Points** N/A
Academic Essay: Sources	**0 Points** No sources of information used / strong evidence of plagiarism / sources very poorly integrated	**1 Points** Some sources of information, but not well-integrated throughout / jarring transition between sources and writers' own text / sources speak for the writer	**2 Points** Good use of sources but source integration needs some improvement / some sense of writer's voice but not entirely clear throughout	**3 Points** Good use of sources and well integrated into the text / writer's voice is clear	**0 Points** N/A
Academic Essay: Content	**0 Points** Totally irrelevant / not well researched	**1 Points** Some good aspects but repetitive or disconnected	**2 Points** Meets expectation / well developed	**0 Points** N/A	**0 Points** N/A
Academic Essay: Comparison of Disciplines	**0 Points** No comparison / very poorly executed	**1 Points** Some comparison but not well executed throughout / some dangling information	**2 Points** Comparison made and well executed throughout	**0 Points** N/A	**0 Points** N/A
Academic Essay: Structure	**0 Points** Essay disconnected and unstructured / no logical flow of ideas	**1 Points** Some good structural elements but not entirely logical throughout	**2 Points** Well structured and logical flow of ideas	**0 Points** N/A	**0 Points** N/A

Criteria	Poor	Satisfactory	Good	Very good	Excellent
Academic Essay: Tone, register and audience	**0 Points** Totally inappropriate use of tone and register / no awareness of audience	**1 Points** Inconsistent use of tone and register / some awareness of audience	**2 Points** Good use of tone and register / awareness of audience	**0 Points** N/A	**0 Points** N/A
Reflective Essay: Content	**0 Points** Totally irrelevant / no self-reflection	**1 Points** Some good aspects but generic and lacking in reflective elements	**2 Points** Good aspects but requires a bit more insight and reflection	**3 Points** Insightful, reflective and original / honest	**0 Points** N/A
Reflective Essay: Why Engineering?	**0 Points** Totally irrelevant / not discussed	**1 Points** Some discussion but generic and lacking in reflective elements	**2 Points** Discussed but requires a bit more insight and reflection	**3 Points** Insightfully discussed, reflective and original / honest	**0 Points** N/A
Reflective Essay: Comparison	**0 Points** No comparison between chosen discipline and second choice	**1 Points** Some comparison but mirrors academic essay / no reflection	**2 Points** Comparison made but requires a bit more insight and reflection	**3 Points** Insightful and honest comparison / reflective and original	**0 Points** N/A
Reflective Essay: Structure	**0 Points** Essay disconnected and unstructured / no logical flow of ideas	**1 Points** Mostly unstructured and poorly integrated, with limited logical flow of ideas	**2 Points** Some good structural elements but not entirely logical throughout	**3 Points** Fairly well structured and logical, but lacks some integration	**4 Points** Well structured and logical flow of ideas / content well integrated
Reflective Essay: Goal Setting	**0 Points** No goal setting / totally irrelevant	**1 Points** Some goal setting, but lacks depth of consideration	**2 Points** Fair goal setting, but limited consideration for short vs long term goals and the connection between these	**3 Points** Good goal setting and consideration for short and long term goals, and the connection between these, but requires more insight and reflection	**4 Points** Insightful and well considered short and long term goals / clear path laid for reader
Reflective Essay: Tone, register and audience	**0 Points** Totally inappropriate use of tone and register / no awareness of audience	**1 Points** Inconsistent use of tone and register / some awareness of audience	**2 Points** Good use of tone and register / awareness of audience	**0 Points** N/A	**0 Points** N/A
Language and Grammar: Sentences	**0 Points** Sentences poorly constructed throughout	**0.5 Points** Many poorly constructed sentences	**1 Points** A fair amount of poorly constructed sentences	**1.5 Points** A few poorly constructed sentences	**2 Points** No poorly constructed sentences

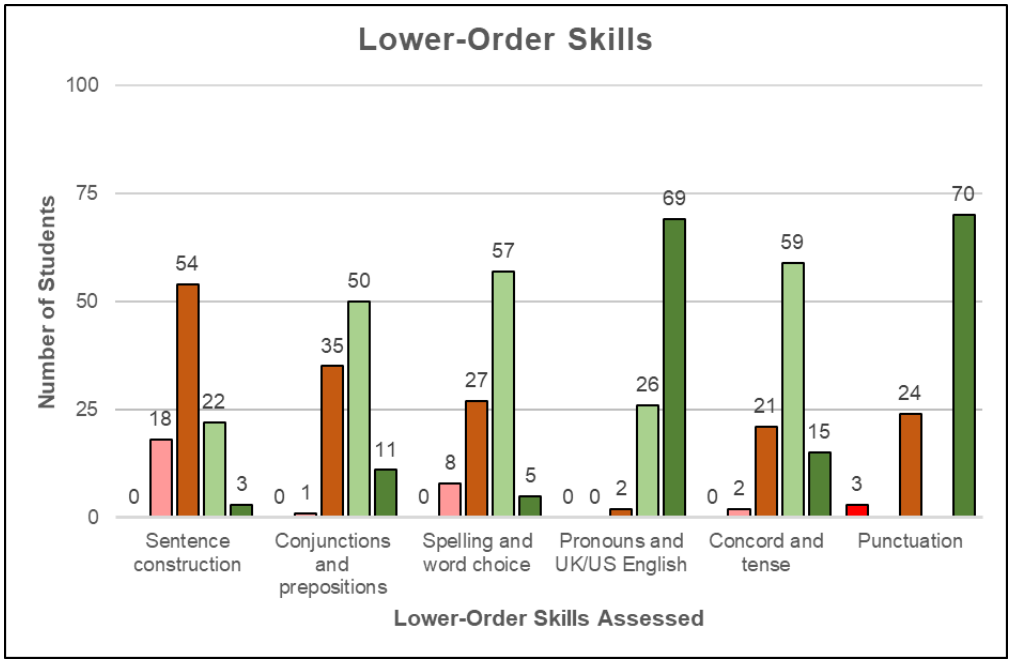
Criteria	Poor	Satisfactory	Good	Very good	Excellent
Language and Grammar: Conjunctions and prepositions	**0 Points** Incorrect use of conjunctions and prepositions throughout	**0.5 Points** Many errors with use of conjunctions and/or prepositions	**1 Points** A fair amount of errors with use of conjunctions and/or prepositions	**1.5 Points** A few errors with use of conjunctions or prepositions	**2 Points** No errors in use of conjunctions and prepositions
Language and Grammar: Spelling and word choice	**0 Points** Spelling and incorrect word choices regularly throughout	**0.5 Points** Many spelling errors and/or word choice errors	**1 Points** A fair amount of spelling and/or word choice errors	**1.5 Points** A few errors in spelling or word choice	**2 Points** No errors in spelling or word choice
Language and Grammar: Pronouns and UK/US English	**0 Points** Incorrect use of pronouns throughout and incorrect use of UK/US English conventions	**0.5 Points** Many errors in pronoun use and/or use of UK/US English conventions	**1 Points** A fair amount of pronoun errors and/or UK/US English conventions	**1.5 Points** A few errors in pronoun use or UK/US English conventions	**2 Points** No errors in pronoun use or UK/US English conventions
Language and Grammar: Concord and tense	**0 Points** Concord and tense errors throughout	**0.5 Points** Many concord and/or tense errors	**1 Points** A fair amount of concord and/or tense errors	**1.5 Points** A few concord or tense errors	**2 Points** No concord or tense errors
Language and Grammar: Punctuation	**0 Points** Punctuation errors throughout	**0.5 Points** A fair amount of punctuation errors	**1 Points** No punctuation errors	**0 Points** N/A	**0 Points** N/A
Overall Readability and Idiom	**1 Points** No/limited readability, use of idiom and coherence	**2 Points** Poor readability, use of idiom and overall coherence	**3 Points** Fair readability, use of idiom and overall coherence	**4 Points** Good readability, use of idiom and overall coherence	**5 Points** Excellent readability, use of idiom and overall coherence

Appendix D: Writing Task Results

Class Averages for the Writing Task

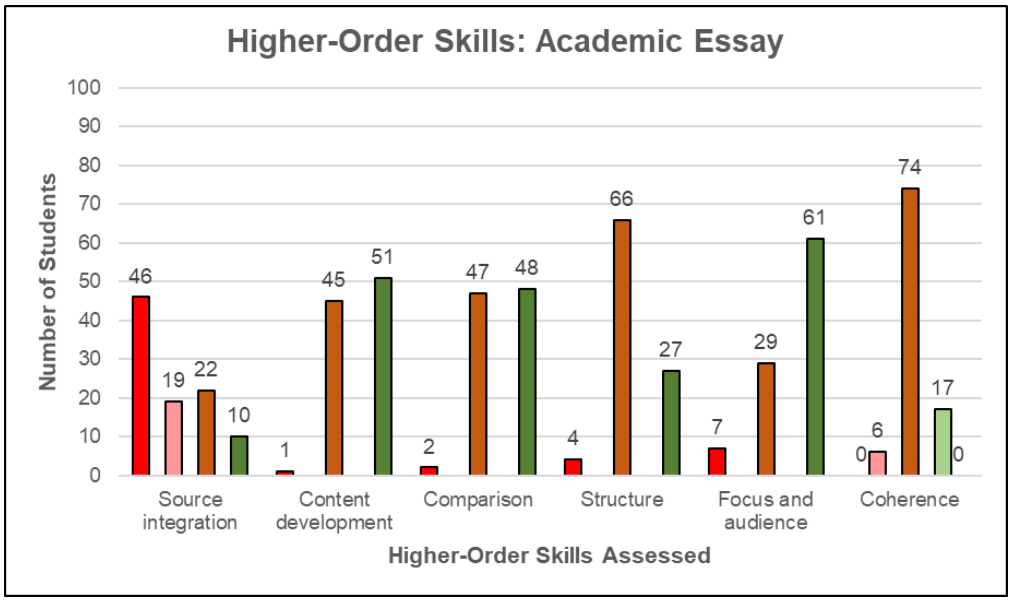


Class Averages for Lower-Order Skills



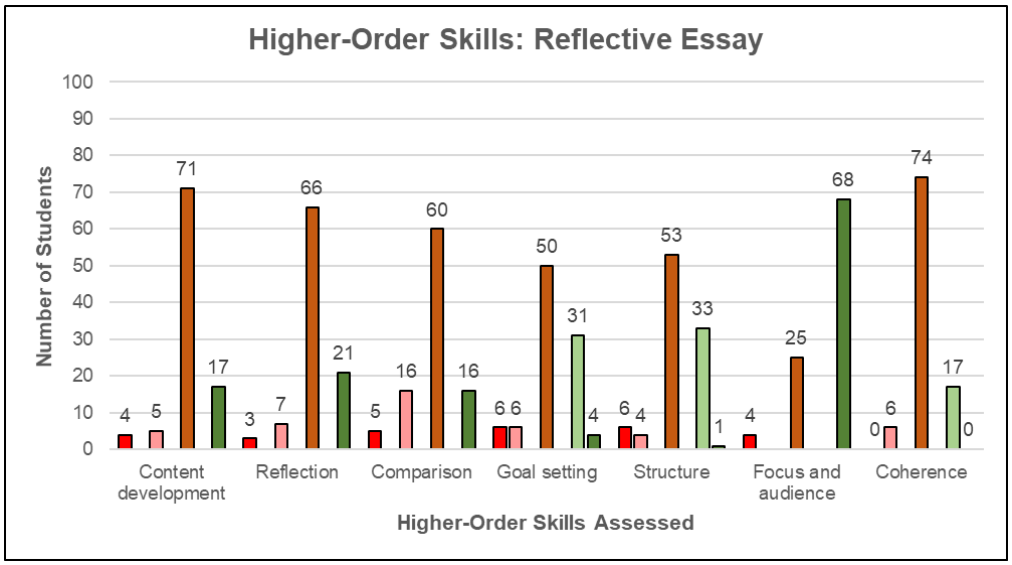
*Dark red = 0-24%; Light red = 25-49%; Orange = 50-75%; Light green = 75-99%; Dark green = 100%

