Academic literacies and the A-B-C-D Formula: Engineering students' use of online activities for critical reading skills development

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Abstract

Academic literacies are linked to core graduate attributes for engineering programmes, and it is essential for students to develop them so they can meet the professional literacy expectations of the engineering field (Ministry of Education, 2020). Specifically, critical reading and academic writing are interconnected practices, and they require considerable time and training to master. However, some programmes provide few opportunities for students to practice these competencies (Craig & Bielenberg, 2015). Others rely on a bolt-on approach that disconnects academic literacy needs from the discipline (Wingate, 2006). This study takes a more proactive approach by embedding the academic literacies model in a first-year engineering course.

An action research intervention was designed, using blended learning as the vehicle through which engineering students practiced an original reading-to-write formula called the A-B-C-D Formula for Critical Reading. This combination aimed to create stronger connections between the practice of academic literacies, discipline-specific content, and related assessments. Two research questions were explored via this approach:

1. How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment?
2. How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process?

Quantitative and qualitative data were collected at different stages throughout the intervention via numerous instruments. These included two surveys, interview transcripts, the critical reading rubric, the feedback comment library, the critical reading online activities, my teaching log, and Moodle's tracking function. Even though this study yielded some statistical data, the resulting trends were viewed in relation to qualitative results through the larger lens of thematic analysis.

Data analysis underwent several stages, which established links between results and generated the study's five key themes:

- the need to practice academic literacies in advance of an assessment;
- students' desire for varied and interactive learning experiences;
- the need for plenty of time dedicated to practice;
- the expectation of receiving high-quality feedback;

- connections between the intervention and students' budding professional identity.

Insights gleaned from this action research have aided the refinement of its teaching and learning resources. An updated version is shared as a model for other educators to adapt and use in their courses. In summary, this thesis serves as a bridge between the fields of academic literacies and engineering by developing the communication skills of students who will build the tools and world of our future. It also illuminates student attitudes towards the role of academic literacies in engineering education, including connections to their evolving identity.

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Important Abbreviations

AI	artificial intelligence
AL model	academic literacies model
APA	American Psychological Association
BL	blended learning
CD-ROMs	compact disc read-only memory; the discs used to store digital media
CeTTL	Te Puna Ako – Centre for Tertiary Teaching and Learning
COVID-19	a disease caused by the coronavirus SARS-CoV-2
EAP	English for Academic Purposes
ELLs	English language learners
ENGEN170	the Engineering and Society course
FLEXI	flexible course mode
HEBUST	Hebei University of Science and Technology
LMS	learning management system
NCEA	National Certificate of Educational Achievement
NET	online course mode
PDF	portable document format; a digital document saved in this file format
STEM	the disciplines of science, technology, engineering, and mathematics
TESOL	teaching English to speakers of other languages
VALUE rubric	Valid Assessment of Learning in Undergraduate Education rubric

Glossary of Key Terms

A-B-C-D Formula for Critical Reading	As a teaching and learning resource devised by Sheila Busteed, this reading-to-write formula covers four key phases of pre-writing that, when completed together, facilitate the critical reading of disciplinary texts as applicable to academic writing tasks.
academic literacies	Reading and writing practices used in higher education that are essential to the completion of discipline-specific tasks and the effective communication of knowledge.
academic literacies model	A framework that views reading and writing as social practices and often utilises ethnographic methodologies to explore the interaction of these practices within disciplines (see Lea & Street, 1998, 2006; Lillis & Tuck, 2016).
academic writing	A formal style of writing often used in educational settings, and it is essential to scholarly discourse and the dissemination of evidence-based knowledge.
blended learning	An educational approach involving the strategic combination of face-to-face and online methods, as well as various tools, technologies and theories, in order to create the optimal learning experience for a specific context (see Cronje, 2020; Yoon & Lee, 2010).
critical reading	The practice of analysing and evaluating resources to determine their potential as referenced sources within a piece of academic writing. This practice depends on several early steps of the writing process, including analysis of task instructions, brainstorming, and resource gathering, before the writer can begin to select content from sources to integrate into an artefact.
formative assessment	An ongoing process of activity completion and the sharing of feedback, which identifies students' learning needs and guides adjustments to teaching strategies (see Black & Wiliam, 1998; Organisation for Economic Co-operation and Development, 2005).
reading-to-write process	The dynamic interaction between reading and writing that occurs when one must interpret and integrate sources to construct original texts — a process that is further shaped by one's internal dialogue, intertextuality, cultural influences, and genre paradigms (see Flower et al., 1990; Wette, 2021).
thematic analysis	A common method of analysing and interpreting patterns in qualitative data, which requires a researcher to present and explain themes and then share exemplary quotations to demonstrate the data fits into those themes (see Agostinone-Wilson, 2012; Braun & Clarke, 2021b; Gournelos et al., 2019).

Chapter 1: Introduction

Some educators have spent their entire lives within the bubble of academia. I am not one of them. Teaching is a second career, having previously spent about a decade working as a journalist in Canada. It is fair to say that I have dedicated most of my life to the craft of writing, having also worked as a creative writer in various capacities and specialising in the writing process across several teaching roles. My diverse professional writing experiences allow me to bring a dynamic outlook to the job; the recognition that one must constantly adapt one's skills to different contexts and projects makes me acutely concerned with what my students need to succeed.

To gain such insight, I cannot simply define myself as a teacher, the one who shares knowledge with others and facilitates their path to understanding. I must also be a learner, one who asks questions, seeks answers, and is always trying to improve. Therefore, I identify as a teacher-researcher because it embodies both responsibilities. In such a role, one duty is not elevated above the other; instead, they inspire and nurture each other, making me stronger in the process. Such strength has been gained not only through years of classroom teaching experience, but also dedicating considerable time to professional development, including conferencing, conducting original research, and furthering my educational qualifications. Throughout, one of the principles guiding me as a teacher-researcher has been the importance of understanding why my students are studying English or communication skills development as well as how they intend to put their learning to use in the classroom and beyond.

Over the years, this identity and its related principles have also made me realise the importance of adapting my teaching strategy to each cohort and designing learning materials customised to their context or chosen discipline. A one-size-fits-all approach or being dependent on a textbook inevitably puts some learners at a disadvantage. Instead, I prefer to utilise the academic literacies model (AL model), which involves exploring "reading and writing in academia as social practice, using ethnographically-oriented methodologies and drawing on a range of critical theories" (Lillis & Tuck, 2016, p. 30). In my view, this approach encourages the development of a symbiotic relationship between lecturers and students, allowing feedback to flow in both directions so all can grow, improve, and gain a deeper understanding of one's performance. For instance, studies following the AL model and using the student voice as a source of ethnographic data can provide educators with valuable insights into the teaching and learning of academic reading and writing and the various influences on these practices. This approach also emphasises being explicit with one's students about their

need to study and practice the writing process so that, even if they do not necessarily enjoy that aspect of their education, they understand how the related skills will be applied in future contexts. I believe this awareness could motivate some students when practicing professional communication skills because they realise these skills are just as important as discipline-specific knowledge to a successful career. These aspects of my personal teaching philosophy, as well as recent experience in the field, motivated me to pursue a practical, classroom-based research project as the basis for my doctoral thesis while simultaneously investigating student attitudes towards the learning experience.

The remainder of this introduction chapter will share a statement of the research topic covered in this project, explain the significance of my research within engineering education and beyond, and outline the two research questions addressed in this thesis. The chapter concludes by providing the reader with outlines of the other chapters in this thesis.

Statement of the Research Topic

Academic literacies are often described as soft skills or considered less important to develop than those specific to one's discipline. This attitude could be present particularly within undergraduate engineering programmes and among the students enrolled in them. According to Goldsmith and Willey (2016), "many engineering students are not provided with the opportunity to develop or practise disciplinary writing" because the teaching and learning of academic literacies are not permanently embedded in engineering curricula (p. A119). There are also questions within academia about who should teach academic literacies within engineering programmes and exactly what this involves (Goldsmith & Willey, 2016; Mgqwashu & Bengesai, 2016; Strauss & Grant, 2018). In fact, academic literacies include a gamut of practices essential to the completion of discipline-specific tasks and the effective communication of knowledge. Academic literacies encompass such skills as the ability to critically read content within one's discipline and produce texts on such topics while following the genre conventions of that field and meeting the academic expectations of the assessment. These skills can be further divided into subsets, each requiring practice to achieve proficiency.

Since standards of practice vary for each discipline studied in higher education, students are expected to develop the academic literacies specific to their programme, adapting them to the expectations of each assessment. Within the engineering discipline, for example, students are often required to follow a process to complete assessments, which involves "problem analysis, synthesis, implementation, operation and evaluation" (International Engineering Alliance, 2021, p. 7). The process frequently involves a research stage and ends with the

creation of a written artefact, meaning that sound judgement and communication are vital to the study of engineering (International Engineering Alliance, 2021). Engineering students can be required to produce artefacts beyond the typical essay. Their success often hinges on composing "clearly structured reports in a technical language" (Wollscheid et al., 2021, p. 24). However, they may also be expected to produce design reports and professional correspondence with clients. To produce strong engineering texts, students must also learn to critically read texts written by experts in this field so they can recognise and follow conventions; as with other kinds of scientific writing, engineering texts are precise and accurate, contain concise sentences, favour paraphrasing over quoting, and often pair written and visual information (McKenzie & Brenner, 2020).

Such expectations within engineering programmes are determined by the Washington Accord.[1] Its description for the attribute of communication, which must be achieved by all graduates of engineering programmes at New Zealand universities, is shared in Figure 1.1.

Figure 1.1

Washington Accord Graduate Attribute of Communication

> Communicate effectively and inclusively on *complex* engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, taking into account cultural, language, and learning differences.

Note. This description was copied from International Engineering Alliance (2021, p. 15).

The need to maintain accreditation under the Washington Accord influences how communication is taught in engineering programmes, and these expectations are reinforced in New Zealand by the Tertiary Education Strategy. This strategy highlights the importance of developing such skills as digital literacy, communication, problem solving, and critical thinking (Ministry of Education, 2020). These expectations for engineering students mirror the professional literacy expectations of the engineering field. As summarised by Wilson-Lopez and Minichiello (2017), engineers must often define problems, generate and evaluate possible solutions, test and optimise them, and then communicate the solutions "orally, visually, mathematically, and in writing" (p. 12).

[1] The Washington Accord is an international agreement between signatory countries. It sets standards for engineering programmes and offers graduates recognition of their qualifications. Therefore, engineers gain greater mobility within the industry. New Zealand has been a signatory country since the Accord's creation in 1989. Go to www.ieagreements.org/Accords/Washington for more information about the Accord.

Guided by the criteria for engineering programmes, my research focuses on engineering students' practice of critical reading skills and their application in academic writing. Despite the crucial role that communication plays in the engineering sector, engineering education provides a challenging context for my research because "the idea of critical reading is not widely discussed or practiced" and "engineering students are generally reticent to develop reading as a skill" (Weaver et al., 2023, p. 129). On top of this, a wide range of ideas about critical reading have circulated in academia over the decades, making it challenging to define. Recently, Van et al. (2022) synthesised various ideas on critical reading by explaining that it requires readers "to locate and interpret texts in conjunction with contextual information to generate meaning" (p. 2). This process also involves evaluating the trustworthiness of texts and connecting ideas across sources "to one's own perspectives, as well as the associated social and academic concepts and arguments" (Van et al., 2022, p. 2). Meanwhile, Manarin et al. (2015) associated the following characteristics with critical reading in academic contexts:

- identifying patterns of textual elements
- distinguishing between main and subordinate ideas
- evaluating credibility
- making judgments about how a text is argued
- making relevant inferences about the text. (p. 73)

For the purposes of this research, I define critical reading as the practice of analysing and evaluating resources to determine their potential as referenced sources within a piece of academic writing. Critical reading depends on several early steps of the writing process, including analysis of task instructions, brainstorming, and resource gathering, before the writer can begin to select content from sources to integrate into an artefact.

Critical reading and academic writing are interconnected practices requiring considerable time and training to master. My experiences as a teacher-researcher have made me acutely aware of this reality. During a previous role as an English for Academic Purposes (EAP) teaching fellow, I was inspired to develop resources that could support students in these practices and develop the academic literacies required for their study of engineering. In 2020, while teaching in one of the University of Waikato's transnational programmes in China, the COVID-19 pandemic forced all teaching online. To encourage student engagement on Moodle (i.e., the university's learning management system or LMS), I developed a series of online review activities. My Chinese students had no prior experience in producing an engineering report in English and supported by scholarly sources. Therefore, my online review activities

provided opportunities to practice newly learned language and literacy skills before having to apply them in that assessment. Finding that the online practice was having a positive effect on students' performance, I began to wonder how such digital resources could be revised and expanded for the benefit of all engineering students. The portions of those resources that focused on critical reading served as a beta-test for my doctoral research project. This prior experience taught me the importance of integrating academic literacies with subject-specific content when designing a curriculum. Moreover, opportunities to practice literacy skills should be customised to suit the expectations of the course, discipline, and a career in that field. These principles align with the AL model (Lea & Street, 1998, 2006).

However, many universities still do not follow the AL model. Its proponents argue that the development of academic literacies should be "part of the core business of teaching and learning in a discipline" (Bassett & Macnaught, 2024, p. 2). Instead, many universities still rely on the more traditional bolt-on approach "based on the deficit model of providing support to weak students," which treats academic literacy needs as disconnected from disciplines of study (Wingate, 2006, p. 458). This is the case at the University of Waikato, which offers services related to study skills development through Te Puna Ako – Centre for Tertiary Teaching and Learning (CeTTL). Despite CeTTL offering a wide range of services, including online resources, workshops, and one-on-one consultations, utilising them remains optional to students for the most part. Even with the availability of these services, some engineering students continue to struggle with tasks that require critical reading, research, and academic writing skills. Such outcomes may be connected to student attitudes about the available yet more generic learning resources; if they are viewed as irrelevant to or disconnected from disciplines of study, this would explain a low level of engagement with such services (Harris, 2016). Based on discussions with colleagues in the School of Engineering, is it common for undergraduate engineering students to reach the final year of their programme yet demonstrate little improvement in their ability to communicate their ideas effectively in reports. After examining criteria for writing assessments in first-year engineering courses, I found that very little weighting is often attached to quality of writing, meaning students can continually fail in that criterion yet pass assessments and advance in their studies. I aim to improve these conditions and draw attention to related attitudes through my research.

Engineering students' communication skills development could be addressed through an approach shaped by the academic literacies field of inquiry. Currently, the generic training available through the bolt-on approach can leave students unable "to understand the sources, to select the relevant ones, or to know why and when to reference" (Wingate, 2006, p. 463).

Instead, the agenda ought to shift away from the deficit discourse that sees "students and their writing as the problem" to a more proactive approach (Lillis & Scott, 2007, p. 17). The goal of my research is to help break the current cycle by embedding the AL model in Engineering and Society (ENGEN170), a first-year, Trimester A course. To achieve this, my action research intervention utilises a blended learning (BL) approach to facilitate students' practice of critical reading skills. This cross-disciplinary research aims to investigate the effect of this practice not only on students' written output but also on their attitudes regarding this intervention and the academic literacy requirements of the engineering field.

Significance of the Research

Academic literacies are not always well developed as part of engineering education, with some programmes still relying on outdated designs. According to Craig and Bielenberg (2015), "today's student is expected to learn increasing amounts of content with limited opportunity to ... develop needed non-technical competencies" (p. 2). The development of strong academic and technical language skills is critical in engineering education yet minimal time is dedicated to this process, which can lead to graduates entering the workplace with substandard communication skills (Khoo et al., 2020; Kovac & Sirkovic, 2017; Raban, 2018). Engineering programmes at the University of Waikato serve as an example of this situation. However, my study offers a way to address the issue. My research design includes a new method for the teaching of academic literacies to engineering students. With minor adjustments, it could be applied to other courses within STEM disciplines.[2] Therefore, my study could guide STEM educators around the world to improve the teaching of discipline-specific communication skills.

By pairing action research with a diverse ethnographic data-gathering strategy, this study yields feedback from students in conjunction with data gained through their written output. Its findings offer unique insights into the application of the AL model in the engineering discipline. The investigation into students' attitudes allows me to ascertain how their learning tools and environment influence their practice of critical reading and writing skills. In addition, insights gained from the study's findings allow me to refine the intervention's resources, creating an improved model revealed herein. Sharing such resources with other practitioners is rare in existing research within the academic literacies field of inquiry, thus complicating attempts at replication. Therefore, my thesis serves as a useful resource for other educators.

[2] STEM is an abbreviation commonly used in education to refer to the disciplines of science, technology, engineering, and mathematics.

While my immediate audience is the University of Waikato community, the adaptability of my data-gathering instruments and intervention resources will appeal to other teacher-researchers across New Zealand and beyond. The thesis demonstrates how a BL-infused AL model might be applied to improve students' critical reading skills across the STEM disciplines.

There is potential for my research to mark the first phase of a series of changes at the University of Waikato, specifically the way it addresses the development of academic literacies. It could begin a collaborative, grassroots strategy to embed the AL model in existing courses and guide changes in instructional design. After the completion of my doctoral studies, I hope to lead professional development workshops on BL and the AL model, helping faculty to adapt my resources slightly and address issues with critical reading across other disciplines. In the future, academic literacies research could be conducted across multiple divisions at the university, and there is also the potential for longitudinal studies within individual programmes.

Statement of Research Questions

Aiming to investigate engineering students' development of critical reading skills, this study utilises customised online activities to aid the practice of a reading-to-write formula. The formula is an original teaching and learning resource I designed for this study, and it is called the A-B-C-D Formula for Critical Reading. As mentioned earlier in this chapter, several initial steps of the writing process feed into students' ability to apply critical reading skills. For this reason, my formula covers four key phases of pre-writing that, when completed together, facilitate the critical reading of disciplinary texts as applicable to academic writing tasks. Figure 1.2 on the next page identifies the four phases of the A-B-C-D Formula for Critical Reading. As part of this research, I also designed a series of critical reading online activities through which students practice the formula's phases. More information about the A-B-C-D Formula for Critical Reading and the associated online activities will be shared in the next two chapters.

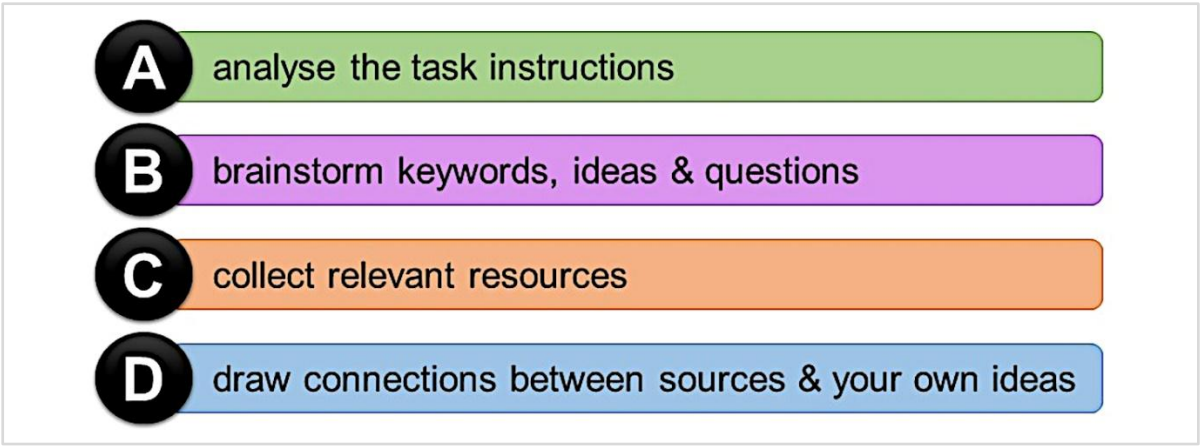
Following a BL-infused version of the AL model, the practice of my reading-to-write formula is embedded in an existing engineering course so I can explore the following research questions:

1. How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment?

2. How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process?

Figure 1.2

Phases of the A-B-C-D Formula for Critical Reading



Overview of Chapters

This first chapter has discussed aspects of my personal teaching philosophy, shared a statement of the research topic, explained the project's significance, and outlined its two research questions. Next, literature on the AL model, the reading-to-write process, and BL pedagogy are reviewed. They are explored separately as core concepts, but connections between them and with engineering education are also highlighted. This process establishes gaps in the literature that my study on critical reading can address. Then Chapter 3 discusses action research, including the intersecting principles of this methodology and the AL model. Details about my project's design are shared, as well as those about its resources and instruments. The chapter also imparts information about the study's participants, technological resources used throughout, and the stages completed as part of a mixed methods approach to data analysis.

The two chapters that follow focus on the study's results. Chapter 4 shares findings relevant to the first research question; this involves insights about students' performance in online practice of the A-B-C-D Formula and trends from the formative assessment of Assignment 2. Post-intervention survey and interview results about the participants' learning experiences during the intervention are also shared in this chapter. Then Chapter 5 covers results connected to the second research question. Here, the intervention's influence on student attitudes is explored via findings from the initial survey, post-intervention survey, and interviews.

In Chapter 6, thematic analysis of all results facilitates a combined discussion of the study's five themes. This chapter mostly focuses on how students' performance and attitudes align and where contradictions arose. Parallels are also drawn between each theme and the AL

model's themes. The chapter highlights possible means of refining the intervention's design for future iterations based on the themes' insights, as well as other ideas to improve communication skills development for engineering education.

Finally, Chapter 7 presents this action research project's final stage of re-planning. The refinements selected to improve the intervention's lecture, workshop, and formative feedback strategy are described. This chapter includes models of the revised critical reading online activities, which other educators can adapt for their own purposes. Details about the intervention's expansion to include a second workshop are shared in this final chapter, too. It also conveys recommendations relevant to the engineering education sector, discusses a few limitations and considerations linked to this study, and proposes pathways for future research.

Chapter 2: Literature Review

This chapter discusses three areas of relevant literature. First, a discussion of the AL model covers its guiding principles and influential contributions to this field of inquiry. Next, the chapter examines literature on the reading-to-write process. The third area is dedicated to a discussion of BL pedagogy. Together, these core concepts are relevant to this study's research questions, so they are explored here individually as well as ways in which the three areas overlap. In doing so, gaps in the literature are revealed, which can be addressed by seeking answers to this study's research questions.

The Academic Literacies Model

The AL model, having evolved from the study skills and academic socialisation approaches, has emerged as a leading field of research on student learning at the tertiary level (Lea & Street, 1998, 2006; Lillis & Scott, 2007; Wingate, 2006). Two articles published by Lea and Street — one in 1998 and the second in 2006 — have been highly influential in this field. They explained that the AL model "takes account of the cultural and contextual component of writing and reading practices, and this in turn has important implications for an understanding of student learning" (Lea & Street, 1998, p. 158). This means that, when students read and write texts as part of their studies, the learning process is influenced by the culture of their institution, the context provided by their discipline, and the social influences of their instructors and peers.

Key Concepts of the AL Model

To have a clear understanding of the AL model, it is important to recognise how it differs from the deficit model. The skills-based deficit model, which is grounded in the premise that academic skills interventions should target students perceived as weak in this area, focuses on technical deficits and applies a universal solution that can supposedly be adapted to any context (Lea & Street, 1998; Wingate, 2006). Hughes (2017) summarised some of the common solutions employed at universities, highlighting that they "focus on patching perceived gaps in students' educational capital, whilst the learning and teaching activities occurring across the university can continue uninterrupted" (p. 68).

Unlike the deficit model, the AL model focuses on meaning making and "views the processes involved in acquiring appropriate and effective uses of literacy as more complex, dynamic, nuanced, situated, and involving both epistemological issues and social processes, including power relations among people, institutions, and social identities" (Lea & Street,

2006, p. 369). Similarly, the academic literacies field of inquiry has been defined as "a transformative interest in meaning making set alongside a critical ethnographic gaze focusing on situated text production and practice" (Lillis & Scott, 2007, p. 13). In other words, the AL model looks at intersecting social relationships that influence not only how students in higher education develop the literacy skills needed to succeed but also their identity as learners and future professionals in their discipline.

My analysis of literature on the AL model, which is discussed throughout this section, found that embedding the AL model can affect pedagogical approaches in the classroom. In this context, embedding means creating opportunities to teach, learn, and reflect on language and literacy skills in connection to a discipline. To embed the AL model effectively, educators can also draw on sociocultural theories of learning, which recommend the use of scaffolding techniques and the creation of a collaborative, social learning environment — ideas that support students' understanding of disciplinary knowledge and help them learn to communicate so they can contribute to their community of practice (Lea, 2008; Lea & Street, 2006; Pritchard & Woollard, 2010; Tavassolie & Winsler, 2018; Vygotsky, 1978; Wingate, 2006). In the case of an engineering course, this involves the strategic augmentation of a curriculum for the simultaneous development of technical and non-technical competencies.

When the AL model is embedded, it causes the focus to shift away from deficits so that all learners can develop the reading and writing skills essential for success in their discipline. According to Lillis and Scott (2007), teacher-researchers ought to be aware of the new level of expansion and inclusion in higher education — that is, an increasing percentage of the local and international population pursuing post-secondary studies at various ages. These changes require them "to identify conventions but also to problematise them in relation to students' interests and experiences" (Lillis & Scott, 2007, p. 14). In return, students gain explicit awareness of the different qualities associated with various genres and modes of texts, as well as any associated overlap, so they can switch practices where appropriate to meet expectations (Lea & Street, 1998, 2006). Regarding the design of course materials, Lea and Street (2006) stated that the AL model requires educators "to be concerned with literacies more generally across academic contexts and not only the assessed texts produced by students" (p. 375). More recent research has highlighted the need for effective collaboration between subject lecturers and academic literacies experts. Such teams must ensure that the embedded teaching and learning of academic reading and writing practices align with disciplinary knowledge and conventions, employ sound pedagogic practices, and yield measurable improvement in students' outputs (Bassett & Macnaught, 2024; Clarence & McKenna, 2017). In addition,

collaboration between students and with their teachers is central to the process of meaning making as part of an embedded AL model. This interaction makes "explicit the different types of knowledge students [have] already used and that they [need] to develop and customize to fit higher education standards" (Lea & Street, 2006, p. 373). I have synthesised the literature and determined that several steps can be followed to ensure these principles of the AL model are applied in the classroom: (a) use scaffolding techniques and models; (b) guide a comparative analysis of texts; (c) conduct group discussions to analyse conventions and determine why they are followed; (d) create opportunities to receive feedback regularly from teachers and peers; and (e) reflect on the practice of literacies, as well as why they are important to the study of a discipline and its associated professional field.

The AL Model in the Disciplines

In recent years, the AL model and its principles have been embedded in a variety of disciplines taught at higher education institutions around the world. The fact that this has been necessary in the first place suggests that subject lecturers at some institutions may not have been developing students' academic literacies to satisfy prescribed graduate attributes and meet employers' expectations (for related insights on policy and agency, see Fenton-Smith & Gurney, 2016). Instead, such responsibilities were traditionally consigned to academic language and learning advisors or even librarians. This is an interesting state of affairs considering that strong reading and writing practices are not developed in a vacuum but customised to the context of one's discipline. According to Green (2020), academic literacies are:

> sets of communicative practices characteristic of, shaped by and enacting the communicative purposes of specific academic discourse communities. They are therefore intimately bound up with membership of and participation within these communities: mastering an academic literacy is also a process of constructing a new identity and becoming comfortable in a new way of thinking, behaving and communicating. (pp. 41-42)

Despite the considerable overlap between academic literacies and one's chosen discipline, scholars tend to categorise related research as either a contribution to the academic literacies field of inquiry or that of disciplinary literacies. According to le Roux et al. (2022), disciplinary literacies are "disciplinary-specific skills, practices and genres for reading, writing, speaking, and working with information, technologies and numbers" (p. 1145). Related research tends to focus on these practicalities and whether learners are prepared to meet the discourse standards

of their chosen discipline (e.g., le Roux et al., 2022; Wortman-Wunder et al., 2023). In contrast, studies applying the AL model also concern themselves with the cultural, contextual, and social influences on meaning making and identity (e.g., Maguire et al., 2020; Paxton & Frith, 2015; Strauss & Grant, 2018). While some insights have been gleaned from publications focusing on disciplinary literacies in engineering education (to be acknowledged later), the majority of this section focuses on literature following the AL model. This field of inquiry was chosen as the focus because, in my view, it follows a more holistic approach to the study of teaching and learning. The AL model also encourages reflection and offers great potential for the student voice to feature in research — factors that can contribute to greater enlightenment among teachers and learners.

Studies on embedding the AL model in disciplines have yielded a variety of helpful insights, but many of them have also contained some notable shortcomings related to explicitness, specificity, and implementation. This is the case with most of the publications discussed in the rest of this section. Such a discussion ought to begin with two articles by Lea and Street (1998, 2006), which have been cited frequently. They highlighted the importance of being explicit with students regarding their academic reading and writing practices as part of meeting expectations within their discipline and institution. However, a level of explicitness is wanting from these articles when the AL model is explained, particularly how it should affect instructional design and institutional policy.

Firstly, Lea and Street's (1998) study found that academic staff implicitly understood what constituted strong student writing within a discipline but often could not explain how to write well. On the other hand, students were aware of the need to switch forms and genres in a general sense, but they struggled "to gauge the deeper levels of variation in knowledge and how to set about writing them" in order to meet expectations (Lea & Street, 1998, p. 163). This was because many of the guidelines provided were too broad and/or reviewed issues (e.g., structure, argument) learned in secondary school, so they struggled to apply this general advice when writing on "specific, course-based knowledge for a particular tutor or field of study" (Lea & Street, 1998, p. 164). However, the article did not provide examples of problematic writing prompts nor offer specific guidance on how to adapt generic writing guidelines to various disciplines. In addition, they did not include many interview quotations from participants nor share samples from several other data-gathering instruments. Some excerpts from students' work and the corresponding feedback were shared in one section, but this came from only one case. The authors reviewed modalities for providing feedback — imperatives, assertions and lone orthographic marks versus mitigated comments expressed clearly — and institutional

policies (e.g., not providing feedback until the end of a module) that can render feedback worthless (Lea & Street, 1998). Besides these points, though, they did not provide much concrete guidance on how to address "the miscommunication between tutors and students" (Lea & Street, 1998, p. 167). As a result, I was left with questions about the study's implications — that is, how the results could guide reforms in policy, instructional design, and other aspects of teaching practice at the participating institutions.

Secondly, Lea and Street's (2006) study described sessions that helped English language learners (ELLs) develop their academic literacies as part of tertiary studies in the UK. The sessions were "making explicit the different requirements as they switched genre from speech to writing or from notes to essays" (Lea & Street, 2006, p. 372). However, the authors were less than explicit about the teaching strategies applied in these lessons and their link to research on language acquisition. Some examples were included in their description, but the article lacked appendices that could have shared additional data from the ethnographic research or samples of resources used in the sessions. Another section in the article focused on the AL model being used in professional development workshops attended by law faculty who would develop new course materials for introductory studies in that discipline (Lea & Street, 2006). While the AL model promotes the importance of explicitness, the participating faculty were not given clear guidelines to address "issues of meaning making and identity" in the workshops (Lea & Street, 2006, p. 374). Tutors provided these participants with little guidance for brainstorming, hoping they would arrive at appropriate responses, instead of introducing them to the principles of the AL model before the activities. The rationale behind this strategy was not explicitly explained nor supported by detailed examples of the workshop activities. Overall, few examples were provided, and both of Lea and Street's articles lack appendices that could have modelled writing prompts and/or additional instructions as well as shared examples of feedback or other data from their ethnographic studies. Since Lea and Street were at the forefront of this field of inquiry, greater explicitness in their articles would have provided a clearer guide to other teacher-researchers interested in applying the AL model when reflecting on teaching practice, developing new curricula, or planning research projects. This is one of the gaps to which my research responds.

Other studies, which have examined the effects of embedding the AL model in nursing, midwifery, education, arts, and science programmes, have yielded several important insights. For instance, early feedback and learning support can help students with initially low scores to pass or earn a higher grade (Palmer et al., 2014). Similarly, scaffolding techniques, feedback, and "total integration between reading, teaching and assessment" encourage new university

students' critical reading practices, while their absence can lead to a breakdown of reading habits (Wilson et al., 2004, p. 344). Thirdly, research by Maguire et al. (2020) highlighted how students internalise disciplinary writing conventions through engagement with disciplinary texts. They found that, by having students read texts rooted in neutrality and evidence, this fosters their professional identity, but it is a gradual process that continues beyond graduation. Murray and Nallaya (2016) highlighted the importance of collaboration between language tutors and Education, Arts and Social Sciences faculty members to ensure that the literacies taught would align with learning outcomes and assessments, with resources developed together to serve this purpose and facilitate students' improvement of academic literacies throughout their programme. Related to this are insights from Macnaught et al. (2022) about establishing cross-disciplinary collaborations, developing materials together, and gradually transferring the responsibility of teaching academic literacies to subject lecturers — a long-term strategy meant to offset trends of low institutional investment in literacy specialists and learning advisors to serve the student population. A study by Paxton and Frith (2015) found that it is vital to uncover students' existing routines and assumptions that may augment academic literacies development or hinder the learning process; this is particularly relevant where discipline-specific language and school versus university discourse practices are concerned.

Meanwhile, other researchers have contributed further insights to this field of inquiry by employing digital learning tools to aid the development of academic literacies across several disciplines. For example, Dunham et al. (2011) shared three processes for adapting policy and curricula across multiple faculties at a New Zealand university in connection to its eLearning Teaching and Learning strategy. Statistics shared about students' low levels of proficiency in certain literacies stressed the urgent need for higher education institutions across New Zealand to prioritise the adoption of the AL model, providing more time for students to practice and reflect on these skills and their value to their future (Dunham et al., 2011). In Australia, Nallaya and Kehrwald's (2013) study revealed how a website can scaffold the AL model: (a) share downloadable, discipline-specific resources in text, audio and video forms; and (b) include online forums to encourage social interaction. The majority of users believed "the online resources met their learning needs," were structured well, easy to read, encouraged engagement, and helped them complete their assignments (Nallaya & Kehrwald, 2013, p. A87). Lastly, Lea and Jones' (2011) ethnographic study of digital literacies included students enrolled in three different tertiary-level institutions across a range of academic, professional, and vocational programmes. Anecdotal evidence from these participants suggested that changes in institutional and tutor practices are influencing students' "appropriation of texts external to the

university" and "what counts as authoritative and legitimate knowledge in today's higher education" (Lea & Jones, 2011, p. 388). Lea and Jones' (2011) comment on students' understanding of plagiarism being "reduced to a technical issue of percentages of reproduced text," such as instances identified in a Turnitin report, is something that could be factored into designs of future studies that involve the AL model and e-learning pedagogy (p. 389). More recently, the COVID-19 pandemic and its aftermath have led higher education institutions around the world to embrace online learning to a greater degree. Digital learning tools are growing in number, and academics are regularly exploring their use and studying their effects on teaching and learning. In the years since my study was first designed, generative artificial intelligence (AI) has entered the marketplace, causing concern in the education sector and triggering research about its impact on teaching and learning (e.g., Anson, 2024; Cambaz & Zhang, 2024; Hutson, 2024). Considering these trends, plans for embedding the AL model could increasingly feature digital learning tools in the years to come.

While most studies mentioned above were successful in embedding the AL model and contributing insights to this field of inquiry, they also illuminated common problems that should be considered when designing future projects. In some articles, a lack of specificity remains a point of contention. For instance, Nallaya and Kehrwald (2013) described their website as "scaffolding students through the various stages of academic literacies starting from the very basic level of communicating the purpose and overview to higher levels where students produce the genres themselves" (p. A91). However, they did not state which specific skills could be practiced through the website's use, so the breadth of academic literacies addressed remains somewhat unclear. In Dunham et al.'s (2011) article, sections were dedicated to three different embedding approaches: one was inspired by the communities of practice approach and applied in the Faculty of Technology and the Built Environment; the second involved collaboration between nursing faculty and academic literacies advisors; and the third consisted of the strategic development of courses to be taken by first-year students in accounting, finance, marketing, and management programmes. However, these sections offered little information to define the specific literacies integral to each discipline or how their learning process was scaffolded for the students. The overlap with the eLearning Teaching and Learning strategy was also unclear in most areas, leaving the reader wondering how online learning tools were used to develop students' academic literacies (Dunham et al., 2011). Thirdly, beyond sharing anecdotes from participants, there is little analysis in Lea and Jones' (2011) study of the students' critical reading processes or how they are applied when a source's content is integrated into their own writing. In all three instances, this lack of specificity means

that the papers can offer only limited guidance as models to other teacher-researchers hoping to apply the AL model in their practice.

Meanwhile, other researchers' attempts to affect change on a grand scale led to complications. Despite having a diagnostic tool at their disposal, Palmer et al. (2014) pointed out several challenges in implementing their study with such a large first-year cohort. Similarly, Murray and Nallaya (2016) found that some staff were uncooperative or unwilling to change their teaching methods. The scale of their initiative — it involved language tutors, department leaders, and academic staff across two undergraduate programmes — was so great that implementation, as it turned out, was not a team effort as designed. This suggests that the AL model is best introduced incrementally and in a manner that minimises the negative effects of curricular change on staff morale, workloads, and departmental cohesion. Conversely, Macnaught et al.'s (2022) study found success by following a more grassroots, collaborative strategy that allowed lecturers to gradually take over academic literacy development from learning advisors. However, this article could have been stronger if the authors had included recommendations for addressing low institutional investment in academic literacies development so their strategy could be applied across numerous programmes and departments.

Ethnographic data gathered as part of the AL model's implementation is meant to help teacher-researchers gain a better understanding of the cultural, contextual, and social influences on students' learning. However, only six of the aforementioned studies used the student voice as a significant source of data. In these instances, group discussions and/or interviews granted student participants the opportunity to reflect on their learning and offer feedback, and this data was often analysed alongside that gained through teacher feedback, observation, and/or student output (Lea & Jones, 2011; Lea & Street, 1998; Maguire et al., 2020; Nallaya & Kehrwald, 2013; Paxton & Frith, 2015; Wilson et al., 2004). Two additional articles (Lea & Street, 2006; Murray & Nallaya, 2016) briefly mentioned feedback from students, but the lack of quotations or other significant references to that data make it difficult to gauge student attitudes. Dunham et al. (2011) and Macnaught et al. (2022) leaned on educators as their source of ethnographic data, giving no voice to students in their articles. Palmer et al.'s (2014) case study on academic literacy did not follow the AL model in execution, instead relying on quantitative data to draw conclusions. The two remaining articles (Lillis & Scott, 2007; Wingate, 2006) presented arguments and critical overviews, discussing trends and issues across the academic literacies field of inquiry without sharing original research. This sample of literature suggests that student attitudes towards academic literacies are not examined often enough in articles about the AL model, thus providing only a limited understanding of the influences on literacy development.

The AL Model and the Engineering Discipline

The above paragraphs impart some of the wisdom gleaned from a collection of influential studies on the AL model. The research mentioned so far in this chapter shares one unifying characteristic, though: none of it focused exclusively on engineering students. There is a distinct gap in existing literature where this discipline is concerned. Granted, some insightful findings are shared through studies involving the overlap of engineering education and disciplinary literacies — see Goldsmith and Willey (2016), le Roux et al. (2022), Mgqwashu and Bengesai (2016), Wortman-Wunder et al. (2023), and Yong and Ashman (2019) as a few recent examples. However, the AL model was not employed in these studies.

Few studies following the AL model have focused on engineering education, particularly the development of critical reading skills and how they are applied to academic writing tasks. Only one study of note, which focuses on the engineering discipline, has been identified. Strauss and Grant (2018) conducted a study in New Zealand that involved interviewing nine engineering lecturers and five engineering students to gather their perceptions on writing. Results of these interviews indicated that two main problems exist: (a) engineering students do not have the requisite writing skills for their discipline or industry, and they are reluctant to seek help; and (b) engineering lecturers do not have sufficient training and/or the willingness to teach these skills effectively (Strauss & Grant, 2018). While the study did not focus specifically on the role of critical reading in the writing process, it did highlight engineering students' issues with critical thinking and its clear expression in their writing (Strauss & Grant, 2018). Comments from participating lecturers lend support for collaboration between engineering faculty and academic literacies experts. They described themselves as "not the experts in that area," so it would not "be in the best interests of the students to ask engineering staff to assume responsibility for improving students' written communication" (Strauss & Grant, 2018, p. 5). Collaboration when embedding the AL model in engineering courses would also address another concern: "It is not realistic to expect a tutor who has no knowledge of engineering to teach writing in an engineering context. In addition, offering students generic writing instruction presupposes their ability to transfer such instruction to the engineering context" (Strauss & Grant, 2018, p. 8).

Therefore, what is called for next is collaborative research in the field of academic literacies that focuses on the engineering discipline. Such research requires engineering faculty to partner with academic literacies experts and embed the AL model in an existing engineering course. It ought to create opportunities for undergraduate engineering students to practice their critical reading skills with subject-specific texts and apply this to writing tasks that align with

their discipline. As suggested by aforementioned studies (e.g., Lea & Jones, 2011; Nallaya & Kehrwald, 2013), this practice could utilise online learning tools to simultaneously develop students' digital literacy skills as applicable to the discipline. Opportunities to reflect on this learning process ought to play an integral role in such research to provide a platform for the voice of engineering students. In the next sections, discussions on literature about the reading-to-write process and BL pedagogy will illuminate their intersections with the AL model and how they can work in concert for such a collaborative research project.

The Reading-to-Write Process

While this research follows the AL model, its focus is the specific literacy skills associated with the reading-to-write process. According to Flower et al. (1990), this process concerns "the complex interaction that occurs when students are reading to create texts of their own" (p. 3). Wette (2021) referred to it instead as source-based writing because it involves more than just the writing process; it concerns genre conventions, intertextuality, socio-cultural influences on text creation, and the cognitive side of the process involving "the internal dialogue that takes place between writers and the voices of source texts" (p. 7). Of course, this goal-directed process requires the development of certain skills, such as the ability to locate print and electronic resources, evaluate them, select information from chosen sources, and organise it via quoting, paraphrasing, and summarising techniques — done collectively so writers can connect ideas, support their position, and meet expectations of writing tasks (Wette, 2021). Similarly, Fitzgerald and Shanahan's (2000) research about the relationship between reading and writing identifies four categories of knowledge: metaknowledge, semantics, universal text attributes, and procedures and skills for negotiating the process (see Table 1 on p. 41 of that article). Other reading-to-write studies have identified several related foci, including the relationship between literacy skills, language proficiency, and educational level on performance; reading's link to argumentation and inquiry processes; the improvement of writing performance through reading interventions and increased interaction with texts; and metaknowledge about reading, reasoning, and writing (Asención Delaney, 2008; Goldman et al., 2016; S. Graham et al., 2018; van Driel et al., 2022).

A search for online reading-to-write lessons revealed that, when applied in primary and secondary education, a vehicle text is often assigned to prompt writing opportunities.[3]

[3] Examples available at: (a) Unit: A Sense of Place (English Year 8) https://dera.ioe.ac.uk/id/eprint/4999/14/en_exem_65y8place.pdf; (b) English Standard Stage 6 (Year 11) – Sample Unit: Reading to Write – Transition to Senior English https://www.educationstandards.nsw.edu.au/wps/portal/nesa/11-12/resources/sample-units

Meanwhile, students at the tertiary level might have a reading list as a starting point but must often do independent research as part of their reading-to-write process. Such requirements likely stretch beyond the familiar practices of secondary school, where students typically read "textbooks and fiction" and write texts "primarily based on their own opinions," which is why they "need explicit support" when working with scholarly sources upon arrival at university (Broussard, 2017, p. 65). To prepare them to navigate the reading-to-write process and meet assignment expectations, lecturers ought to provide new university students with "relevant, accessible information and practice opportunities" (Wette, 2021, p. 6). The practice of reading-to-write is "a gate into that higher literacy in which information from a source text is not only understood on its own terms, but is transformed in the hands of the writer" — an ability that any student at the tertiary level is expected to develop and demonstrate through various assessments (Flower et al., 1990, p. 4). When students reach that higher state of being critically literate, it means they have developed the ability to question established ideas effectively, analyse and synthesise what they read, and use this information to generate original written artefacts that satisfy their own purposes (Flower et al., 1990). This is essential as students prepare to enter the workforce since it allows them "to walk into the discourse and have a say; it is the means by which students enter the conversation of their disciplines and learn to talk and think like historians and physicists" (Flower et al., 1990, p. 5) — or, in the case of my research, like engineers. In other words, being critically literate goes beyond the ability to meet the expectations of university assessments; for engineering graduates, it includes the readiness to employ reading-to-write in a professional capacity and tailor written artefacts to the needs of an employer or client. In short, there are several reasons why the reading-to-write process is relevant to this study's application of the AL model, so related literature will be examined hereafter.

The Reading-to-Write Process in the Disciplines

Existing literature on the reading-to-write process covers a wide variety of disciplines taught in higher education, and this field of research has been of particular interest to professionals in the TESOL industry.[4] Flower et al. (1990) published a seminal book on this subject called *Reading-to-write: Exploring a cognitive and social process*, which focused on their exploratory inquiry. Rooted in cognitive studies, Flower et al.'s (1990) research spawned a composition course dedicated to raising students' awareness of their reading-to-write process,

[4] TESOL stands for teaching English to speakers of other languages, and this global industry operates in countries where English is the official language as well as abroad where it is a foreign language.

as well as developing related teaching and learning strategies. The study looked at patterns of elaboration (or lack thereof) while reading, their influence on what students wrote, and how various social contexts informed students' goals and strategies (Flower et al., 1990). It was found that students struggled to meet two key expectations of academic discourse: the integration of their own ideas with those from sources, and the interpretation of source content to suit their own purpose (Flower et al., 1990).

Since then, others have added to the literature on various aspects of the reading-to-write process as applies to higher education (Ackerman, 1991; Fujimoto et al., 2011; Gyuris & Castell, 2013; McGinley, 1992; McKenzie & Brenner, 2020; Shi, 2010; Strømsø & Bråten, 2002). However, the participants in these inquiries were studying education (McGinley, 1992); human-resource management (Fujimoto et al., 2011); law (Strømsø & Bråten, 2002); biology (McKenzie & Brenner, 2020); environmental science (Gyuris & Castell, 2013); science, arts, and social science (Shi, 2010); or graduate-level psychology and business (Ackerman, 1991).

In addition, a considerable number of reading-to-write studies have involved ELLs as participants (Doolan & Fitzsimmons-Doolan, 2016; Kim & Kim, 2017; McCulloch, 2013; Plakans, 2008; Qin & Liu, 2021; Shin & Ewert, 2015; Soltani & Kheirzadeh, 2017; Yu, 2016). However, results drawn from participant groups comprised solely of ELLs may not reflect more diverse student cohorts, such as those found at New Zealand universities or in other multicultural, multilingual contexts. Still, they can offer insights relevant to cohorts that include some international students.

Within this collection of literature, a few studies stand out as having greater relevance to my research. Firstly, Fujimoto et al.'s (2011) study focused on developing students' academic reading skills by completing a multi-step collaborative activity, operating within a discipline-specific context, and connecting it all to an upcoming written assessment. Meanwhile, Gyuris and Castell (2013) examined the effectiveness of a 90-minute session in demonstrating how students ought to critically read a scientific journal article in order to compose a written critique. Most recently, McKenzie and Brenner (2020) shared several recommendations for guiding first-year biology students through the critical reading of an experimental report, highlighting the importance of discussing typical language used and the kinds of questions readers should ask themselves during this practice. They also endorsed cross-disciplinary collaborations between subject lecturers and academic literacies experts "to ensure that students understand the content of a paper" and "better grasp the rhetorical moves" (McKenzie & Brenner, 2020, p. 45).

While existing literature on reading-to-write covers a wide array of disciplines and has involved participants from diverse backgrounds, there is one clear gap that my research helps address. Only a couple of the aforementioned reading-to-write studies (Flower et al., 1990; Plakans, 2008) included a single engineering student amongst their participant groups, which were comprised of students from multiple disciplines across undergraduate and graduate levels. Discounting them, research that focuses on engineering students reading discipline-specific content and using it when producing a written artefact within a genre common to their discipline was not found. Luarca and Ramachandran's (2023) study offers a close facsimile, though: first-year engineering students participated in collaborative literature circles in which they read discipline-specific texts, with each team member assigned a role so they focused on different aspects of the texts. However, these collaborations culminated in group presentations about the texts instead of the production of a written artefact, which is the main deviation from reading-to-write studies. Talikka and Eskelinen (2013) also contributed a related study involving mechanical engineering students at a Finnish university receiving information literacy instruction. This learning was embedded in the curriculum, and a cross-disciplinary collaboration occurred to aid students' search for resources published in three languages. While their efforts to create a model to study students' research abilities is of some interest, the participants were not new undergraduate students, nor did the study focus on students' ability to critically read sources found and synthesise the information in a written artefact. As identified here, even though a small number of papers have touched on some of the aforementioned criteria, a clear gap in the literature has endured until now.

Links Between Reading-to-Write and the AL Model

Existing reading-to-write literature remains relevant to my research because some principles align with the AL model. For instance, Flower et al.'s (1990) study highlighted the importance of cognition and context. They argued that effective teaching of academic writing involves the following:

> (1) teach students to understand and expand on their own repertoire of strategies for planning, revising, and so on; (2) create a context that supports thinking processes we value; and (3) also help students examine some of the nonsupportive contexts and assumptions they may be carrying in their own heads. (Flower et al., 1990, p. 12)

Therefore, reading-to-write overlaps with the AL model in several ways, including the importance of scaffolding and reflection when teaching and learning skills relevant to the writing process, as well as the various contextual influences on meaning making. Similarly,

Broussard (2017) highlighted the importance of existing knowledge, values, past experiences, and current reading goals in connection with meaning making because students "do not arrive to higher education as blank slates" (p. 92). With time and practice, they can learn to reflect on the texts they read, compare this information to what they already know, and synthesise it in order to use sources effectively in their writing. Granted, other conditions — for instance, providing formative feedback, creating opportunities to rethink habits and unlearn faulty assumptions, and designing effective assignments — ought to be met so students find success in the reading-to-write process at the tertiary level (Broussard, 2017).

The main deviation is that aforementioned research on the AL model recommended embedding it in the disciplines, while Flower et al. (1990) and others offered independent courses to study the reading-to-write process. Over time, though, some reading-to-write research has started to align more closely with the AL model. For instance, Broussard (2017) recommended that assignments have a clear audience, specific purpose, and follow discipline-specific genre conventions for added authenticity. It was also acknowledged that cross-disciplinary collaboration could "bring complementary skill sets and perspectives into the classroom" (Broussard, 2017, p. 94). Meanwhile, McCulloch (2013) did a better job of embedding reading-to-write by having participants follow a think-aloud procedure while reading self-selected sources relevant to their dissertations. As a result, her study revealed how one's rhetorical purpose guides one's reading strategies and ways of engaging with source content, which "reflects the complex, multi-faceted nature of reading to write as it occurs in real-life academic tasks" (McCulloch, 2013, p. 146). Commonalities in existing literature on the reading-to-write process and the AL model reinforce their relevance, thus making them important components in my research design.

Issues with Existing Reading-to-Write Literature

While existing ideas about reading-to-write inform my research in some ways, they are not infallible. The first problematic trend in the literature relates to unrealistic learning and assessment contexts in which students are expected to complete the reading-to-write process. Flower et al. (1990) argued that this process "is highly subject to the goals of the writer, the influence of the context in which it occurs, and the abilities of the writer" (p. 7). As a result, lecturers must apply pedagogical strategies when assigning reading-to-write tasks so this process fosters students' critical literacy — that is, the lecturers "have to create a context for writing that sets such goals and to teach the thinking strategies that can support these goals" (Flower et al., 1990, p. 7). As McCulloch (2013) pointed out, though, a fair amount of reading-to-write research has involved timed writing tasks like those suited to an examination — a

context that would impact strategies taught and learned during the process. This does not align well with many writing tasks assigned as part of engineering education. For example, assessments connected to courses in the University of Waikato's engineering programmes are often composed over days or weeks as part of the completion of a larger project or experiment.

Another particular concern relates to the relevancy of writing prompts and how this might influence written output. According to Flower et al. (1990), "the entry into academic discourse depends on strategic knowledge of the goals and strategies a particular discourse requires rather than on some basic or invariant set of skills or text types or on textual features" (p. 26). Conflicting with this statement, their composition course used an essay prompt with deliberately complex wording. Participants were first identified as English majors, but Flower et al. (1990) later described one participant as an engineering student who often relied on a "gist and list strategy," approaching essay writing as if it were a research report (p. 44). It is possible that the isolated context of their composition course, including the chosen topic and genre, was part of the problem. The relevance (or lack thereof) of a writing task to one's chosen discipline could influence task representation. It is even possible that an inauthentic task could leave students with the impression that reading-to-write is about testing their ability rather than communicating ideas (Broussard, 2017). In the case of that engineering student, her tried-and-tested, more formulaic approach to writing proved a mismatch with expectations for the essay. Instead, by embedding the AL model in each discipline, the context in which students practice reading-to-write would be more relevant to their studies and possibly yield written output that is better aligned with expectations in that professional field.

Insights Gained Through Existing Literature

Certain lessons can be learned from reading-to-write research and then applied to an embedded AL model. For example, Flower et al. (1990) found that a lecturer's understanding of a task's instructions and expectations for the assignment can differ greatly from those of the students, with interpretations varying from student to student, too. In fact, they "were holding radically different representations of the task and relying on strategies that would inevitably produce very different papers" (Flower et al., 1990, p. 45). Moreover, in some past cases, factors such as purpose, audience, and authenticity did not inform the teaching of the reading-to-write process. Granted, such factors are now being considered in research published more recently (e.g., see Broussard, 2017). These problems suggest that, when task instructions are first shared with students, the opportunity for collaborative analysis ought to be embedded in the lesson. Doing so would scaffold each writer's construction of a task representation, raising awareness of options and expectations (Flower et al., 1990).

Secondly, context — that which informed existing knowledge, values, and assumptions, plus the ones in which students currently learn — has a great influence on how students read and interpret texts and then apply that information in their own writing (Broussard, 2017; Flower et al., 1990). With great diversity in the student body, universities must appeal to a wide variety of culturally informed expectations of learning and levels of experience. Today, a single cohort can include high school leavers, mature students, those who are more practiced in oral communication due to their heritage, international students who are still learning the language of instruction, and students with learning disabilities. These diverse backgrounds can affect how each student engages in academic discourse. In addition, the cultures and education systems in which students are raised can shape how they learn — for example, those that prioritise observation and rote learning versus those that orient to particular ways of expressing critical thinking and problem solving. Such influences may even impact learners' cognitive styles and rhetorical tendencies, including how they think and reason, interpret readings, and construct arguments in their own writing (Connor, 2002; Kaplan, 1966; Nichols, 2025); this might explain some issues with organisation and coherence described by Flower et al. (1990). For these reasons, reading-to-write practice must employ a variety of strategies to appeal to diverse cohorts, which ought to be further customised to the needs of each discipline as part of an embedded AL model.

Existing literature on the reading-to-write process provides valuable insights, which have been applied in the design of my research project embedded in the University of Waikato's School of Engineering. Within its undergraduate programmes, enrolled students from various backgrounds are expected to follow the rigorous conventions of the scientific process, and they often communicate the steps of a project or experiment in an engineering report. This genre comes with its own academic and discipline-specific writing conventions as well as vocabulary unique to engineering, all of which can differ from the genres and subject areas that the students have prior experience in writing. I have also considered that students enrolled in the engineering programmes bring with them varied levels of experience with engaging in academic discourse. Doing so successfully at this institution will first require the guided practice of certain academic literacies. In particular, critical reading skills must be developed at the beginning of tertiary studies before students can adapt their strategies and meet goals through the rest of their programme. It is possible that a reading-to-write formula could help them establish that foundation. Since it can be challenging for new undergraduate students to develop critical reading skills while adapting to higher education, Corrigan (2023) advocates for "reducing the complexity of critical reading by guiding students step by step through the

intellectual moves required" (p. 7). The A-B-C-D Formula for Critical Reading, which I designed for this study, aligns with this recommendation. As students develop the associated academic literacies, they can apply the formula to other academic topics and genres that require the interpretation and integration of source content in their own writing. Inspired by other research mentioned earlier that touched on digital literacies, I have chosen to combine my reading-to-write formula with a BL approach, using its online component as the vehicle through which participants practice critical reading skills. The next section will examine relevant literature on BL, which further influences my research design.

Blended Learning

So far, this chapter has discussed literature on the AL model and the reading-to-write process, the principles of which have guided my research design. However, it is the pedagogy of BL that shapes the intervention at the core of my action research. In the field of education, BL is part of the evolution of distance learning aided by technology, which has included lessons broadcast via radio, TV-mediated instruction, computer-based training courses, interactive learning with CD-ROMs, web-based training, and online courses utilising various digital resources delivered through a LMS (Alexander, 2010; T. Anderson & Dron, 2011; Bersin, 2004; Pappas, 2015).

Defining Blended Learning

BL differs from these other options because it marries aspects of face-to-face classroom learning with the use of online tools to facilitate e-learning (Garrison & Kanuka, 2004; C. R. Graham et al., 2013; Milad, 2019; Poon, 2013). Although, existing literature identifies inconsistencies in the definition of BL since delivery methods can vary with each application to include "instructor-delivered content, e-learning, webinars, conference calls, live or online sessions with instructors, and other media and events" (Banditvilai, 2016, p. 220). As Bersin (2004) pointed out, unique combinations of available synchronous and asynchronous options mean that, in some applications of BL, the former can be instructor-led lessons conducted live via the internet instead of in a classroom setting and the latter can involve the offline self-study of books and other physical media. Inconsistencies extend beyond the definition to beliefs about the percentage of online learning required as part of a BL approach (Cronje, 2020; Garrison & Kanuka, 2004; Hiasat, 2022; Moskal et al., 2013; G. G. Smith & Kurthen, 2007; K. Smith & Hill, 2019). Claiming BL's mixture is often arbitrary, Moskal et al. (2013) argued that there are "virtually unlimited possible combinations, each one no more or less valid than all the others" (p. 15). Cronje (2020) drew attention to the fact that many studies applying BL

specify the mixture utilised more than the pedagogy of the BL approach to ensure effective learning. While a variety of BL definitions exist across the literature, one offered by Yoon and Lee (2010) is especially thorough and applicable to my research design:

> blended learning is defined as bringing together the positive attributes of online and offline education, including instructional modalities, delivery methods, learning tools, etc., in relation to language teaching and learning approaches and methods in order to reinforce learning process, to bring about the optimal learner achievement, and to enhance the quality of teaching and learning. (p. 180)

While the authors wrote this definition from their perspective as English language teachers, it also applies to the study of academic literacies as well as learning the specific and academic language needs of a particular discipline where English is the medium of instruction. Offering an updated, more succinct definition, Cronje (2020) stated that BL should involve "the appropriate use of a mix of theories, methods and technologies to optimise learning in a given context" (p. 120).

Within the context of engineering education, recent studies have utilised BL to aid students' learning of engineering materials, thermodynamics, biomechanics, situated mathematics, English language skills, academic integrity expectations, and academic literacies (Blake, 2021; Duff et al., 2020; Francis et al., 2012; Garner & Neal, 2022; Hennig et al., 2015; Lee, 2013; Pang et al., 2023; Raban, 2018; Vo et al., 2020). Those listed here that are most relevant to my research will be discussed in greater detail towards the end of this chapter.

BL at an Institutional Level

The literature reveals that institutions can benefit from a BL approach, but complications can be born of conceptual inconsistencies in the approach. At some institutions of higher education, a top-down approach to BL implementation has been followed, involving strategic plans overseen by programme and faculty leaders, deans, and/or other administrators (C. R. Graham et al., 2013; Gutlerner & Van Vactor, 2013; Poon, 2013). Moskal et al. (2013) described how to make such institutional plans successful. A top-down strategy to implementing BL can come with drawbacks, though. Concerns have been raised about some universities shifting to a business model, requiring educators to rely on a designated LMS and deliver centrally-designed courses for the sake of uniformity, instead of seeking regular input from faculty and allowing the creative, innovative use of various BL strategies and external learning tools (Repman et al., 2010). On the other hand, there are institutions where individual faculty have made a "grass-roots effort" to add BL to offerings, which can blind administrators

to the extent of its implementation and level of effectiveness (C. R. Graham et al., 2013, p. 4). Accordingly, Garrison and Kanuka (2004) emphasised the importance of "thoughtful integration" since a BL approach comes with "virtually limitless design possibilities and applicability to so many contexts" (p. 96). Regardless of the BL implementation strategy followed, institutions must acknowledge that university culture will change as a result; this is not limited to the concerns of new students, who may have expected lecture-based learning taking place on campus, but extends to a recognition that faculty and student workloads are impacted so administrative policies ought to adapt in kind (Godlewska et al., 2019).

Lessons learned from other institutions' experiences with BL have influenced my research design and its place at the University of Waikato, as has my experience with teaching online through the COVID-19 pandemic. Prior to the pandemic, blended and online learning had been offered at the university for years, but in a more ad hoc manner. Then in early 2020, COVID-19 spread through New Zealand communities and triggered lockdowns, forcing this institution to shift all offerings online, and then administrators chose to follow what they called a "blended approach" as restrictions continued to change (University of Waikato, 2020). This evolved into giving students the option of continuing to learn online, return to campus for face-to-face classes, or enrol in certain courses offered in FLEXI mode[5] (University of Waikato, 2021). While FLEXI mode remains an option in some programmes, all engineering offerings at the University of Waikato have reverted to pre-pandemic requirements of face-to-face learning. This means the e-learning aspects of BL are not available to students studying this discipline, and it is typical for engineering courses to use the LMS as just an assessment and resource-sharing space. In contrast, my research utilised and embedded BL in an existing engineering course, and this process was informed by principles of the AL model and the reading-to-write process, as well as the needs of this university. Moreover, my intervention has benefitted from the support of the course convenor as well as other departmental leaders, thus following a more cooperative, community-based approach to implementation.

Educators Adopting BL

While existing literature indicates that educators can benefit from following a BL approach, it can also come with complications. BL offers greater flexibility for teaching, improves the accessibility of resources, and can incorporate a variety of delivery methods and activities (Alexander, 2010; Banditvilai, 2016; Han, 2023; Levy et al., 2011). Of course, these

[5] The University of Waikato described FLEXI mode as flexible courses where learning can happen face-to-face on campus or online, allowing each enrolled student to choose how and where they learn.

benefits depend on educators and learners having sufficient internet and device access. However, the effective use of BL requires "rethinking and redesigning the teaching and learning relationship" (Garrison & Kanuka, 2004, p. 99). For instance, depending on the pedagogical approach taken, BL integration into a course can affect the level of control held by the teacher, who might become "more of a guide than an instructor, but who assumes the critical role of shaping the learning activities and designing the structure in which those activities occur" (T. Anderson & Dron, 2011, p. 85). As a result, educators planning to introduce BL to existing offerings would need to adjust teaching methods, dedicate more energy to course management, spend more time programming online learning tools and activities, and regularly check their functionality (Godlewska et al., 2019). This reliance on technology requires educators to learn how to use it, and there is no guarantee it will run smoothly. As applications are updated and new ones are launched, educators would need regular professional development opportunities to keep pace with the technology available to them. Even though many current students belong to a generation that makes them digital natives, teachers should not assume that they possess the right attitude or necessary skills to use educational technologies for online learning in a way that meets the expectations of higher education (Le et al., 2022; Prior et al., 2016; S. Smith & Chipley, 2015; Tang & Chaw, 2016; Waycott et al., 2010). Especially where interactive and collaborative online activities are concerned, it is necessary to address feelings of anxiety and fear related to writing online, as well as regulate and mediate competitiveness, conflict, or other inappropriate behaviour (Waycott et al., 2010; Wheeler, 2010). In short, educators would need to teach digital literacy skills, establish expectations for online decorum, and scaffold any online activities as part of a BL approach to ensure students can tackle those tasks effectively.

Secondly, there is some disagreement in the literature about how best to embed BL in a course, which is likely a product of its rather loose definition. It is possible that varied strategies described in the literature have further muddied the waters. For example, Precel et al. (2009) recommended that core theories be taught in face-to-face lectures, leaving online learning tools to facilitate the completion of authentic tasks. However, their course design involved posting all content online and leaving attendance of face-to-face meetings as optional; this creates an unbalanced mixture that does not align well with most definitions of BL since students can choose to avoid in-person interactions and the benefits they bring to the learning process. Granted, this is a rather old study, and many educators have gained greater awareness of BL since it was published. More recently, Han's (2023) study highlighted a different application of BL, following the production-oriented approach and incorporating aspects of the flipped

classroom strategy when planning tasks for before, during, and after class. Although this approach benefitted students in multiple ways, it was applied in a college English course taken by non-English majors so content covered did not relate to their discipline of study. Meanwhile, Gutlerner and Van Vactor's (2013) research demonstrated how short-format nanocourses can be embedded in a graduate-level science programme to help students develop technical skills relevant to their discipline. The nanocourses had their own modular curriculum, though, which disconnected the skills somewhat from the rest of the programme's courses, learning outcomes, and assessments. The cases identified here demonstrate that different interpretations of BL can contribute to it being embedded at varying depths.

Two studies were found that demonstrate a more thoroughly embedded BL approach, thus making them more relevant to my research. Firstly, Godlewska et al. (2019) employed BL and active learning strategies in a first-year geography course to combat growing class sizes, increase engagement with content, and develop related academic skills. In their study, considerable cross-disciplinary collaboration and experimentation with teaching methods and materials were utilised to improve the course. Some aspects of their revised course focused on developing critical reading skills in connection with discipline-specific academic writing, making this article more relevant to my research than those mentioned earlier. Besides online submission and feedback practices, though, it is not entirely clear how online learning activities were linked to assessments (Godlewska et al., 2019). The second study, which involved assessing the information literacy and research skills of first-year undergraduate students enrolled in education programmes, demonstrates a deep level of embedding of its BL approach (Yager et al., 2013). The researchers created connections between face-to-face lectures, an online quiz and other tasks, formative feedback, and a portfolio assignment. Yager et al. (2013) also determined that using a "quiz and rubric in tandem offers more opportunities for learning and assessment" (p. 69). The study had its drawbacks, though: not all learning activities were compulsory, and "there was very little discipline focus" (Yager et al., 2013, p. 69). In short, much can be learned about embedding BL in courses from the examples in this section. Most importantly, a clear integration strategy is needed that links online activities to face-to-face elements, course content, learning outcomes, and assessments in ways that facilitate authentic practice within the discipline.

Learning from existing literature about the challenges related to applying an effective BL approach, I have opted to infuse the AL model with BL. I use BL as the vehicle through which students practice my reading-to-write formula — a strategy that creates stronger connections

between academic literacies, content, and assessments. It also provides opportunities to reflect on the teaching and learning process.

BL and the Student Experience

The literature identifies the value of BL and possible hurdles from the students' perspective, too. For example, a BL approach promotes greater independence while offering students increased control over their learning, and it encourages "a scaffolded acceptance of responsibility for constructing meaning and understanding" (Garrison & Kanuka, 2004, p. 98). Such principles align with those of the AL model as well as a key reason why students pursue higher education: to prepare themselves for the professional challenges of their field. However, a small number of students may abuse this responsibility for their own learning, neglecting to complete any online activities meant to practice skills but that do not contribute to grades. Of course, leaving online activities incomplete may be unintentional in some cases if students are not aware of requirements for independent learning and/or are more accustomed to directive learning experiences (e.g., those of secondary school). This is where Garrison and Kanuka's (2004) comment on "thoughtful integration" comes back into play (p. 96). At the commencement of a course, students need a clear explanation of how a BL approach will impact their workload (versus a traditional lecture- and exam-style course) so they can plan accordingly (Godlewska et al., 2019). They also need to see an explicit connection between online activities and a graded assessment so they can understand how completing them is to their benefit. Secondly, when BL is embedded across a discipline, the flexible course designs and learning environments can "accommodate the fact that students have different learning needs and preferences" (Poon, 2013, para. 9). This is especially relevant to any international students and ELLs studying a discipline because their diverse cultures and experience of different educational practices shape their learning of that discipline. Moreover, BL builds trusting relationships and a sense of togetherness, has the potential to foster teamwork skills, and encourages expression and the sharing of knowledge as part of conducting academic inquiries (Garrison & Kanuka, 2004; Garrison & Vaughan, 2008; Sheerah, 2018). While not part of a discipline's core knowledge, these so-called soft skills and traits are integral to the experience of higher education, the meeting of graduate outcomes, and the making of a successful professional.