Class Averages for Higher-Order Skills: Academic Essay



* Dark red = 0-24%; Light red = 25-49%; Orange = 50-75%; Light green = 75-99%; Dark green = 100%

Class Averages for Higher-Order Skills: Reflective Essay



* Dark red = 0-24%; Light red = 25-49%; Orange = 50-75%; Light green = 75-99%; Dark green = 100%

Appendix E: Individual Report Overview

"The University of Pretoria commits itself to produce academic work of integrity. I affirm that I am aware of and have read the Rules and Policies of the University, more specifically the Disciplinary Procedure and the Tests and Examinations Rules, which prohibit any unethical, dishonest or improper conduct during tests, assignments, examinations and/or any other forms of assessment. I am aware that no student or any other person may assist or attempt to assist another student, or obtain help, or attempt to obtain help from another student or any other person during tests, assessments, assignments, examinations and/or any other forms of assessment."

Ensure that you use a JPO styles Menu to create your report template and format your document. Dr Naidoo will guide you through this process.

Title

Subtitle

Compiled by: **Name Surname ########**

Professional Orientation (JPO 110)

23 June 2021

Keywords

A keyword is a word of significance in the text, or a word that you can search to find information on the topic. List five keywords here and separate them with a semi-colon (;)

Acknowledgements

An acknowledgement is a thank you note to the person(s) who helped or contributed to your project/report. If the acknowledgement is short, it can be on the same page as the Keywords. If you have a lengthy acknowledgement, rather have it on a separate page

Note: Do not type the table of contents and list of tables and figures. The table of contents and list of tables and figures are 'automatically' created **after** all the headings and captions are inserted in the report. ALWAYS **update them** all **after** completion of a report to ensure that the page numbers are correct.

In order to insert the Table of Contents, go to References, Table of Contents, Automatic Table 2. Do not type the details.

You will still have to further edit this at a later stage. Keep the Table of Contents on a separate page of its own.

Table of Contents

Keep the List of Tables and List of Figures on the same page. In order to do so go to References, Captions, Insert Table of Figures (edit to List of Tables). Repeat this process for your List of Figures.

List of Tables

List of Figures

2. Introduction

Here you provide your problem statement and respond to the 5 'Ws' (who, what, where, when, why). You can divide your introduction into four paragraphs, namely: problem statement, background, objectives, and overview.

- Problem statement – **golden thread**
- Background – **Who**? **Where**? **When**?
- Objectives – **Why**?
- Overview – **What**?

3. Reasons for Construction Failures

In this section you will provide a broad context explaining **why** construction failures occur, i.e., Identify the problem.

Use at least one source (remember to cite and reference your source/s).

4. Case Studies

This section will be divided into three sub-sections: Case Studies One, Two, Three. Here, you will first include an introductory paragraph to this section, i.e., Provide an overview of this section — **What** is going to be discussed in this section?

3.1 Case Study One: Foreshore Freeway

In this sub-section you will provide an overview and analysis of the Foreshore Freeway project and the reasons for its failure. Here you are going to use at least one source (remember to cite and reference your source/s) to respond to the following questions in the form of a paragraph/s:

Where is the Foreshore Freeway located?

Why would the Foreshore Freeway project be considered a failure?

What caused the project to fail?

Who were the stakeholders involved in the project?

When was the project started and how long has it been underway?

You must also include a figure in this sub-section (remember to cite and reference it) that shows the reader what the Foreshore Freeway looks like. (It must be relevant and enhance your discussion here.) Figure 1 (Unknown, 2020) is representative of a Professional Orientation student thinking about the report and its contents.

Figure 1: Thinking

3.2 Case Study Two: Grayston Bridge

In this sub-section you will provide an overview and analysis of the Grayston Bridge collapse and the reasons for its failure. Here you are going to use at least two sources (remember to cite and reference your sources) to respond to the following questions in the form of a paragraph/s:

Where is Grayston Bridge located?

Why would the Grayston Bridge project be considered a failure?

What caused the project to fail?

Who were the stakeholders involved in the project?

When did the project start and how long had it been underway before it failed?

To enhance your discussion, you may have to provide a diagram, table, or both.

3.3 Case Study Three: Injaka Bridge Failure

In this sub-section you will provide an overview and analysis of the Injaka Bridge failure and the reasons for this. Here you are going to use at least two sources (remember to cite and reference your sources) to respond to the following questions in the form of a paragraph/s:

Where was the Injaka Bridge located?

Why would the Injaka Bridge project be considered a failure?

What caused the project to fail?

Who were the stakeholders involved in the project?

When did the project start and how long was it underway before it failed?

To enhance your discussion, you may have to provide a diagram, table, or both.

5. Discussion

Here, you must **insert a table** (cite and reference your sources of information) which summarises the three case studies. Include the following information in your table: year of failure, root cause of the failure, consequence of failure.

Your table must look something like Table 1 (Foreshore Freeway, 2020; Grayston, 2015; Engineering News, s.a.).

Table 1: Example of a Table

Failure	Foreshore Freeway	Grayston Bridge	Injaka Bridge
Year			
Root Cause			
Consequence			

Then, contrast the consequences of the Grayston and Injaka Bridge collapses in the **form of a graph. This graph must demonstrate the number of people who were injured and killed in these bridge collapses. Hint:** you will first have to draw a table and then transform this into a graph.

Your graph must be completed in Excel and copied into your report, and it must be labelled as a Figure — Figure 2.

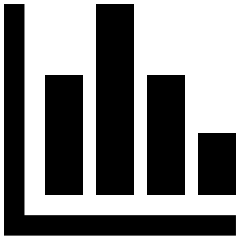


Figure 2: Example of a Graph

NB! You must introduce your table, include your table, and, finally, discuss the main ideas included in your table (i.e., **Why** is this information relevant?).

Then, you must introduce your graph, include your graph, and, finally, discuss the relevance of your graph (i.e., **Why** is this information relevant?).

6. Conclusion and Recommendations

In a paragraph, revisit the problem (**What** issue was explored in the report?), synthesise the main ideas from the report (**What** stood out in the discussion?), and state the relevance of these findings (**Why** are these findings relevant?)

Then, look at the ECSA exit-level outcomes and use these to formulate two recommendations for avoiding construction failures in the future.

7. References

Remember to use the Harvard referencing system to generate a list of the references you used in your report. You should have a minimum of **eight** sources.

Appendix F: Individual Report Rubric

Report Content

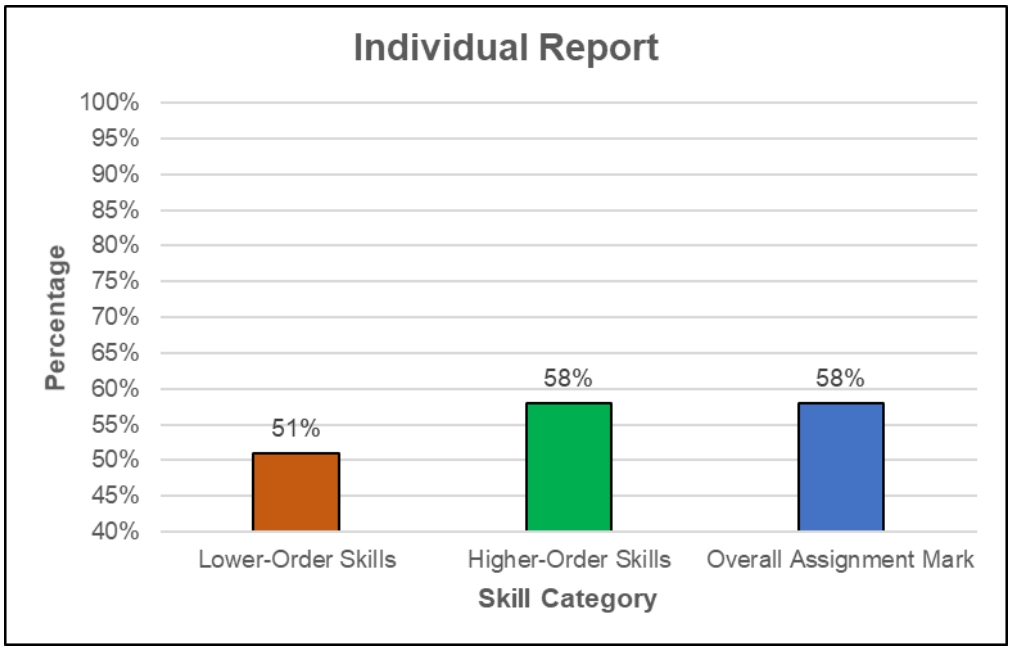
Criteria	Scales				
	Poor	Satisfactory	Good	Very Good	Excellent
Introduction Background: Provides context for the study by responding to Who? Where? When?	0.00 Does not provide context for the reader; misleading; vague; poorly integrated; poor response to Who? Where? When?	1.00 Provides some context for the reader, but vague and/or poorly integrated at times; satisfactory response to Who? Where? When?	2.00 Provides good context for the reader; well integrated; responds to Who? Where? When? questions	0.00 N/A	0.00 N/A
Introduction Objectives: Provides reasons for the study by responding to Why?	0.00 Does not offer objectives for the study; misleading; false; poorly integrated; poor response to Why?	1.00 Outlines some objectives for the reader, but vague and/or poorly integrated at times; satisfactory response to Why?	2.00 Outlines good objectives for the reader; well integrated; responds to Why?	0.00 N/A	0.00 N/A
Introduction Overview: Provides direction for the study by responding to What?	0.00 Does not offer direction for the study; misleading; vague; poorly integrated; poor response to What?	1.00 Provides some direction for the reader, but vague and/or poorly integrated at times; satisfactory response to What?	2.00 Provides good direction for the reader; well integrated; responds to What?	0.00 N/A	0.00 N/A
Section 2 Reasons for construction failures: Describes why construction failures occur	0.00 Does not offer a description as to why construction failures occur; misleading; vague; poorly integrated; does not refer to article provided	1.00 Offers a broad description as to why construction failures occur, but vague and/or poorly integrated; refers to article provided	2.00 Offers a fair description as to why construction failures occur; fairly well integrated; refers to and sources article provided	3.00 Offers a good description as to why construction failures occur; well integrated; refers to and sources article provided; integrates source well into the response	0.00 N/A
Section 3 Section introduction: Provides direction for the section that follows by responding to What?	0.00 Does not offer direction for the section; misleading; vague; poorly integrated; poor response to What?	1.00 Provides direction for the reader; responds to What	0.00 N/A	0.00 N/A	0.00 N/A