Considering STEM students, a BL approach is beneficial because it can offer "collaborative, independent, and problem-based learning to reach the broadest range of learning types" and align with many of the disciplines' learning outcomes (Lothridge et al., 2013, p. 408). Focusing on engineering students in particular, many of them can be categorised

as “visual, sensing, … and active” learners, which ought to be considered when designing online activities as part of a BL approach (Felder & Silverman, 1988, p. 680).[6] Among the available web-based learning tools, wikis, blogs, forums, and other online group discussion spaces are commonly used and recommended because they have the potential to foster interaction and collaboration (Abdallah, 2010; Ajjan et al., 2010; Escofet & Marimon, 2010; Hennig et al., 2015; Owston et al., 2020; Waycott et al., 2010; Wheeler, 2010). However, one must still question how authentic such learning activities are within the context of the student’s chosen field — that is, how often professional engineers might contribute to a wiki or post to a forum as part of their job. Framing these activities within a discipline-specific context is essential so students can transfer the practice of skills to their professional field.

While there is limited literature linking the BL approach to engineering education, one can discern from related articles the importance of ensuring that participation and/or collaboration are not the only goals when students do online activities. To make online activities more authentic and better aligned with learning outcomes, their completion could contribute to skills development leading to a graded team-based project, be connected to the group’s composition of a report, or play a role in reflective practice. Garner and Neal (2022) shared a noteworthy example that involved first-year students completing weekly online discussion forums to improve their reading habits. In this study, students read texts about writing and professional skills that could be applied to engineering, and participation in the forums was meant to enhance their reading depth and level of criticality in posts. Even though this graded forum activity was embedded in a course designed to develop students’ discipline-specific writing abilities, participants found that some of the readings did not encourage much criticality due to their topic (Garner & Neal, 2022). Perhaps student attitudes could have been improved in this case if a greater variety of texts were read. For instance, weekly forums could have started with readings that would aid the development of their writing skills and then transitioned to other topics, such as texts that would introduce them to recent innovations in engineering or encourage reflection on discipline-specific concepts including ethics or sustainability. In short, educators ought to ensure that an embedded BL approach not only contributes to the development of academic literacies but also discipline-specific knowledge.

[6] Felder and Silverman’s article remains highly relevant within engineering education even today. According to Semantic Scholar, it has been cited more than 5,000 times since its publication, although Google Scholar credits the updated 2002 version with more than 10,000 citations. Felder wrote a new preface for the article in 2002 to comment on its enduring influence in academia, saying it earns about 100,000 readers a year. That preface also provided an update on some of the content, specifically the deletion of the inductive/deductive dimension. Felder explained that later sampling contradicted the assumption that students favour induction. For this reason, I have used an ellipsis in the above quotation to remove the word *inductive* from among those listed.

Still, the link between BL and academic literacies is highly relevant to engineering students since they are typically required to read advanced engineering texts, gather data for analysis, and solve problems in order to compose the kinds of texts (e.g., lab report, technical report, research thesis) relevant to their discipline.

The Intersection of Concepts, Context, and Content

Despite the benefits that a BL approach can offer engineering students, studies using BL to develop these learners' critical reading skills appear largely absent from the literature. The aforementioned study by Garner and Neal (2022) is one of only two found that meet these criteria. However, their study relied on only one type of online activity to practice academic reading and writing. Moreover, it could be argued that content around which their forum activity was built had limited relevance to the context of engineering education, meaning the way it was embedded in the course could have been more aligned with the discipline. A similar issue with embedding was noted in the second case. Blake's (2021) study involved computer science and engineering students in Japan enrolled in a critical reading course taught in English. It was not fully embedded because the online activities completed did not involve discipline-specific readings.

Otherwise, related literature has been published but lacks the exact intersection of BL, critical reading, and engineering education. For instance, Francis et al.'s (2012) study involved BL and engineering students but did not focus on critical reading skills; however, its insights on providing digital feedback as part of BL are worth considering for my own research design. Similarly, Duff et al. (2020) examined a first-year, BL engineering course and its students' engagement with SIERA modules. Their study, while sharing valuable findings about the role of such resources in academic literacies development, focused on academic integrity instead of critical reading. Other studies have demonstrated the value of language and literacies experts helping STEM students improve their communication and academic skills (Day et al., 2015; Griffiths & Davila, 2022; Lengsfeld et al., 2004; Letchford et al., 2017; Saffková & Tuma, 2012). This small number of studies also reinforces my position that cross-disciplinary research and teaching partnerships are scarce in higher education. Meanwhile, Raban's (2018) study involved BL and a small sample of engineering students but within the context of an EAP course that did not focus exclusively on critical reading. Lee's (2013) study offers a similar example: a BL approach was followed for an English course in which ELLs majoring in Shipping Technology or Marine Engineering produced reading response e-journals, but the texts read were not related to their disciplines. Further research conducted by EAP and TESOL experts has involved critical reading and BL, but these studies did not include engineering

students as participants (Bhooth et al., 2015; Fola-Adebayo, 2019; Gilbert, 2013; Kara, 2018). Therefore, an opportunity exists for my research to address this gap.

Overall, several gaps in the literature have been signposted throughout this chapter. My research will respond to them while exploring the following questions:

1. How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment?

2. How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process?

This chapter's analysis of the literature has identified issues of explicitness, specificity, and implementation common to many applications of the AL model. It has also touched on the need for context-driven, authentic practice of the reading-to-write process and fully embedding a BL approach in a discipline to maximize benefits for students. Especially where the AL model is concerned, my critiques of early literature highlight how some scholars offered insufficient guidance on how to use this framework. Despite this limitation, I have decided to proceed with the AL model as the primary concept guiding my research. This is motivated in part by its capacity to yield valuable ethnographic data, but I am also driven to demonstrate how a teacher-researcher can use the AL model in a way that can serve as a model to others. I address this need directly by supporting my research design with practical and original resources. They facilitate data collection relevant to my research questions and provide explicit guidance to other teacher-researchers. Issues in the literature, which were identified throughout this chapter, are also addressed through my research via the intersection of concepts, context, and content. Each of these pieces fit together, as if part of a jigsaw puzzle, and the collective space at the core is occupied by my research. Figure 2.1 on the next page illustrates this intersection.

My research is designed around two original teaching and learning tools, the first of which is the A-B-C-D Formula for Critical Reading. As mentioned in the previous chapter, this formula consists of four key phases that facilitate the critical reading of disciplinary texts as part of academic writing. The second resource I designed for this project is a series of critical reading online activities. Students complete these activities to practice the formula's phases.

Each phase of the A-B-C-D Formula is further divided into key steps and recommended actions, which offer practical guidance to students as they work through its phases. Phase A involves the analysis of task instructions. To complete this phase, students confirm their understanding of all terms in the writing prompt. They also determine its task word(s), intended

audience, specific purpose, required perspective or voice, and the text genre that they are expected to produce. Next, Phase B has them brainstorming keywords and synonyms relevant to the task instructions. They also create lists of their existing knowledge on the task's topic, questions that need answering through research, and ideas about where to find information to fill the gaps in their knowledge. This brainstorming feeds the research they conduct in Phase C in order to collect relevant resources. In the third phase, they scan search results, analysing each one's relevancy and appropriateness. This leads to the reading of excerpts to determine each text's connection to the task instructions. Lastly, Phase D involves drawing connections between sources and their own ideas. It is also the phase in which they practice using reporting verbs and in-text citations. The series of critical reading online activities provides a method for students to practice the key steps and recommended actions of these phases leading up to a writing assignment.

Figure 2.1

The Intersection of Concepts, Context, and Content

Note. A template by HiSlide.io was used to create this figure.

Together, these two teaching and learning tools shape my research, and they arose from past experiences in teaching academic writing and research skills to engineering students as well as my examination of the literature. Those past experiences, as described in Chapter 1, led me to hypothesize that engineering students could benefit from a formulaic approach to academic literacies development that is fully embedded in their discipline. The A-B-C-D Formula for Critical Reading makes explicit to students the kind of process involved when one must engage critically with disciplinary texts and use them to support one's academic writing. It breaks that process down into specific steps that are easy to remember and follow. The choice to design my original formula in this way and focus on four phases was strategic. Its teaching of critical reading skills is not exhaustive — for instance, it does not cover skimming and scanning techniques or how to unpack and critically read full academic articles. However, the A-B-C-D Formula is designed to cover many academic literacies that contribute to effective pre-writing, including the critical reading of discipline-specific excerpts and abstracts. It maximizes the time allotted to me by the University of Waikato's School of Engineering for this study by helping students learn foundational critical reading skills leading into one of the first significant writing assignments they tackle in undergraduate studies. Using BL to implement the teaching and learning of my formula in the classroom ensures that students engage in authentic practice of all its steps prior to submitting this assignment.

In the chapters that follow, I will investigate how the AL model can be embedded in an existing engineering course at the University of Waikato, using BL to facilitate the practice of critical reading skills as part of the reading-to-write process. The phases of my reading-to-write formula, designed to be taught face-to-face, are clearly defined and feature scaffolding of their completion process. This involves outlining key steps and recommended actions to follow, reinforced by examples, models, and online practice. Implementation links the online activities to one existing assessment within an engineering course. Even though the online activities are customised to that assessment, their design could serve as a model for other teachers and researchers to adapt easily for their purposes. Further details about this strategy, its design, and its application are shared in the next chapter.

Chapter 3: Research Methodology

This study employed an action research methodology in order to address the following two research questions:

1. How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment?

2. How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process?

The chapter begins with a discussion of action research, which shaped the design of my project. The section also shares the rationale behind the selection of this methodology and identifies how its principles intersect with those of the AL model. Next, the chapter summarises the technological resources used to complete my research. This is followed by a section about the study's participants, their demographics, and how ethical matters were addressed where they are concerned. Then details are provided about the design of resources used during the action research intervention. This is followed by a section about the study's quantitative and qualitative data and the instruments used to gather it. Towards the end of the chapter, my mixed methods approach to data analysis is described, including details about its stages.

Action Research

Action research is a pragmatic, problem-solving methodology designed to help the practitioner (Lewin, 1946). While Kurt Lewin is credited with the first use of this term, works by Donald Schön, John Elliott, Lawrence Stenhouse, and Richard Winter were also key to the foundations of action research (Baumfield et al., 2013; McAteer, 2013; Stringer, 2008).

Within the field of education, teacher-researchers conduct action research with the aim to improve their teaching practice, which requires them to follow a process of conscious, critical reflection in order to understand their practice and its effects (Baumfield et al., 2013; McAteer, 2013). These reflections focus on the evidence gathered during practice (i.e., an action research project), which contributes to theorising (McAteer, 2013). According to Stringer (2008), while action research "often makes use of quantitative or statistical information," it holds a closer association with the paradigm of qualitative research (p. 15). This is the case with the methodology for my study. While its design best suits the definition of a mixed methods research paradigm, a considerable amount of the mixture is qualitative data.

The Design of my Action Research Project

Action research operates systematically and in stages, each one informing that which follows. Lewin (1946) described "a spiral of steps each of which is composed of a circle of planning, action, and fact-finding about the result of the action" (p. 38). In an educational context, an action research design requires "a series of linked enquiries with teachers formulating questions arising directly from their classroom experiences at each stage in the process" (Baumfield et al., 2013, p. 3).

My action research design was guided by Kemmis et al.'s (2014) "spiral of self-reflective cycles" (p. 18). However, there was one clear deviation: re-planning the change with further action and observation in the classroom did not occur as part of my doctoral research. Instead, I interpreted that final stage in a different way. As mentioned in Chapter 1, an initial reflecting stage took place while I was still teaching in the Waikato-HEBUST transnational programme, and this was in connection to the beta-test of online review activities. Later, I reflected on existing pedagogical and assessment practices in the School of Engineering at the University of Waikato. Together, those reflections led to the design of the A-B-C-D Formula for Critical Reading and the creation of a revised, expanded set of critical reading online activities. They were the backbone of my classroom intervention.

This intervention was embedded in the ENGEN170 course, allowing me to gather data during a single trimester, thus determining the study's scope. Despite this constraint, the design of my action research project included multiple opportunities to observe and reflect on the effects of the intervention throughout the reading-to-write process. In addition, feedback loops were in place during each stage of the project, which allowed students to gain insights from formative assessment and facilitated my collection of data from the students' perspective for analysis.

In the case of my project, the action research cycle ends with a final stage involving an element of re-planning. The results of this study have inspired further refinements to the intervention's teaching materials, particularly the critical reading online activities. The last chapter of this thesis will share a revised and expanded plan for how to embed the intervention permanently in ENGEN170. This includes an improved version of the critical reading online activities. Together, these teaching and learning resources can serve as a model for other teacher-researchers to adapt and apply in other contexts.

Regarding my research design, teaching materials and instruments were created to yield data and feedback, which were analysed collectively to respond to the research questions. Participating students were a cornerstone of this process because my goal was not merely to

provide tools that could make their learning and practice of a complex process more manageable; the process also gathered feedback from students about these tools, which has yielded insights into overall attitudes about critical reading in engineering education.

My action research intervention was divided into four stages, as outlined in Table 3.1 below. Various forms of data were gathered during this time, some of which related to the effects of the intervention while others concerned student attitudes. They proved sufficient to answer the research questions and determine how the design of resources could be improved for later applications.

Table 3.1

Stages of my Action Research

Stages	**Planned Action**	**Data, Reflection & Feedback**
Stage 1: Foundations	1) Gathered information on participants 2) Established initial student attitudes	1) Initial survey
Stage 2: Reading-to-write formula	1) Taught A-B-C-D Formula for Critical Reading during intervention lecture (1 hr.) 2) Students completed Assignment 2 – Part 1 (pre-test writing task)	1) Teaching log used to note any questions asked during lecture or about pre-test writing task 2) Assessed pre-test writing task using critical reading rubric and provided students with feedback
Stage 3: Critical reading online activities	1) Students completed critical reading online activities during intervention workshop (2 hrs.)	1) Teaching log used to note any questions asked during workshop or any problems students had while completing online activities 2) Automated online feedback as formative assessment of students' practice of the A-B-C-D Formula 3) Recorded trends in students' answers to the online activities
Stage 4: Post-test	1) Students completed Assignment 2 – Part 2 (post-test writing task) 2) Gathered students' feedback on the intervention 3) Established current student attitudes	1) Assessed post-test writing task using critical reading rubric, provided students with feedback, and compared results to pre-test writing task 2) One-on-one interviews with a select group of students 3) Post-intervention survey (compared results to initial survey)

The first stage took place at the beginning of ENGEN170 when I introduced myself to the cohort of enrolled students. This course was delivered face-to-face across the university's two campuses, and students were expected to attend weekly lectures, workshops, and tutorials. Only the lectures were recorded for possible online viewing, and ENGEN170 was not available in a NET or FLEXI mode.[7] Initial contact with the students occurred on 1 March 2023. At the Hamilton campus, I did a 10-minute, face-to-face introduction presentation at the end of a lecture. That same day, the course convenor played an introduction video to participants at the Tauranga campus. During these introductions, I informed students of the plan to conduct action research within their course and asked them to complete the initial survey through Moodle.

Next, I taught a one-hour intervention lecture, introducing the cohort to the A-B-C-D Formula for Critical Reading. During this second stage, participants submitted Assignment 2 – Part 1, which served as a pre-test writing task.[8] I worked with the course convenor to select its deadline to ensure all students had several days to complete the task. I assessed it for my purposes using the critical reading rubric (see Appendix A), but the convenor completed the official grading for the course. Students also received instruction to bring their own laptop or tablet to class for the next stage so they could get online.

Stage 3 focused on the critical reading online activities, which students completed during a two-hour intervention workshop. Most of the activities were programmed to give students automated feedback as they completed each task, guiding them to improve their application of my reading-to-write formula. A few of the online activities were designed so students received group feedback or peer feedback instead. Additional observations were noted in my teaching log during this stage and the one that preceded it.

The final stage of my action research focused on the post-test writing task. For this, participants completed Assignment 2 – Part 2, which was due on 26 March 2023.[9] In the days that followed, I used the critical reading rubric again for its assessment (see Appendix A), while students completed the post-intervention survey made available to them through Moodle. I also conducted one-on-one interviews with six participants via Zoom, which were recorded for later transcription. By 9 April 2023, the four stages identified in Table 3.1 were completed, so I turned my attention to data analysis.

[7] NET is a code used by the university to indicate a course is studied online, while FLEXI means that students can choose to complete a course face-to-face on campus or online.

[8] Assignment 2 – Part 1 involved the submission of one short academic text on an engineering topic. Later in this thesis, it is sometimes referred to as Task #1.

[9] Assignment 2 – Part 2 involved the submission of two short academic texts on different engineering topics. Later in this thesis, they are sometimes referred to as Task #2 and Task #3.

Rationale Behind Choice of Action Research as Methodology

Action research as methodology was chosen for this project because its traits are appealing to me as a teacher-researcher. This methodology operates in authentic teaching spaces, creating opportunities for reflection and professional growth. In the case of my study, this methodology allowed me to test the effectiveness of a new approach to teaching and learning critical reading skills within an existing engineering course. Its cyclic nature also created multiple opportunities to gather data and offer feedback during the intervention. These traits align well with the AL model's capacity to establish a symbiotic relationship between lecturers and students, as mentioned in Chapter 1, by encouraging the sharing of feedback and the improvement of one's practice.

My action research was designed around the principles of the AL model. According to McNeill and Chapman (2005), this means my research engaged in methodological pluralism because I employed "more than one method of research in order to build up a fuller and more comprehensive picture of social life" (p. 22). Since the AL model is concerned with the social aspects of academic literacies, it often relies on ethnographic data (Lea & Jones, 2011; Lillis & Scott, 2007). Such data can be key to understanding learning because this process "involves a change in one's knowledge, beliefs, behaviors, or attitudes" (Larkin, 2015, p. 12). This idea lends itself well to explaining how action research and the AL model worked together in my study: the teaching intervention assessed students' knowledge and application of critical reading skills, while the AL model yielded data about their changes in attitudes. Specifically, ethnographic data was gathered via the surveys and interviews. Students' reflections provided insights into the practice of the A-B-C-D Formula for Critical Reading and its influence on meaning making as part of their reading-to-write process. In turn, the critical reading online activities scaffolded students' practice of critical reading, and they received formative feedback as they completed each phase of those activities. Additional feedback on their pre- and post-test writing tasks was provided. Later chapters will discuss the connection between these feedback loops and student attitudes towards the learning context, their identity as future engineers, and the role that critical reading plays. Altogether, this means that the AL model was woven into each stage of my action research and then influenced data analysis.

As stated earlier, action research is a systematic methodology that operates in stages; these characteristics are ideal considering my research aims to address some of the shortcomings of the AL model. As identified in the previous chapter, early studies following the AL model were lacking in some details about how it was applied. This gap can be addressed by pairing the AL model with action research. This chosen methodology facilitates practical,

classroom-based research. It allows me to collect data in the classroom by logging observations. It also enables the discovery of trends in students' practice of academic literacies and the analysis of their written output. When combined with ethnographic data on student attitudes collected as part of the AL model, it leads to a more robust set of findings. This strategy ensures a thorough test of the intervention's design to determine how best to improve and redeploy it for the benefit of future cohorts. On top of this, my project adds a further layer of explicitness by sharing all the teaching and learning resources in this thesis to ensure its implementation can be duplicated and/or serve as a model for other practitioners to adapt.

In choosing action research as methodology, the teacher-researcher must also consider the intention for the research, its process, and its audience (Baumfield et al., 2013). In the case of my study, intentions were shaped in part by other agents, including the course convenor and other School of Engineering leaders. Negotiations were anticipated as part of cross-disciplinary collaboration. However, I maintained control of the data-gathering and analysis process as well as all related resources. These decisions ensured I could share my resources with other practitioners via this thesis. The impetus of the study must also be considered. My action research was spurred by a desire to further develop the use of BL as a means to address existing limitations in academic literacies, especially among undergraduate engineering students. The amalgamation of a BL-infused AL model with action research made it possible to design my reading-to-write formula and the critical reading online activities, test them in an authentic classroom setting, and improve them for future use by other teachers, researchers, and learners.

Technological Resources

To complete this research, various technological resources were utilised. These included the Microsoft 365 Office Suite and other software programs, including Zoom, Qualtrics, Moodle, and Turnitin Feedback Studio. Additional training in the use of these programs was necessary and provided by colleagues at the university. Multiple external learning tools were found online and used, too. Access to ENGEN170's Moodle page and the relevant submissions by students was necessary for the project. Library services and research databases were utilised throughout so I could connect my thesis to existing literature. Lastly, a personal laptop, external storage devices, and the university server were relied upon to safeguard my work.

Participants

The participants of this study were the 2023 cohort of undergraduate students enrolled in Engineering and Society (ENGEN170). This is a first-year, Trimester A course that all engineering students take at the University of Waikato. Since ENGEN170 is offered to

engineering students at the Hamilton and Tauranga campuses, my action research intervention was embedded in the course taught at both locations. Enrolment in courses can fluctuate in the early weeks of a trimester, so a student list was gathered from the course's Moodle page towards the end of the intervention. This list indicated that a total of 221 students were enrolled in ENGEN170 across the two campuses — 193 in Hamilton and 28 in Tauranga. It must be noted that the numbers of students who completed stages of the intervention and submitted the three writing tasks of Assignment 2 did not always equal the total number of students enrolled in the course. Numbers of students who participated in the surveys and one-on-one interviews also did not equal the total number of students enrolled. Participation rates connected to the study's data-gathering instruments are shared in later chapters about the findings.

For students enrolled in ENGEN170, participation in Stages 2-3 of the intervention as well as both parts of Assignment 2 (see Table 3.1) was mandatory. Participation in the two surveys and interview was voluntary but encouraged as part of self-reflection. Moreover, students were incentivised through the offering of prizes. When students completed a survey, their names were added to a draw for one of 10 gift cards valued at $10. In addition, participation in the interview involved an extra incentive. Interview participants who also completed both surveys automatically received a gift card valued at $25. At the beginning of the intervention, I informed students that participation in the surveys and interview came with these incentives. I also mentioned that there was a cap on the number of interview participants I could accept, so they had to sign up to claim one of the 15 available spots.

Participant Demographics

Demographics information about the cohort enrolled in ENGEN170 was gathered via the intervention's initial survey and analysed using Qualtrics. Since its completion was voluntary, the information that follows is not representative of the whole cohort but illustrates its diversity.

Firstly, the engineering programme allows students to study under several streams, so information about their specialty was recorded. Civil engineering was the most common (27 students), followed by mechanical engineering (21), software engineering (15), electrical and electronic engineering (10), mechatronics engineering (9), chemical and biological engineering (4), environmental engineering (2), and materials and process engineering (2). Two additional students identified their programme of study as one other than engineering; one of these students was enrolled in science, while the other was studying environmental sciences.

Next, the survey gathered information about participants' age. The vast majority of them (72 students) selected 17-18 years old as their current age, suggesting that most of the cohort was comprised of high school leavers. The next most common age selected was 19-20 years

old (8 students), followed by 21-24 years old (7), 25-35 years old (2), 36-40 years old (2), and one student aged 41 or older.

Thirdly, data on the students' gender was gathered. Among the survey participants, 68 identified as male, 20 as female, two as non-binary, one as transgender, and one student chose *prefer not to answer*. This information on gender reflects the wider engineering field since it remains a male-dominated industry.

The survey also gathered information about language usage. English was the most common first language among participants, having been selected by 74 students, but a wide variety of other mother tongues were identified. These included Mandarin (3 students), Tagalog (3), Hindi (2), Arabic (1), Burmese (1), Dutch (1), Korean (1), Punjabi (1), Samoan (1), Sinhala (1), Somali (1), Urdu (1), and Vietnamese (1). Interestingly, none of the survey participants identified Te Reo Māori as their mother tongue even though it is one of New Zealand's official languages. Among these participants, 77 of them indicated that they had been using English their whole life. Seven other students had been using English for 10 years or more, followed by five students using it for 5-6 years, one student for 7-9 years, one student for 3-4 years, and one student who had started learning English less than 3 years prior. The language diversity amongst these survey participants highlights the importance of communication skills development within engineering education, ensuring that related lessons are designed to help native English speakers and language learners improve the academic literacies essential for success in their discipline.

Six members of the cohort volunteered to participate in one-on-one interviews; despite the small number, the group reflects the diversity of the cohort. These six participants were of different genders and ages. Four of them — identified as E.C.Y., R.C.R., R.J.A., and V.I.S. — were high school leavers. Another interview participant (A.B.A.) was more than halfway through the degree programme, and the sixth one (E.D.W.) was a mature student with some professional experience but was attending university to upgrade qualifications.

Ethical Matters Relating to the Participants

Due to the nature of action research, particularly my study's dependence on students as sources of data, I applied to the Division of Education Research Ethics Committee on 3 October 2022 for ethical approval to conduct the research. The committee approved the application on 2 November 2022 (see Appendix B).

Several ethical principles applied to this research. Firstly, while all students were expected to participate in certain tasks due to the embedding process, the surveys and interview remained voluntary. Students were reminded of this fact more than once during the

intervention. Secondly, informed consent was ensured during the first week of the course. This involved reviewing points about the study and students' rights as participants during my introduction presentation. At this time, students had the opportunity to ask questions about the points. This was also the moment when students were made aware that they could choose to opt out of the study (i.e., their data would not be used). Such non-participation would not affect grades for ENGEN170 because the intervention was designed as formative assessment. I also posted a covering letter and informed consent sheet (see Appendix C and Appendix D, respectively) on the Moodle page in case a student wanted to review the information or had missed my introduction presentation. Thirdly, steps were taken to ensure participants' anonymity and confidentiality. This included using random initials instead of participants' names in connection with sharing any data gathered. For added security, data has been stored on the university server via a password-protected account, with back-up copies stored on my personal laptop and in my home office.

Intervention Resources

This action research project was built around two primary resources: the A-B-C-D Formula for Critical Reading, which was introduced to students in a one-hour lecture (see Appendix E for a copy of its slides), and a series of critical reading online activities (see Appendix F) that they completed during a two-hour workshop. These resources functioned as different levels of scaffolding[10] in an intervention designed around this kind of learning progression. First, the formula served as "a support structure to enable certain activities and skills to develop" (Walqui, 2006, p. 164). The next level was the completion of the critical reading online activities, during which students followed the procedures learned in the lecture and gained assistance by interacting with me and their peers (Walqui, 2006). Students received feedback of various forms (i.e., online automated feedback, verbal group feedback, peer feedback) as they completed these online activities; this kind of timely formative assessment was designed to aid their learning progression by providing "evidence of their current status and understanding" (Broussard, 2017, p. 32). Later, they applied what was learned during these sessions independently to Assignment 2. The formative feedback received on those submissions served as the last level of scaffolding since it informed them of their strengths and weaknesses in applying the formula and how they could improve for future writing tasks.

[10] Scaffolding involves setting up learners for success by making the introduction of new knowledge easy for them to understand, and then gradually reducing the amount of support provided as they ritually practice using that knowledge. Eventually, the learner becomes self-directed, able to adapt the knowledge and apply it as needed. See Walqui (2006) for more information on scaffolding.

Together, these intervention resources provided students with knowledge of critical reading and the opportunity to practice these skills so they could be applied effectively in academic writing. In turn, the formative assessment of students' critical reading skills provided me with a considerable portion of the data for this study.

To engage in an action research project built around formative assessment, it is first important to understand this term. According to Black and Wiliam (1998), it encompasses "all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (pp. 7-8). Similarly, a report published by the Organisation for Economic Co-operation and Development (2005) defined formative assessment as "frequent, interactive assessments of student progress and understanding to identify learning needs and adjust teaching appropriately" (p. 21). In the case of my action research project, evidence about students' development of critical reading skills was gathered for interpretation, which I could use to improve future versions of the intervention resources (see related definition shared by Wiliam, 2017, p. 48).

In addition, students could use the feedback received to improve their critical reading skills and apply them more effectively in future writing tasks. Jolly and Boud (2013) pointed out that, in "professional courses such as … engineering, students have rarely been given the chance to iteratively work towards a goal" and respond to formative feedback (p. 106). This issue was addressed in my project through multiple instances of formative feedback. Specifically, students received automated feedback as they completed the critical reading online activities. There were also instances in this workshop during which they received group feedback and peer feedback. Later, formative feedback comments were attached to each text submitted as part of Assignment 2. For those students who opted to participate in the post-intervention survey, there was a question asking them to reflect on the quality of feedback provided. This assortment of feedback loops ensured that formative assessment was woven into multiple stages of the intervention with the aim of it having a positive influence on the teaching and learning process.

While designing my intervention resources, I considered existing literature on formative assessment and recommended practices for sharing feedback with students. Shute's (2008) review of formative feedback studies provided considerable guidance because of the focus on important features and conditions for sharing it. For example, she recommended that feedback comments be clear, concise, and specific as long as they are not overly complex. Particular details, such as those that "(a) address the topic, (b) address the response, (c) discuss the

particular error(s), (d) provide worked examples, or (e) give gentle guidance," could feature in feedback comments to ensure students' understanding of problematic areas and how to improve their written output (Shute, 2008, p. 158). Similarly, Evans (2013) commented that feedback ought to strike a balance in its ability to provide information that can improve students' performance as well as impact their motivation and behaviour. There has also been discussion in the literature about the timing of feedback, with Shute (2008) reasoning that favour ought to be given to immediate feedback on procedural skills, while delayed feedback was suitable on concept-formation tasks. Guidance from these authors and others, which will be discussed in greater depth later in this chapter, shaped the formative assessment and feedback strategies applied in my action research intervention.

The remainder of this section will describe how I designed the intervention's two primary resources and connected them to my overall formative assessment strategy. The section will also provide a summary of supplementary resources shared with the students that they could use to aid their independent study.

The A-B-C-D Formula for Critical Reading

For this intervention, I created a reading-to-write formula called the A-B-C-D Formula for Critical Reading. It was devised with engineering students in mind but would likely appeal to other STEM students, too. It breaks pre-writing down into four phases (see Figure 1.2 shared in Chapter 1). Each phase of the formula is further divided into key steps and recommended actions, and these were discussed in detail during the lecture so students could understand how they related to Assignment 2 – Part 1. Refer to descriptions of the formula's phases shared in the previous chapter. Overall, this resource operates under the hypothesis that a formulaic approach to critical reading would be an effective way "to scaffold the necessary procedural skills" and make the cognitive load involved in pre-writing more bearable (Broussard, 2017, p. 32). As a result, new university students choosing to follow the formula would find it easier to remember, follow, and apply these skills to their academic writing process.

There were certain factors that required consideration as I designed the phases of the A-B-C-D Formula for Critical Reading. For instance, Phase A looks at task words and other language cues within a writing prompt that instruct students on what and how to write. I was unsure of how much experience the cohort would have in interpreting task instructions, and it was possible that a gap would exist between any prior knowledge of task words and the meanings applied to them in higher education for the purposes of discipline-specific academic writing (Hutchings, 2006). This matter was discussed with ENGEN170's course convenor, who recommended that I investigate the kind of prior knowledge of task words students would

bring with them from secondary school. First, I learned that students enrolling in the University of Waikato's Bachelor of Engineering with Honours programme must have earned some NCEA Level 3 credits in Physics, Calculus, and Chemistry, among other entry requirements (University of Waikato, 2022). When planning Phase A, I considered the kinds of tasks done to earn those Level 3 credits and whether such prior knowledge overlapped with the task words used in Assignment 2. My analysis of the NCEA information about these level achievements found certain task words, including *identify*, *compare*, *describe*, *summarise*, *explain*, *analyse*, *discuss*, and *justify* (New Zealand Qualifications Authority, 2022). In addition, students with at least NCEA Level 2 credits in English would also be familiar with writing terms like *purpose*, *audience*, *perspective*, and *text types*. Therefore, many of the task words and other language cues appearing in Assignment 2 would likely be familiar to students due to their experience in NCEA subjects, so only a brief review was necessary as part of my formula. Still, such a review was important to include in case international students enrolled in the course. Also, as indicated by demographics information, the cohort included a considerable number of ELLs, who would have benefitted from it, too. This review ensured that the whole cohort's understanding of task words and related language cues was consistent and aligned with expectations at the university level.

However, more time and detail had to be applied to teaching the cohort about Phase B and Phase C. Based on the available information about the aforementioned NCEA subjects, it was unclear how much time students were given previously to practice brainstorming and research skills. For example, I did not find any mention of the practice of brainstorming as part of pre-writing within the information about NCEA Level 2 in English (New Zealand Qualifications Authority, 2022). Also at this level, students learned to work with sources; however, it was not always clear whether such sources were scholarly or otherwise, nor if they were supplied by the teacher or found independently (New Zealand Qualifications Authority, 2022). Since these skills are integral to my reading-to-write formula, considerable time was allotted to Phase B and Phase C so they could be learned in greater detail.

Since Phase D would require students to draw connections between sources and their own ideas, I decided it was important to plan this phase around how the skill is typically applied in engineering texts. Again, I consulted with ENGEN170's course convenor to learn more about secondary research and referencing expectations within the discipline, which were factored into how the phase was taught to the cohort. The School of Engineering does not require students to follow a particular referencing style, and ENGEN170's Moodle page shares referencing guides for the IEEE and APA systems. I opted to teach students the latter one as

part of my formula since it is most widely used at the university. In addition, prior knowledge of these practices had to be considered when planning Phase D. The aforementioned NCEA Level 3 subjects required students to reference sources, but they were not always assessed on their ability to do so correctly (New Zealand Qualifications Authority, 2022). Since the appropriate use of source information and referencing systems is necessary for the successful completion of many tertiary-level writing assessments, including Assignment 2, a fair amount of time was dedicated to Phase D skills as part of my formula.

The cohort learned about the A-B-C-D Formula for Critical Reading during a lecture, so its slideshow required thoughtful design. Various methods were employed to aid the effective communication of the formula, many of which are observable in the copy of the slideshow shared in Appendix E. I made use of certain scaffolding techniques and strategies for disciplinary reading suggested by Walqui (2006) and But (2020), respectively. For instance, each phase of the formula was broken down into steps and actions, which I modelled for the students in the slideshow so they would have clear examples of how to employ the formula while completing Task #1. Within Phase A, the bridging technique was used when their prior knowledge of task words was activated. Then in the slides covering Phase B, my model of how to take brainstorming notes also demonstrated the importance of utilising existing knowledge. Phase C and Phase D were designed to encourage active reading and foster higher-order thinking skills as students analysed available resources, evaluated their chosen sources, and synthesised information from those sources and their own ideas as part of text creation.[11] Phase D's slides also included several paragraphs from a model text addressing Task #1. These paragraphs demonstrated how to use reporting verbs and in-text citations correctly in academic writing, while the entire model text was shared with the cohort through Moodle as an example of writing expectations. Throughout, the slideshow made use of colours, symbols, images, and animations, which were an application of the contextualising technique; these drew attention to disciplinary vocabulary and academic language patterns, represented meanings, and aided my oral explanations during the lecture. Several other ideas mentioned by But (2020), including the use of a rubric to assess reading skills and surveying students about them, were also applied in my study and will be discussed later in this chapter.

[11] For related information on Bloom's Taxonomy, refer to the following two resources: (1) Anderson, L. W., & Krathwohl, D. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Addison Wesley Longman. (2) Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals*. Longmans, Green and Co. Ltd.

Design of the Critical Reading Online Activities

The intervention's other primary resource was its series of critical reading online activities, made available to the cohort via ENGEN170's Moodle page. Smaller groups of students completed the critical reading online activities on their own devices during two-hour workshop sessions. Organised in sequence with one-click navigation from one activity to the next, these online activities enabled the practice of the A-B-C-D Formula for Critical Reading. These activities were also directly linked to Assignment 2 – Part 2. I facilitated this process of completion by guiding students through each phase with the aid of a slideshow, going over activity instructions, answering questions as they arose, and sharing my observations and feedback with the groups.

Before deployment in the workshops, the critical reading online activities underwent a pilot study completed by two engineering students further along in their degree, who had been recommended by ENGEN170's course convenor. Their feedback allowed me to refine the design of the online activities before my study's participants used them to practice my reading-to-write formula.

For the most part, the online activities were created using Moodle's activity tools (i.e., H5P, Wiki, Forum). Initially, only one external tool was used; a link to Mentimeter was provided so students could complete a Phase B activity involving the collective brainstorming of keywords and synonyms to generate word clouds. However, two more external tools were added to the series later when flaws were discovered in two activities. The flaws were caused by existing yet unknown limitations in Moodle's Wiki and Forum tools, which were not caught when the convenor's two former students trialled the critical reading online activities before deployment. Specifically, a Phase B activity had been designed with the Wiki tool, which would not permit multiple students to post or edit content simultaneously. They had to take turns adding to the different parts of the Wiki, which conflicted with the amount of time allotted to the activity. Also, a Phase C activity had used the Forum tool, but students could not see each other's posts due to a time delay, meaning they could not add replies within the time allotted to the activity. These two flaws only revealed themselves during the first workshop, which took place at the Tauranga campus.

To ensure that later workshops at the Hamilton campus ran smoothly where these two activities were concerned, I used new external tools to allow students to complete the same activities. The Wiki tool was previously used for a collaborative brainstorming activity, which was then completed using Dotstorming. An analysis of excerpts from discipline-specific texts, which was paired with a peer feedback component, was previously done using the Forum tool,

but this activity was recreated in Parlay Ideas. In the case of these two activities, the change to a different digital learning tool ensured they could function as initially intended. In later chapters, these two activities will be identified by these external tools because most of the cohort completed them this way. Even though this part of the intervention faced some technical difficulties, I identified and addressed these constraints swiftly to minimise the immediate impact on the study. Also, the design of the critical reading online activities is reviewed in detail in later chapters and then refined as part of closing the action research cycle. Please refer to Appendix F to see a copy of the critical reading online activities as planned before they were first programmed in Moodle.

The design of the critical reading online activities was influenced by insights shared in recent literature. To improve academic literacies, Hughes (2017) recommended that students complete a series of activities to develop their critical reading skills, help them analyse writing prompts and understand expectations, and determine sources' credibility especially where online content is involved. Such activities ought to involve collaboration, group discussion, and formative feedback to aid the learning process (Hughes, 2017). Meanwhile, Williams et al. (2013) noted that the availability of Web 2.0 applications has created more opportunities for group activities in digital learning environments — especially true now in the post-COVID era, when most students are in some way familiar with the use of such applications for teaching and learning. I followed their advice by having students practice my reading-to-write formula through a series of online activities, and they benefitted from various types of formative feedback throughout the process. I was conscious of ensuring that every student would gain individual practice of all phases of my formula through the online activities, but a few of them were designed so that students would also benefit from collaborative learning and peer feedback. This decision ensured greater variety of experience during the workshop. It was also influenced by the knowledge that group work and team projects would be required throughout the engineering programme. Collaboration and peer interactions featured in my online activities would contribute to students' preparedness "for team-based learning in professional contexts" (Williams et al., 2013, p. 136). Such variety of experience also aligns with Fernando's (2020) research: while the use of customisable Moodle quizzes was promoted for the formative assessment of writing, their limitations for interactivity were highlighted. It was recommended that other Moodle tools be used in conjunction with the quizzes to create opportunities for student-student and teacher-student dialogue about the learning process (Fernando, 2020). Even though the Moodle Quiz tool was not used in the design of my critical

reading online activities, I still followed this guidance by using a variety of Moodle and external tools to enable practice of my reading-to-write formula.

Formative feedback was built into the critical reading online activities in several ways. The H5P activities were programmed so students received automated feedback after completing each one. In these instances, I adhered to guidance found in the literature. Following Shute's (2008) recommendations and guidelines for formative feedback, my online activities utilised immediate feedback that verified and elaborated on responses. Similarly, Jolly and Boud (2013) suggested that feedback be "pre-programmed within a computer mediated response" for the immediate benefit of students completing tasks "to encourage or discourage a course of action" (p. 108). Wiliam (2017) pointed out that "feedback improves performance when it is focused on what needs to be done to improve, and particularly when it gives specific details about *how* to improve" (p. 133). Applying this guidance, I utilised automated feedback comments programmed into my H5P activities. They allowed students to gain awareness of when they were practicing my formula correctly or how they could improve its application if struggling with a particular phase. Care was taken when composing the automated feedback comments. Young et al. (2021) recommended that the use of codes and abbreviations be avoided when creating a feedback library; it is better to be more explicit instead, especially when referring to course resources. I followed this advice, writing my feedback comments in complete sentences that were concise yet detailed. When drafting the comments, I was guided by the principle that "feedback should leave the thinking with the student. Supporting students as they work through *desirable difficulties* in their work is likely to have a greater impact on long-term learning than feedback that just tells students what to do" (Wiliam, 2017, p. 139). In particular, I limited the use of "final vocabulary"[12] because it lacks specific details and guidance and does not encourage dialogue about the learning process (Jolly & Boud, 2013, p. 115). Instead, I favoured feedback that offered students more direction when applying my formula in future writing tasks. Please refer to Appendix F to see a copy of automated feedback comments programmed into the H5P activities.

Automated feedback was not used exclusively in the critical reading online activities. For the activities not designed using the H5P tool, students benefitted from instances of verbal group feedback and peer feedback. Guidance from existing literature was considered when building these types of feedback into the online activities. Firstly, I had chosen to utilise

[12] The authors listed comments like "good," "well done," and "the level of detail is poor" as examples of final vocabulary that commonly appear in feedback.

Mentimeter's word cloud generator during a Phase B activity because word clouds "can be an extremely visually effective way to display the group's thoughts, and their use increases engagement" (Hughes, 2017, p. 71). The students entered keywords and related synonyms to create the word clouds. Then I displayed them on screens in the workshop classroom — a moment that generated discussion about trends in their contributions and allowed me to provide verbal group feedback on how effective those terms would be when used to search for resources (Hughes, 2017). Secondly, previous experience in having students use online activities as learning tools caused me to agree with Williams et al.'s (2013) position that Web 2.0 applications used for group activities had "the potential to increase peer feedback" (p. 136). This motivated me to incorporate peer feedback again as an aspect of the Parlay Ideas activity in Phase C. Evans' (2013) summary of guidance from literature on utilising peer feedback (see p. 92) was considered when planning the Parlay Ideas activity. For example, it was designed so that each student should receive peer feedback from more than one classmate, and specific guidelines were provided so participants would know how to provide effective peer feedback. Even though students did not receive individual feedback from me during this complex activity, the use of peer feedback here was one element within a larger intervention design that utilised other formative assessment and feedback practices. Ultimately, the combination of peer, group, and automated feedback ensured that students could learn about their strengths and weaknesses in relation to each phase of the A-B-C-D Formula as they practiced its use via the critical reading online activities.

Supplementary Intervention Resources

In addition to the A-B-C-D Formula for Critical Reading and corresponding series of critical reading online activities, several supplementary resources were shared with the cohort via ENGEN170's Moodle page. At the end of the lecture introducing the formula, I advised students to review these files before submitting Task #1. The following list identifies these supplementary resources[13] and provides a brief description of their content:

- **Task Words Chart** — This PDF contained a definition of *task words* as well as those for three styles of writing (*expository*, *argumentative*, *analytical*), followed by a chart listing various task words and their meanings. I created this file, which included some content found on page 285 of Cottrell's (2019) book.

[13] Only the last two files in this list have been shared as appendices in this thesis since they were key materials created for the intervention. The critical reading rubric facilitated the formative assessment of Assignment 2 submissions and collection of related data. The lecture introduced students to the A-B-C-D Formula for Critical Reading, so a copy of its slides was shared as an independent study resource.

- **Additional Guidance for Academic Writing** — This file was an adapted version of a slideshow originally prepared by Te Puna Ako – Centre for Tertiary Teaching and Learning, offering some general guidance on completing academic writing assignments. Since my intervention replaced this lesson in the course, I revised the slideshow and shared a copy of it so students could still access the information.
- **APA referencing help sheet** — This PDF, which is made available to all students by the university's library, offered guidance when applying APA format to their writing.
- **Task 1 - Model Text** — This PDF shared a model text I wrote for Task #1, which demonstrated expectations for quality of writing, application of critical reading skills, text length, formatting, and other features.
- **Critical reading rubric** — This PDF contained the rubric I used during the intervention for the formative assignment of Assignment 2.
- **Copy of lecture slides** — A PDF version of the slideshow was posted after the lecture was taught at both campuses in case students wanted to review its content or add to their notes.

While the use of these supplementary files by students was optional, Moodle has the capacity to track how many students chose to access them. After the intervention, I noted these files' rate of use, which will be discussed in a later chapter.

Instruments and Data Collection

A variety of instruments were utilised to collect data for this study. Primary sources of data included the two online surveys, transcribed video recordings of interviews, the critical reading rubric and feedback comment library used to assess students' written output, and Moodle records about students' completion of the critical reading online activities. My teaching log and Moodle's tracking function yielded some additional data. The following subsections provide more information about the data collection strategy for this study.

Online Surveys and the One-on-One Interview

Online surveys and one-on-one semi-structured interviews were conducted to collect this study's ethnographic data; this kind of data is an important feature in research applying the AL model (Lillis & Scott, 2007). Surveys and interviews are also effective methods for gathering qualitative data as part of action research (Baumfield et al., 2013; Norton, 2019; Stringer, 2008). Questions for these data-gathering instruments were planned carefully to satisfy the study's theoretical and methodological needs and yield answers that could address both research questions.

Regarding my surveys, students were able to access them through ENGEN170's Moodle page. Links were provided directing them to the surveys, which were created using Qualtrics software. In action research, a typical survey uses a questionnaire and/or a measurement scale using predetermined responses (Norton, 2019). My surveys featured closed questions to gather demographics information, a measurement scale to learn about attitudes, and some open-ended questions to gather additional opinions. Questions used in the initial survey and post-intervention survey are shared in Appendix G and Appendix H, respectively. The initial survey's purpose was to collect demographics information on participants and establish their initial attitudes towards critical reading. The post-intervention survey gathered feedback on the intervention and more information on attitudes towards critical reading so I could establish whether these changed because of the intervention. Once the surveys closed, the Qualtrics software aided the analysis of the data.

For the one-on-one interview, I hosted conversations with students via Zoom. This videoconferencing software made it easy to record each session for later transcription, but I supplemented this with shorthand notes of the students' answers written in a notebook in case a video recording was corrupted. It was anticipated that each interview would take approximately 30 minutes, but this varied depending on participants' responses. For instance, video recordings of the interviews range in length from 23 to 48 minutes. I scheduled these sessions with the students at their convenience soon after the deadline for Assignment 2 – Part 2 had passed. The use of open-ended, guiding questions is recommended for interviews since this can yield a seamless flow of rich data (Agostinone-Wilson, 2012; Dörnyei, 2007). In addition, the researcher should be willing to explore topics further and be guided by the interviewee's pacing, yet be prepared to intervene if necessary (Agostinone-Wilson, 2012; Dörnyei, 2007). An action research interview should start with a more general question to help build rapport and relax the interviewee, while probes can be used later to help extend the interview (Dörnyei, 2007; Norton, 2019; Stringer, 2008). My interviews were semi-structured, and the list of questions prepared aligns with this advice from the literature (see Appendix I). The interviews gathered additional data about student attitudes towards the role of critical reading in the engineering discipline as well as feedback on the intervention.

Critical Reading Rubric and Feedback Comments

A considerable portion of this study's quantitative data was collected via the use of the critical reading rubric (see Appendix A), which was designed for the formative assessment of Assignment 2, as well as the corresponding feedback comment library (see Appendix J). The design of my rubric went through several stages. Early iterations were inspired by rubrics

already in use at the university, specifically within its English for the Professions (ENSLA100) course. I had previously taught that course, was familiar with its rubrics, and knew their designs aligned with guidance found in literature on assessment practices. However, considerable revisions were required to ensure my rubric for ENGEN170 focused on the application of critical reading skills in a piece of academic writing. A review of recent assessment literature and consultation with the School of Engineering prompted further customisation.

The design of the critical reading rubric was influenced by recommendations in existing literature. It is important to note, though, that task-specific rubrics assessing critical reading skills or any aspect of reading-to-write are rare commodities (Chan et al., 2015). As a result, I had to look further afield for inspiration. Firstly, I considered the traits of the VALUE[14] rubric used to assess student learning of critical thinking skills since critical reading requires the application of critical thinking skills (Association of American Colleges & Universities, 2018). The VALUE rubric was not designed for grading; instead, it lists various criteria accompanied by performance descriptors and proficiency-level terms, such as *benchmark*, *milestones*, and *capstone* (Association of American Colleges & Universities, 2018). This rubric offered excellent inspiration, especially regarding how to assess a student's ability to analyse and evaluate sources and determine how this interacts with their own position, so it served as a model as I revised my rubric. However, the VALUE rubric is an American resource that would have been unfamiliar to most students based in New Zealand, so adapting some of its ideas was necessary as I designed my rubric. Next, I considered how to plan the wording of the critical reading rubric to best suit a New Zealand educational environment. NCEA assessment documents for Level 2 in English use the proficiency-level terms *achievement*, *achievement with merit*, and *achievement with excellence* (Te Kete Ipurangi, n.d.). Given the high proportion of domestic students in the cohort, who would already be familiar with such terms, they were integrated into the design of my rubric with only minor adaptations. My proficiency-level terms appear as headings of columns containing detailed descriptors that align with five criteria for the formative assessment of critical reading. Together, these details clarify the assessment expectations for students.

An examination of other assessment literature yielded several insights, but it was found that very few resources overlapped with this study's focus. For example, Chan et al. (2015) developed reading-to-write rubrics featuring criteria for the application of critical reading

[14] VALUE is an abbreviation for Valid Assessment of Learning in Undergraduate Education. Refer to https://www.aacu.org/value for more information about this series of rubrics.

skills. These rubrics, while designed well and validated empirically, were used with English language proficiency examinations instead of university coursework. Other articles by Panadero and Jonsson (2013), Larkin (2015), and Leist et al. (2012) discussed the use of rubrics for formative assessment. In each instance, a rubric was used in connection with a discipline-specific writing task; however, the rubric used by Leist et al. (2012) was the only one to assess critical reading achievement specifically. An aspect that these articles share is the fact that their rubrics featured numerical scores or point values, suggesting a design better suited to summative — not formative — assessment. While Leist et al.'s (2012) study overlapped the most with mine regarding focus and their participants demonstrated a significant improvement in critical reading skills, ideas were not taken from their rubric because descriptors were quite short and simplistic. Overall, these resources taught me the importance of considering every detail in a rubric designed for formative assessment. I aimed to create clearer connections between critical reading and academic writing in my rubric's descriptors and the associated feedback comments.

Other resources proved more influential on my formative assessment strategy. Firstly, insights shared in Wiliam's (2017) book were particularly useful. He described how students' achievement can be positively affected by constructive feedback, while offering a grade or written praise does not have the same impact but does affect the ego more. For this reason, the critical reading rubric did not use numerical values (unlike the VALUE rubric and others linked to studies mentioned above) to encourage students to focus more on the feedback they received from its performance descriptors and the corresponding feedback comments.

Another source of inspiration came in the form of McTighe and Frontier's (2022) report on the link between well-designed rubrics and providing feedback. Its description of a developmental rubric — one that "describes growth along a proficiency continuum, ranging from novice to expert" in order to "emphasize skill development over time" — seemed well suited for use in formative assessment (McTighe & Frontier, 2022, p. 18). Their report also featured clear descriptions of quality plus concrete examples that could be followed when composing rubric descriptors and feedback comments, which helped in my design (McTighe & Frontier, 2022). This report's guidance aligns with advice from Brookhart (2013) that criteria ought to connect to learning outcomes through substantive descriptions about levels of quality. Following these recommendations, my rubric's descriptors are specific, feature clear differences between levels, and avoid general language that could lead to subjective assessment of students' writing. McTighe and Frontier's (2022) recommendations also aided my composition of a library of feedback comments that would align with my rubric's criteria. For

example, the inclusion of general praise was avoided when creating the library. Instead, feedback comments are more specific; they identify strengths and weaknesses of the students' work, include phrasal links to the rubric, and offer advice on how to better apply my reading-to-write formula in the future.

In addition to being mindful of wording and level of specificity in my critical reading rubric and the corresponding feedback comment library, I wanted to ensure that these resources were not overly complex in their design. An article by Nordrum et al. (2013) offered a useful lesson. Their participants "expressed a concern that it was difficult to revise drafts based on rubric-articulated feedback, and that they therefore tended to use in-text feedback for this purpose" (p. 929). The difficulty may have been a product of the rubric design: covering 2.5 pages, it featured overly complex descriptors and different categories within the three overarching criteria. This evidence was factored into my formative assessment plans. I created a more succinct rubric containing five assessment criteria and five proficiency levels, but the performance descriptors were short enough that the whole table could fit on one page. Feedback comments were more detailed but aligned with my rubric criteria since this could influence students' application of critical reading skills in later submissions, particularly Assignment 2 – Part 2. Therefore, my design aligned with one of Nordrum et al.'s (2013) recommendations: formative assessment involves "conscious use of rubric-articulated feedback in its capacity to feed forward into future writing" while corresponding comments can help students "act on feedback from the more immediate perspective of the next draft or assignment" (p. 934). For instance, my participants could review the critical reading rubric to inform them of their proficiency in the different criteria, while the feedback comments they received would highlight their strengths and weaknesses and offer recommendations for future improvement.

Similarly, research by A. I. Graham et al. (2022) influenced my choice of tools used to conduct the formative assessment of participants' written output. They used Feedback Studio[15] to mark assignments and provide online feedback — that is, a rubric was paired with comments selected from a pre-programmed library. Their assessment methods aligned with several features found in the other studies, which encouraged me to use Feedback Studio to deliver formative assessment results to my participants. The University of Waikato was already using

[15] As a tool within Turnitin, Feedback Studio includes several features that facilitate instructor feedback. For instance, rubrics can be created in it and attached to an assignment for the purpose of formative assessment or summative grading. QuickMarks is another feature in Feedback Studio, and it allows instructors to apply feedback comments from a pre-programmed library or create a new set customised to their needs.

Turnitin in connection with assignment submissions via Moodle, so its Feedback Studio tool was readily available to me.

In addition to the literature, requirements set by the School of Engineering influenced my formative assessment plans. As mentioned earlier, I opted to pair five criteria with proficiency-level descriptors instead of numerical values. I consulted with ENGEN170's course convenor on the wording of the descriptors, and her feedback ensured that my formative assessment of students' written output would align with her existing expectations for Assignment 2. In addition, numerical values were left out of the critical reading rubric due to a need to avoid confusion among the students. While the course convenor and other School of Engineering leaders supported the embedding of my action research project in the course, they did not want to change existing assessment plans. Therefore, the use of descriptors in my rubric allowed me to conduct formative assessment of students' application of critical reading skills in their writing, while the course convenor graded Assignment 2 following the normal criteria. She was not making use of Feedback Studio to grade it, which ensured my formative assessment plans would not interfere with the existing summative grading method.

Sharing task-specific rubrics with students in advance has been recommended by several experts (e.g., Brookhart, 2013; Reddy & Andrade, 2010) as part of an effective formative assessment strategy. My one-page critical reading rubric was saved as a PDF file so it could be easily shared and discussed with students at the same time as the writing task instructions — a strategy that lends transparency of expectations to the assignment. I also used Feedback Studio's rubric tool to recreate my rubric within its system, and my feedback comment library became a new set of QuickMarks so individual comments could be dragged and dropped onto submissions.

The issue of timing was also a factor in this study where the use of the critical reading rubric and feedback comment library are concerned. The timing of deadlines, release of formative feedback, and summative grading were negotiated with ENGEN170's course convenor, and our decisions aligned with guidance available in related literature. As recommended by Shute (2008), Assignment 2 submissions received delayed feedback, which verified students' application of critical reading skills through my rubric. The corresponding feedback comment library was used to elaborate on the rubric's formative assessment by identifying problems and suggesting corrections, and these feedback comments were worded so students would be directed back to my formula and its role in their academic writing process. The use of QuickMarks allowed me to provide each student with written comments and release the formative assessment results quickly — a choice supported by recommendations to save

time by using new technology to recycle commonly shared written comments (Al-Bashir et al., 2016). The formative assessment and summative grading of Assignment 2 were planned to align with Wiliam's (2017) position on the impact that grading can have on students' reactions to feedback. A hard deadline was applied to Assignment 2 – Part 1, but these submissions were not graded by the convenor and her assistants until after the submission of Assignment 2 – Part 2. This way, students received only my formative feedback after Part 1's submission. This feedback was shared with them before Part 2's submission deadline so it could be useful to students. Even though the hard deadline prevented students from revising Part 1 submissions, my formative feedback gave them the opportunity to improve their performance in Part 2, which could impact Assignment 2's summative grade. By controlling the timing of grading, it was believed that students would be more receptive of the formative feedback provided via the critical reading rubric and related commentary. Controlling this variable could also impact their motivation to improve their application of critical reading skills in Part 2 submissions.

In summary, the critical reading rubric and corresponding feedback comment library allowed for the collection of much of this study's quantitative data. They were used first to assess Assignment 2 – Part 1, which served as participants' pre-test writing task. This evaluation established existing abilities and provided students with feedback on their strengths and weaknesses. These instruments were used again later in the intervention to assess the post-test writing task (i.e., Assignment 2 – Part 2), allowing me to provide students with more feedback and compare their results to the pre-test writing task. I used Excel spreadsheets to record formative assessment data on students' application of critical reading skills in both parts of Assignment 2, which aided a later process of comparative analysis.

The Critical Reading Online Activities

The completed critical reading online activities yielded data that could be analysed for trends in student performance. This was possible in various ways depending on the activity. For most of the activities, the use of H5P was beneficial because it came with its own built-in answer tracking function, allowing for statistical analysis. Secondly, when students created word clouds of keywords and related synonyms in Mentimeter, they could be examined visually for trends. For instance, the larger the keyword appeared in the word cloud, the more students had used it in that activity. Data from the Dotstorming activity was sorted based on subtopics and analysed to determine relevant patterns in students' brainstorming notes. Lastly, students' posts during the Parlay Ideas activity yielded data about writing traits and how well they met expectations for the activity, which could be analysed for patterns based on frequency of appearance in the posts.

Additional Data

My teaching log and Moodle's tracking function provided the study with some additional data. I recorded notes in the teaching log based on observations during the intervention. The tracking function built into ENGEN170's Moodle page allowed me to record data about students accessing certain information related to the intervention. After the data from primary sources was analysed, this additional data was reviewed to determine its relevancy to the results. It was determined that only a portion of the additional data lends itself to the discussion of my study's combined results, either by highlighting issues with the design of the intervention or being connected to findings about student attitudes. More information about the analysis of this additional data is provided in the next section.

Forms of Analysis

Since this study yielded quantitative and qualitative data, a mixed methods approach to analysis was utilised. Even though my study yielded some statistical data, the resulting trends were viewed in relation to qualitative results through the larger lens of thematic analysis. As a common method of analysing and interpreting patterns in qualitative data, thematic analysis requires a researcher to present and explain themes and then share exemplary quotations to demonstrate the data fits into those themes (Agostinone-Wilson, 2012; Braun & Clarke, 2021b; Gournelos et al., 2019). Therefore, it is best to describe my overall analytical strategy as leaning more towards an interpretivist epistemology. This means inductive reasoning is required when data is gathered from multiple sources, allowing the researcher to look "beyond the individual to how they relate to their peers, their family, their class and culture" (Baumfield et al., 2013, p. 16). This attitude was applied even to the quantitative data; I looked beyond statistical trends by drawing connections between them and the qualitative data via thematic analysis. This chosen analytical strategy aligns with the AL model, which considers the influence that one's institution, discipline, and social interactions have on meaning making and identity as part of the learning process.

Stages of Data Analysis

My analytical strategy involved three stages. Table 3.2 on the next page depicts how they were completed and linked to my research questions. This strategy was loosely inspired by Ivankova's (2015) descriptions of merged and connected mixed methods data analyses. First, I analysed the quantitative data. This began with descriptive statistical analysis of student responses to the surveys. Since a portion of the participants completed both surveys, t-tests were also completed to compare the means of these two data groups. Specifically, answers to

initial survey questions 8-11 were compared to those for post-intervention survey questions 4-7, respectively. Next, the formative assessment data from students' written artefacts underwent descriptive statistical analysis, which then allowed me to compare the pre- and post-test writing tasks. Thirdly, the completed critical reading online activities were analysed to determine any trends. As mentioned earlier, this involved some statistical analysis as well as pattern detection in written content.

Table 3.2

Data Analysis Stages & Links to Research Questions

Stages	Links to RQ1	Links to RQ2
Stage 1: Analysis of quantitative data	Post-intervention survey questions 1-2 (closed portions) Formative assessment of pre- and post-test writing tasks Results of online activities	Initial survey questions 6-11 Post-intervention survey questions 3-7 (closed portions)
Stage 2: Analysis of qualitative data	Post-intervention survey questions 1-2 (open-ended portions) Interview questions 3-7, 10	Post-intervention survey questions 3, 6-7 (open-ended portions) Interview questions 1-2, 8-9
Stage 3: Connect combined results	Qualitize results of Stage 1, linking its trends to Stage 2 results Code and determine themes plus connections to AL model Code additional data to draw connections to combined results	Qualitize results of Stage 1, linking its trends to Stage 2 results Code and determine themes plus connections to AL model Code additional data to draw connections to combined results

RQ1 = How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment?
RQ2 = How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process?

The second stage focused on a thematic analysis of the qualitative data. A coding process was used across the interview transcripts and students' responses to the post-intervention survey's open-ended questions. Several rounds of coding occurred, which are described in more detail in the next subsection, and this process helped in generating initial themes.

The final stage involved connecting the results of the quantitative data and the qualitative data. The former dataset went through a qualitizing transformation, which involved sorting quantitative results into narrative categories for further qualitative analysis (Ivankova, 2015). This step determined whether links exist between statistical trends and the results of the thematic analysis. It required further coding and analysis centred on the existing themes of the

AL model — that is, the various influences on meaning making and how they affect students' identities as learners and future engineers. This final stage generated the study's overarching themes, as shared in Chapter 6's discussion of combined results. Part of this final stage also involved reviewing the additional data to determine if any of my classroom observations or information gained via Moodle's tracking function correlated to the combined results. Codes representing the overarching themes were used to determine relevancy and how any applicable point may factor into the combined discussion.

Typology of Thematic Analysis & Description of Coding Process

Regarding typology of thematic analysis, my approach best aligns with the codebook approach as described by Braun and Clarke (2022): by using a codebook to track my analysis as it developed, I was able to bring structure to the coding process and develop some themes early on — specifically, connecting some data to the AL model's existing themes. Since those existing themes are a lens through which I interpreted data, this means there is also an element of the reflexive approach in my thematic analysis (Braun & Clarke, 2022). Reflexive thematic analysis acknowledges the contextual nature of knowledge, so there is more flexibility when generating themes and the researcher's subjectivity is considered an asset instead of a problem (Braun & Clarke, 2021a, 2022). My experience in this project as both the teacher of the intervention and the researcher analysing the data collected during it inevitably "makes 'pure' induction impossible" (Braun & Clarke, 2022, p. 8). The use of a codebook helped limit subjectivity in the early stages of my thematic analysis and maintain focus on "exploring the truth or truths of participants' contextually situated experiences, perspectives" and attitudes (Braun & Clarke, 2022, p. 8). Then some subjective interpretation allowed me to determine connections between quantitative and qualitative results in the final stage of data analysis, refine themes identified early on, and define new themes that became part of the analytic output of all stages of analysis (Braun & Clarke, 2021a, 2022; Saldaña, 2021). This kind of methodological mash-up, as Braun and Clarke (2021a) called it, was necessary in this study due to the influence of the AL model's existing themes on my use of thematic analysis as well as the study's overall mixed methods approach.

My coding strategy involved several steps and was guided by recommendations in Johnny Saldaña's (2021) book *The Coding Manual for Qualitative Researchers*. As suggested, I completed the coding process on hard-copy printouts, which allowed me to use pens of different colours to represent different categories of codes (Saldaña, 2021). Inductive coding was used during the process since this is a "data-driven method" typical in ethnographic studies and other kinds of qualitative research, although there was a round of coding that involved

actively searching for details in student responses that connected with the AL model's themes (Saldaña, 2021, p. 41).

Student responses to open-ended survey questions and interview questions went through four rounds of manual coding: In Vivo coding, Magnitude coding, Structural coding, and Concept coding (see Saldaña, 2021). A code key explaining the meaning behind codes applied in those last three rounds is available in Appendix K. Examples representing the four rounds of coding are also available in Table 3.3 below.

Table 3.3

Examples of Coding

Coding Round	Application Method	Examples of Corresponding Data
In Vivo coding	underlined key words/phrases with red ink directly in student responses	"gave me structure" "more specific" "important for anyone no matter what"
Magnitude coding	wrote code (e.g., MIXED) in border next to relevant response	"It seemed like a really good activity, but it just needed more time."
Structural coding	wrote code (e.g., IV.STR) in border next to relevant response	"put what we've learned into action before we've got something at stake"
Concept coding	wrote code (e.g., ID) in border next to relevant response	"it is also important to have great critical thinking and communication skills as an engineer"

In Vivo coding was applied first, which involves selecting key words or phrases found directly in student responses — an important coding method for studies like mine "that prioritize and honor the participant's voice" (Saldaña, 2021, p. 138). For instance, I underlined words and phrases that contained important details, represented the essence of the student's attitude, or jumped out as a quotable moment. Then the data was reviewed again so Magnitude coding could be applied. This type of coding indicates "intensity, frequency, direction, presence, or evaluative content," so it was used to create categories of comments based on attitudes expressed (Saldaña, 2021, p. 115). The third round involved Structural coding, which is another kind of categorisation of student responses allowing connections to be drawn to other data in the study (Saldaña, 2021). Specifically, it highlighted student comments that could influence the final cycle of my action research by identifying what they viewed as the intervention's strengths and limitations as well as suggestions for making improvements to the

teaching and learning materials. Lastly, Concept coding was applied to aid my analysis of student responses in connection to broader ideas essential to the research — that is, the existing themes associated with the AL model (Saldaña, 2021).

All codes applied were recorded in a Codebook and Analytic Memo document, where I drafted a descriptive summary of the data and my reflections. These notes related to: (a) participants' actions, reactions, and interactions; (b) routines, rituals, rules, roles, and relationships; (c) what I found intriguing, surprising, or disturbing; (d) emergent patterns, categories, themes, and links to the AL model; (e) results that indicate problems with the study; and (f) tentative answers to the research questions and key assertions resulting from this research (Saldaña, 2021). Later, I returned to the Codebook and Analytic Memo to add notes on the qualitizing transformation of the quantitative results. This was also the space where notes were drafted about the study's overarching themes.

Summary of Chapter

This chapter has described how an action research methodology was employed to address the study's two research questions. It began with a discussion of action research. Specifically, I explained how I interpreted this methodology, how the intervention's stages were completed, and how this thesis' last chapter will close the action research cycle by sharing the revised intervention plans and resources. My rationale for choosing action research as the study's methodology was shared, too. Next, the chapter summarised the technological resources used to complete this study. A section about participants followed, which described their demographics and how related ethical matters were addressed. The chapter also provided details about the design of resources used during the action research intervention. Mainly, this focused on the A-B-C-D Formula for Critical Reading and the critical reading online activities, as well as how their design was influenced by existing literature on formative assessment practices. This was followed by a section about the numerous instruments used to collect the study's quantitative and qualitative data, including details about the design of those data-gathering instruments. Finally, the mixed methods approach employed for data analysis was described, including details about its three stages and how links between quantitative and qualitative data were established in order to generate the study's overarching themes.

The next two chapters will share results found via the primary sources of data — that is, the surveys, one-on-one interviews, formative assessment of Assignment 2, and the completed critical reading online activities. Chapter 4 is devoted to results relevant to the first research question, while Chapter 5 will focus on findings that address the second research question. As

stated earlier, additional data collected via my teaching log and Moodle's tracking function will not be included in these chapters on research findings. Instead, only the additional data relevant to Chapter 6's combined discussion of results will be included in this thesis. In the chapters that follow, the student voice features prominently as evidence and is shared in two ways: (a) direct quotations from individual participants, who are identified using random initials; and (b) key words and brief phrases used by participants, appearing in italics to aid the synthesis and discussion of results.