Section 3 Case Study One – Foreshore Freeway: Provides a good overview of the Foreshore Freeway project	0.00 Does not offer an overview of the Foreshore Freeway project; misleading; vague; poorly integrated; poor response to 5Ws	1.00 Offers a broad overview of the Foreshore Freeway Project, but vague and/or poorly integrated; refers to article provided; mediocre response to 5Ws	2.00 Offers a fair overview of the Foreshore Freeway project; fairly well integrated; refers to and sources article provided; satisfactory response to 5Ws	3.00 Offers a good overview of the Foreshore Freeway project; well integrated; refers to and sources article provided; integrates source well into the response; responds	4.00 Offers an excellent overview of the Foreshore Freeway project; well integrated; refers to and sources article provided; integrates source well into the response; responds
Section 3 Case Study Two – Grayston Bridge: Provides a good overview of the Grayston Bridge collapse	0.00 Does not offer an overview of the Grayston Bridge collapse; misleading; vague; poorly integrated; poor response to 5Ws	1.00 Offers a broad overview of the Grayston Bridge collapse, but vague and/or poorly integrated; refers to articles provided; mediocre response to 5Ws	2.00 Offers a fair overview of the Grayston Bridge collapse; fairly well integrated; refers to and sources articles provided; satisfactory response to 5Ws	3.00 Offers a good overview of the Grayston Bridge collapse; well integrated; refers to and sources articles provided; integrates sources well into the response; responds	4.00 Offers an excellent overview of the Grayston Bridge collapse; well integrated; refers to and sources articles provided; integrates sources well into the response; responds
Section 3 Case Study Three – Injaka Bridge failure: Provides a good overview of the Injaka Bridge failure	0.00 Does not offer an overview of the Injaka Bridge failure; misleading; vague; poorly integrated; poor response to 5Ws	1.00 Offers a broad overview of the Injaka Bridge failure, but vague and/or poorly integrated; refers to articles provided; mediocre response to 5Ws	2.00 Offers a fair overview of the Injaka Bridge failure; fairly well integrated; refers to and sources articles provided; satisfactory response to 5Ws	3.00 Offers a good overview of the Injaka Bridge failure; well integrated; refers to and sources articles provided; integrates sources well into the response; responds well to 5Ws	4.00 Offers an excellent overview of the Injaka Bridge failure; well integrated; refers to and sources articles provided; integrates sources well into the response; responds well to
Section 4 Discussion: Summarises, synthesises, compares, and contrasts three case studies	0.00 Does not discuss the three failures; misleading; vague; poorly integrated; poor response	1.00 Offers a broad discussion of the three failures, but vague and/or poorly integrated; summarises case studies	2.00 Offers a fair discussion of the three failures; fairly well integrated; refers to and sources articles provided; satisfactory discussion	3.00 Offers a good discussion of the failures; well integrated; refers to and sources articles provided; integrates sources well into the response; summarises, compares	4.00 Offers an excellent discussion of the three failures; well integrated; refers to and sources articles provided; integrates sources well into the response; summarises, synthesises,
Support Use of figures, tables and graphs	0.00 Does not incorporate supporting information into sections 3 and 4; does not use this to enhance discussion; poor attempt at using supporting information	1.00 Incorporates some supporting information into sections 3 and 4, but does not enhance discussion; mediocre attempt at using supporting information	2.00 Incorporates required supporting information into sections 3 and 4, but does not enhance discussion; satisfactory attempt at using supporting information	3.00 Incorporates required supporting information into sections 3 and 4; enhances discussion; fairly well integrated; good attempt at using supporting information	4.00 Incorporates supporting information well into sections 3 and 4; enhances discussion; well integrated; excellent attempt at using required and additional supporting information

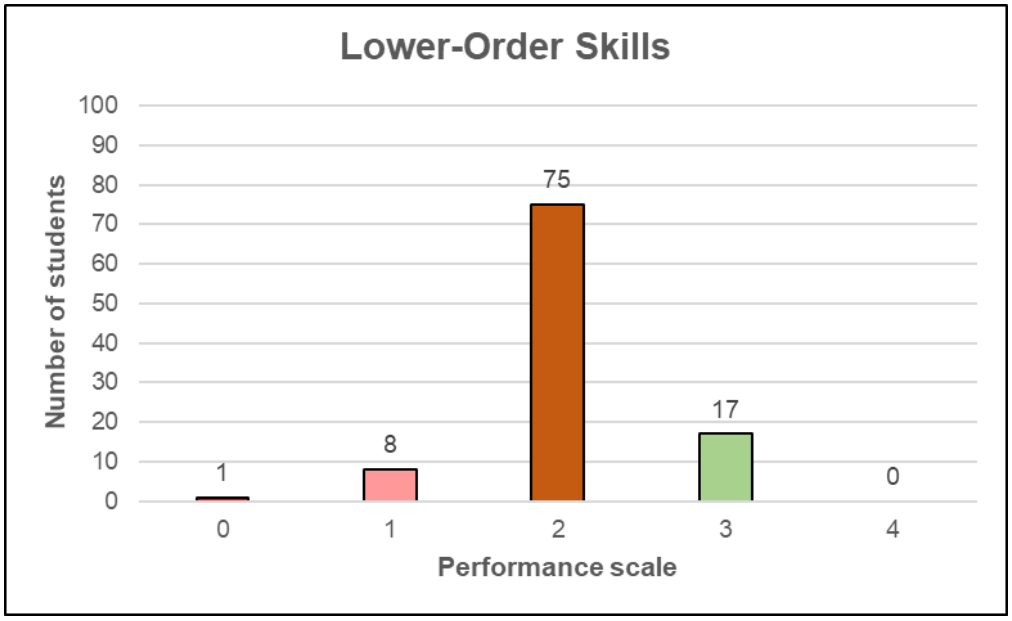
Conclusion Revisits the problem statement; synthesises main findings; states the relevance of the findings; offers recommendations	0.00 Does not offer a conclusion; vague; poorly integrated; poor attempt at drawing conclusion	1.00 Offers a mediocre conclusion; no recommendations; vague	2.00 Offers a fair conclusion; vague response to all criteria; reasonably well integrated; some attempt at offering recommendations	3.00 Revisits the problem statement; summarises main findings; highlights relevance of findings; offers recommendations based on ECSA outcomes; could be more	4.00 Revisits the problem statement; summarises main findings; highlights relevance of findings; offers recommendations based on ECSA outcomes; well integrated
Sources Sources have been integrated, cited, and referenced using the Harvard style	0.00 Sources not well integrated; no citations / not cited correctly; no reference list / incorrect referencing style used; evidence of plagiarism	1.00 Sources not well integrated; citations inaccurate / inaccurately places; reference list incomplete / inaccurate; citations do not match references	2.00 Sources integrated; does not include eight references; citations and references match but not done correctly	3.00 Sources integrated; includes eight references; citations and references match; small errors in spelling or grammar	4.00 Sources integrated; includes all relevant references; citations and references match; Harvard style applied accurately; no spelling or grammar mistakes; no signs of
Coherence Style, tone, register and audience	0.00 Informal; inappropriate; no integration; no audience awareness; generally poorly constructed	1.00 Semi-formal; some attempt at integration and awareness of audience	2.00 Formal; fairly well integrated; aware of audience; coherent	3.00 Formal; appropriate throughout; well integrated throughout; aware of audience; coherent	0.00 N/A
Composition Spelling, grammar, word choice, sentence construction, punctuation, tenses, concord	0.00 Numerous mistakes throughout	1.00 Many mistakes throughout	2.00 A few mistakes throughout	3.00 Very few mistakes throughout	4.00 No mistakes throughout

Appendix G: Individual Report Averages

Class Averages for the Individual Report

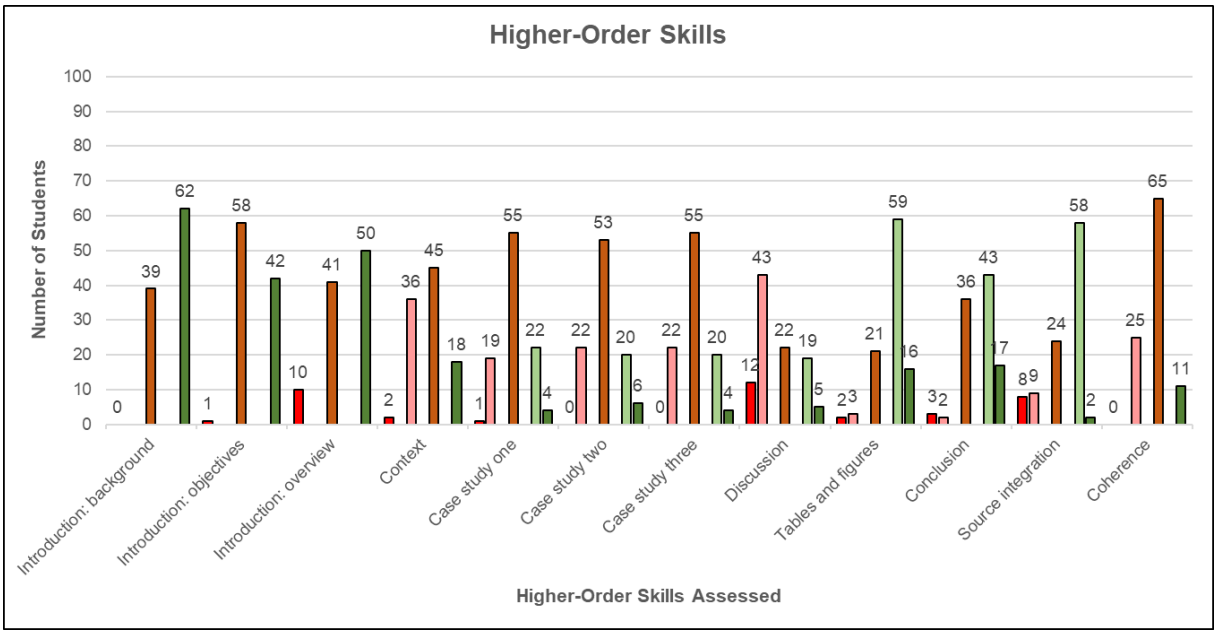


Class Averages for Lower-Order Skills



*Dark red = 0-24%; Light red = 25-49%; Orange = 50-75%; Light green = 75-99%; Dark green = 100%

Class Averages for Higher-Order Skills



*Dark red = 0-24%; Light red = 25-49%; Orange = 50-75%; Light green = 75-99%; Dark green = 100%

Appendix H: Opinion Piece Rubric

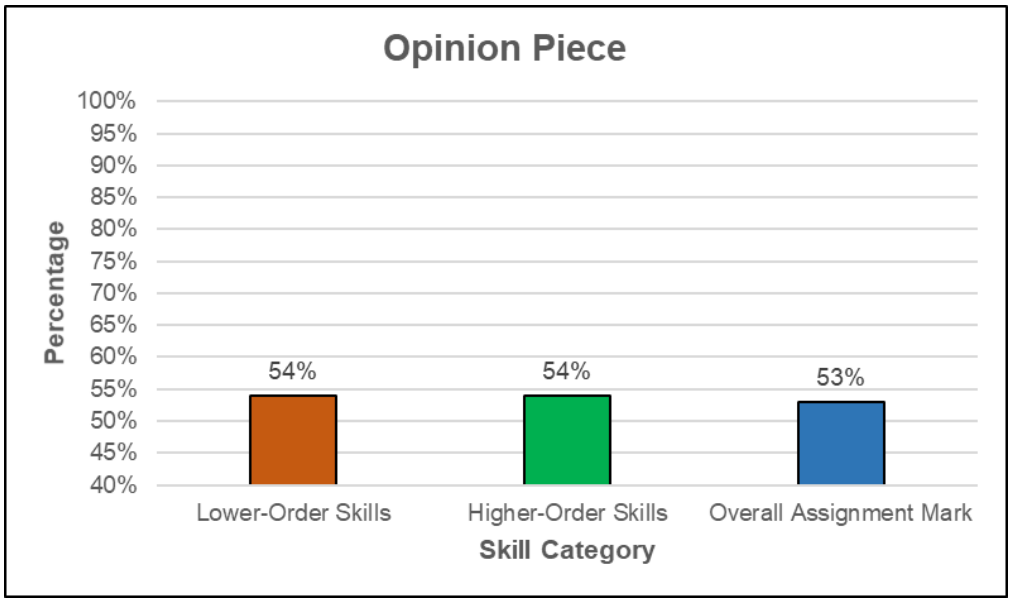
Criteria	Scales					
	Scale 1	Scale 2	Scale 3	Scale 4	Scale 5	Scale 6
Planning Text mapping and unpacking	0.00 No planning / Very poor / Not useful	1.00 Poor planning / Does not offer direction	2.00 Mediocre planning / Offers limited direction	3.00 Satisfactory planning / Offers fair direction	4.00 Good planning / Offers good direction	5.00 Excellent planning / Offers excellent direction
Essay Content Use of information and resources provided	0.00 Information/Resources not applied / Irrelevant	1.00 Information is largely irrelevant / Resources applied to a limited extent	2.00 Information is relevant but limited / Opinion unformulated	3.00 Information is relevant and sufficient / Opinion requires further validation	4.00 Information is relevant and detailed / Opinion is well formulated / Integration could be better	5.00 Information is relevant, sufficient, and detailed / Opinion is well formulated / Discussion is well integrated
Argumentation Use of facts to formulate a convincing argument	0.00 No comparison or argument offered	1.00 Limited comparison / Argument is weak	2.00 Some comparison / Argument is mediocre	3.00 Fair comparison / Argument is satisfactory	4.00 Good comparison / Clear train of thought and argumentation	5.00 Excellent comparison / Clear train of thought and argumentation / Convincing
Sources Sources have been integrated, cited, and referenced using the Harvard style	0.00 Sources not well integrated / no citations / not cited correctly / no references / incorrect referencing style / evidence of plagiarism	1.00 Sources not well integrated / citations inaccurate / reference list incomplete / citations do not match references	2.00 Sources integrated to some extent / does not include three sources / citations and references match, but incorrect style used	3.00 Sources integrated / includes three sources / citations and references match, but not completed correctly	4.00 Sources integrated / includes minimum number of sources / citations and references match, but small mistakes	5.00 Sources integrated / includes minimum number of sources / no evidence of plagiarism / no mistakes
Composition Language factors such as spelling, grammar, word choice, sentence construction, punctuation, tenses, concord	0.00 Numerous mistakes throughout / numerous types of mistakes	1.00 Many mistakes throughout / different types of mistakes	2.00 A few mistakes throughout / a few different types of mistakes	3.00 Limited mistakes throughout / limited types of mistakes	4.00 Very few mistakes throughout / only one type of mistake	5.00 No mistakes throughout
Coherence Cohesion and coherence and factors such as style, tone, register, audience, argument development, overall structure	0.00 Informal / inappropriate / no integration / limited awareness of the audience / poorly constructed	1.00 Semi-formal / limited integration / limited audience awareness / mediocre construction	2.00 Inconsistent style / some integration / some awareness of the audience / inconsistent construction	3.00 Consistent style / fair integration / awareness of the audience / fair construction	4.00 Consistent style / good integration / awareness of the audience / good construction	5.00 Excellent use of style / well integrated / consistent awareness of the audience / very well constructed

Total Score: --/30

Apply to Grade | Close

Appendix I: Opinion Piece Averages

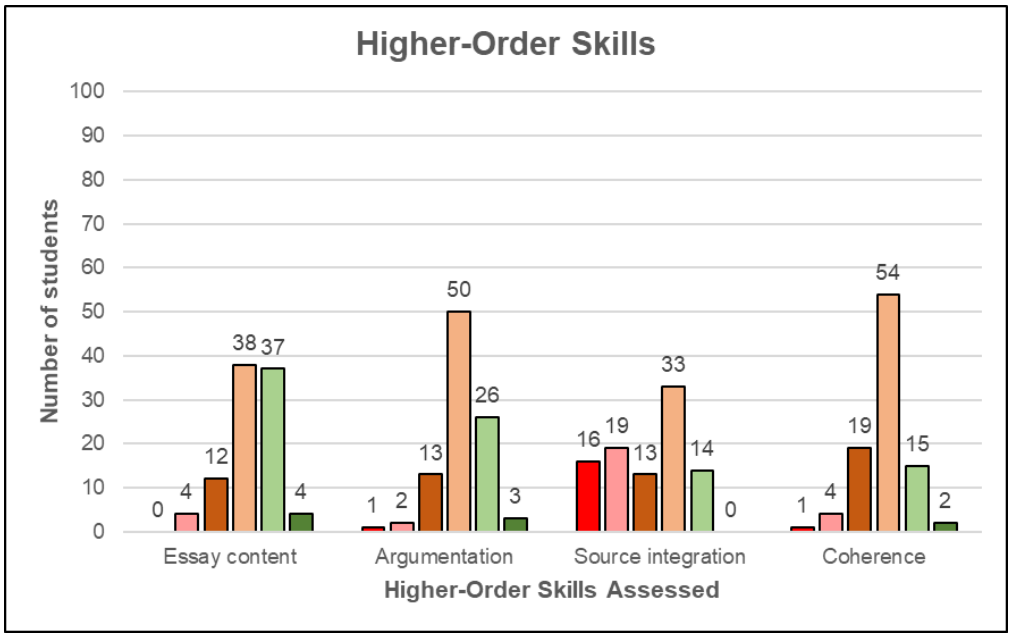
Class Averages for the Opinion Piece



Class Averages for Lower-Order Skills

*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

Class Averages for Higher-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

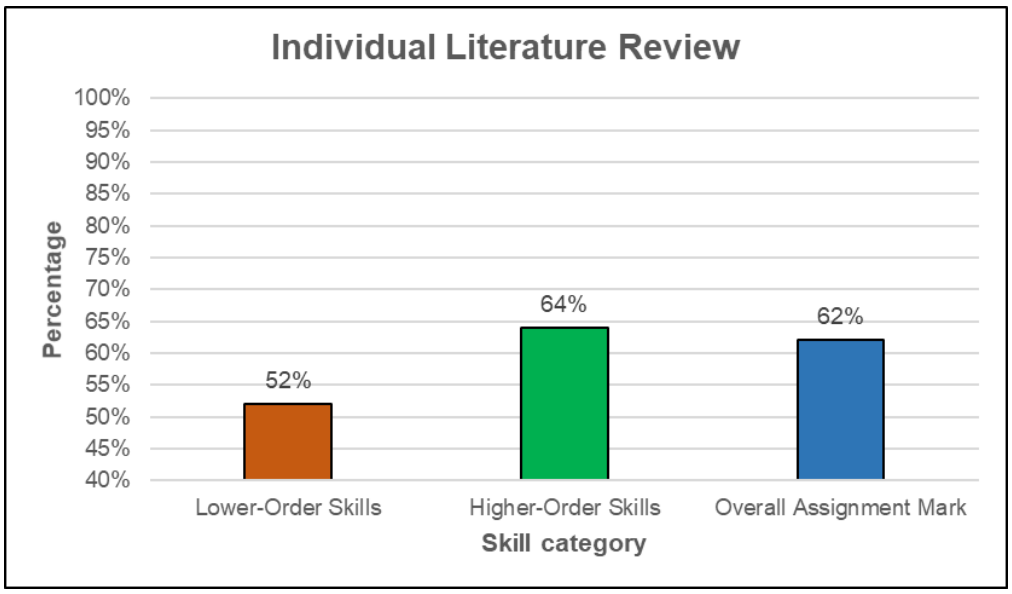
Appendix J: Individual Literature Review Rubric