Chapter 4: Research Findings — Part One

An action research intervention was embedded in an undergraduate engineering course in order to investigate the students' development of critical reading skills. This intervention applied a BL approach, following the hypothesis that online practice of a reading-to-write formula could have a positive impact on the application of critical reading skills in academic writing. Chapter 4 shares results that are relevant to the first research question: How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment? Several data-gathering instruments were applied to gain these findings, which are shared independently and then summarised together in this chapter.

Online Practice and Formative Assessment of Critical Reading Skills

This section is divided into four parts to share findings relevant to the first research question. It starts with results from students' completion of the critical reading online activities. From there, findings from the formative assessment of Assignment 2 will tie the intervention's teachings to students' written output. The section ends with relevant results from the post-intervention survey as well as those from one-on-one interviews.

Students' Completion of the Critical Reading Online Activities

Critical reading online activities were completed by 203 students across the two campuses, although there are some instances where an activity within the series was left incomplete. Where data on an activity is missing for a student, it was caused by a late arrival to the workshop, an inability to complete an activity within the allotted time, or technical difficulties.

The students completed five activities related to Phase A of the formula (see Appendix F). The purpose of Phase A activities was to facilitate the analysis of remaining task instructions associated with Assignment 2. The first activity involved matching 10 terms and phrases from Task #2 and Task #3 to their definitions. Analysis revealed that 86.6% of students earned a score of 7 or higher on this activity, suggesting a strong understanding of task-related vocabulary across the cohort. A log of incorrect selections revealed that two possible errors were most common: 43 students mismatched the terms *discipline* and *field*, while 17 students mismatched the terms *discuss* and *persuasive argument*.

The next four activities in Phase A were multiple choice questions concerning the assignment's task words, content expectations, intended audience, writing style, and voice; the

cohort's performance was strong and reasonably consistent across them. Specifically, 86.6% of students were able to correctly identify Task #2's task word, and 76.8% of them identified the best way to cover the required points for that task within its word count limit. For the next question, 74.3% of students correctly identified Task #3's intended audience, while 77.3% of them chose the right answer related to that task's required text type and how this would influence the writer's voice. Participants were provided automated feedback after each question, which explained why incorrect answers were wrong.

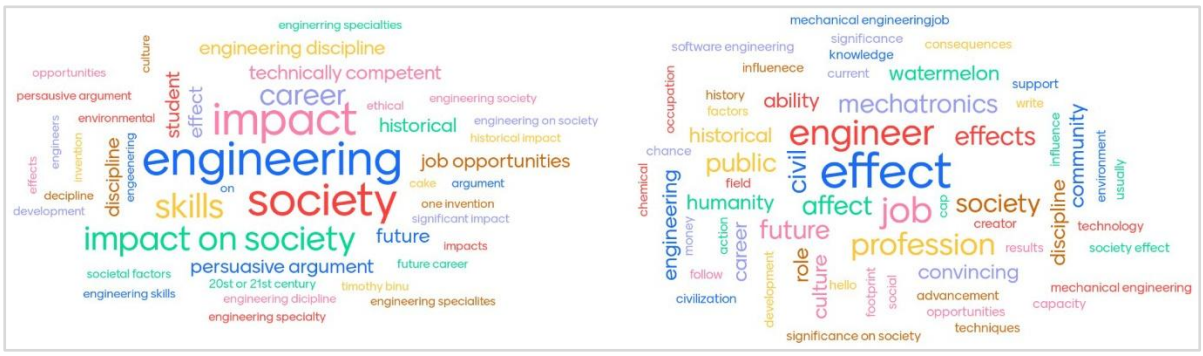
Next, the students proceeded to work on online activities related to Phase B of the formula (see Appendix F). The first one was a drag and drop activity that had them complete example keyword searches related to Task #2. The activity had a value of 10 points, and 123 students completed it perfectly. A further 23 students got a score of 8, while 17 students scored 7. Together, they equal 80.2% of the participants, suggesting a strong understanding within the cohort of how to pair keywords with symbols to find relevant resources.

Also in Phase B, students completed two activities wherein links were provided to external teaching tools that would facilitate collaborative brainstorming. The first of these was for Mentimeter, a website where they submitted keywords and synonyms related to the instructions for Task #3 and then discussed the word clouds generated with them (see Figure 4.1 on the next page). Across the workshop groups, keywords like *engineering*, *impact*, *society*, and *skills* were used most often in the first word cloud. They suggest a level of consistently strong choices across the cohort. Moreover, these keywords all appear in the task instructions, linking to its topic and key points that must be covered to meet writing expectations. However, many other keywords appeared in the first word cloud across the workshop groups, with *persuasive argument* and *technically competent* commonly used. Even though these words appear in the task instructions, they do not have a strong link to the topic or writing expectations. These popular yet incorrect keyword submissions suggest that several students did not fully understand the difference between details provided in the task instructions as guidance and those that were important enough to the topic that they could be used in a keyword search to find relevant resources. Next, the workshop groups submitted synonyms that could be used as keywords, which generated a second word cloud. Here, there was some consistency in strong choices (e.g., *effect*, *community*, *influence*), but these often shared the top spots with terms that already appeared in the task instructions thus going against the activity's guidelines. In addition, there was a lack of connection between the task instructions and some of the submitted keywords and synonyms (e.g., *chatgpt*, *cake*, *invention*). In fact, a couple of them

have a stronger connection to other tasks within Assignment 2 — this is despite having displayed Task #3's instructions in the workshop slideshow during this activity.

Figure 4.1

Examples of Word Clouds Generated During Mentimeter Activity



Note. The keywords word cloud on the left was created by Hamilton Workshop Group 2, while the synonyms word cloud on the right was created by Hamilton Workshop Group 1.

The next collaborative brainstorming activity in Phase B linked students to the Dotstorming website, where they were able to add ideas to a list based on three categories.[16] The collected lists were analysed to determine patterns across the workshop groups. For instance, points related to *existing knowledge on the topic* were sorted based on three subtopics required by Task #3 — that is, *impact on society*, *what engineers do (job opportunities)*, and *other skills needed*. Any points that did not fit clearly into one of these three subtopics were noted based on whether they were off-topic or lacking sufficient detail. It was found that students most often listed points related to the *other skills needed* subtopic, while the one for *what engineers do (job opportunities)* received the least number of points.

This process was repeated for points related to the second category, *questions that need answering through research*. Here, the subtopics with the most and fewest points were flipped when compared to the earlier category, suggesting a causal relationship exists between the number of points listed per category across the three subtopics. The less existing knowledge the students had on a writing topic, the more likely they would engage in brainstorming questions related to it to feed the next phase of the formula. In this instance, their minimal knowledge of *what engineers do (job opportunities)* also caused some students to veer off-topic, with several questions listed pertaining to an engineer's salary instead of possible duties, job titles, and career prospects.

[16] Students at the Tauranga campus completed this same activity but as a Moodle Wiki. Due to the aforementioned issue with Moodle Wiki (see pp. 50-51), the activity was recreated using Dotstorming. This means five of the six workshop groups completed the activity through this external learning tool.

For the third category, students listed *where to find information to fill gaps in knowledge*, so repeated ideas were tallied and any inappropriate or off-topic ideas were noted. Trends in these answers suggest that most students would rely in near equal measure on (a) scholarly sources and the kinds of research tools that would lead to them (e.g., Google Scholar, the university library), and (b) resources provided as part of their studies and human sources of information (e.g., their lecturers, professional engineers). The preference for human sources, while certainly relevant to the study of engineering, may not be acceptable for a writing assignment. Other students listed a variety of inappropriate tools they would use to find information, including popular search engines, Wikipedia, YouTube, TikTok, ChatGPT, and blogs. While capable of leading them to engineering-related content, these tools are unlikely to yield the kind of information appropriate for academic assignments.

Phase C online activities were tackled next in the workshop (see Appendix F), starting with a drag and drop activity requiring students to complete point-form analysis of four search results. As they examined the details visible in screenshots of these search results, the activity tested their ability to determine each source's relevancy to Task #2 and its appropriateness as a possible source. With 17 points available, results were wide-ranging and only 45.8% of students scored 13 or higher. This lower success rate shows students struggled considerably with this activity, despite being offered a tip at the beginning of it — that is, they were told each source was examined first for relevancy and then appropriateness.

Students linked to the Parlay Ideas website for the next Phase C activity.[17] It required them to read two excerpts, answer four analysis questions about each of them, and then post feedback to classmates' answers. In reading the students' initial posts, several trends were observed. The majority of students demonstrated a strong understanding of the readings in their answers — a bit stronger with Reading 1 versus Reading 2 — but the quality of their writing was less consistent. Most students followed the instruction about formatting their answers as a paragraph. However, those who did so did not always provide enough context within sentences to connect them back to the questions and/or make use of transition words, thus negatively impacting paragraph cohesion. In contrast, several students grouped the sentences together as if they were creating a paragraph yet still included a numbering system to link each answer to its question. There were many instances in which posts did not answer all questions required and/or cut off suddenly, demonstrating that students did not have enough time to complete the

[17] Students at the Tauranga campus completed this same activity but as a Moodle Forum. Due to the aforementioned issue with Moodle Forum (see pp. 50-51), the activity was recreated using Parlay Ideas. This means five of the six workshop groups completed the activity through this external learning tool.

task within the allotted limit. Another observed trend involved students paraphrasing content from the excerpt as an answer to the third question instead of explaining how it could be done to satisfy one of Task #2's requirements. In a small number of posts, students copied several details from the excerpt instead of using paraphrasing skills to frame the answer to suit the question. Examples of these issues are evident in students' posts shared in Table 4.1.

Table 4.1

Examples of Students' Posts During Parlay Ideas Activity

J.V.E.	This text is talking about the history of plastics up until present day. This excerpt is related to task two because it is discussing an invention made in the 20th or 21st century. Some content from this excerpt could be paraphrased by summarising this history in you own words. Eg in the 1800's the first plastics were found invented using milk proteins. A weakness of this text is that it does not go into detail about the impact this invention had
N.Y.N.	The article describes the invention of plastic and the evolution of the material into other commercially available product. It gives the historical, societal factors that lead to the development of the material. It also gives the names of the inventor. Invention of Nylon began 1938, as an alternative to silk, which became commercially utilised to produce stockings. The weakness of the source is that it does not explain the societal impact in m
M.Z.O.	While modern day plastics are convenient, they are not necessarily sustainable. Food packaging creates a lot of single use plastics, that could benefit from creating a more sustainable alternative. The Body Shop did not necessarily have issues with technologies and materials, but had issues with legal requirements that caused issues with the refilling and reusing of packaging and plastic containers.
C.O.E.	a) The excerpt is discussing being able fundamental changes without the introduction of plastic. b) This excerpt is connected to task 2# as it discusses the impact on society. c) The plastics provide freshness, convenience, safety, accountability and affordability d) A weakness is that excerpt does not tell the historical events that lead to the invention.

Note. The first two posts are examples of students' answers to the analysis questions for Reading #1, while the next two posts are those for Reading #2. Contributing participants are identified here by initials in the left column.

In this same activity, additional issues were noted in participants' replies to classmates for the purposes of sharing peer feedback. They were provided two questions to guide these replies. While this prompt was followed most of the time, there were 50 instances across the two readings where students merely agreed with the writer and/or offered brief, positive comments instead of constructive feedback. In other instances, their comments were constructive but focused on the post's content and structure instead of answering the feedback questions. Also, many posts went without feedback, meaning that a significant number of participants did not have time to complete this step of the activity. The myriad issues observed

in students' completion of the Parlay Ideas activity indicate it requires considerable redesign to ensure they have a clearer model of expectations and sufficient time to complete all steps.

The last activity for Phase C required students to read an abstract and answer three multiple choice questions to determine how the source might be connected to Task #3. An analysis of their choices determined that 71.4% of students were able to identify the set of four keywords from the abstract that best demonstrates its connection to Task #3. For those who chose a different set, it is possible that earlier difficulties in brainstorming effective keywords, as found during a Phase B activity, may correlate to struggles here in drawing connections between keywords appearing in the abstract and the writing expectations for Task #3. The cohort struggled more with the next question, with only 54.1% of students correctly determining that the abstract's content suggested the source could be used to address the first two requirements from the task instructions. Although, an additional 14.2% of them selected one of the two correct options. When answering the last question, only 56.1% of students correctly determined that the abstract's weakness was its lack of details about additional skills needed for an engineering career. It is possible that some students struggled to understand the abstract's content, leaving them confused when selecting answers to these last two questions.

Three Phase D online activities rounded out the series (see Appendix F). The first of these involved matching six quotations from sources to a corresponding part of the task instructions, an idea, or an unanswered question raised during brainstorming. Only 60 of the participants earned a perfect score here; instead, the vast majority of them either failed the task or did not complete it. Trends in their results revealed that two particular error patterns were responsible for nearly 40% of these failures.

The final two drag and drop activities were closely connected: first, students had to place reporting verbs and parts of in-text citations into the correct boxes to complete a model text, and then they did the same with parts of references to complete that text's bibliography. To complete these two activities, which were each worth 10 points, participants referred to a screenshot of search results for the text's two sources. Analysis revealed that 65.5% of students earned a score of seven or higher when completing the model text, but 46 of them did not complete this task. While results do not indicate that particular error patterns dominated, participants struggled slightly more with using reporting verbs correctly than parts of in-text citations. Students struggled more in completing the text's bibliography, with only 44.8% of them making minimal or no errors in the activity. On top of that, 51 students did not complete the activity within the allotted time. The higher rate of incomplete work in the final online activities is likely symptomatic of a time crunch towards the end of the workshop sessions;

students who ran overtime while working on earlier activities may have been left without sufficient time to work on those in Phase D.

Formative Assessment of Assignment 2

Assignment 2 in ENGEN170 required students to write three short texts about topics related to engineering and society. The formative assessment of these submissions, using my critical reading rubric and feedback comment library set up in Turnitin Feedback Studio, is this study's primary measure of students' application of critical reading skills in their academic writing. This section analyses assessment results across the rubric's five criteria for each of the three writing tasks within Assignment 2. Then the section examines trends in the feedback comments used in relation to the criteria across the three tasks. Finally, results for these tasks are compared against each other to determine trends across the assignment.

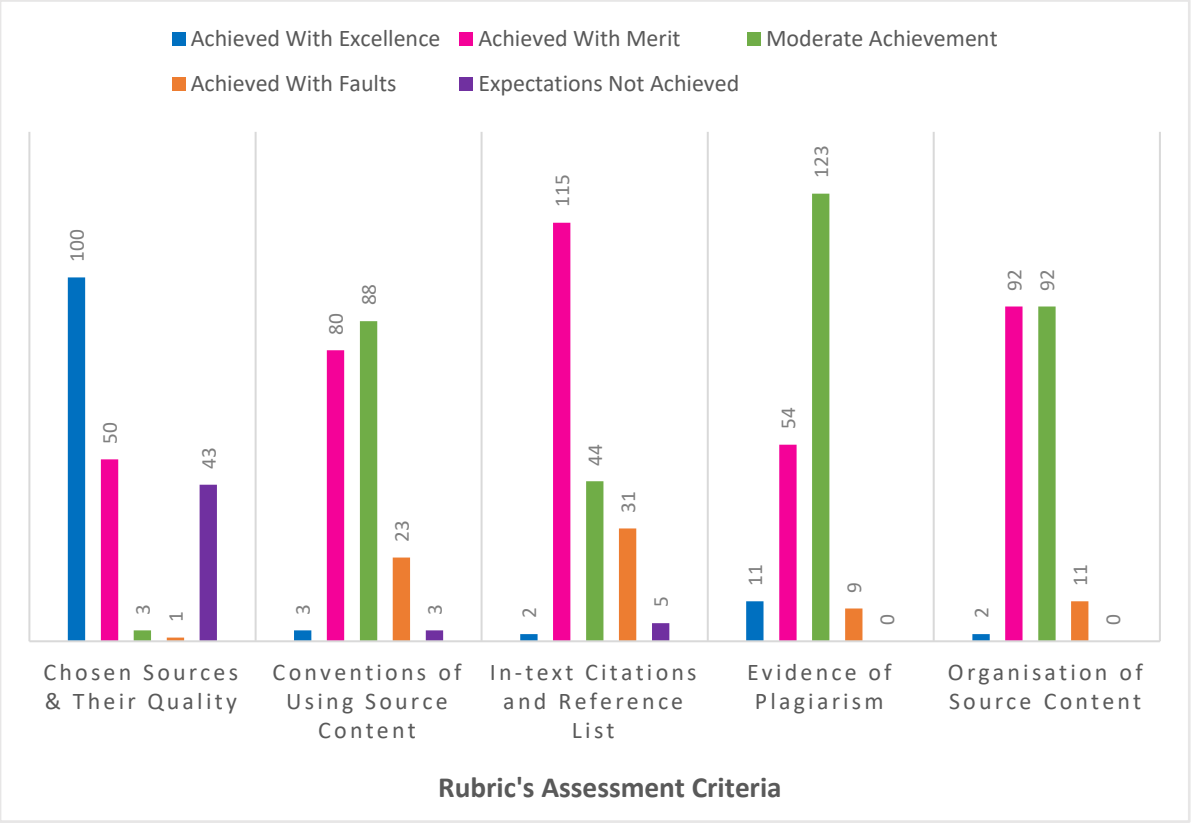
Task #1 of Assignment 2 required students to write about an invention, technology, or software they thought would become economically pervasive in the future and explain its likely effect on society. Students were introduced to the A-B-C-D Formula during the intervention lecture and then required to submit the text for this writing task a few days later. A total of 197 texts were received for Task #1, and the results of their formative assessment are represented in Figure 4.2 on the next page. Overall, the majority of students were assessed at an excellent, merit, or moderate achievement level for Task #1, which is a good result, but performance varied across the five assessment criteria. These initial findings, as described in the next paragraph, and the associated bar graph were previously published in a paper for the 34th Australasian Association for Engineering Education Conference (Busteed, 2023).

Regarding the first assessment criterion, 100 out of the 197 submissions met the minimum requirement of relevant and appropriate sources. It is also worth noting that 43 submissions did not meet research expectations; instead, these texts used inappropriate sources like blogs and websites in place of scholarly works. Secondly, the majority of students struggled somewhat to follow discipline-specific writing conventions when using source content. The greatest number of students (n=88) were rated at a *moderate achievement* level for this criterion, followed closely by those who *achieved with merit* (n=80). In many instances, students relied on quotations too often to support their ideas, even though they were told during the lecture that the engineering discipline favours the use of paraphrased source content. This indicates there is considerable room for improvement within the cohort regarding paraphrasing skills and the ability to integrate source content that lends strong support to the writer's ideas. The third criterion relates to the use of in-text citations and inclusion of a reference list. While students made an impressive effort to follow the complex rules of APA format in this first

submission, they were applied imperfectly in the vast majority of cases. Only minor errors were most often noted in the in-text citations and/or the reference list, but a considerable number of students rated lower due to a source not being acknowledged at all. These results are linked to the data for the next criterion. Students' novice level of understanding of academia's strict referencing standards led to a prevailing trend of minor plagiarism in submissions. In addition, minor organisational issues were noted in nearly all texts for Task #1. In half of these cases, the problem involved source content occupying the place in a paragraph that should have contained a topic sentence and/or concluding sentence.

Figure 4.2

Formative Assessment of Task #1 Using Critical Reading Rubric

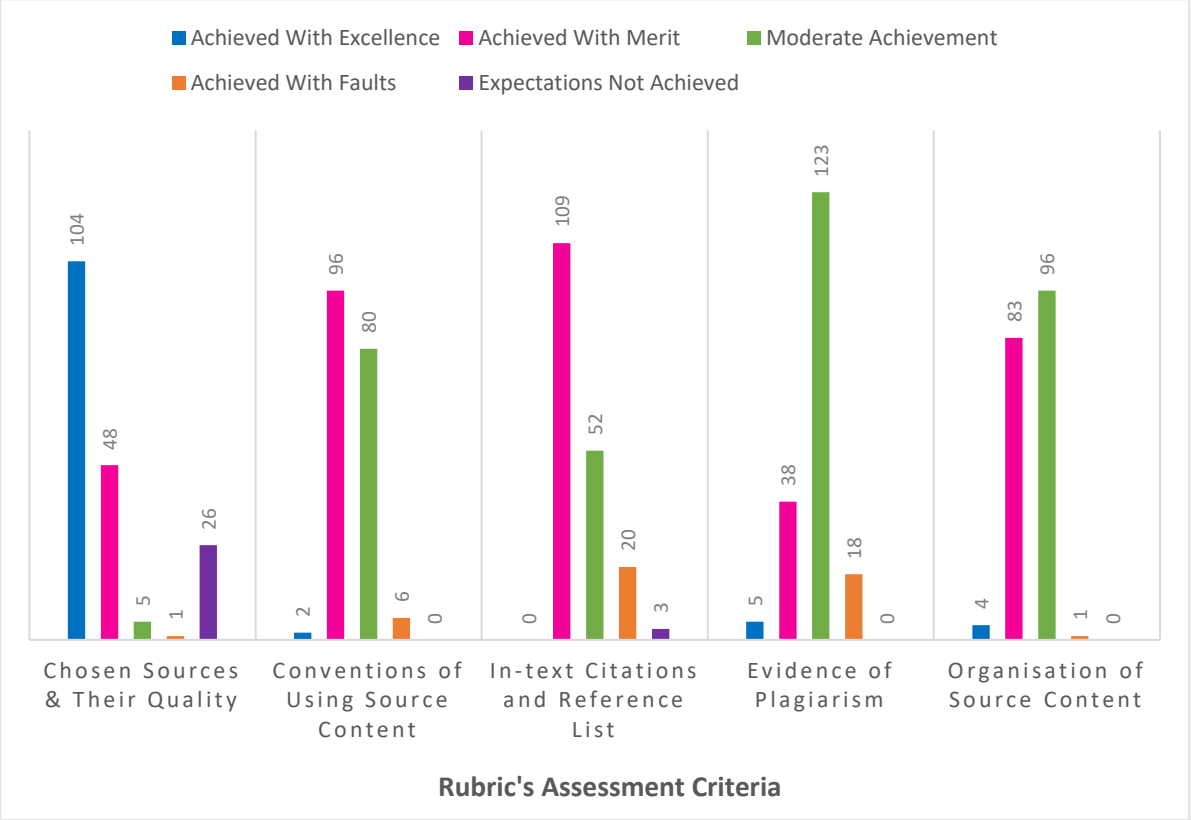


Note. This bar graph shows the number of students assessed at each rating across five criteria when applying their critical reading skills in Task #1 of Assignment 2.

Later in the teaching intervention, students completed the critical reading online activities during a workshop, after which they had more than a week to submit the two remaining writing tasks for Assignment 2. For Task #2, students wrote about an invention from the 20th or 21st century, discussing the significant impact it has had on society as well as the historical and societal factors that contributed to its invention. The submission rate dropped slightly to 184 texts for this task. Results of their formative assessment are represented in Figure 4.3.

Figure 4.3

Formative Assessment of Task #2 Using Critical Reading Rubric



Note. This bar graph shows the number of students assessed at each rating across five criteria when applying their critical reading skills in Task #2 of Assignment 2.

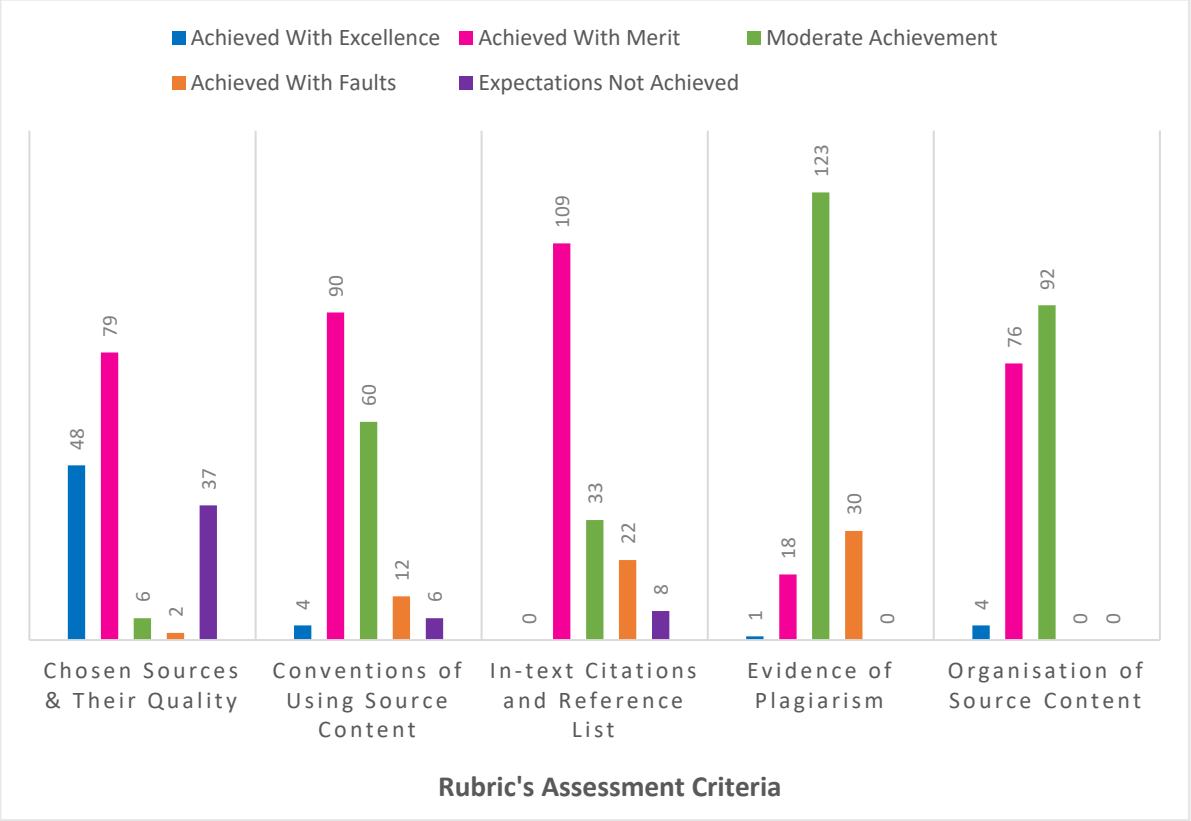
Data revealed that 104 of the 184 submissions used two or more relevant and appropriate sources, and the number of students who did not meet expectations for the first criterion dropped to 26, too. Next, the greatest number of students (n=96) earned an *achieved with merit* rating related to conventions of using source content, followed by those with a *moderate achievement* rating (n=80). Nearly all submissions were rated within these two levels for Task #2, indicating greater consistency across the cohort in applying the conventions of their discipline. Thirdly, minor errors were found again in in-text citations and the reference list, but the rate of significant faults in APA format dropped for this task. For the fourth criterion, the occurrence of minor plagiarism in submissions remained high, while cases containing significant evidence of plagiarism doubled for Task #2. Regarding organisation of source content, submissions continued to contain minor errors. Although, a greater number of students (n=96) were rated at a *moderate achievement* level this time, signalling that more submissions featured source content in inappropriate places within paragraphs. Data on the formative assessment of Task #2 reveals that, after students gained extra practice in applying the A-B-C-D Formula via the critical reading online activities, they were able to make some gains in their

written output for the first three criteria. However, it appears that this coincided with poorer overall performance in the last two criteria.

Task #3, which shared a deadline with Task #2, required students to write a persuasive essay that would convince high school students to pursue a career in engineering while also providing them with certain information about the discipline. A total of 172 texts were received for Task #3 — a notable drop in the submission rate compared to the first writing task. The results of their formative assessment are represented in Figure 4.4.

Figure 4.4

Formative Assessment of Task #3 Using Critical Reading Rubric



Note. This bar graph shows the number of students assessed at each rating across five criteria when applying their critical reading skills in Task #3 of Assignment 2.

For the first criterion, only 48 out of the 172 submissions met the minimum requirement of relevant and appropriate sources. Instead, the greatest number of students (n=79) were rated at an *achieved with merit* level. Those who did not meet expectations for the first criterion increased somewhat; the number of submissions at the lowest level was greater than that for Task #2 but did not reach the high number recorded for Task #1. Secondly, 90 submissions were rated at an *achieved with merit* level regarding conventions of using source content, followed by 60 submissions with a *moderate achievement* rating. However, the number of

submissions with significant faults for this criterion doubled since Task #2. These results show that many students are still struggling to paraphrase source content and/or resorting to quoting sources more often than they should in an engineering text. Regarding the third criterion, the majority of students still made minor errors in in-text citations and/or the reference list. Although, Task #3 submissions also featured the greatest number of cases across Assignment 2 where expectations for citing and referencing were not achieved at all. These results can be connected to those for the fourth criterion. While cases of minor plagiarism remained high in Task #3 submissions, fewer students earned the top two ratings. Cases containing significant evidence of plagiarism were at their highest across the three writing tasks. These results indicate that, while source content was being used to help persuade readers of arguments, those sources were rarely given credit in the manner expected for university-level compositions. Lastly, submissions continued to contain organisational errors, with the greatest number of students (n=92) earning the *moderate achievement* rating. This shows that many of them continued to position source content in inappropriate places within paragraphs.

The analysis of formative assessment results for the three writing tasks, as offered above, can be expanded by examining trends in the feedback comments used. The interpretations that follow reference data shared in Appendix L; its table tallies the number of times each feedback comment was applied to a submission per task. To better understand this table, Appendix J shares the complete feedback comment library so readers can see each comment's name alongside the corresponding remarks.

Regarding the Chosen Sources & Their Quality criterion, the Excellent Sources comment was used the most during Task #2, having increased slightly after Task #1. However, the number of students who received that comment dropped significantly for Task #3. Instead, this last task saw the greatest number of comments shared about Source Appropriateness, Not Enough Sources, and Faulty Source Choice. On top of that, the number of Lacking Quality Sources comments rose considerably for Task #3, nearly matching their peak from Task #1. Task #2 submissions appear to be the strongest overall for this criterion based on the comments used while Task #3 was the weakest, yet these two tasks shared a deadline. However, part of the problem with Task #3 may have been its topic. Since the text had to persuade high school students to pursue a career in engineering, many participants chose to reference salary information from various career websites. This is an interesting trend because such information, while typically not found in scholarly publications, would be useful to their readers, making it reasonable to turn to career websites as sources. However, the websites

chosen were deemed inappropriate considering the assignment's guidance to stick to scholarly sources, which accounts for some of the feedback offered about the first criterion.

For the Conventions of Using Source Content criterion, the number of students who received the Skilled Paraphrasing comment remained consistently low across the three tasks. Instead, two other comments were used most often across the tasks: Problematic Integration and Deeper Analysis Needed. This trend aligns with earlier results suggesting that students struggled to paraphrase source content properly while integrating it into their writing. In fact, the drop in the number of students receiving the Quote Less comment across Assignment 2's tasks corresponds to more students making the effort to paraphrase (albeit erroneously) instead of quote from sources. Many of them also neglected to include their own analysis following the use of source content in a paragraph, thus connecting it to their own ideas and/or explaining its significance — although this became less of an issue as students progressed through Assignment 2.

The third criterion, which assessed students' citing and referencing techniques, saw a fairly consistent application of feedback comments. The Strong Referencing comment was used most across the three tasks, although its rate of use dipped slightly for Task #2. There was also a slight drop in the use of the Missing Source & Errors comment for Task #3. Interestingly, no one received the Excellent Referencing comment for Task #2 or Task #3, and there was a slight increase in the use of the Referencing Not Attempted comment for Task #3. These trends imply that, while techniques for acknowledging sources were strong across most of the cohort throughout Assignment 2, students need to be more detail-oriented and spend more time when applying APA format to ensure they meet the high expectations set within academia.

Regarding the Evidence of Plagiarism criterion, trends in feedback comments used are explained in part by the writing traits noted in the previous two paragraphs. For Task #1, the comment most frequently used was Improve P/Q Technique,[18] but numbers for it dropped significantly by Task #3. Instead, there was an increase in the use of the Minor Plagiarism and Sig. Plagiarism = Warning comments as students progressed through Assignment 2. This could correlate to the increased attempts to paraphrase source content; when students left strings of words exactly as they appeared in the source and spliced them into sentences containing some of their own words, they would have received feedback about this issue. The frequency of this occurrence, paired with the level of accuracy in their use of in-text citations and corresponding references, would have determined which comment was attached to their submissions. Trends

[18] P/Q refers to paraphrasing and quoting, respectively.

here suggest that, despite the students gaining more practice in applying critical reading in academic writing, less attention was paid to integrating and crediting sources across Assignment 2's tasks, thus contributing to an increase in the amount of plagiarism observed in submissions. At the same time, the flawed attempts at paraphrasing source content, which contributed to the rise in the rate of plagiarism, may hint at a positive development: as students progressed through Assignment 2's tasks, they made more effort to try to apply paraphrasing skills, and making such mistakes when developing a skill can be considered a part of the learning process.

For the final criterion, called Organisation of Source Content, trends in comments used revealed an interesting fluctuation in written output. For Task #1, the Improve Org. & Logic comment was used most frequently, followed closely by the Improve Logic comment. However, the rate of use for these comments dropped steadily as students progressed through Task #2 to Task #3. Instead, there was a sharp increase in use of the Support Ideas + Fix Logic comment, suggesting that paragraphs were increasingly disorganised (i.e., not following a linear logical progression) and source content was more often disconnected from the writer's own ideas.

This section has examined students' application of critical reading skills in the three writing tasks of Assignment 2 based on data gathered using the critical reading rubric and feedback comment library. Now, formative assessment results across Assignment 2 will be presented, using the data from Table 4.2 on trends across the submissions (see next page).

Firstly, data show that students' use of relevant and appropriate sources peaked in Task #2, having improved slightly compared to Task #1. However, Task #3 saw ratings in this first criterion drop as more students depended on sources that would be categorised as secondary or inappropriate instead of scholarly. These results show that practice gained through the critical reading online activities had a positive effect where Task #2 is concerned.