Name: Grade: /21

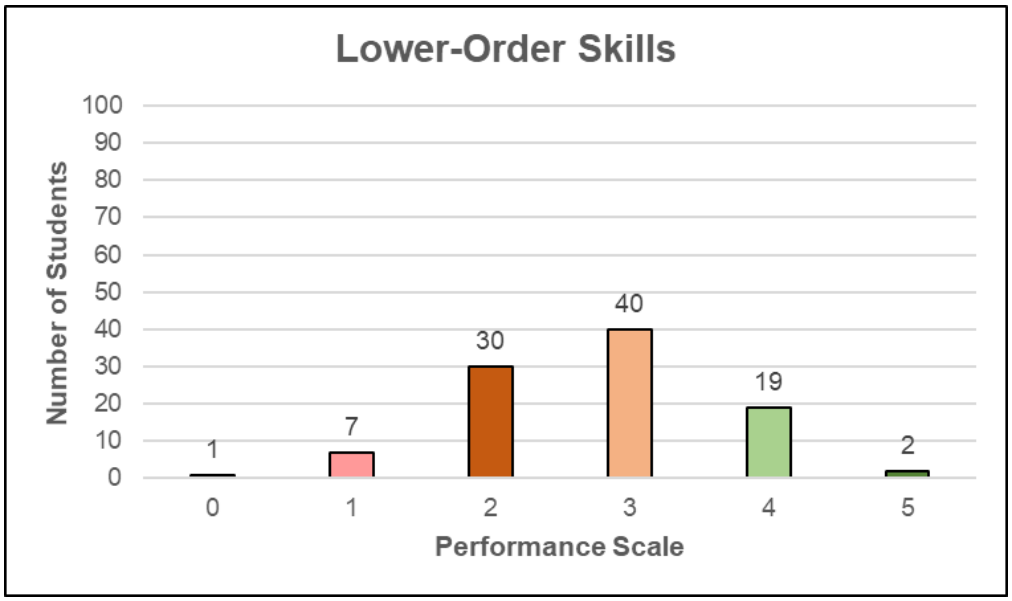
Criteria	Scales					
	Scale 1	Scale 2	Scale 3	Scale 4	Scale 5	Scale 6
Structural	0.00 Team topic not introduced	1.00 Team topic introduced	2.00 Team topic introduced, individual perspective clear	3.00 Team topic introduced, individual perspective clear, trends identified	4.00 Team topic introduced, individual perspective clear, trends identified and linking to other research perspectives	0.00
Content	0.00 Not done	1.00 Below average response Irrelevant, vague, insufficient information, research perspective unclear	2.00 Acceptable Average response Generalised answer to research question, generic perspective and information	2.50 Satisfactory Average response Better developed and relevant answer to research question, clear research perspective	3.00 Above average: Good response Well-developed answer to relevant research question, insightful information included, 5 references/sources used	4.00 Above average: Excellent response Very well-developed answer to relevant research question, interesting and insightful information included, more than 5
Sources	0.00 No evidence of sources used	1.00 Harvard style used	1.50 Harvard style Alphabetical order	2.00 Harvard style Alphabetical order Variety of sources	2.50 Harvard style Alphabetical order Variety of sources Citatations	3.00 Harvard style Alphabetical order Variety of sources Citations Citations match reference list
Composition	0.00 Numerous mistakes throughout/numerous types of mistakes	1.00 Many mistakes throughout/many different types of mistakes	2.00 A few mistakes/ a few different types of mistakes	3.00 Limited mistakes throughout/ limited types of mistakes	4.00 Very few mistakes throughut/ only one type of mistake	5.00 No mistakes throughout
Coherence	0.00 No integration/informal/ inappropriate/limited awareness of audience/poorly constructed	1.00 Limited integration/Semi formal/limited audience awareness/mediocre contruction	2.00 Inconsistent style/ some integration/some awareness of the audience/inconsistent contruction	3.00 Consistent style/ fair integration/awareness of the audience/fair construction	4.00 Consistent style/ good integration/clear awareness of the audience/good construction	5.00 Excellent use of style/ well-integrated/consistent awareness of the audience/ very well constructed

Appendix K: Individual Literature Review Averages

Class Averages for the Individual Literature Review

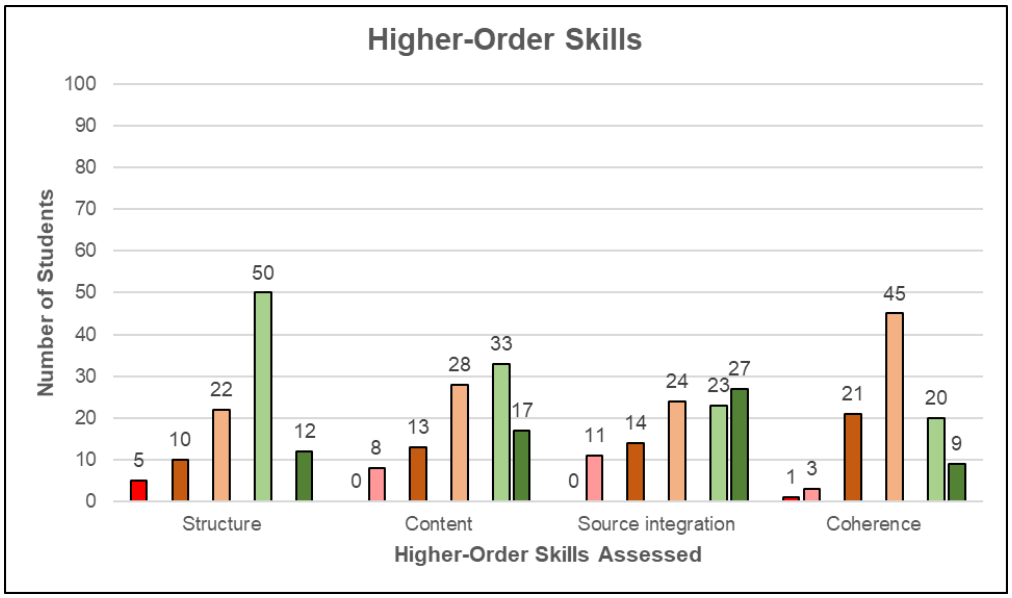


Class Averages for Lower-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

Class Averages for Higher-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

Appendix L: Final Individual Report Test Paper

University of Pretoria

School of Engineering

Professional Orientation
JPO 120

Semester 2 Test 2

30 October 2021
Time: 3.5 hrs
Maximum marks: 110

Instructions:

1 Your test will evaluate your report writing skills, and includes two sections, namely:
- Section A: Comprehension (35 marks) available for 75 minutes from 07h30 to 08h45
- Section B: Report (75 marks) available for 135 minutes from 08h45 to 11h00

2 These sections will be completed in different formats via different clickUP platforms, which you can find under the semester test folder in clickUP. They are:
- clickUP test
- Turnitin submission

3 In order for your test submissions to count as valid, you need to **complete** the **plagiarism declaration** provided and available in the 'Semester 2 Test 2' folder.

By signing the plagiarism declaration, you are accepting the following:

> *"The University of Pretoria commits itself to produce academic work of integrity. I affirm that I am aware of and have read the Rules and Policies of the University, more specifically the Disciplinary Procedure and the Tests and Examinations Rules, which prohibit any unethical, dishonest or improper conduct during tests, assignments, examinations and/or any other forms of assessment. I am aware that no student or any other person may assist or attempt to assist another student, or obtain help, or attempt to obtain help from another student or any other person during tests, assessments, assignments, examinations and/or any other forms of assessment."*

4 Once you have completed the test, make sure that you upload your documents to the correct folder.

5 Each section of the test will be open for the time periods specified under point 1. Thereafter, the given section will become unavailable and you will move on to the next section. There are only two sections in this test, and Section A will serve as preparation for Section B.

6 All lecturers for JPO 120 are available via email from 07h30 to 11h00 on the day of the test. You may submit your queries to the following:
- clickUP test and report content – lauren.fouche@up.ac.za and erika.muller@up.ac.za
- Report technical – saloshana.naidoo@up.ac.za

GOOD LUCK 😊

Section A: Comprehension

The information you gather in this section of the test will be used to complete a report in Section B of the test.

Instructions

You have 30 minutes to skim, scan, and familiarise yourselves with the following sources of information:

Reading Sources

1. Gamera Case Study
2. Aerovelo Article
3. Aerovelo Technical

Images

1. Gamera Design CAD
2. Aerovelo Size (1)
3. Aerovelo Size (2)

YouTube clip

1. Aerovelo Flight

Then, complete the clickUP test titled 'Section A: Comprehension'. You will have 45 minutes to complete this section of the test.

Sub-total for Section A: 35 marks

Section B: Technical report

Section A has provided you with all of the background understanding you will need to compile a report on the differences between the Gamera and Aerovelo human-powered helicopter designs. The purpose of this report is to provide information on the reasons why Aerovelo won the Sikorsky Prize with their Atlas helicopter and the Gamera did not with their design. Thus, you are responding to the following research question:

Why did team Aerovelo (with the Atlas) win the Sikorsky Prize and not team Gamera?

You have 135 minutes (2 hours and 15 minutes) to complete this section of the test.

Instructions

Copy the report layout template into a blank JPO styles menu to compile a report that subscribes to the format taught to you in JPO 110 and 120. Your report must include the following:

- A title page
- Editorial pages
- A literature review
- A reference list

Use the following activities to help guide you through the process.

Activity 1: Title page

1.1 Use the format prescribed in JPO 110 and 120 to create a title page that includes the following important information: (4)

- Name and surname
- Student number
- Report title
- Submission date

Activity 2: Editorial page

2.1 Include the following information on your editorial page (if applicable). Make sure that you format your page according to the JPO 110 and 120 report conventions you were taught. (4)

- Table of Contents
- List of Figures
- List of Tables

Activity 3: Literature review

3.1 Introduction: Use the information that you gathered and your understanding of the topic to write a cohesive and coherent introduction to your report. You must apply what you were taught by your JPO 110 and 120 lecturers about writing an introduction to a report. (5)

3.2 Body: Use the information that you gathered in 'Section A: Comprehension' to compile the body of your literature review. The body of your literature review must be divided into the following sections: (31)

The Design of the Gamera

In the form of cohesive and coherent paragraphs, answer the following in this section:

What is the design of the Gamera?

Who was responsible for this design?

Where was this design developed?

When was this design developed?

Why was it designed this way?

The Design of the Atlas

In the form of cohesive and coherent paragraphs, answer the following in this section:

What is the design of the Atlas?

Who was responsible for this design?

Where was this design developed?

When was this design developed?

Why was it designed this way?

Comparison between Gamera and Aerovelo

In the form of cohesive and coherent paragraphs, try to articulate the reasons as to why team Aerovelo was more successful with their aircraft design than team Gamera.

It is important that the body of your report is coherent and logical.

3.3 In order to 'flesh out' your report and make it more legible to your reader, insert the following:

(21)

A table

Use a table to represent some of your information so that it is easier for your reader to interpret. Use JPO styles conventions to format your table.

For example, a table in which you compare some of the design elements of the Gamera to those of the Atlas.

A bulleted list

Use a bulleted list to represent some information that is easier for your reader to interpret in this form.

For example, design details.

A figure

Select one of the provided images and insert it into your document in the form of a figure to enhance one of your sub-sections. Use JPO styles conventions to format your figure.

3.4 Write a concluding section to the report by synthesising, "pulling together", all information discussed in the different sections. Again, apply the conclusion writing strategies you were taught in JPO 110 and 120. (5)

Activity 4: Referencing

4.1 Use the Harvard referencing method to complete the following: (5)

a) Citations to all of the information that you got from the sources provided and included in your report.

b) A Harvard style reference list that includes each of the references you used in your report.