Next, participants' work featured improvements in following the conventions of using source content after completing the critical reading online activities. Although, there was more consistent performance across the cohort in Task #2, while Task #3 saw more students earning the highest and lowest ratings for this criterion. As indicated earlier, paraphrasing source content properly remained a challenge for many students in all tasks, as did expanding on source content with one's own analysis.

Thirdly, the presentation of in-text citations and the reference list showed minor improvement after students completed the critical reading online activities, but the cohort's

performance was not consistent in Task #2 and Task #3. While some students improved task on task, others made more errors.

Table 4.2

Formative Assessment Results Across Assignment 2

Assessment Criteria:	**Task #1** (*S* = 197)	**Task #2** (*S* = 184)	**Task #3** (*S* = 172)
Chosen Sources & Their Quality			
Achieved With Excellence	50.76	56.52	27.90
Achieved With Merit	25.38	26.08	45.93
Moderate Achievement	1.52	2.71	3.48
Achieved With Faults	0.50	0.54	1.16
Expectations Not Achieved	21.82	14.13	21.51
Conventions of Using Source Content			
Achieved With Excellence	1.52	1.08	2.32
Achieved With Merit	40.60	52.17	52.32
Moderate Achievement	44.67	43.47	34.88
Achieved With Faults	11.67	3.26	6.97
Expectations Not Achieved	1.52	0	3.48
In-text Citations and Reference List			
Achieved With Excellence	1.01	0	0
Achieved With Merit	58.37	59.23	63.37
Moderate Achievement	22.33	28.26	19.18
Achieved With Faults	15.73	10.86	12.79
Expectations Not Achieved	2.53	1.63	4.65
Evidence of Plagiarism			
Achieved With Excellence	5.58	2.71	0.58
Achieved With Merit	27.41	20.65	10.46
Moderate Achievement	62.43	66.84	71.51
Achieved With Faults	4.56	9.78	17.44
Expectations Not Achieved	0	0	0
Organisation of Source Content			
Achieved With Excellence	1.01	2.17	2.32
Achieved With Merit	46.70	45.10	44.18
Moderate Achievement	46.70	52.17	53.48
Achieved With Faults	5.58	0.54	0
Expectations Not Achieved	0	0	0

Note. This table compares percentages of the critical reading rubric's ratings applied to submissions (*S*) for the three tasks of Assignment 2. Percentages were calculated to two decimal places without rounding.

In addition, evidence of plagiarism increased across Assignment 2, indicating that the critical reading online activities alone are not enough to help participants meet the ethical standards of academia. Granted, students' weak paraphrasing skills and inaccurate application of APA format are factors that contributed to the prevalence of plagiarism in submissions. This is a complex issue, too, because their increased attempts at paraphrasing, even though done incorrectly, can be interpreted as a positive move away from a reliance on quoting sources directly. Therefore, addressing these challenges more thoroughly in future iterations ought to improve ratings for the fourth criterion.

Lastly, a small yet growing portion of students achieved the highest rating for organisation of source content after completing the critical reading online activities. Meanwhile, fewer students were rated as having faulty organisation after the workshop. Still, a moderate achievement level for this criterion remained the most common rating across the tasks. This indicates that students need more instruction and practice in presenting ideas in a linear logical progression in their writing, as well as where it is appropriate to include source content within paragraphs.

To address the lingering issues identified above, materials used in the intervention will require revision and possible expansion in preparation for future use. Optimal pathways will be discussed in Chapter 7. This will include sharing improved designs of the critical reading online activities as a model, which other practitioners could adapt to various teaching contexts.

Analysis of Post-Intervention Survey Questions

In the post-intervention survey (see Appendix H for list of questions), the first two questions aimed to gather students' opinions about using the A-B-C-D Formula for Critical Reading and the feedback they received throughout the intervention. These questions feature a closed segment where students selected one of the provided options, followed by an open-ended portion asking them to explain their choice by writing a short response. Thus, the results gathered through analysis of their answers, as follows, is presented in segments.

The first question asked students to rate how helpful the A-B-C-D Formula was in developing their understanding of the academic literacy skills involved and how to use them. Of the 35 answers, the most commonly chosen option was *slightly agree* (12 students), followed by *moderately agree* (9) and *strongly agree* (8). Only six students had a neutral or negative opinion of my reading-to-write formula.

Survey participants were asked to elaborate on these opinions, writing up to 50 words to explain why the A-B-C-D Formula was useful or not. A thematic analysis of the 31 responses found the majority of respondents shared positive comments. Frequent use of terms like *outline*,

routine, *structure*, *guide*, *order*, *process*, *steps*, and *method* indicates participants have an appreciation for the formulaic approach to critical reading to which they were introduced. Some examples of these comments from students are shared in Table 4.3.

Table 4.3

Examples of Students' Comments from Post-Intervention Survey Q1b

O.D.M.	Gave me a routine to write this and future essays, helped to make it a lot easier to understand what to write
D.Y.B.	It was somewhat helpful however I did not find it particularly different from what I had previously learnt through high-school and primary. So whilst I agree it is a good method, I did not need to refer back to it as I have already developed research and analysis skills.
Y.H.L.	It helped me to break down the process of writing essays rather than thinking about essays as 1 big overwhelming task. I especially found the first two parts to do with understanding the task and finding good sources helpful.
B.W.N.	It was helpful because it created a clear stepwise method for text deconstruction. However the steps were relatively broad so I found I was getting lost in the middle of each step
A.B.A.	It helps clear up the steps for gaining a good understanding of the question, creating ideas, and how to research it, as well as how to reference sources that you find. Particularly highlighting verbs in the question has helped me, often I miss words such as 'ideate' or 'discuss' when answering written questions, and that leads to misguided responses.
R.C.R.	Found myself starting with the ABCD formula. However, I would quickly divert from it in the early research stage of my work.
O.A.C.	It gave me structure and helped me guide my writing further so that I can meet the criteria or marking rubric and include all the relevant information

Note. These comments were among those offered when students were asked to explain why the A-B-C-D Formula was useful or not. Contributing participants are identified here by initials in the left column.

Within the responses, there is a trend of students mentioning how the formula helped them understand task instructions, find appropriate resources, and follow referencing conventions. However, not all comments about the formula were positive. Within the mixed or negative feedback on it, several students suggested that the formula covered ideas they learned in high school or even at the primary level. Some of these respondents stated that they did not refer to the formula while working on Assignment 2; others picked from it a step or two to follow, returning to established routines for the rest of the assignment. Only one student went so far as to refer to the A-B-C-D Formula as *highly redundant*.

Next, students were asked how they would rate the feedback received throughout the critical reading intervention. Of the 31 students who completed this question, 15 of them chose

slightly helpful as their answer. A further six students selected *very helpful*, followed by *moderately helpful* and *not helpful at all* with five votes each.

Then students were asked to write 50 words or less on why the feedback was helpful or not. These explanations were also meant to identify to which feedback they referred. Thirty-one responses were received and analysed, and it was found that the majority of respondents shared mixed or negative remarks about the feedback. The following phrases suggest many participants had concerns about the feedback comments' specificity and level of detail:

very broad	*didn't identify exactly*
not very descriptive	*exactly what was wrong*
too general	*methods to overcome the issues*
more direct	*where I could do better*
more detail	*how I can improve*
more specific	

More exactly, there is a trend within students' mixed and negative remarks about feedback comments applied to Assignment 2 submissions: the comments were seen as merely identifying errors in a general sense without highlighting their locations within the text, leaving these students without specific instructions for improving performance in future written output. Meanwhile, positive remarks on the feedback related to the rubric (x1), automated feedback in the online activities (x4), feedback comments attached to submissions (x5), or more general comments (i.e., highlighting what was done wrong, ideas on how to improve). It is also worth noting that three participants could not find the feedback provided or did not register it as being feedback. Recommendations for revising materials that provide students with feedback will be discussed in a later chapter.

Analysis of Interview Responses

I conducted one-on-one interviews with six participants after the intervention. Six questions were asked to gain further data on various aspects of the intervention and its teaching materials from the students' perspective (see Appendix I). Interview transcripts underwent thematic analysis to discover trends in the responses, which are discussed in this section.

When asked whether enough time was provided to complete the online activities during the workshop, several comments were made about feeling *rushed*. R.J.A. described getting through them *pretty quickly* while observing that some classmates "were struggling a bit." V.I.S. mentioned feeling *stressed* and *rushed* yet argued *plenty of time* was allotted. He explained that more time would have made the workshop feel *dragged out* and *slow*, although he chose to review the activities in his own time after the workshop. Similarly, E.C.Y. commented that the class was given "a good amount of time" for the most part, but he would

have preferred "a little extra time" to *look over* his work and *compare* with classmates. A.B.A. went further by commenting on the lack of breaks during the workshop and having to complete all the online activities *so quickly*, whereas she would have preferred up to *another hour* dedicated to such practice to make it *comfortable*. She justified this suggestion by noting that "in general more time should be allocated to practicing and expanding on your critical reading and writing skills anyway in engineering," but the programmes' primary focus of developing students' *technical knowledge* makes it "hard to squeeze in a writing paper." R.C.R. agreed with this sentiment, stating that "not enough time was given" to *ask questions* or "pause and reflect on the tasks as a class," which he argued would have helped "to cement that knowledge foundationally." In particular, the Parlay Ideas activity in Phase C was identified by five out of six interview participants as requiring more time. R.J.A. identified it as the one instance that caused her some struggle: "It seemed like a really good activity, but it just needed more time." Likewise, A.B.A. described feeling *quite rushed* during that activity.

On a similar note, interview participants were asked whether they thought completing the online activities was a good use of class time or if they would have preferred to do them in their own time as online homework. As it turns out, insistence by the course convenor and assistant dean of teaching and learning that the online activities be completed in a workshop received strong (but not unanimous) support. Four of the six interviewees agreed that completing the online activities during the workshop was a good use of class time. For example, E.C.Y. preferred completing them during the workshop because of the setting's multiple positive effects on learning:

> you don't have to wait for an email back or rely on someone you know that's done the same thing. They're sitting right next to you, so you can get real-time feedback and can improve on each other's work. It also gives you time to focus and get it all done at once.

He went so far as to suggest that, if the online activities had been assigned as homework but without a grade attached, "no one would do it." Similarly, V.I.S. offered this argument in support of completing the online activities during a workshop: "If we're doing it in class, we're kind of obliged to do it really, like it's something we want to do. Rather than if it's in our own time, we'll always find a way to not do it." R.C.R.'s answer aligned with these comments about feedback and peer interaction. He added that having to complete the online activities independently would have made them harder for some students who "need a bit of direction" to understand instructions and new concepts. Meanwhile, two interviewees stated that they

would have preferred to complete the critical reading online activities in their own time. E.D.W. explained that "class time could be better used where there is direct feedback with the lecturer" instead of relying on automated feedback. Also, a couple of participants mentioned the *immature*, bothersome behaviour of a few students during a collaborative brainstorming activity in Phase B. On this matter, A.B.A. suggested that the behavioural issues meant "no real brainstorming was happening," resulting in the activity not living up to its potential.

The critical reading online activities were tied directly to the students' completion of Task #2 and Task #3 of Assignment 2, so interview participants were asked to describe the ways in which the former affected their completion of the latter. A variety of benefits were shared. For instance, E.D.W. pointed out that aligning the online activities with Assignment 2 provided *highlights* of "exactly what you needed for the assignment" as well as "where you've made mistakes" — something, he argued, lecture notes alone cannot provide. Similarly, V.I.S. described the online activities as an effective way to "put what we've learned into action before we've got something at stake." He also recognised their *diagnostic* function, an ability to identify one's current skill level and which literacies may require improvement. R.J.A. specifically mentioned the benefits of in-depth analysis of *the question*, selecting and using *keywords* to find *good quality* resources, and the practice of *APA referencing*, which had the combined effect of making her submissions appear *more professional*. R.C.R. added that Phase B practice was *quite useful* because he had never been taught about keywords quite so *explicitly*. In addition, E.C.Y. stated that the online activities *motivated* him to apply more effort to his writing and gave him *more confidence*, which in turn enabled him "to write more, write faster, and not have to rewrite it a million times." Meanwhile, A.B.A. commented on the benefits of some activities yet identified other areas that provided insufficient practice. In addition to Assignment 2, she has already begun applying methods learned during the practice of Phase A across her university workload; she reasoned that gaining a better understanding of task instructions "changes your entire answer." She also found the keyword searching techniques practiced in Phase B *useful* because they "lead to better results." Although, she wishes greater practice was possible for how to brainstorm effectively and select content from sources to support a position in her writing. Even though answers to this question lack a certain consistency or trend, they still have something in common: all interview participants identified at least one way in which their submissions were positively impacted by completing the critical reading online activities.

From here, interview participants offered more detail by identifying which of the online activities helped them the most; it is notable that many of them favoured the most challenging

ones. R.J.A. mentioned that the Phase C activity requiring an analysis of search results "helped with understanding why certain resources were better than others," thus ensuring she would have *more insight* during her own searches and could *filter* out the inappropriate or irrelevant ones more effectively. She added that the design of this activity made the key steps and recommended actions *more obvious* than the way they were introduced in the lecture. A.B.A. chose two Phase C activities as most helpful, stating the first one trained her to *skim over* search results and identify those that would be *more useful*, which led to the use of *better sources*. She added that the Parlay Ideas activity offered helpful *practice* because "very little do I actually find a full paragraph of a text and analyse it that deeply." E.D.W. also chose the Parlay Ideas activity, stating its time limit in particular "highlights your engrained knowledge" so "you can see where you're really lacking." Meanwhile, E.C.Y. identified the Phase D activity providing practice in the use of reporting verbs and APA format because it taught him how to "properly credit people," which he had never learned to do in high school. V.I.S. also chose this Phase D activity because referencing was *new* to him, and its *intuitive* design served as "a nice little template." Although, his response aligned with those from R.J.A. and A.B.A. about the benefits of Phase C activities in their ability to help him "pick out the best sources." R.C.R. was the only interview participant to identify an activity from the first half of the formula as being most helpful. His reason for choosing the Phase B word cloud activity as his *favourite* was twofold: it identified unknown *gaps* in his knowledge, and the brief class *discussion* that followed the activity's completion helped *correct* his technique when selecting keywords.

Next, nearly all interview participants were in agreement about which of the critical reading online activities was most difficult to complete. Five of them identified the Parlay Ideas activity from Phase C. The following phrases were used when discussing it:

not having enough time	*didn't understand*
time pressure	*ask of me*
limited time	*supposed to be doing*
write it in the time limit	*how to proceed*
quickly read it	*had our scaffolds kicked out from under us*
racing to read	*a bit lost*
struggle with the reading	*I need super specific instructions*
really difficult	*read it again*
more taxing	*very scientific*

Despite these challenges, four of them spoke of this activity in a positive manner, too, describing it as *beneficial*, *still very helpful*, and *a real application* of *the skill we're trying to develop*. Similarly, A.B.A. identified the first Phase C activity as most challenging because she

was *confused* by some of the *syntax* in the analyses and felt as if she was *rushing through* to complete it on time. V.I.S. identified a second activity during his interview as tied for most difficult. He described the referencing activity in Phase D as challenging because it was *something new* that "wasn't really branching off of any existing knowledge."

The answers above highlight what interview participants recognised as the intervention's strengths as well as perceived limitations of its teaching materials; however, these students also offered suggestions for possible improvements. As identified earlier, some interview participants thought more time should have been allocated to the completion of the online activities because the workshop felt *rushed*. The Parlay Ideas activity in Phase C was the main (but not sole) source of comments of this nature. To address this matter, E.C.Y. suggested that "a little more wiggle room" be added to the second half of the workshop. R.C.R. specified that this extra time would allow for *questions*, which could *clarify* expectations, and some *discussion* to encourage *reflection*, which would allow students "to gain a deeper understanding of the formula."

Secondly, it was recommended that revisions incorporate increased peer interaction and verbal feedback from the lecturer. For example, R.J.A. suggested that the critical reading online activities should "have a degree of interactivity within them," and the lecturer needs to "spend more time actually talking to the students rather than just sitting them behind their laptops and having them do this stuff." She explained that, under the current arrangement, she witnessed some of her classmates "getting disengaged, getting bored, getting off-task," so more activities ought to share the qualities of the one in Phase C done through Parlay Ideas. E.D.W. agreed with this sentiment, stating that the reliance on automated feedback "doesn't feel like it's genuine feedback," so revisions should incorporate more *back and forth* between students and with their *lecturer*. R.C.R. cited the Phase B word cloud activity as an *engaging* one with qualities that could be incorporated into others. He pointed out that, during this activity, all students were *inputting keywords*, which allowed him to gain "a holistic sense of what everyone's general idea about it was," and then the lecturer offered further insights by commenting on these *trends*.

Thirdly, some online activities were identified as *gamey*, thus a mere *process of elimination* was necessary to complete them. For example, E.D.W. pointed out that *drag and drop* activities can cause students to shift their *focus* from *the content* to *the words* — that is, "the word best fits here instead of here." He wished more of the online activities resembled the Parlay Ideas one from Phase C because its design meant students "really had to try." Likewise, A.B.A. suggested that some activities were designed in such a way that "it's a little bit obvious

where everything goes." She was able to "figure out just from context" what many of the answers should be because "a lot of the sentence [is] already written," which led her to doubt whether she was *actually improving* the skills practiced. She recommended that such activities be made *more complicated* if time allows. Granted, she acknowledged that online activities by nature come with *limitations*, including the requirement of *a set answer* in order to provide *automated feedback*.

Insights gained from the thematic analysis of interview transcripts will factor into revisions made to the design of the critical reading online activities. Some of the interview participants' recommended changes, in particular, will be adopted. These revisions will be shared in Chapter 7.

Summary of Results Addressing RQ1

This chapter has explored findings gained through a variety of data-gathering instruments in connection to the study's first research question: How might undergraduate engineering students' critical reading skills be enhanced by online practice of the A-B-C-D Formula as formative assessment? Thus far, each set of findings has been examined independently, but this final section will establish links between them to address the research question in a more succinct manner. This section will summarise results about the impact of the intervention's reading-to-write formula, online practice of critical reading, formative feedback, and their influence on written output.

Firstly, evidence indicates that learning about critical reading via the A-B-C-D Formula was beneficial yet insufficient for students to meet university-level expectations. This finding is supported by results from the post-intervention survey, which revealed that participants hold mostly positive opinions of the A-B-C-D Formula. They expressed appreciation for being taught critical reading through a formulaic approach, describing it as a useful learning tool that offered multiple benefits in developing related subskills. However, it was noted that some confusion remained about paraphrasing, integrating source content, and following APA formatting conventions. In addition, assessment results from Task #1 reveal there is still considerable room for improvement in students' ability to apply critical reading skills in their academic writing.

Next, the cohort's completion of the critical reading online activities yielded a wealth of data on the benefits and drawbacks of this approach to practicing critical reading skills. This is reinforced by comments made during interviews. An analysis of students' performance during the workshop revealed strong understanding of aspects covered in Phase A activities. During

Phase B, the cohort demonstrated a strong understanding of how to pair keywords and symbols to search for resources. However, collaborative brainstorming activities in this phase will require revision due to some issues encountered. For example, some students needed clarification about which keywords relate to the topic, they struggled to generate useful synonyms, and they sought to rely on inappropriate sources. Interview participants also commented on the behavioural issues that arose during the Dotstorming activity, arguing that this needs to be addressed in any revisions.

The second half of the critical reading online activities proved more challenging for many students. For instance, many participants struggled to complete the analysis of search results during Phase C. Also, students' posts during the Parlay Ideas activity revealed a trend of paragraph cohesion and/or structuring issues. Some posts demonstrated weak paraphrasing while others cut off suddenly, and a considerable number of them lacked constructive peer feedback. Many students continued to struggle in the last Phase C activity, too. Interview participants summarised that the Phase C activities were the most challenging to complete and require the most revision. In Phase D, many students failed the activity requiring them to match quotations to points about Task #3. The last activities, which dealt with reporting verbs, in-text citations, and a bibliography, were left incomplete by a fair number of students. Time limitations were a factor here. Overall, interview participants noted feeling rushed to complete the critical reading online activities, especially the more complex ones in Phases C and D. Most of them thought the online activities were a good use of class time and had positive effects on their learning, and nearly all of them identified more complex activities from this second half as being the most helpful. In summary, the critical reading online activities were able to enhance students' critical reading skills in some regards.

Following the online practice of critical reading, students' written output was enhanced in some ways, but there was still room for improvement. The formative assessment of Task #2 indicates that the critical reading online activities provided the practice needed for students to make gains in some criteria. Performance in two criteria — evidence of plagiarism and organisation of source content — was poorer, though, when compared to the assessment of Task #1. Meanwhile, Task #3 saw less consistent performance across the cohort, with some students not performing as well on certain criteria compared to Task #2. In particular, the formative assessment of these tasks reveals four main issues remain after gaining online practice. Many students continue to rely on non-scholarly websites as sources, and weak paraphrasing skills are prevalent. Also, a considerable portion of the cohort still has difficulty with APA format and presenting ideas in a linear logical progression to ensure text cohesion.

While participants' issues with plagiarism are concerning and deserve more consideration, they are not the focus of this study. Regardless of the assessment results, all interview participants identified at least one way in which their written output was positively affected by the online activities.

Lastly, the formative feedback provided throughout the intervention was perceived as somewhat helpful to the development of critical reading skills, but it came with limitations. According to trends from the post-intervention survey, students expected to receive more specific feedback. In addition, interview participants commented that the critical reading online activities would benefit from more interactivity and variety in the types of feedback used. Specifically, they would prefer to give and receive peer feedback during more aspects of the workshop and receive additional verbal feedback from the lecturer as they complete the online activities' phases.

This chapter has examined how undergraduate engineering students' critical reading skills were enhanced by online practice of the A-B-C-D Formula. The next chapter will share findings that explain how this online practice influenced student attitudes towards critical reading and the academic writing process.

Chapter 5: Research Findings — Part Two

As stated in the previous chapter, the action research project employed BL to investigate engineering students' development of critical reading skills to aid their academic writing. This chapter focuses on results connected to the second research question: How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process? Parts of the two surveys and the one-on-one interviews were employed to address the question. Their findings are shared in this chapter.

The Influence on Student Attitudes

This section is divided into three parts to share findings relevant to the second research question. It starts with results from the initial survey. From there, findings from the post-intervention survey are shared and compared to the earlier survey. The section ends with results from the one-on-one interviews.

Analysis of Initial Survey Questions

In the initial survey (see Appendix G), questions 6-11 were designed to gather data about student attitudes on existing writing skills, their incoming understanding of the term *critical reading*, and their current ability in applying critical reading skills. The questions also sought to gain insights on what role they thought critical reading should play in their education and how important it would be after graduation. All these questions used a closed design, asking students to select one of the provided options.

The initial survey asked students to reflect on existing writing skills and identify what they thought the term *critical reading* meant. These more general questions were included to establish student awareness of these foci before partaking in the intervention. When asked how they would rate their current writing skills, respondents chose one statement that best suits them from the five options. Their answers are represented in Table 5.1, which indicates that the greatest number of participants believed their writing skills to be satisfactory, yet they were less confident where academic writing for university is concerned. Overall, participants' answers reveal a fairly high level of confidence in existing writing skills yet an acknowledgement that academic writing in higher education comes with a new set of challenges. However, the question probing participants' incoming understanding of critical reading revealed an unexpected issue. Students were asked to choose up to three of the words/phrases provided to define their current understanding of the term *critical reading* (see Figure 5.1), but some students seemed to confuse this skill with merely understanding a text.

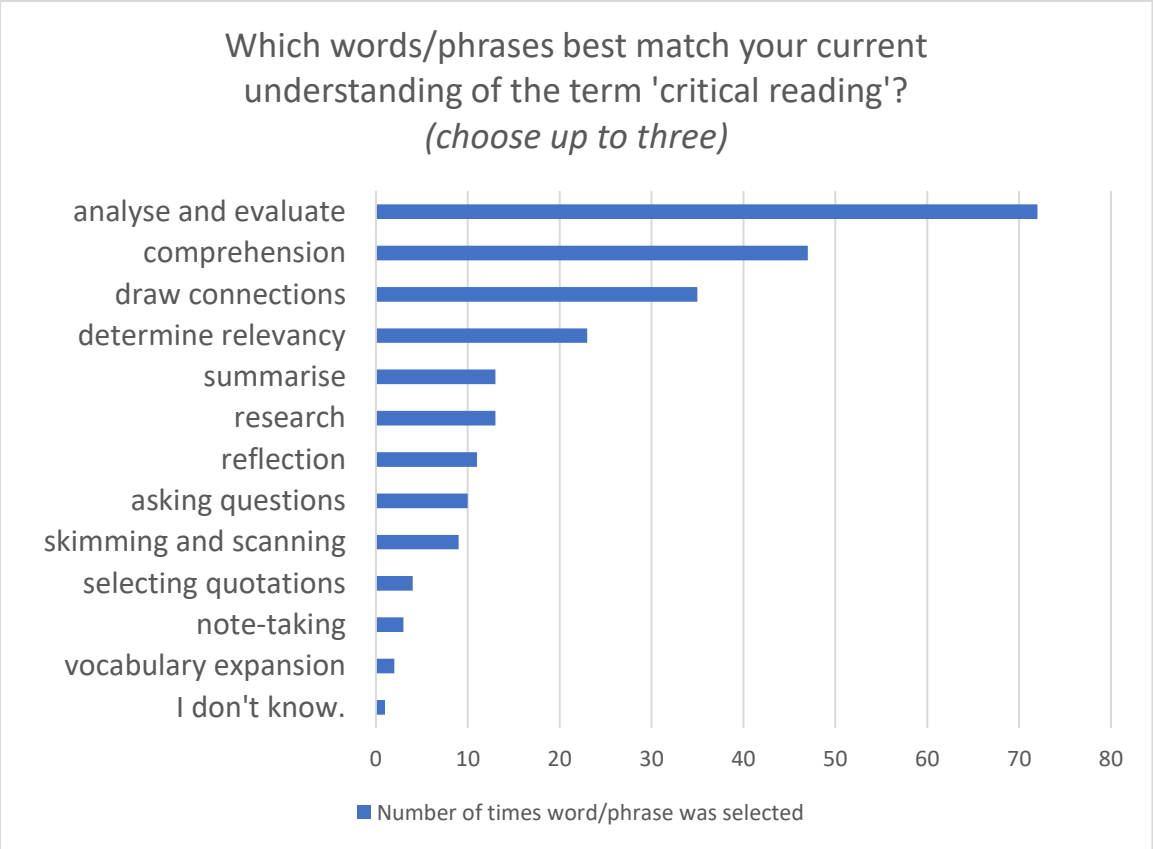
Table 5.1

Students' Reponses to Initial Survey Question About Current Writing Skills

How would you rate your current writing skills?	**Numbers of students**
My writing skills are excellent, so I'm confident I can meet the expectations of academic writing tasks at university.	9
Generally, I'm a fairly strong writer, but doing well on academic writing tasks at university is a little more challenging for me.	26
I'm satisfied with my writing skills overall, but I'm less confident that I can meet the expectations of academic writing tasks at university.	35
My writing skills are slightly weak, and I find academic writing tasks at university particularly challenging.	16
Overall, my writing skills need significant improvement, so I'm not confident I can meet the expectations of academic writing tasks at university.	4

Figure 5.1

Students' Understanding of Critical Reading Before the Intervention



When defining the term *critical reading*, *analyse and evaluate* was selected most often, but the next most common selection was *comprehension*. The former option has the strongest connection to the term's meaning — refer to this study's definition in Chapter 1, as well as related descriptions shared by Manarin et al. (2015) and Van et al. (2022). Therefore, its frequent selection indicates participants had a fair grasp of critical reading's purpose. However, reading for comprehension and critical reading are quite different skills, and it appears many students in this cohort believed they were one and the same. Other options, including *research* or *selecting quotations*, would have better matched the meaning of critical reading than *comprehension*. A considerable number of students also selected *draw connections* and *determine relevancy* as part of their definition of critical reading, which are the next best choices after *analyse and evaluate*.

Next, when participants were asked to rate their current critical reading skills when applied during the academic writing process, they could choose from one of five statements. Their answers, which are represented in Table 5.2, reveal the prevailing self-assessment as average or slightly above. Since nearly all participants recognised the existence of room for improvement here, a correlation is established between these results and those for the question that followed. In it, students were asked to choose their level of agreement with this statement: Teachers should provide opportunities to practice critical reading leading up to academic writing assignments. A considerable majority of participants agreed with this statement to varying degrees — that is, 28 of them chose *moderately agree*, 21 chose *strongly agree*, and 19 chose *slightly agree*. A further 14 participants held a neutral opinion on the statement, while eight students disagreed with it to various extents. Together, these results indicate that students, recognising their critical reading skills currently fall short of the mark, see their lecturers as responsible for offering occasions to further develop these skills in a classroom setting.

Table 5.2

Students' Reponses to Initial Survey Question About Critical Reading Skills

How would you rate your current critical reading skills when applied during the academic writing process?	**Numbers of students**
I have excellent critical reading skills.	1
My critical reading skills are fairly effective.	31
My critical reading skills are satisfactory.	44
I have slightly weak critical reading skills. I need some help to improve them.	13
My critical reading skills are very weak, so I struggle to meet the basic requirements of academic work at university.	1

The final two questions of the initial survey asked participants to share attitudes on the importance of critical reading skills as part of engineering studies and as pertains to a future career. Regarding the former context, 40 participants rated critical reading skills as *very important*. This was followed by 25 participants choosing *moderately important*, 18 choosing *extremely important*, and seven choosing *slightly important*. Next, they shared opinions about the importance of critical reading skills in their future career. Again, *very important* was the most common answer with 37 participants selecting it. A further 27 participants chose *extremely important*, 21 chose *moderately important*, and five chose *slightly important*. It is interesting to note that *extremely important* and *moderately important* swapped places in ranking for this last question. A comparison of these results indicates that, while many students consider critical reading skills to be very important to their study of engineering, they are viewed as even more vital in a professional context.

This section has examined students' initial understanding of and attitudes towards critical reading, the academic writing process, and their role in engineering education and related career pathways. These results from the initial survey will be compared to those from the post-intervention survey in the next section, and they will also factor into discussions and conclusions shared in later chapters.

Analysis of Post-Intervention Survey Questions

In the post-intervention survey (see Appendix H), questions 3-7 gathered data on student attitudes towards practicing and applying critical reading skills, how this skill is taught at university, and its importance in engineering studies and the profession. These questions feature a closed segment where students selected one of the provided options, three of which are followed by an open-ended portion asking for further explanation. As noted in Chapter 3, completion of the surveys was voluntary, which explains why the participation rate for this survey was lower than that for the initial survey. The following results are shared in segments based on the question asked.

Students were asked whether they thought the critical reading online activities were an effective way to practice their critical reading skills in connection to the writing assignment. Of the 30 answers, the most commonly chosen option was *slightly agree* (11 students), followed by *moderately agree* (9). Meanwhile, five participants chose *slightly disagree* from among the options, and a further three students expressed a *neutral* opinion on the matter. Only two participants had a strong opinion; one of them chose *strongly agree* while the other chose *strongly disagree*. The mostly positive attitudes towards the critical reading online activities

indicate that participants viewed them as an effective learning tool, although some dissenting attitudes were expressed.

Survey participants were asked to elaborate on these opinions, writing up to 50 words to explain why the critical reading online activities were effective or not. A thematic analysis of the 30 responses found the majority of respondents shared positive or mixed comments. Positive comments on the online activities related to how they:

- created an opportunity to practice/improve/review — e.g., writing, A-B-C-D Formula, research skills, identifying keywords, interpreting instructions, paraphrasing skills, reading (x11);
- provided opportunities for feedback (x2);
- clarified the assignment's expectations (x1);
- broke learning down into steps (x1);
- included time pressure (x1);
- highlighted weaknesses (x1);
- served as a reference when working on assessments (x1).

Some respondents' positive comments were more general; they described the critical reading online activities as *beneficial*, *helpful*, *useful*, *effective*, and *good* because they were *repeatable*, *fun* to complete, and this kind of *interactive* learning was something they *enjoyed*. This long list of positive comments suggests there are multiple strengths to the online component of this intervention.

However, not all comments about the critical reading online activities were positive. Within the mixed and negative explanations, the following words and phrases reveal a trend:

too fast	*found myself a bit behind*
drag on	*more condensed*
too long	*time pressure was not beneficial*
really quick	*couldn't take my time to refine things*
fast pace	*rushing through them*
quite rushed	*weren't given much time*
so fast	*time pressure*
rushing	*the reality of how much time can be wasted*
long	

Many students faced considerable time pressure and felt that a two-hour workshop was not enough for them to complete the series of online activities in a way that would maximise the benefits to learning. Within the explanations, there is specific mention of time pressure multiple times in connection with the Parlay Ideas activity and how this made it challenging for some

students to understand and/or absorb content. Meanwhile, a small number of participants expressed appreciation for the time pressure and/or thought too much time was allocated to the online activities.

Other limitations of the critical reading online activities, as identified by participants, relate to (a) the brainstorming activities; (b) lack of clarity about why certain answers were correct; (c) talking in the classroom causing issues with concentration; and (d) the style of certain activities being gamey or only requiring process of elimination to complete. Despite the level of detail included in participants' mixed and negative comments, only two students described ways to improve the online activities. For example, one participant recommended that they have "more of a defined focus on critical reading," while the other student commented that "doing paragraphs then getting them checked off would have been better."

Subsequently, students were asked how they would rate their critical reading skills when applied during the academic writing process now that they had completed the recent practice. They could select one of five statements to complete this question. Table 5.3 on the next page shares the 30 answers received. They reveal that nearly all participants think their critical reading skills could still be improved to varying degrees — even after practicing these skills in a discipline-specific context and by a means that tied the practice directly to an upcoming assessment. Since this question was designed so its results could be compared against those for the initial survey's eighth question, a t-test was conducted to determine statistical significance (see Appendix M). The mean increased from 2.5 in the initial survey to 2.68 in the post-intervention survey. Factoring in a two-tail P-value of 0.257488, these results reveal that participants think slightly less of their critical reading skills after the intervention compared to their initial attitude. Even though these results are indicative of a small difference, the analysis indicates that this is not statistically significant.