Sub-total for Section B: 75 marks

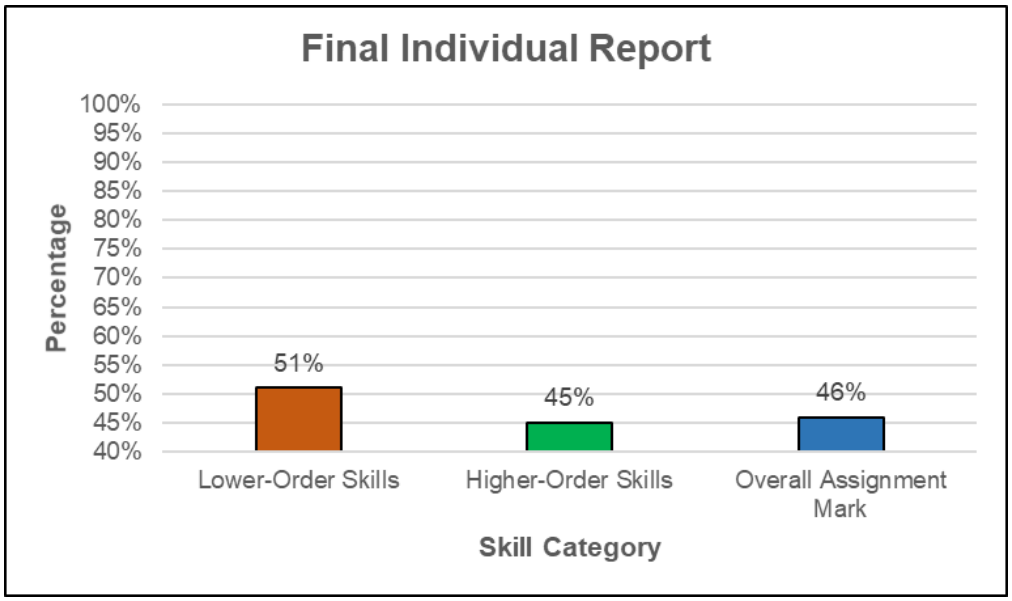
Appendix M: Final Individual Report Rubric

Criteria	Scales					
	Scale 1	Scale 2	Scale 3	Scale 4	Scale 5	Scale 6
Introduction Contextualises the report; responds to 5 Ws (background, objectives, and overview); logical	0.00 Not done / incoherent / off topic / does not provide context for the report	1.00 Provides limited context / largely incoherent / background, objectives, and overview remain largely undetermined	2.00 Provides some context to the report / mostly coherent / limited background, objectives, and overview / could be further developed	3.00 Provides context to the report / coherent / aspects of the background, objectives and overview are lacking / could be further extended	4.00 Provides context to the report / coherent / provides background, objectives and overview / small areas for improvement	5.00 Provides context to the report / coherent / provides background, objectives and overview / no areas for improvement / excellent introduction
Gamera Responds to the 5 Ws; coherent; logical	0.00 Not done / incoherent / off topic / does not outline the design of the Gamera	1.00 Provides limited information on the design of the Gamera / largely incoherent / research questions remain largely unanswered	2.00 Provides some information on the design of the Gamera / mostly coherent / limited response to research questions provided	3.00 Provides information on the design of the Gamera / coherent / some aspects of the research questions provided remain unclear / could be further extended	4.00 Provides information on the design of the Gamera / coherent / responds to research questions provided / small areas for improvement	5.00 Provides information on the design of the Gamera / coherent / responds to research questions provided / no areas for improvement / excellent discussion
Atlas Responds to the 5 Ws; coherent; logical	0.00 Not done / incoherent / off topic / does not outline the design of the Atlas	1.00 Provides limited information on the design of the Atlas / largely incoherent / research questions remain largely unanswered	2.00 Provides some information on the design of the Atlas / mostly coherent / limited response to research questions provided	3.00 Provides information on the design of the Atlas / coherent / some aspects of the research questions provided remain unclear / could be further extended	4.00 Provides information on the design of the Atlas / coherent / responds to research questions provided / small areas for improvement	5.00 Provides information on the design of the Atlas / coherent / responds to research questions provided / no areas for improvement / excellent discussion
Comparison Compares team Gamera to team Aerovelo; explains why Aerovelo did better; coherent; logical	0.00 Not done / incoherent / off topic / does not explain why Aerovelo beat Gamera	1.00 Provides limited comparison / largely incoherent / still unclear as to why Aerovelo beat Gamera	2.00 Provides some comparison / mostly coherent / limited explanation as to why Aerovelo beat Gamera	3.00 Provides a comparison / coherent / some aspects of the reason as to why Aerovelo beat Gamera remain unclear / could be further extended	4.00 Provides a comparison / coherent / explains why Aerovelo beat Gamera / small areas for improvement	5.00 Provides a comparison / coherent / explains why Aerovelo beat Gamera / no areas for improvement / excellent discussion
Support Includes supporting details (table, list, figure); enhances content; relevant; logical; accurate	0.00 Not done / supporting information not well integrated / does not enhance content	1.00 Supporting information included to a limited extent / not as well integrated as it could be / enhances content to a limited extent	2.00 Supporting information included to some extent / some integration / enhances content to some extent	3.00 Supporting information included to the required extent / some integration / enhances content to an extent / requires some improvement	4.00 Supporting information included to the required extent / integrated / enhances content / requires small improvements	5.00 Supporting information included to the required extent / well integrated / enhances content / no areas for improvement / excellent use of supporting information

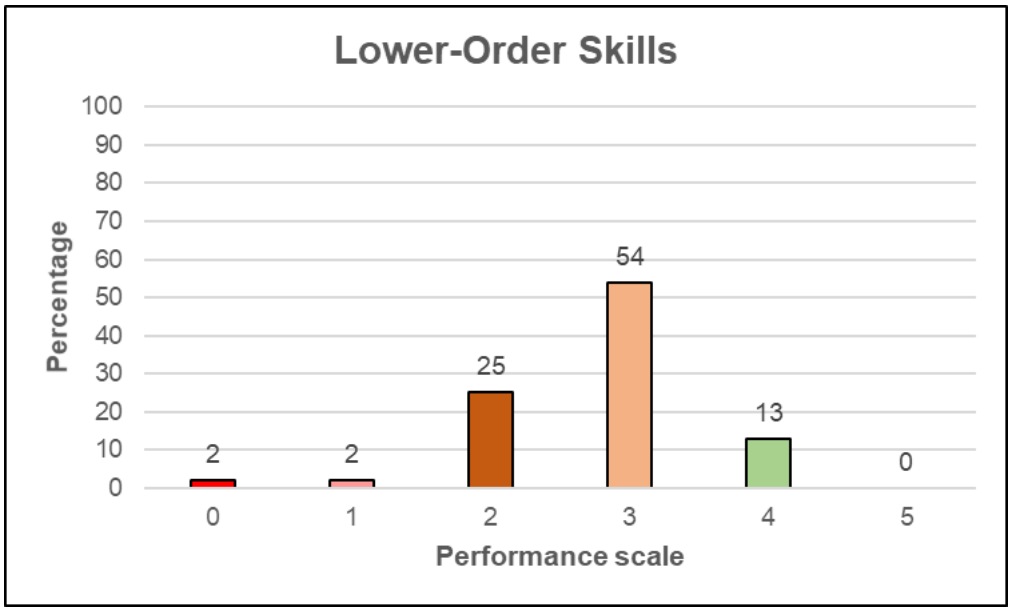
Conclusion Synthesises relevant report content; ties up loose ends; provides no new information; logical	0.00 Not done / incoherent / off topic / does not conclude the report as required	1.00 Provides limited conclusion / largely incoherent / synthesis and conclusion to report remain largely unsatisfactory	2.00 Provides some conclusion to the report / mostly coherent / limited synthesis and concluding factors / could be further developed	3.00 Provides a conclusion to the report / coherent / aspects of the synthesis and conclusion lacking / could be further extended	4.00 Provides a conclusion to the report / coherent / provides synthesis and concluding factors / small areas for improvement	5.00 Provides a conclusion to the report / coherent / provides synthesis and concluding factors / no areas for improvement / excellent conclusion
Sources Sources have been integrated, cited, and referenced using the Harvard style	0.00 Sources not well integrated / no citations / not cited correctly / no references / incorrect referencing style / evidence of plagiarism	1.00 Sources not well integrated / citations inaccurate / reference list incomplete / citations do not match references	2.00 Sources integrated to some extent / does not include three sources / citations and references match, but incorrect style used	3.00 Sources integrated / includes three sources / citations and references match, but not completed correctly	4.00 Sources integrated / includes minimum number of sources / citations and references match, but small mistakes	5.00 Sources integrated / includes minimum number of sources / no evidence of plagiarism / no mistakes
Coherence Cohesion and coherence and factors such as style, tone, register, audience, argument development, overall structure	0.00 Informal / inappropriate / no integration / limited awareness of the audience / poorly constructed	1.00 Semi-formal / limited integration / limited audience awareness / mediocre construction	2.00 Inconsistent style / some integration / some awareness of the audience / inconsistent construction	3.00 Consistent style / fair integration / awareness of the audience / fair construction	4.00 Consistent style / good integration / awareness of the audience / good construction	5.00 Excellent use of style / well integrated / consistent awareness of the audience / very well constructed
Composition Language factors such as spelling, grammar, word choice, sentence construction, punctuation, tenses, concord	0.00 Numerous mistakes throughout / numerous types of mistakes	1.00 Many mistakes throughout / different types of mistakes	2.00 A few mistakes throughout / a few different types of mistakes	3.00 Limited mistakes throughout / limited types of mistakes	4.00 Very few mistakes throughout / only one type of mistake	5.00 No mistakes throughout

Appendix N: Final Individual Report Averages

Class Averages for the Writing Task

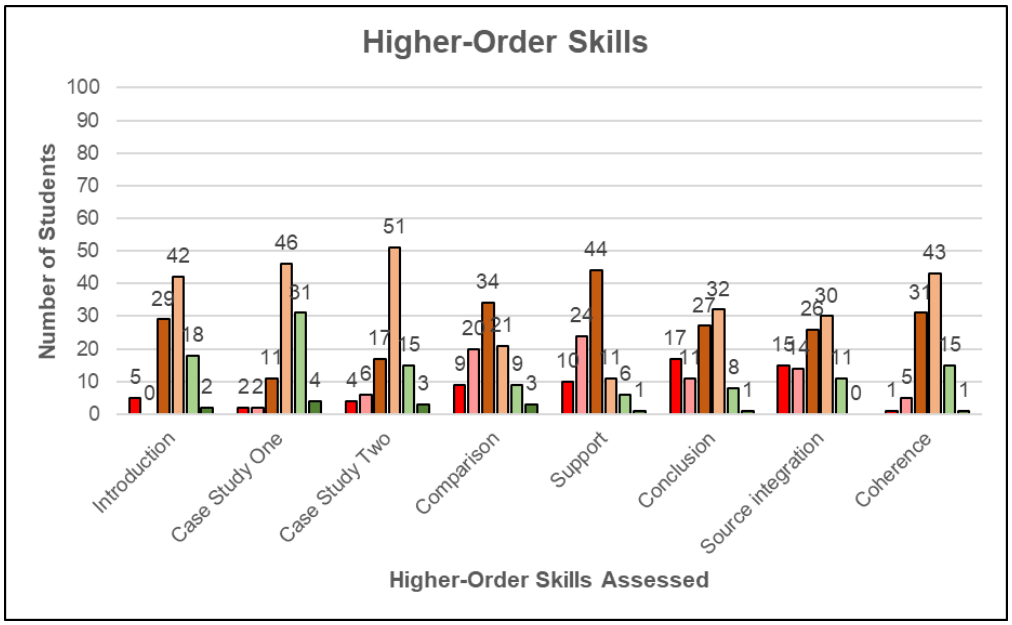


Class Averages for Lower-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

Class Averages for the Higher-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

Appendix O: Team Report Instructions

LEGO Final Report

Compile a team report on the LEGO project. Use the information in this document to guide you towards the compilation of the final report. An **e-copy** of the report must be submitted on **Friday, 19 November by 17h00**, by the team's **project coordinator** to the Turnitin link provided. Save the document as **Group#Team#_LEGOReport**.