Another post-intervention survey question asked students to share their attitudes on whether teachers should adapt the online activities for their courses, thus providing more practice of critical reading in connection with other academic writing assignments. Of the 30 answers, *slightly agree* (9 students) was the option chosen most, followed by *moderately agree* (8). Meanwhile, seven participants expressed a *neutral* opinion on the matter. A further five students disagreed to varying degrees, and only one participant chose *strongly agree*. The majority of attitudes are positive here, indicating support for the adaptation of the online activities for use in other courses. However, the numerous participants expressing a neutral attitude align with the mixed attitudes expressed earlier towards the online activities, suggesting that they could require some revision. This question's results were compared against

those for the initial survey's ninth question by conducting a t-test (see Appendix M). The mean decreased from 5.772727 in the initial survey to 4.5 in the post-intervention survey, with a two-tail P-value of 0.006062. These results indicate a statistically significant shift to a more neutral attitude about whether teachers should adapt the online activities for their courses. This shift reinforces the idea that adjustments to the online activities may benefit future students.

Table 5.3

Students' Reponses to Post-Intervention Survey Question About Critical Reading Skills

Having completed the recent practice, how would you now rate your current critical reading skills when applied during the academic writing process?	**Numbers of students**
I have excellent critical reading skills.	3
My critical reading skills are fairly effective.	11
My critical reading skills are satisfactory.	9
I still have slightly weak critical reading skills. I need extra practice to improve them.	7
My critical reading skills are still very weak, so I struggle to meet the basic requirements of academic writing.	0

Next, students were asked how they would rate the importance of critical reading skills in their study of engineering now that they had learned more about them. Thirty answers were received, among which *very important* (17 students) was the most commonly chosen option. A further five students chose *slightly important*, followed by *extremely important* (4) and *moderately important* (4). Survey participants were asked to elaborate on these attitudes, writing up to 50 words to explain why they rated the importance of critical reading in their studies that way. A thematic analysis of the 30 responses found the majority of respondents shared positive comments. These touched on how critical reading skills:

- help them do their work and meet expectations of university assignments (x8);
- help them understand texts they read (x7);
- help them communicate effectively (x6);
- contribute to the development of academic writing skills (x6);
- help them meet the expectations of a future client/stakeholder/employer (x6);
- help them do research (x3);
- help them reference sources accurately (x1).

Some respondents' positive comments, while more general, mentioned that critical reading skills relate to *critical thinking*, *learning*, being *well informed*, and *conveying facts* as part of

university studies. The belief that development of such skills is often *overlooked* was also identified. Overall, the sizeable list of positive comments indicates participants associate the development of critical reading skills with many benefits to their university studies.

However, a few of the explanations were mixed or negative in nature, revealing a minor trend in attitudes that suggests critical reading skills are viewed as a low priority within engineering education. These comments involved the occasional use of phrases like *more of it is math*, *not an English teacher or a journalist*, *without thinking about this*, *extra math classes*, and *take away from other learning*. In particular, two of the students with overtly negative attitudes shared comments indicating they viewed critical reading as having no place in their university studies. T.R.S. stated that engineering students "dont need alot of reading"[19] and that it "would have been a lot better for extra math classes" to be included. Then R.K.O. went so far as to state, "I'm an engineer, not an English teacher or a journalist." Among participants who shared mixed opinions on the importance of critical reading, R.J.A. commented that "maths, physics and programming take up most of the priority" in engineering studies, but "it is also important to have great critical thinking and communication skills as an engineer." Similarly, E.D.W. had this to say on the subject: "Critical understanding of previous literature on a given subject (especially in engineering) is always good, however I would guess you could go your entire career as a software engineer without thinking about this at all." The attitude that critical reading skills development is often viewed as a low priority within engineering education was noted in a few positive comments, too. For instance, B.U.R. viewed critical reading as important "to pass." Likewise, B.C.S. expressed the belief that "engineering is more than testing materials and completing math calculations. There is much critical reading and writing skills needed that often get overlooked and are very beneficial out in the workforce." These positive comments contradict other views by expressing the importance of critical reading to engineering education. Together, these comments offer considerable insights into students' attitudes on the development of academic literacies as part of their engineering studies.

Only a couple of comments here provided an element of feedback on the intervention. For example, O.D.M. stated that "it helped me understand how to read scholarly sources and write properly in a way which I would need to use in future assessments/jobs." Meanwhile, A.B.A. expressed the concern that "integrating critical reading exercises into existing courses

[19] Student-made errors left in.

packed with content may make them overwhelming, or take away from other learning." Other participants did not draw direct connections between the intervention and this question.

The question was designed so its results could be compared against those for the initial survey's tenth question, so statistical significance was determined via a t-test (see Appendix M). The mean increased from 3.545455 in the initial survey to 3.681818 in the post-intervention survey, with a two-tail P-value of 0.525324. These results are indicative of a small difference in student attitudes; since the intervention, they see critical reading skills as more important to their study of engineering than they did at the start of the course. However, this result is not statistically significant.

The last question in this survey asked students how they would rate the importance of critical reading skills in their future career now that they have learned more about them. Of the 30 answers, the most commonly chosen option was *very important* (13 students), followed by *moderately important* (9). A further five students chose *slightly important* from among the options, and three chose *extremely important*. Then survey participants were asked to elaborate on these attitudes, writing up to 50 words as an explanation. Table 5.4 shares some examples of these comments from students.

Table 5.4

Examples of Students' Comments from Post-Intervention Survey Q7b

Y.H.L.	We use critical reading to understand the impact our work and others work is having on the world. We can then use this info to guide our research/decisions.
B.C.S.	Civil engineers need to be able to work with clients and produce report writings, presentations and more that require further research.
R.C.R.	I intend to be an engineer. As an engineer I am going to have to be able to intake information about what I am doing and recent research in my field as well as write proposals or other academic [pieces] and in order to be proficient at these tasks critical reading skills are required.
U.S.M.	I intend to do software engineering. When I will work with clients the projects they give me will probably [be] different from each other and will have aspects to them that I don't understand. Critical reading will help me improve my understanding of those aspects.
D.Y.B.	In a professional environment I will need to find accurate sources and communicate my ideas in a professional manner.
A.B.A.	While my planned career is atypical to most engineering jobs (science communication), understanding and communicating technical knowledge is essentially the whole premise of the job, making critical reading extremely important.

Note. These comments were among those offered when students were asked to explain why they had rated the importance of critical reading skills in their career in a particular way. Contributing participants are identified here by initials in the left column.

A thematic analysis of the 30 responses found that a considerable majority of respondents shared positive comments about why critical reading will be important to their future career. These comments touched on how critical reading skills:

- help them understand texts they read (x7);
- contribute to professional writing responsibilities (x7);
- help them interact with a future client/stakeholder/employer (x6);
- help them communicate effectively and professionally (x5);
- help them do their work/complete engineering projects (x4);
- help them do research (x4).

In addition, some respondents' positive comments were more general, featuring such words/phrases as *cooperation*, *convey facts*, *moderately important to engineering*, *important for anyone no matter what*, *important skill in the workplace*, *keeping up*, *successful*, and *important*. Together, the long list of positive comments demonstrates that participants associate the development of critical reading skills with many benefits to their future careers.

Meanwhile, occasional use of phrases like *more just writing code*, *I don't imagine*, *just coding*, *more hands on*, and *only required to write sometimes* suggests that a small number of participants view critical reading skills as having low importance for their future careers. This attitude appears more prevalent among respondents specialising in software engineering. It is possible that these few students believe that writing code is the only kind of writing a software engineer will need to do, thus rendering the development of critical reading skills less important. As T.R.S. put it, software engineers only need to "use ctrl f for anything [they] need."

Since this question was designed so its results could be compared against those for the initial survey's last question, statistical significance was determined via a t-test (see Appendix M). The mean decreased from 3.545455 in the initial survey to 3.454545 in the post-intervention survey. Since the two-tail P-value was 0.69292, these results are indicative of a small difference in student attitudes. Having completed the intervention, they now see critical reading skills as slightly less important to their future career than they did before, but this result is not statistically significant.

This section has shared student attitudes towards their critical reading skills, aspects of the intervention, and how they factor into engineering studies and potential career pathways. These results from the post-intervention survey will influence discussions shared in a later chapter as well as revisions made to the intervention's teaching and learning resources.

Analysis of Interview Responses

As stated in the previous chapter, I conducted one-on-one interviews with six participants after the intervention (see Appendix I for the list of interview questions). Four of the questions were asked to gain further data on student attitudes towards the intervention's teaching materials and critical reading's role in their engineering education and future career. Transcripts of these interviews underwent thematic analysis to discover trends in their responses, which are discussed in this section.

Firstly, a variety of responses were noted when interview participants were asked what they thought about the critical reading online activities being a part of ENGEN170. For instance, R.J.A. expressed excitement because they "joined the two interests" of engineering and English. Similarly, A.B.A. described the idea as *interesting* and *quite refreshing* because it allowed students "to engage with the topic and work on the skills." E.D.W. expanded on this by stating he *wasn't surprised* by the online activities' inclusion in the course; in fact, it was *expected* because engineering students and graduates "need those sort of skills." Likewise, R.C.R. stated that "it made perfect sense" to include the online activities in the course because critical reading skills are *important* to develop at university. On the other hand, E.C.Y. conveyed mixed feelings about the online activities. He believed that NCEA Level 2 would be "the last I'd see about work on my writing," yet he was *happy* to have the opportunity *to improve* and receive *feedback* because he self-identified as "not a very strong writer." V.I.S. had a similar initial reaction — "Oh great, we're doing English" was uttered in a sarcastic tone — but eventually saw it as "an opportunity to make sure I can do the best I can" in discipline-specific writing tasks. Therefore, interview participants represent the gamut of attitudes towards having to complete the critical reading online activities as part of the course.

Next, interview participants described attitudes on the experience of using the critical reading online activities. Employing such words as *helpful*, *positive*, *useful*, and *great*, all interview participants identified at least one way in which they benefitted from completing the online activities. However, several comments were made about feeling *rushed* to finish them. The issue of time provided to complete the critical reading online activities was explored in greater detail in the previous chapter. Despite this issue, interview participants expressed positive attitudes towards using the online activities as a method to practice their critical reading skills.

Later, the focus of the interviews shifted to examine more broadly how the A-B-C-D Formula and the online activities might influence the students' approach to the academic writing process through the rest of their programme. Evidence indicates a strong appreciation

among interview participants for the fact that critical reading was taught and practiced through a step-by-step, formulaic approach. Their comments included such phrases as *how to approach*, *how to implement*, *really clear idea*, *clear stepping stone*, *regimen*, *what order to do it*, *stay relevant*, *going to stay useful*, *look back on and utilize*, *continue to use*, *checklist*, *as a reference*, *makes it easier*, *keep those throughout university*, and *changed my approach completely*.

When asked this question, some interview participants even described attitudes towards particular phases of the formula they find most influential, revealing what was learned through the intervention is already being applied elsewhere. For example, A.B.A. stated that the analytical skills developed through the practice of Phase A proved so helpful during Assignment 2 that she has "already used [them] for other papers." Similarly, E.C.Y. commented that activities related to selecting and using keywords "made finding information a lot less of a huge task," and this ability is improving his writing by giving it *more order* and keeping it *on the subject*. Meanwhile, R.C.R. attached greater benefit to the first half of the formula and described *supplementing* what was learned during Phases C and D with existing knowledge "brought in from high school" and *other skills* he expects to develop in the future. R.C.R.'s comment is not surprising since these phases cover the more complex aspects of the formula, and the intervention provided only one instance of practice. During that interview, it was pointed out that mastering critical reading and its application in academic writing can extend beyond one's undergraduate studies as a lifelong pursuit. I added that it was always intended for the students to gain what they could from this formulaic approach to critical reading, adapting it if necessary to their own needs when producing each new text. When this aim was brought to R.C.R.'s attention, he agreed that the formula "covers the academic writing process" and he will "still have to go through that process in order to write academically," which is why he will *find some way* to *leverage* Phases C and D to make them work for him. Therefore, R.C.R. serves as an example of a student capable of recognising the benefits of a learning tool and adapting it to other circumstances to maximise those benefits — a sign that the A-B-C-D Formula and its critical reading online activities worked as intended overall.

Interview participants were also asked to discuss the relevance of critical reading in their engineering education and beyond. Attitudes were unanimous; they believe it plays a crucial role in their studies, explaining its connection to various academic and professional expectations. The following phrases were featured in their reasoning:

extremely relevant	*read sources*
very relevant	*how much of it is relevant*
very critical	*incorporate into your own work*

very important skill	*draw complicated connections between ideas*
incredibly important	*writing and research*
critically important	*writing pretty detailed reports*
highly crucial	*complicated reports*
embedded into me	*communicate pretty complicated ideas*
to be more informed	*communicating ideas well*
being informed	*portray ideas to clients*
constantly learning and researching	*pitching to investors*
a need to do proper research	*working with stakeholders*
reading the question	*what they want of us*
read publications	*making the best solutions*

Although, E.D.W. suggested that, for those studying engineering, the continued relevance of critical reading "depends on where you decide to go" after graduation. For example, some pathways within software engineering might allow him to have a career "without even touching this stuff again," but other roles involving research would require him to follow "strict academic writing standards." A.B.A. offered a similar comment, highlighting that the application of critical reading will vary after graduation "depending on what kind of job" is accepted within the engineering field. Still, she pointed out that it is "an important skill to build while in your degree rather than in the field." Meanwhile, R.C.R. went so far as to state that developing critical reading skills is a necessity that extends beyond studying engineering and is "just relevant to being an informed person in general." These responses indicate that interview participants view critical reading as essential to success in their studies and most future career paths due to its connection to a wide range of duties they must fulfil as learners and future professionals.

This section has shared student attitudes towards the intervention's teaching and learning resources, as well as critical reading's role in their engineering studies and possible career pathways. Later chapters will incorporate these findings into discussions and outline how they have influenced revisions made to the intervention's design.

Summary of Results Addressing RQ2

In this chapter, findings have been explored in connection to the study's second research question: How does online practice of the A-B-C-D Formula influence student attitudes towards critical reading and the academic writing process? Each set of results has been examined independently so far. This final section will establish links between these findings, thus addressing the research question in a more succinct manner. This section creates connections between results of the initial survey, post-intervention survey, and one-on-one

interviews in order to summarise how the different aspects of the intervention influenced student attitudes.

Firstly, it was found that online practice of the A-B-C-D Formula for Critical Reading is viewed by most students as a positive learning experience. This is despite the students expressing a fairly high level of confidence in their initial writing abilities and demonstrating a fair understanding of the term *critical reading*, as indicated in initial survey results. Once the cohort practiced the phases of the A-B-C-D Formula during the intervention, many of them expressed positive attitudes towards the critical reading online activities. They highlighted the multiple strengths of this online component of the intervention, indicating that the online activities were viewed overall as an effective learning tool. These results from the post-intervention survey are reinforced by comments shared during the one-on-one interviews. Those few students shared an array of attitudes towards completing the critical reading online activities as part of ENGEN170. Even though comments were varied in their focus, all interview participants identified at least one way they benefitted from completing the online practice. Their interviews also revealed a strong appreciation for critical reading being taught via the A-B-C-D Formula. These students recognised the benefits of learning the formula's different phases and the fact that this knowledge could be adapted to other circumstances to help them meet expectations for a variety of writing tasks. Together, these results reveal a positive overall attitude towards this method of critical reading skills development.

Despite students having the opportunity to practice their critical reading skills during the intervention, evidence indicates that two trends in attitudes exist around the idea that more improvement is still needed. The first of these trends has to do with students' belief that their ability to apply critical reading skills in academic writing is not yet up to the mark. When the course began, students rated their existing skills as average or slightly above, acknowledging there was room for improvement. Then in the post-intervention survey, participants indicated that their critical reading skills could still be improved to varying degrees, even though they had just completed some online practice in a discipline-specific context that was tied directly to an upcoming assessment. In fact, it was found that they thought slightly less of their skills after the intervention compared to their initial attitude. These findings relate to the second trend: many students believe that improvements to the critical reading online activities would be beneficial before wider integration into the engineering curricula is pursued. This trend was established by comparing results from the two surveys. In particular, the initial survey revealed that a considerable majority of participants think teachers should provide opportunities for them to practice critical reading leading into academic writing assignments. After students

completed the intervention's online activities, though, the post-intervention survey found that there was a statistically significant shift towards a more neutral attitude on this matter. Comments shared indicate that many participants think the critical reading online activities require some refinement, especially related to the time provided to complete them. This means that students' support for the adaptation and wider integration of the critical reading online activities was tempered by the belief that some revision is required before taking that next step.

Lastly, the experience of practicing the phases of the A-B-C-D Formula via online activities helped students recognise the importance of critical reading in their studies and future career. The initial survey found that many students consider critical reading skills to be very important to the study of engineering but view them as even more vital in a professional context. However, these existing attitudes were affected somewhat by their participation in the intervention. After gaining some online practice of the A-B-C-D Formula, many positive comments were shared in the post-intervention survey, indicating that students associate the development of critical reading skills with many benefits to their university studies. In fact, when compared to initial attitudes, students now believe critical reading is more important to their studies than previously thought. However, a minor trend in this survey's results revealed that some students see the development of critical reading skills as a low priority in engineering education — a view that relates to student attitudes on academic literacies overall. In contrast, students now see critical reading skills as less important to their future career than previously thought. This change in attitudes since the intervention relates to comments shared about the benefits of such skills depending on one's engineering specialty and career path. Despite this shift from initial attitudes, the majority of post-intervention survey participants still shared positive comments about the importance of critical reading skills to their future career. These findings are reinforced by comments shared during the one-on-one interviews. Attitudes were unanimous in the interviews regarding critical reading's relevance. These students think critical reading skills are essential to success in engineering studies and most future jobs due to their connection to a variety of academic expectations and professional responsibilities; however, their continued relevance would vary depending on one's chosen professional pathway.

This chapter has examined how online practice of the A-B-C-D Formula influenced undergraduate engineering students' attitudes towards critical reading and the academic writing process. The next chapter will discuss all findings from this chapter together with those from the previous chapter. It will also establish links between this study's results and the AL model's themes, as well as consider possible refinements for the intervention's design so engineering programmes can improve the development of academic literacies.

Chapter 6: Discussion of Combined Results

The previous two chapters shared results separately related to students' performance and attitudes as part of a mixed methods approach to analysis. Now, thematic analysis of the combined results allows for the discussion of the study's five themes. In this chapter, possible improvements to the intervention will be identified briefly, as well as broader ideas addressing communication skills development that could be embraced by engineering programmes.

Discussion of Combined Results

A wide variety of insights can be gleaned from this study of the effects of embedding the AL model in engineering education. This was made possible by conducting action research and using BL to facilitate students' practice of an original reading-to-write formula in a first-year undergraduate course. The results dealt separately with the intervention's impact on students' application of critical reading skills in academic writing as well as their related attitudes. However, this chapter combines those results to discuss the alignment of students' performance and attitudes as well as any contradictions. The discussion is organised into five themes:

1. the need to practice academic literacies in advance of an assessment;
2. students' desire for varied and interactive learning experiences;
3. the need for plenty of time dedicated to practice;
4. the expectation of receiving high-quality feedback;
5. connections between the intervention and students' budding professional identity.

These themes are presented in this chapter in the order listed above. A key word or phrase used by a participant is featured in the themes' headings to help identify them.

The Need for Practice 'Before We've got Something at Stake'

The research findings demonstrate that the opportunity to practice critical reading and its application in discipline-specific academic writing is essential as undergraduate cohorts begin engineering studies. There is not only evidence that students' written output benefits from such practice, but also indications that they appreciate such practice being incorporated into the initial weeks of university studies to help them meet expectations. The discussion of this theme is supported by Assignment 2's formative assessment results, evidence from the surveys and interviews, and a few observations noted in my teaching log.

To begin with, it is worth recalling that, based on initial survey results, the ENGEN170 cohort started their studies with a fairly high level of confidence in existing writing skills, but

they were aware that academic writing in higher education would involve developing a new set of skills. That same survey revealed that, in some instances, there was confusion about the difference between critical reading and reading for comprehension. Meanwhile, most participants assessed their own ability to apply critical reading skills as average or slightly above, meaning they recognised that there was room for improvement. The majority of participants hold lecturers responsible for offering opportunities to practice these skills so they can make the requisite improvements and are prepared to tackle upcoming assessments. Together, these initial survey results reveal an awareness within the cohort that expectations at the university level would present new challenges where academic literacies are concerned, so they would require further guidance in order to navigate assessments in their new learning context. These findings relate to some of the AL model's key themes, as identified in Chapter 2, particularly how higher education institutions are expanding and becoming more inclusive so their offerings have to adapt to ensure new students can meet standards (Lea & Street, 2006; Lillis & Scott, 2007). This is where the advantage of following the AL model for my intervention in an engineering course becomes clearer. Embedding academic literacies practice creates moments for developing essential non-technical competencies; in this case, it involved updating a small portion of ENGEN170 to create more opportunities for students to practice critical reading and better prepare them to apply those skills in an upcoming assessment and future academic contexts (Lea & Street, 2006). In the process, my application of the AL model fostered collaboration between students and with their lecturer as part of meaning making by including various opportunities to interact as part of the learning process, which helped make tertiary-level expectations more explicit (Lea & Street, 2006). Overall, the strategy aligned well with the cohort's expectation that entering university studies would require them to improve critical reading and develop new skills for academic writing.

It is worth noting, however, that students holding their lecturers responsible for such practice opportunities seems to contradict the existing ecology of the university. It suggests that subject lecturers are viewed as being the pool of all knowledge from which undergraduates can drink — an expectation similar to that experienced in secondary school. Meanwhile, universities are typically designed in a way that requires students to forage for the different kinds of nourishment required to learn and achieve their educational goals. This means interacting not just with subject lecturers but also teaching assistants, tutors, librarians, and other university staff. This institutional strategy is problematic because, as Strauss and Grant (2018) noted, engineering students can be reluctant to seek help with academic writing tasks for fear of embarrassment or other unexplained reasons. The tendency to avoid seeking support

is a trait observed amongst students new to higher education across disciplines. Therefore, when embedding opportunities to develop discipline-specific academic literacies in first-year courses, it is recommended that subject lecturers and academic literacies experts offer explicit guidance to students on how to seek further guidance and who within the institution is best suited to provide it. This idea embraces the AL model for engineering education but also clarifies to cohorts the expectation of taking charge of their studies and utilising the variety of institutional resources available. Even better, each department or division could arrange for an academic literacies expert to be attached to first-year courses as a co-teacher to ensure new students have more than one point of contact as they adapt to the expectations of tertiary studies. This kind of embedded team teaching would provide students with more comprehensive feedback. The complexities of these collaborations are acknowledged in the literature (e.g., Ashton-Hay & Chanock, 2023; Grossi et al., 2021) but should still be pursued. My study is a successful exemplar of such a pedagogy: it shares an original reading-to-write formula and comprehensive set of online practice activities for a critical reading intervention designed with input from engineering subject lecturers. These materials are accompanied by supplementary resources, all of which work to smooth students' transition to the university ecology. However, more researchers should explore this space in the future and add to the literature on collaborating across disciplines to embed academic literacies development.

Next, the intervention lecture introduced students to the A-B-C-D Formula for Critical Reading, which garnered a positive reception. The majority of survey participants commented on its usefulness and expressed appreciation for learning a formulaic approach to critical reading. They described the formula as *clearly structured* and *easy to understand*, so it proved to be *a useful resource* by bringing *order* to that aspect of the writing process and serving as a *guide*. These survey results are reinforced by attitudes expressed about the formula during interviews. For instance, R.J.A. stated that the formula "gives me a really clear idea of what to do and what order to do it." Similarly, E.D.W. expressed his appreciation for the formula giving him "a clear stepping stone to approach any sort of writing task" because "a strict regimen to follow makes it easier for me." Several of the other interview participants identified specific phases within the formula as particularly helpful to them.

In my teaching log, a few key observations were recorded pertaining to the intervention's lecture on the formula. Firstly, I noted that students were focused on the presentation, but not all of them took notes during it. This could suggest that some students had not yet developed notetaking habits while simultaneously listening to the teacher — a standard practice at the university level when one is attending lectures but not necessarily so among engineering

students, as this study has demonstrated. As the lecture ended, one student from the Tauranga campus approached me to ask questions about the meaning of paraphrasing when using source content. In response to this, it may be advantageous to share a link or additional resource with students in the future that breaks down this writing technique and sets expectations for tertiary-level assessments within the engineering discipline. Dedicated practice time that develops paraphrasing skills may also be necessary. After the lecture at the Hamilton campus, several students approached me to seek clarification. For example, I was asked the following four questions: (a) Do in-text citations have to be linked? (b) What details go in in-text citations? More specifically, can these details be reduced with repeated use? (c) Is my chosen topic appropriate? (d) Based on the publication year, is this resource too old to use as a source? These questions indicate a desire among students to meet assignment expectations and a willingness to seek assistance in order to do so. They are also very relevant questions, which implies that the lecture content is well pitched for the students' level of preparedness. These log notes suggest that students would benefit from repeated practice and/or review of research and APA formatting conventions; a one-off introduction to such standards seems insufficient considering the level of nuance involved, especially if the students have not had previous exposure to them.

Later in the intervention, I noted in my teaching log that the following three questions were asked during the workshop: (a) What constitutes a scholarly source? (b) Who is considered an expert? (c) Can conversations be sources? These questions indicate that some content covered during the lecture was not fully comprehended or had already been forgotten. Despite this, they are relevant questions that cannot be answered easily or quickly, which is evidence of good engagement by students with the content. Sharing an announcement on Moodle reminding students to review the lecture slides before attending the workshop may be an appropriate solution. Collectively, this evidence from my teaching log demonstrates that learning the formula through a lecture does not cement all its guidance, which is why practical application of the lesson is a necessary next step. The lecture merely serves as the first step for students, and its ideas need to be revisited over the course of their studies to consolidate the learning and related skills.

Together, this evidence suggests that the A-B-C-D Formula for Critical Reading, as a learning tool, offers multiple benefits. It does not merely provide a clear structure for engineering students to follow; its individual phases contribute to the development of multiple subskills associated with critical reading. Therefore, my reading-to-write formula provides the kind of explicit support called for as new university students start working with scholarly sources as part of the complex process of composing their own texts (Broussard, 2017; Flower

et al., 1990). Moreover, the formula meets various needs thus aligning it with Wette's (2021) comments about skills for source-based writing, and its role in an intervention designed for engineering students addresses the discipline-related gap in the literature. There is also evidence in survey and interview comments that some students had started to leverage the formula to meet various needs in other assignments and courses, which is a positive sign. This evidence satisfies one of the objectives of developing a reading-to-write formula, as mentioned in Chapter 2, which is to establish a foundation of strategies that students could adapt to meet goals through the rest of their programme. However, the fact that notetaking during the lecture was not universally practiced and some students asked certain questions later to which the lecture already provided answers suggest that a lecture alone does not provide enough exposure to such information for it to be absorbed by all students.

It is important to remember that this lecture was delivered during the first days of the academic year, and nearly all students were new to university. Their interaction with the lecture content suggests that additional guidance is vital during the transition period as they adapt to learning in a university environment. The lecture's impact offers an important insight for understanding student learning within the context of engineering education, this institution's culture, and research on the AL model (Lea & Street, 1998). It indicates that engineering programmes and the institutions offering them need to do more than run a single lecture to support discipline-specific academic literacies development at the undergraduate level. Taking this idea further, it would be beneficial to create explicit moments in other core courses, enabling engineering students to develop academic literacies and communication skills year on year throughout their studies. Other teacher-researchers could act on this suggestion and expand the literature connecting academic literacies and engineering education.

Overall, evidence suggests that the intervention lecture achieved its principal aim. Students gained valuable guidance from the A-B-C-D Formula for Critical Reading within a discipline-specific context. The intervention lecture covered a lot of ground in only one hour by teaching students about critical reading through an original, formulaic approach. Many of them expressed appreciation for learning about critical reading through its steps, and some students began adapting this learning tool to other circumstances. Even though the intervention lecture had an overall positive impact on student attitudes, that session alone did not afford the cohort opportunities to practice what was learned. While some negative comments on the intervention were expressed, it is important to remember that its lessons were designed to be linked directly to an assessment. Even though students were able to learn the formula in a lecture, their ability to implement it demonstrated room for improvement. This was evident in

the results of the formative assessment of Task #1 of Assignment 2. Essentially, future iterations of ENGEN170 should continue to follow the pedagogical principles of the AL model, as established in recent literature, for the teaching and learning of the reading-to-write process. If the lecture were left to function alone, this partial embedding would eliminate necessary practice of my formula, disconnect it from the assessment, and limit its potential as a learning tool for the engineering discipline.

The intervention lecture, which introduced the cohort to the A-B-C-D Formula for Critical Reading, enjoyed a mainly positive reception and proved to be a useful first step in preparing students to meet the expectations of writing assignments in undergraduate engineering studies. However, limitations still exist. This assertion is based on the results of the formative assessment of Assignment 2 – Part 1. Written output for Task #1 confirmed that, even when the lecture is customised to the engineering discipline and embedded in one of the programme's courses, there is still considerable room for improvement in students' ability to apply critical reading skills in academic writing. For instance, nearly half of Task #1 submissions did not meet the minimum requirement for relevant and appropriate sources because, even after gaining related guidance in the intervention lecture, these students chose to use blogs or websites instead of scholarly sources. In addition, some confusion remained about paraphrasing, integrating source content, and following APA formatting conventions. This suggests that, while the lecture did well to set up students' exploration of critical reading skills, the more complex aspects of applying them requires more than one session to learn. These results reinforce assertions in the literature about the necessity of scaffolded practice as university students develop new skills on the path to becoming critically literate (Flower et al., 1990; Wette, 2021). In general, since no one earned the *achieved with excellence* rating across all five criteria, it stands to reason that every participant needed more guidance than that provided during the intervention lecture. The importance of focusing on these skills is why practice time was provided during the intervention workshop.

Actively practicing critical reading skills before having to apply them in a writing assignment can help clarify expectations for new university students. This became evident when Assignment 2 – Part 2 submissions underwent formative assessment. Improvements were noted in some criteria after students had the opportunity to practice my reading-to-write formula via the critical reading online activities. This evidence is reinforced by attitudes expressed in survey comments about the workshop providing opportunities to practice academic literacies in advance of assessments without risk of failure. Many participants viewed the critical reading online activities as having a positive influence on meaning making and their

application of the formula's phases in their writing. A comment shared by E.D.W. during his interview offered a perceptive summary of this sentiment: "I felt like it was easier to do it with aligned assignments than just scrolling through lecture notes or lecture slides." Since it is confirmed that this embedded, BL approach enhanced students' critical reading skills in preparation for a related assessment, it is recommended that a lecture on the A-B-C-D Formula for Critical Reading continue to be paired with online practice of its phases. As V.I.S. stated in his interview, the critical reading online activities "helped us kind of practice and put what we've learned into action before we've got something at stake." Essentially, new undergraduate students need such practice as they adapt to the expectations of tertiary-level writing assignments. My series of critical reading online activities — another original resource designed for this study — has demonstrated that it can help meet students' need for practice.

However, survey and interview comments about the intervention were not universally positive in nature, thus contradicting its measured benefits. There remains a surprising divide in attitudes among participants towards the A-B-C-D Formula for Critical Reading and its practice. The minor trend of negative attitudes towards learning and practicing the formula is of particular concern, especially when factoring in the associated writing performance. The analysis of survey comments suggests that the cohort, which is comprised mostly of school leavers, received an uneven education where the writing process is concerned. While most of them found the guidance provided by the formula useful as they began their university studies, others were content to stick to established routines and/or did not welcome having to review existing knowledge as adapted for their current context. For instance, R.C.R. mentioned that, even though he would start by following the formula, he "would quickly divert from it"; expressing a lack of confidence in his understanding of Phase C and Phase D, he "fell back more on what I'd learned in high school." Similarly, U.S.M. suggested that, while the formula was *helpful for others*, he was "comfortable doing research as I have always done." R.K.O. went so far as to describe the formula as *highly redundant* and practicing its application in the workshop as "not useful and a waste of time."

For this kind of dismissiveness and negativity to already exist mere weeks into the start of university studies could indicate a preexisting negative relationship with English studies and the writing process, especially upon realising that academic and professional writing will play an important role in their engineering education and related career paths. Such attitudes align with Emerson's (2019) findings about students entering STEM disciplines at university with negative attitudes towards writing, which were rooted in their experience of studying English as children in school. My participants' existing attitudes could even have a negative impact on

power relations and engagement in the university classroom. If some students believe the lecturer is wasting their time by introducing the formula, future stages of the intervention and/or feedback shared by the lecturer may be dismissed, too. This could hinder students' chances of improving their critical reading skills and meeting the expectations of writing assignments at university. In worst-case scenarios, a belief that their time is being wasted or that they do not have to take academic literacies development seriously could lead to students not showing up to scheduled lessons and eventually contribute to attrition rates. Granted, a view that the formula is not useful may be because the student received a solid English education before entering university and is already a skilled writer able to earn above-average grades on discipline-specific writing assignments. Future iterations of the intervention may need to address negative attitudes towards developing critical reading for academic writing directly by helping new undergraduate students better understand the essential role of communication skills in their engineering studies and future career paths. As established earlier, though, the majority of participants appreciated and learned from the intervention, which ought to be given greater credence than the negative attitudes expressed by a small number of students.

Other interesting insights regarding the need to practice critical reading as part of discipline-specific academic writing were revealed by the formative assessment of Assignment 2. These insights may influence how future versions of the intervention could provide such practice opportunities. Firstly, regarding the use of relevant and appropriate sources across Assignment 2, results suggest that students new to university expectations can slip back into the habit of turning to easily accessible websites as sources of information. This issue was demonstrated in their output for Task #3, despite the online practice having had a positive effect where Task #2 was concerned. It is probable that overlapping deadlines and the challenges associated with composing a persuasive essay influenced this behaviour, so it may be necessary to make small changes to the design of Assignment 2. Secondly, where the presentation of in-text citations and the bibliography are concerned, the cohort's inconsistent performance in Task #2 and Task #3 indicates that the related online activities were less helpful than required. While the time crunch at the end of the workshop would have had an effect here, perhaps a greater variety of activity types would have appealed to more learning styles where this subskill is concerned. Granted, APA format comes with many complex rules, and learning something of this nature can require considerable practice. It would be unrealistic for educators to expose new university students to a challenging skill like this one and expect them to apply it perfectly after minimal practice. Students need more time and additional attempts for such learning to sink in and become part of their academic writing regimen.