Guidelines

1. Just as the whole team had to help develop the initial concept and final Mecabricks design, so too does the whole team have to help write the report. **All team members** are involved in and contribute to **each part** of the report.

2. The details of the winning team's crane in each group will be shared by Friday, 12 November on clickUP. Use this information to draw a comparison between your team's crane and the winning crane design. (Winning teams, compare your crane with the winning crane design from the other group.)

3. Note that, in order to avoid plagiarism, a Turnitin link will be used. You must be sure that you have eliminated plagiarism when you submit the final document. The whole team will be held responsible for any plagiarism found in the report.

Your Document

Use a JPO Styles Menu to compile a final LEGO report. This report must include the relevant technical requirements of a report and contain the sections outlined in Table 1.

Table 1: Report Sub-Sections

Headings in report	Instructions to complete the report
EBIT Cover Page	Add and complete an EBIT Team Cover Page to the start of your report.
Title page	Add the usual contents of a title page. Add the role, name and student number of each team member, in that sequence. Use tabs to align the information. **Example:** Project manager Jack Parrot 12345678
Keywords, Acknowledgements, Table of contents, List of figures, List of tables	Set up the editorial section of the report. Remember to update it when you finalise the report. Apply the same formatting you used in the Construction Failures report in semester 1.
1. Introduction	Must include (not necessarily in this sequence): Background (who, where, when) Aims and objectives (why). Keep in mind that, while the aim is to design a LEGO crane, the project also has educational aims. Overview (what) You may choose if you would like to use sub-headings or not in this section. If you choose to use sub-headings, make sure that you are consistent.
2. Literature review	Improve your combined literature review by applying the feedback that you received on your first draft. Eliminate any instances of plagiarism. Remember that this section should not exceed 1 800 words.
3. Method	Briefly describe the stages of the LEGO project. Insert a flow/process diagram to help you summarise and explain the CDIO framework within which you worked. Furthermore, add information regarding the rules, specifications, and limitations applicable to the project. This information should serve to introduce this section of the report, which includes planning, apparatus, and design development.
3.1. Planning	Briefly describe the composition of the team, and completion of the tutorial, concept design and concept defence in preparation for the final design development, as well as the time schedule that was followed.
3.2. Apparatus	Briefly describe the apparatus (Mecabricks itself and LEGO piece outline) used and include relevant images of the apparatus. Focus on the pieces that were pertinent to the success of your final design (for

	example, gear sizes, pulley wheels, and supporting beams).
3.3. Final design	Write a paragraph in which you highlight the difference(s) between your team's initial concept and the final design. Use your LEGO design document to inform your discussion in this section and use images (in the form of figures) to enhance your discussion.
3.4 Final design comparison	Look at your group's winning crane design and compare their concept development and final design to your team's. In the form of cohesive and coherent paragraphs, make sure that you respond to the following in your discussion: Who: Who is the winning team? Where: How has their design evolved from beginning to end? When: In which phase/s did the most significant changes to each of the designs occur (yours and the winning team's)? What: In what ways is their design similar to / different from your team's? Why: In what ways and why is this design better / worse than your team's design?
4. Results	Set up a **graph** in Excel (either line, bar or column) with the proposed final lifting weights for the LEGO teams in your group, and the average proposed performance for the group. Copy your graph into your report document and indicate your position on the graph. Then, unpack the important contents of the graph in writing. Explain why you achieved your position, what trends you can observe in the data, what important differences/similarities exist between the teams, and where there might be possible errors in the calculations.
5. Discussion	Briefly introduce this sub-section of your report.
5.1. Discussion – Results	In a **paragraph**, analyse and compare your team's crane and the crane that claims to be able to lift the most weight. If your team's crane is stated as being able to lift the most weight, explain why your crane will be so successful. Base this discussion on the data in the 'Results' section, but do not repeat what you said under 'Results'.
5.2. Discussion – Team work	Analyse and discuss the teamwork in each CDIO stage of the LEGO project: • Describe what did and what did not work well in your team.

	• Discuss how issues/problems were addressed, taking into consideration your own learning style preferences. • Comment on the use and value of iPeer in the execution of the project. • Comment on the differences/similarities between teamwork in the GoGreen project and the LEGO project.
6. Conclusion and Recommendations	Write a conclusion reflecting on the LEGO project as a whole. Include a few recommendations on how to design a good crane, how to approach the teamwork facet of the project, and general recommendations on the project as a whole.
7. References	Include a list of references (Harvard method) for the compiled literature review and attached images (if not your own).
8. Appendix	Complete a plagiarism declaration as a team and add it as an appendix to the end of your document.

Appendix P: Team Report Rubric

Criteria	Scales					
	Poor	Mediocre	Moderate	Satisfactory	Very good	Excellent
Introduction Background: Provides context for the study by responding to Who? Where? When?	0.00 Does not provide context for the reader; misleading; vague; poorly integrated; poor response to Who? Where? When?	1.00 Provides some context for the reader, but vague and/or poorly integrated at times; satisfactory response to Who? Where? When?	2.00 Provides good context for the reader; well integrated; responds to Who? Where? When? questions	0.00 N/A	0.00 N/A	0.00 N/A
Introduction Objectives: Provides reasons for the study by responding to Why?	0.00 Does not offer objectives for the study; misleading; false; poorly integrated; poor response to Why?	1.00 Outlines some objectives for the reader, but vague and/or poorly integrated at times; satisfactory response to Why?	2.00 Outlines good objectives for the reader; well integrated; responds to Why?	0.00 N/A	0.00 N/A	0.00 N/A
Introduction Overview: Provides direction for the study by responding to What?	0.00 Does not offer direction for the study; misleading; vague; poorly integrated; poor response to What?	1.00 Provides direction for the reader; well integrated; responds to What?	0.00 N/A	0.00 N/A	0.00 N/A	0.00 N/A

Lit Review Discusses cranes, mechanical advantage, gears, levers, pulleys, and torque	0.00 Does not include a literature review / completely misguided or irrelevant	1.00 Offers an incomplete review / not all aspects discussed / does not offer sufficient direction to the study	2.00 Offers an overview of most research perspectives / some aspects require further investigation / offers some direction to the study, but insufficient	3.00 Offers an overview of all research perspectives, but general / some aspects require further investigation / offers direction to the study, but could be more specific to the	4.00 Offers an overview of all research perspectives / a few general areas of discussion / limited aspects require further investigation / offers some direction to the study	5.00 Offers an overview of all research perspectives / specific and focused throughout / consistent / offers direction to the study
Lit Review Shows relationship between perspectives and makes improvements to previous effort	0.00 Relationship between different perspectives unclear / incomplete / no improvements made to previous effort	1.00 Relationship between limited perspectives is clear, but inconsistent and jarring / improvements made to limited perspectives	2.00 Relationship between most perspectives is clear, but requires further integration / improvements made to some perspectives	3.00 Relationship between all perspectives is clear, but requires further integration / improvements made to most perspectives	4.00 Relationship between all perspectives is clear and fairly well integrated / improvements made to all perspectives	5.00 Relationship between all perspectives is clear and well integrated / improvements made to all perspectives / an excellent overall effort
Method Introduction to sub-section: Flow diagram, CDIO, rules, specifications, and limitations	0.00 Does not introduce this sub-section of the report / largely incomplete / misguided	1.00 Introduces the relevant sub-section of the report to some extent / some information vague or incomplete	2.00 Introduces the relevant sub-section of the report / complete, but could be better integrated or further developed	3.00 Introduces the relevant sub-section of the report / complete / well integrated and developed	0.00 N/A	0.00 N/A
Method Planning: Team composition and initial project phases (tutorial, concept design, defence, and schedule)	0.00 Does not outline plan / largely incomplete / misguided	1.00 Outlines some aspects of the plan, but excludes many aspects of the discussion / poorly developed	2.00 Outlines the plan / all relevant aspects included, but could be better integrated and further developed	3.00 Outlines the plan / all relevant aspects included / well integrated and developed	0.00 N/A	0.00 N/A
Method Apparatus: Mecabricks and LEGO piece outline	0.00 Does not outline the apparatus used / largely incomplete / misguided	1.00 Outlines some aspects of the apparatus used, but excludes some pertinent aspects of the discussion / poorly developed	2.00 Outlines the apparatus used / general / excludes specific details / moderate development	3.00 Outlines the apparatus used / specific details outlined, but some areas excluded or undeveloped / fairly well developed	4.00 Outlines the apparatus used / specific details outlined / well developed	0.00 N/A

Method Final design: Initial concept, revised concept, final design	0.00 Does not include the final design or outline the process / largely incomplete / misguided	1.00 Includes final design, but does not outline design development / excludes pertinent information / poorly developed	2.00 Includes final design and aspects of design development / excludes some pertinent details / moderate development	3.00 Includes initial concept and final design / some aspects in development excluded / satisfactory development	4.00 Includes initial concept, revised concept (if relevant), and final design / describes changes made / good development, but requires minor improvement	5.00 Includes initial concept, revised concept (if relevant), and final design / describes all changes made / excellent development
Method Final design comparison: Team's crane design and winning design	0.00 Does not include design comparison / largely incomplete / misguided	1.00 Includes a limited design comparison / does not respond to most aspects of discussion / poorly developed	2.00 Includes a moderate design comparison / responds to most aspects of discussion / moderately developed	3.00 Includes a satisfactory design comparison / responds to all aspects of discussion, but requires further insight and development	4.00 Includes a good design comparison / responds to all aspects of discussion, but requires minor improvements	5.00 Includes an excellent design comparison / responds to all aspects of discussion in detail / no improvements or areas for development required
Results Contents of the graph, trends, differences and similarities, possible errors	0.00 Does not discuss the results depicted on the graph / largely incomplete / misguided	1.00 Limited discussion of results depicted on the graph / poorly developed / limited observations made	2.00 Moderate discussion of the results depicted on the graph / some aspects of the discussion excluded / moderate development	3.00 Satisfactory discussion of the results depicted on the graph / all aspects included, but requires further development	4.00 Good discussion of results depicted on the graph / all aspects included / fair integration and development	5.00 Excellent discussion of results depicted on the graph / all aspects included / well developed and integrated
Discussion Extension of discussion of results; focus on comparison between team's crane and crane proposed to lift the most weight	0.00 Does not discuss the team's crane proposed performance / largely incomplete / misguided	1.00 Limited discussion/comparison between team's crane and team proposed to lift the most weight / poorly developed / limited observations made	2.00 Moderate discussion/comparison between team's crane and team proposed to lift the most weight / some aspects of discussion require further discussion / moderate	3.00 Satisfactory discussion/comparison between team's crane and team proposed to lift the most weight / all aspects included, but requires further development	4.00 Extension to previous section / good comparison between team's crane and team proposed to lift the most weight / all aspects included / fair integration and development	5.00 Extension to previous section / excellent comparison between team's crane and team proposed to lift the most weight / all aspects included / well developed and
Discussion Teamwork throughout phases of CDIO	0.00 Does not discuss teamwork / largely incomplete / misguided	1.00 Limited discussion of teamwork / poorly developed / limited observations made	2.00 Moderate discussion of teamwork / general observations made / moderate development	3.00 Satisfactory discussion of teamwork / focuses on some aspects of the CDIO project phases / requires further development	4.00 Good discussion of teamwork / focuses on the CDIO project phases / fair integration and development	5.00 Excellent discussion of teamwork / focuses on the CDIO project phases / well integrated and developed

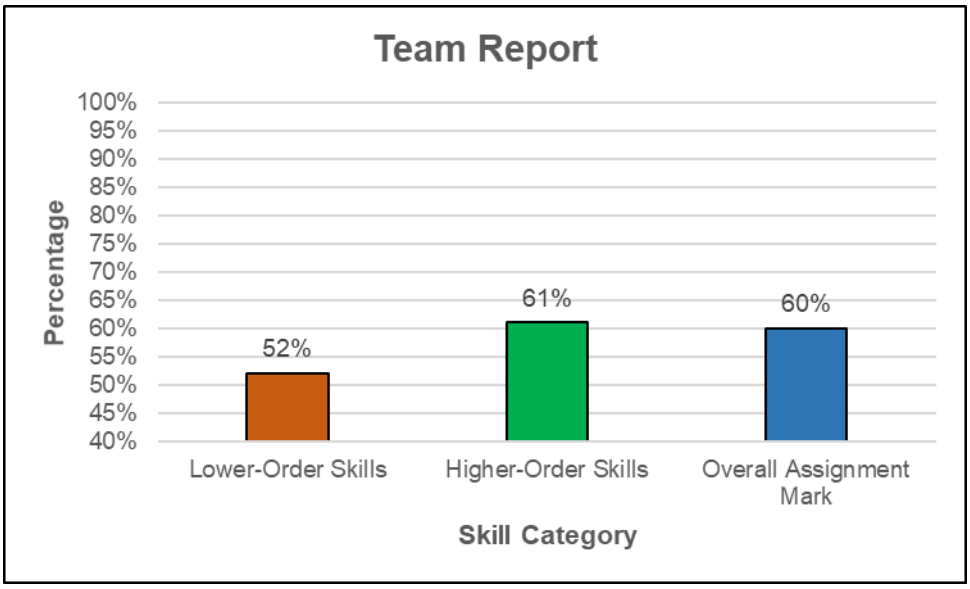
Conclusion Revisits the problem statement; synthesises main findings; states the relevance of the findings; offers recommendations	0.00 Does not offer a conclusion; vague; poorly integrated; poor attempt at drawing conclusion	1.00 Offers a mediocre conclusion; no recommendations; vague	2.00 Offers a moderate conclusion; responds to most criteria, but vague; some integration; no recommendations offered	3.00 Offers a fair conclusion; vague response to all criteria; reasonably well integrated; some attempt at offering recommendations	4.00 Revisits the problem statement; summarises main findings; highlights relevance of findings; offers recommendations on design and teamwork; could be more	5.00 Revisits the problem statement; summarises main findings; highlights relevance of findings; offers recommendations on design and teamwork; well integrated
Sources Sources have been integrated, cited, and referenced using the Harvard style	0.00 Sources not well integrated; no citations / not cited correctly; no reference list / incorrect referencing style used; evidence of plagiarism	1.00 Sources not well integrated; citations inaccurate / inaccurately places; reference list incomplete / inaccurate; citations do not match references	2.00 Sources integrated; does not include five references; citations and references match but not done correctly; incorrect style used	3.00 Sources integrated; includes five references; citations and references match; errors in composition	4.00 Sources integrated; includes all relevant references; citations and references match; Harvard style applied accurately; minor errors; no signs of plagiarism	5.00 Sources integrated; includes all relevant references; citations and references match; Harvard style applied accurately; no spelling or grammar mistakes; no signs of
Coherence Style, tone, register, audience, and discussion development	0.00 Informal; inappropriate; no integration; no audience awareness; generally poorly constructed	1.00 Semi-formal; fairly poorly integrated; limited audience awareness; limited development	2.00 Semi-formal; some attempt at integration and awareness of audience	3.00 Formal; some integration and awareness of audience; coherent	4.00 Formal; fairly well integrated; aware of audience; coherent	5.00 Formal; appropriate throughout; well integrated throughout; aware of audience; coherent; excellent construction
Composition Spelling, grammar, word choice, sentence construction, punctuation, tenses, concord	0.00 Numerous mistakes throughout (+5 prevalent types)	1.00 Many mistakes throughout (4 prevalent types)	2.00 A fair number of mistakes throughout (3 prevalent types)	3.00 A few mistakes throughout (2 prevalent types)	4.00 Very few mistakes throughout (1 prevalent type)	5.00 No mistakes throughout (no prevalent types)

Total Score: --/70

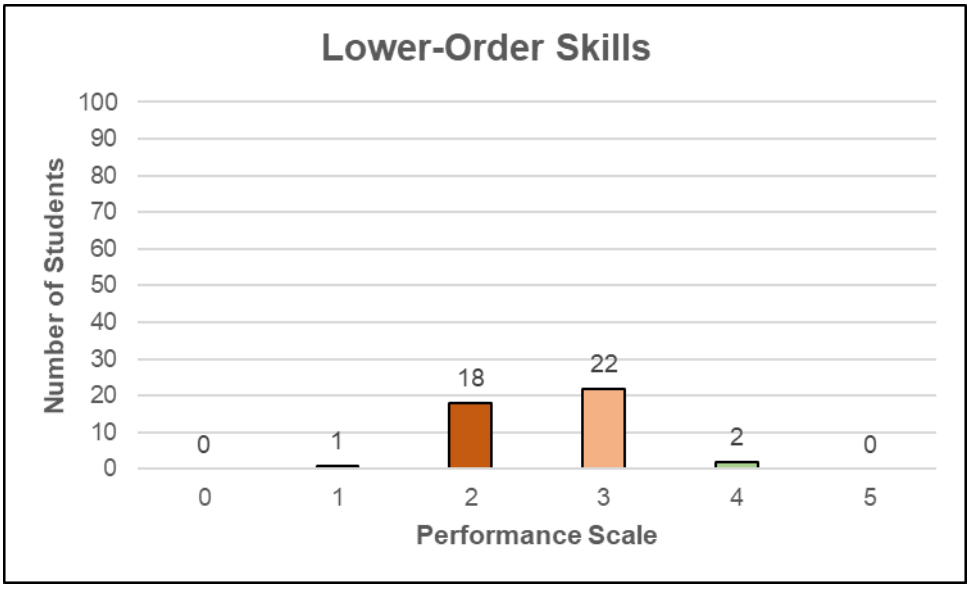
Apply

Appendix Q: Team Report Averages

Class Averages for the Team Report

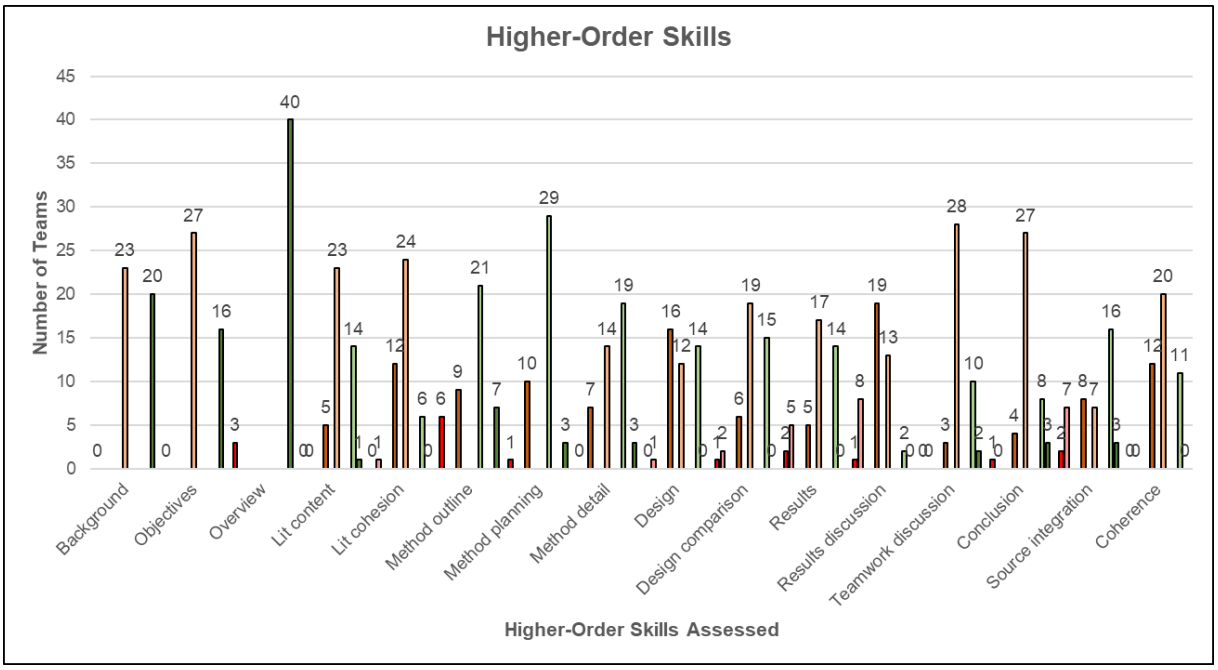


Class Averages for Lower-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%

Class Averages for Higher-Order Skills



*Dark red = 0%; Light red = 1-20%; Dark Orange = 21-40%; Light Orange = 41-60%; Light green = 61-80%; Dark green = 81-100%