Together, these examples demonstrate the importance of prioritising academic literacies development in first-year engineering courses to help students cement a routine, understand academic expectations, and strive to meet them in every instance of written output. In turn, these insights lend weight to the decision to embed the AL model in ENGEN170, and it could be advantageous to increase the AL model's role so students gain additional practice in the more complex subskills. Going forward, reminders could be added ahead of other assignments and incorporated into other engineering courses to prompt students to follow the A-B-C-D Formula for Critical Reading as they begin academic writing tasks. Expanding the intervention to include more opportunities for practice, reflection, and feedback may reduce the likelihood that students take steps backwards in academic literacies development. Engineering departments would benefit from embedding the AL model across their programmes so non-technical competencies can be developed over the years of students' undergraduate studies, creating moments when they can move from practicing and applying easier skills to more advanced ones. This strategy would push students to adapt their communication skills to the standards set by the engineering discipline and the institution while simultaneously creating opportunities for other researchers to conduct longitudinal studies.

It is also important to highlight two key facts related to this intervention having created the opportunity for engineering students to practice academic literacies via the workshop's online activities. Firstly, evidence suggests that, even after completing the intervention, most students would benefit from more practice in applying critical reading to their academic writing. This fact is manifest in students making gains in some criteria during Task #2 that were then lost in Task #3. Granted, some of these issues could be attributed to overlapping deadlines or a struggle with Task #3's text genre. Still, this underscores the complexity of the skills that are the focus of the intervention, and the need to ensure scaffolded opportunities are provided for students to revisit them throughout their studies. In particular, additional practice is recommended where the more problematic subskills are concerned. The majority of survey participants reinforced this fact by expressing positive attitudes towards the idea of having other teachers adapt the critical reading online activities for their courses to provide more practice opportunities of this nature. In addition, comments from interview participants indicated that they perceived the critical reading online activities as having a positive effect on their completion of Assignment 2 – Part 2, and they tended to favour the most challenging of the online activities because they wanted to gain a deeper understanding of the A-B-C-D Formula. Such comments emphasise the importance of providing more opportunities to practice academic literacies in a discipline-specific context in advance of an aligned

assessment. The issue of the amount of time provided to practice academic literacies will be discussed further in a later theme.

Secondly, it must be acknowledged that the design of the critical reading online activities is linked to the quality of practice students experienced in the intervention. As mentioned earlier, all interview participants identified that their written output was positively affected by the online activities in at least one way, suggesting that aligning such practice with Assignment 2 was perceived as enhancing their application of critical reading. However, there is some room for further refinement. While the online activities worked well for a great number of students, there will always be those who do not connect with or learn easily from online content. Optimising the workshop design to appeal to a greater number of learning styles is recommended. It is also worth considering the possibility of shifting some emphasis away from a few steps in the first phase or two, instead focusing on the more complex and productive ones. Overall, the results from the completion of the critical reading online activities as well as the formative assessment of Assignment 2 suggest that the online component of the intervention would benefit from some revision. Additional themes will discuss how the experience of practicing critical reading could be improved, and plans for these refinements will be described in the next chapter.

Less 'Gamey,' More Varied and Interactive Practice

The critical reading online activities, as an approach to practicing critical reading, proved to come with benefits and drawbacks for the participants of this action research intervention. Survey results revealed that students held mostly positive attitudes towards the online activities, saw them as an effective tool, and would generally support other teachers adapting them for use in other courses. However, participants maintained that further refinement of the critical reading online activities is needed first to ensure they benefit future students. Changes, which are based on evidence gained through this study, ought to occur in order to introduce more variety into the practice of critical reading and embrace greater interactivity. The discussion of this theme is supported by trends in the results of the critical reading online activities, comments shared in the post-intervention survey and interviews, and a few teaching log notes.

A key issue with the design of the online activities, as highlighted in interview comments, is that some of the simpler, drag and drop ones were perceived as *gamey*.[20] E.D.W. explained that he finished some of these activities by merely thinking, "the word best fits here instead of

[20] The participant's use of *gamey* was not a reference to the term gamification; instead, it was used to compare some activities to playing a simple game or to explain that they could be solved easily through process of elimination.

here," instead of "thinking about the content of the activities." Similarly, A.B.A. described her approach to finishing one such activity as a *process of elimination* involving *matching words*. When creating the online activities, I was aware of the universal nature of H5P across LMSs, which made it a suitable choice for the intervention's future adaptability in other contexts. However, these interview comments highlight that a reliance on H5P can come with programming limitations.

To offset some limitations and prevent simpler activities from seeming *gamey*, greater attention should be paid to the purpose of the activity. This means that pedagogy directs the educator's choice of online learning tool and overall activity design. One strategy for the simpler activities could have involved randomising the list of choices and allowing greater flexibility of choice by including more draggable elements than necessary; this path might have reduced the use of a process of elimination strategy. It must be acknowledged that drag and drop activities were a prominent part of the workshop, so recreating the practice of one or two subskills using a different style of online activity may be necessary. Doing so would make the workshop more challenging, likely appeal to more learning styles, and could result in more positive attitudes towards developing those subskills, too. This issue with the online activities highlights the importance of engagement as a component of the intervention. Next, the discussion goes into greater detail by breaking down the critical reading online activities into their phases, using evidence to highlight how they could be improved so that online practice offers a better student experience and attitudes towards such practice could be more positive altogether.

Starting with Phase A activities, students demonstrated a strong understanding of the associated concepts, as evident in trends of this phase's completion. In turn, Phase A activities were identified by several students as beneficial. For example, R.J.A. exclaimed, "I definitely liked the part where we broke down the question a lot." M.H.K. clarified that these activities caused him to "interpret the question differently," while O.D.M. stated that they "gave me a clearer idea of what was being asked and how to approach it." Not all attitudes expressed towards Phase A activities were positive, though. For instance, A.B.A. explained that, where the definition matching activity was concerned, "matching words with meanings didn't teach much, as process of elimination works." While the majority of comments about Phase A activities were positive, it must be noted that this phase involved the least amount of teacher-student or peer interaction. It could be argued that Phase A's design did not meet expectations for interactivity, which is seen as one of the core benefits of online learning (Abdallah, 2010). Moreover, this whole phase could be classified as *gamey* since its activities utilised either drag

and drop or multiple choice designs and were dependent on automated feedback.[21] Going forward, it would be beneficial for the lecturer to pause and reinforce the automated feedback and address any questions if students need clarification. This transitional moment would increase the level of interactivity in the workshop, thus helping it better align with BL pedagogy.

Next, trends from Phase B activities suggest that many students were able to identify strong keywords and related synonyms, but their performance during collaborative brainstorming proved somewhat inconsistent. During interviews, positive attitudes towards this phase's activities were expressed several times. Referring to the Mentimeter word clouds activity, R.C.R. stated, "I found it quite helpful, particularly as we got a holistic sense of what everyone's general idea about it was. And then you provided guidance on the general trends of the class … and I thought that was really good." E.C.Y. explained that learning and practicing Phase B has "shown me how to properly find the keywords even easier." Meanwhile, A.B.A. admitted, "I could improve on brainstorming; I'm not the best at that currently. So Phase B could help with that." These positive findings about the use of Mentimeter in Phase B align with previous research touching on the benefits of word clouds, specifically how they encourage engagement and learning from a group's thoughts (Hughes, 2017). Despite these affirmations of Phase B activities' benefits, some performance issues have been noted. Firstly, in examining the Mentimeter word clouds, a fairly consistent presence of off-topic keywords and synonyms was observed. This could indicate that a smaller portion of students lacked understanding of the purpose of keywords within the pre-reading stage and/or were disengaged from brainstorming as part of the reading-to-write process. Even if these students understood the underlying ideas of Phase B, minimal practice could explain their inability to execute perfectly what was learned. Generally, the cohort's performance indicates that they would benefit from additional guided practice in brainstorming for future assignments, and interview comments suggest that such practice would be appreciated. Especially where keyword searches are concerned, this could ensure that their search results feature a greater consistency of relevant resources.

Another concerning trend from Phase B relates to students' performance during the Dotstorming activity. It revealed limited existing knowledge on some topics, and some students were still listing inappropriate types of sources due to their ease of access or familiarity. It is

[21] I am reusing the term *gamey* here, which originated from a participant's comment. I agree with that description where Phase A activities are concerned.

possible to connect these findings to trends in reading achievement rates and digital device usage, which could impact students' understanding of what constitutes legitimate knowledge and authoritative sources (Hood & Hughson, 2022; Lea & Jones, 2011). This situation could be an example of how one's membership within the digital generation is not a guarantee of strong digital literacy. Now, the existence of generative AI programmes has the potential to hinder students' academic literacies further. The option for students to have ChatGPT or other large language models generate a written product without them having to brainstorm the topic — or complete subsequent stages of the writing process, for that matter — might jeopardize skills development. While little research had been conducted connecting ChatGPT's use to academic literacies at the time of my action research intervention, more research on AI in higher education has become available since then. Educators are advised to keep an eye on the literature and what this technology can do.[22] The importance of complementary fields of expertise, even in a future with AI, must also be acknowledged, and academic literacies experts will remain important players. New cohorts of engineering students will continue to need help developing critical reading and other skills that contribute to successful academic writing because it goes deeper than surface-level writing mechanics. The A-B-C-D Formula and its critical reading online activities can contribute to such skills development, helping students take steps towards becoming critically literate and able to contribute to engineering discourse (Flower et al., 1990).

In addition to these performance issues, the functionality of the Dotstorming website placed further limitations on the success of Phase B practice. Firstly, as noted in my teaching log, some inappropriate behaviour occurred during collaborative brainstorming. This included a few students posting irrelevant and inappropriate images as well as one comment that used a racial slur. Some of the behavioural problems were made possible by the Dotstorming website allowing users to post images to the brainstorming boards, but this does not excuse all of it. In fact, behavioural issues during the Dotstorming activity arose in half of the workshop groups. In these instances, the groups had to be rebuked for their lack of professionalism and worthwhile contributions to the collaborative brainstorming effort. This situation, when viewed alongside others described in previous literature, supports the assertion that it is necessary to address inappropriate online behaviour as it arises as part of BL (Waycott et al., 2010; Wheeler, 2010). These behavioural issues were identified by interview participants as disruptive to the

[22] I have co-authored two manuscripts with Laura Gurney about an academic literacies study in which we embedded the use of ChatGPT alongside process writing pedagogy in an academic writing course. These articles will be published in the coming weeks.

learning process. For instance, R.J.A. brought up the ideas contributed by classmates: “I was not really impressed by some of the stuff that was being left in there.” A.B.A. added that, because of the immature behaviour of a few students, the collaborative brainstorming activities “didn’t live up to what they could have been.” These comments highlight how dynamic and nuanced — even potentially negative — the social influences on meaning making can be (Lea & Street, 2006). A second issue with Dotstorming arose during one of the workshop sessions. A student informed me that the website’s functionality was browser dependent, so I noted this observation in my teaching log. This student was working on a tablet and found that the Dotstorming website worked well when accessed through Chrome but not Safari. This anecdote highlights the fact that dependence on technology for teaching and learning inevitably causes complications.

In light of some low-quality contributions to Phase B activities as well as the observations noted in my teaching log, I will have to reconsider some design choices since they may have negatively impacted students’ practice. It might be necessary to explore different digital resources so collaborative brainstorming activities can stay in the series. Alternatively, an interactive brainstorming activity conducted in small groups, using a voting application, and moderated by the teacher could replace the Dotstorming activity. Choosing to redesign Phase B to feature more guided practice of brainstorming could curb bad behaviour in the process.

Trends from Phase C activities indicate that they proved challenging for many students, so it is likely these ones will require considerable revision. As mentioned earlier in this thesis, many participants struggled with the first Phase C activity, which required them to complete an analysis of four search results. To do so, students had to look closely at the details visible in screenshots of the search results, and then they dragged and dropped words/phrases into a point-form text that summarised each source’s relevancy to Task #2 and its appropriateness as a possible source. Since student performance on this activity varied considerably, perhaps its format needs to change from point form to a more consistent sentence structure. Along this line, A.B.A. suggested improving this activity “with better formatting of each section,” noting it would be easier if “relevancy and appropriateness [appeared] in their own little subsections.” While this first Phase C activity provided students with formative feedback as they practiced analysing potential resources, as recommended by Hughes (2017), these findings demonstrate that other aspects of its design need inspection and revision if it is to better contribute to my BL approach.

Various limitations in students’ performance during Phase C’s Parlay Ideas activity were noted, indicating that it would benefit from some redesign. Specifically, the quality of writing

in their posts was not consistent, with instances of paraphrasing errors and copying directly from the source noted. Attitudes expressed in nearly all interviews indicate that the Parlay Ideas activity was viewed as the most difficult, with participants stating that they struggled to understand the instructions as well as comprehend the associated readings. For instance, R.C.R. explained that the Parlay Ideas activity seemed "a little hectic and confusing" because the instructions for writing and then providing peer feedback were *a bit unclear*. Furthermore, E.D.W. admitted, "I'm not much of a reader" so there were "some parts that I didn't understand." Despite these challenges, A.B.A. insisted that the Parlay Ideas activity was "useful because very little do I actually find a full paragraph of a text and analyse it that deeply. And it's probably very good practice for me." In addition, it was observed that the Parlay Ideas activity caused the most difficulty across all workshop groups. I noted in my teaching log that, in some instances, this activity was when students started to lose focus, while others worked too slowly through it and were overwhelmed by its requirements. During this activity, I even overheard one student mutter to a classmate, "this is so mind-numbing." Together, these issues suggest that the Parlay Ideas activity requires revision to provide students with more guided practice, a clearer model of expectations, and additional live interaction instead of relying wholly on the website. As R.C.R. suggested, participants may benefit from the lecturer offering feedback to the class at the end of the activity, thus prompting discussion and a "way of reflecting back on those answers." These ideas for additional scaffolding and group reflection could provide more "thoughtful integration" of this portion of online practice into students' experience of learning my reading-to-write formula (Garrison & Kanuka, 2004, p. 96). Together, such revisions could help keep students' focus and bolster engagement.

Many students also struggled with the last Phase C activity, which required them to read an abstract and answer some multiple choice questions about it. It is possible that a poor understanding of the abstract's content hindered their ability to determine how it connected to instructions for Task #3. I must also acknowledge that students may have interpreted the questions in different ways, and/or my reliance on a multiple choice format was ill-suited to practicing this part of the formula. Instead, it may be better to do so in a way that involves small group discussion. Considering that, at this stage of the workshop, students' focus was starting to wane, too, redesigning this last Phase C activity is recommended in order to infuse the session with more interactivity. Small teams could read and analyse the abstract together and vote on answers to the questions. The lecturer could employ an online program to facilitate this voting process and a subsequent discussion of trends, following a similar protocol to that used with Mentimeter in Phase B. A team-based approach to this part of Phase C would

introduce more collaborative learning to future iterations of the intervention, thus making it a more authentic task for engineering students and better aligned with the pedagogical principles of BL. Overall, interview comments and classroom observations reinforce the assessment that the Phase C activities, in their current form, proved challenging to complete and require the most revision.

Similarly, trends from the completion of Phase D activities suggest that students new to academic writing expectations at the undergraduate level would benefit from more guided practice in integrating source content into their academic writing. This would ensure it supports their own ideas and is presented using correct APA format. This study's results indicate that revisions to the design of Phase D activities could help in this regard. The first activity in this phase required students to match quotations from sources to part of the task instructions, an idea, or an unanswered question. Proving especially problematic, many students failed this activity. Meanwhile, A.B.A. identified this activity during an interview as being "a little bit obvious," which left her questioning "if it was actually improving my skill to draw connections between sources and ideas." As with the previous activity, it is possible that the activity design used here did not suit the subskill being practiced. After all, this is the stage in the formula when writers begin to integrate source content into their own words and establish their voice in a piece of academic writing — a highly individualised process that may be difficult to simulate within the confines of an online activity. Perhaps this activity should be replaced by another in which the lecturer guides the class through some paraphrasing practice, seeing as paraphrasing source content proved challenging for many students in Assignment 2. This strategy could offer students a solid introduction to transforming source text as part of practicing reading-to-write, while allowing the lecturer to defer deeper development of their critical literacy to coincide with a different assessment in first-year studies (Flower et al., 1990). Such a replacement activity could also ensure that more discussion, peer interaction, and reflection are integrated into the practice of this phase of the formula.

At the end of Phase D, students also encountered some difficulty with the last drag and drop activities, which had them add reporting verbs and in-text citations to a model text and then complete its bibliography. It must be acknowledged that time limitations were a notable factor at this point in the workshop and contributed to some students' poor performance; the issue of time will be discussed in greater detail in the next theme. According to comments shared during interviews, a lack of previous experience in following APA format contributed to performance issues. For instance, E.C.Y. stated, "I didn't know anything about how to properly reference before those tasks." Similarly, V.I.S. admitted, "I haven't done referencing

before," so those activities were *the most difficult* because they were not "branching off of any existing knowledge." Even with the time limitations, comments like these from participants seem to provide good support for doing this activity. Their lack of exposure to formal referencing systems prior to undergraduate studies is of concern since academic integrity is taken very seriously in higher education. However, this situation is not surprising. As Broussard (2017) pointed out, any writing experience prior to entering university was likely limited to the production of opinion-based texts, so their secondary school teachers were not obligated to teach them about APA format. It is recommended that additional focus on this part of the formula is built into the intervention for future cohorts. Perhaps instructing students to review the lecture slides before attending the workshop is also warranted to ensure sharper memory of certain details where this phase is concerned. It may even be worth quickly displaying related models, like those shared in the lecture slides, before students begin this last part of the workshop.

Generally, students tended to struggle more with the second half of the critical reading online activities, so it is possible that their skills were not enhanced by this practice as much as anticipated. Since interview participants noted feeling rushed to complete the more complex ones in Phases C and D, a rebalance of time allotted to their practice versus the first two phases may be needed. In addition, various design issues mean that revision is required to maximise the potential of this online mode of practice. As recommended by R.J.A., adding "a degree of interactivity" to the online activities should be prioritised to boost engagement, and the lecturer should "spend more time actually talking to the students rather than just sitting them behind their laptops" to practice the formula. Similarly, R.C.R. suggested adding more opportunities to *ask questions*, have *a discussion*, or "pause and reflect on the tasks as a class." These and other interview comments, when taken together, indicate that revisions to the critical reading online activities ought to feature a greater variety of interactions and feedback practices. Design decisions ought to better manage student behaviour, too. These changes would ensure that future iterations of the workshop facilitate positive social influences on meaning making, thus strengthening my pedagogical approach to a BL-infused AL model.

Overall, trends in student performance, feedback from participants, and their suggestions for revisions must be considered together when deciding how to improve student engagement during the intervention. While having students complete the critical reading online activities in the classroom during a workshop proved an asset, I need to capitalise on this more when refining intervention materials for future use. Doing so could help legitimise infusing the AL model with BL pedagogy for application within engineering education. More specifically, an

improved intervention permanently embedded in an undergraduate engineering course would help it align better with Washington Accord requirements by dedicating class time to the practice of critical reading and its application in discipline-specific academic writing.

Facing 'Time Pressure' and the Issue of 'Rushing Through' Practice

Students' completion of the critical reading online activities has proven that time to practice such skills can have a positive effect on student performance; however, the amount of time that ought to be dedicated to this practice remains a thorny subject. Quantitative evidence indicates that more practice time is needed in certain areas. Meanwhile, attitudes expressed about time dedicated to practice are varied and sometimes contradict what was gleaned through the analysis of student performance. The discussion of this theme is supported by trends in the results of the critical reading online activities, Assignment 2's formative assessment results, evidence from interviews and the post-intervention survey, and a few observations noted in my teaching log.

During the two-hour workshop, students' completion of the critical reading online activities revealed that some areas of this practice were more challenging to them than others, suggesting that more time may be needed to practice those aspects of the A-B-C-D Formula for Critical Reading. The first of these examples occurred during Phase B as students contributed to the Mentimeter mind maps. A small portion of the cohort struggled to determine the difference between task details that were there as guidance and those about the topic thus could serve as keywords. This activity also revealed that some students would benefit from more practice brainstorming synonyms that could be used to search for relevant resources. Secondly, a preference for scholarly sources, course resources, and human sources was revealed during the Dotstorming activity, but there was still a lingering, misguided belief among some students that inappropriate online tools (e.g., ChatGPT, YouTube, TikTok) could yield useful information for academic work — a belief that could be corrected through additional practice time.

In the latter half of the workshop, some performance issues arose that indicate more time to practice is needed. Starting with Phase C's drag and drop activity, students' analysis of search results revealed wide-ranging performance and an overall lower success rate. There were also various issues in writing performance in the Parlay Ideas activity. In my teaching log, I noted that some students worked too slowly during this activity, so revision of its design is recommended to make the activity more manageable in the time allotted. On top of that, some students left parts of this activity as well as Phase D activities incomplete, which was due in part to a time crunch at the end of the workshop. These shortcomings suggest that students

would benefit from more time being allocated to the practice of Phase C and Phase D subskills. However, in a small number of cases, activities were left incomplete due to those students forgetting to bring a laptop or tablet to the workshop, forcing them to complete all activities on a smartphone instead. As noted in the teaching log, layout issues resulting from viewing the activities on such a small screen made Phase C and Phase D activities especially challenging to complete within the time limits. Overall, the amount of time dedicated to the practice of the formula's different phases may require adjustment. A simplification of some activities in the first two phases, allowing for the redistribution of time, is one option for creating a better balance during the workshop. This would ensure that the more complex subskills are granted added practice time.

Related to these quantitative findings and classroom observations are trends in formative assessment results, which suggest that additional time ought to be dedicated to the practice of academic literacies so students can improve with each instance of written output. After Task #1, the critical reading online activities helped many students improve in several criteria for Assignment 2 – Part 2, but more improvement is still needed to meet the expectations of higher education. Specifically, students need to improve their abilities to select scholarly sources consistently, follow the rules of APA format, and paraphrase source content correctly when integrating it into their writing. Their ability to include their own analysis in an academic text and ensure it follows a linear, logical progression could also be improved. Together, these conventions for writing at the university level are part of institutional culture since they are applicable to numerous disciplines and text genres; therefore, permanently embedding the AL model in first-year studies would be an appropriate way to ensure that incoming students are explicitly aware of the academic literacies in need of cultivation (Lea & Street, 1998, 2006; Lillis & Scott, 2007). Based on the formative assessment results from this study, additional time should be dedicated to developing these qualities in engineering students' discipline-specific texts, especially in the early weeks of undergraduate studies when their understanding of such expectations is still developing.

Even though a two-hour workshop was dedicated to the practice of the A-B-C-D Formula for Critical Reading, the above evidence of student performance suggests that more time ought to be dedicated to the development of these skills. However, attitudes expressed in the post-intervention survey and interviews were somewhat less consistent where the issue of practice time is concerned. Firstly, the survey's findings revealed mixed attitudes towards the time pressure associated with completing the series of critical reading online activities within a single workshop session. While many students expressed feeling *rushed* to complete certain

activities, this was not a universal sentiment. For example, C.I.L. stated, “I really struggled with doing the activities and rushing through them as fast as we did made it hard to actually absorb the information/learning.” Similarly, O.A.C. pointed out that the Phase C activities, in particular, were “too fast for me and I found myself a bit behind,” while Y.H.L. added that “we weren’t given much time to read and understand.” Secondly, attitudes expressed during interviews also drew attention to the issue of time dedicated to practice. The majority of interview participants identified the workshop format as *rushed* to varying degrees, with the time allotted to Phase C highlighted as being particularly problematic in this regard.

On the other hand, some participants held the opposite attitude about the time pressure. They indicated that too much time was dedicated to practice in the workshop or that the time limits applied were beneficial to the process of practicing the formula. R.J.A. mentioned that “there were times when the activities seemed to drag on for a bit too long,” so it was suggested that certain parts be “a bit more condensed.” Likewise, D.N.Z. claimed the online activities were *long* and that they “could have been shorter to keep us motivated.” Meanwhile, Z.K.T. maintained that the *time pressure* was *effective* because it “attempts to fine tune the writing process to be more efficient.” V.I.S. expressed appreciation for the intervention being “short and sweet, just direct” and that the workshop’s *faster* pacing was *more beneficial*. Aligning with this attitude, E.D.W. stated the following: “When you are rushed to do something, I think it highlights your engrained knowledge of something. And when you do that, you can see where you’re really lacking in certain fields.” While participants commenting that they were rushed to complete the critical reading online activities held a slight majority, a notable number of other students maintained considerably different attitudes towards the amount of time dedicated to practicing the formula. Considering these comments together, it is not surprising that many participants indicated further adjustments to the critical reading online activities are necessary, especially to address their timing, before other educators adapt them for use in other contexts. These findings demonstrate the merit of critical ethnographic inquiry centred on the student voice as part of the AL model: the participants’ attitudes about practicing the formula during the workshop have deepened my understanding of how much practice time is needed and how it is valued by the cohort (Lillis & Scott, 2007).

Despite these diverse attitudes expressed regarding the amount of time dedicated to practicing the A-B-C-D Formula for Critical Reading, other evidence points to some awareness among participants that more time ought to be dedicated to improving their academic literacies to varying degrees. This was apparent in the way they rated their critical reading skills when applied in academic writing after practicing the formula in the workshop. When these ratings

from the post-intervention survey were compared to those from the initial survey, the results were indicative of a small difference in opinion, meaning they thought slightly less of their skills after the intervention. It appears that dedicated practice time during the workshop shone a brighter light on the complexities of applying critical reading to academic writing at the university level. Comments shared about the critical reading online activities provide evidence of this. O.D.M. explained that "they gave me ways to apply the ABCD formula to my actual assignment and gave me a clearer idea of what was being asked and how to approach it." Also, V.I.S. stated that they provided an opportunity to *practice writing* in advance of *a high-risk assessment* without facing "any risk of failure." Thirdly, Z.K.T. pointed out that the *time pressure* associated with the online practice can raise students' awareness of "how much time can be wasted" when producing written output. Therefore, the intervention workshop made some students more aware of their existing strengths and weaknesses, as well as how much more time they need to dedicate to practicing academic literacies within an engineering context in order to meet scholarly expectations and achieve desired grades. Such evidence reinforces Dunham et al.'s (2011) recommendation that New Zealand universities, including this one, ought to permanently embed the AL model and provide more practice time so cohorts can adapt to the institutional culture of higher education and improve proficiency in critical reading and related literacies.

Participants' wide-ranging commentary on the issue of time pressure in relation to this intervention can be connected to the overarching issue of pressure faced to manage workloads and meet assessment deadlines at university. It is a matter that also connects to the AL model, since it concerns itself with the influence of institutional culture and disciplinary context on reading and writing practices as well as the overall learning process (Lea & Street, 1998). As new undergraduate students adapt to the culture of higher education, it may seem to some that they have been thrust into a harsh reality: there is typically limited time to grasp new concepts and complete the work assigned in order to meet expectations across their courseload. Time limitations and the associated pressure could negatively affect meaning making as these students learn to read scholarly sources and produce academic texts.[23] Examples of this effect were evident in some participants' comments on practicing my reading-to-write formula during the workshop, particularly when they spoke of time limits contributing to *less thoughtful thinking* and impacting their ability to *concentrate*, *read and understand*, *absorb the*

[23] It is worth noting that such reading and writing typically occurs as part of independent study instead of in the classroom under the guidance of a lecturer — a variable that may, for some students, add to the pressure experienced. This variable will be discussed in more detail later in this theme's section.

information, and *refine things*. It is important to acknowledge that, before my intervention was embedded in ENGEN170, new cohorts did not experience a two-hour workshop dedicated to practicing the application of critical reading in connection with an upcoming assessment. This means that students enrolled in the course in the past likely faced even greater pressure to complete early assessments like Assignment 2 and meet the associated expectations because time had not been devoted to the development of discipline-specific academic literacies as part of students' transition into the engineering programmes.

This issue of limited time devoted to academic literacies development in the early weeks of undergraduate engineering education is a matter of particular concern when poor performance in literacy skills among some high school students in New Zealand is added to the equation (Hood & Hughson, 2022). As those students transition to university, they bring their reading and writing struggles with them. It is possible that such struggles impact their ability to adapt to and meet the demands of their chosen programmes, especially when each programme comes with its own standards for discipline-specific academic literacies that would be foreign to high school leavers. Together, these factors — that is, pressures associated with adapting to a university's learning culture, developing the academic literacies of one's discipline, and attempting to tackle the courseload with preexisting literacy limitations — could explain in part the range of attitudes expressed by my participants on the amount of time dedicated to practicing the A-B-C-D Formula via the critical reading online activities.

In addition, the amount of time dedicated to learners' development of academic literacies in advance of an assessment can be linked to who these participants are as university students and how they fit into the institutional culture. This is another matter connected to the AL model because, as mentioned in Chapter 2, it looks at influences on learners' identity. By embedding my intervention in ENGEN170, the experience likely raised awareness among school leavers (i.e., the majority of the cohort) of the differences between secondary school and university pressures and expectations. This relates to Wollscheid et al.'s (2021) comments on student identity and preparedness for university expectations. They noted that school leavers are accustomed to writing "very brief texts" (p. 30), have "weak generic writing skills" (p. 29), and can be unprepared for notetaking. Within engineering studies, in particular, it was found that school leavers were unprepared to meet the requirements of disciplinary writing, specifically composing a report, and tackle the volume of independent reading required within the time available to them (Wollscheid et al., 2021). Therefore, my intervention served as a bridge between two worlds for most of the cohort. Their old world was defined by experiences in secondary school, where more generic literacy skills were developed. Their new world requires

them to meet a new set of expectations associated with the discipline of engineering while developing the study habits necessary for success at university. Dedicated time for the development of discipline-specific academic literacies ought to be embedded in first-year engineering courses not only to ensure learners can meet the new expectations but also to aid their adjustment to a new identity as university students.

To this matter of identity, it is possible to connect student comments shared earlier about time pressure preventing opportunities for deep thinking and refining their work — a characteristic of the workshop that reflects a facet of a university's learning culture. Lectures and workshops are meant to introduce students to new ideas, concepts, and information; initiate discussions about them; and provide some opportunities to apply new knowledge. However, the majority of the work is often done outside the classroom, which can make learning at the tertiary level stand apart from experiences of secondary school. Independent learning is an essential element of university studies, and it is those moments alone when deep thinking and refining one's work come into play. It is possible that, by condensing the practice of the A-B-C-D Formula for Critical Reading into a two-hour workshop thus minimising opportunities for such moments, the intervention helped familiarise a new cohort of engineering students with the balance of on- and off-campus learning that is typical of university culture. This is especially relevant to the application of critical reading, research, and writing skills — all typically part of independent study. Therefore, my formula and its practice functioned as a tool to help students new to university expectations fill gaps in their academic literacies and adjust their learner identity to a new institutional culture. It is suggested that future iterations of this intervention make this point to students explicitly by informing them that, while the intervention is designed to introduce them to discipline-specific academic literacies, they will need to dedicate more time outside the classroom to strengthening these skills. This kind of disclaimer could improve their awareness of the essential role of independent learning across all courses taken as part of tertiary studies. While the issue of time dedicated to practicing academic literacies at university has been connected here to identity in a limited way, the concept of identity will be explored in greater depth as part of this chapter's last theme.

Exploring the issue of time pressure and the amount of time dedicated to practicing academic literacies has provided some insights on how I might improve my intervention's design, specifically the workshop in which students complete the critical reading online activities. Firstly, as indicated by responses during one-on-one interviews, students' preferences lean towards online activities that provide practice of Phase C and Phase D, making it essential to revisit the issue of time limitations, as identified earlier. Some of the interview

participants even offered suggestions on changes. For instance, E.C.Y. recommended adding "a little more wiggle room" to the timing of the critical reading online activities, especially for the *more complex ones* in Phase C and Phase D, because students were *struggling there* and the extra time would help them *get a rhythm*. Referring to the latter half of the workshop, R.C.R. mentioned that "the time pressure made it very difficult." In response to this issue, he recommended that changes be made so there would be *less time pressure*, while also adding "some time for questions" and to "pause and reflect on the tasks as a class" because "having a discussion would be a better way to cement that knowledge foundationally." Meanwhile, A.B.A. recommended dedicating *more time* to practicing certain phases and making those activities *more complicated*, but she acknowledged that this would depend on the *time budget* provided in future iterations of the course. Taking such student feedback into consideration, I should weigh the benefits and drawbacks of condensing the practice of Phase A and/or Phase B in order to ration more time to the second half of the formula. After all, rushing through the activities perceived as most helpful just because of a time crunch could put limits on their positive impact.

Secondly, a couple of recommendations offered during the post-intervention survey reiterated the idea of minimising certain activities in order to dedicate more time to more complex phases of the formula, as well as providing more time to practice writing. However, it would be difficult to fit this into the series of online activities in a way that would still provide each student with formative feedback. After all, the current design relies mostly on automated feedback, and the two-hour timeframe of the workshop prevents the teacher from reading everyone's drafts.

To satisfy these requests, it is likely that some kind of AI program would have to be employed to read and comment on paragraphs instantaneously. The only one I am aware of designed for such a purpose is Grammarly, although it is meant to check for sentence-level errors instead of provide feedback on larger drafts. Meanwhile, the University of Waikato provides students with access to Studiosity. The version of this service available at the time could take up to 24 hours to return writing feedback, meaning it was not a practical tool to use during the intervention's workshop. More recently, Studiosity has become an AI-powered study support service. With development of AI programs expanding considerably since my intervention was conducted, it is suggested that other teacher-researchers explore the use of newer options, such as the paid version of ChatGPT. It could be worth studying the impacts of having the chatbot provide students with instantaneous formative feedback during academic writing practice activities.

Since AI is an emerging technology and the higher education sector is still grappling with how to adapt to its availability, relying on it for formative feedback may not be in the best interest of an improved intervention design at this time. Alternatively, an additional workshop could be dedicated in part to reviewing formative feedback on early submissions. Interestingly, this idea aligns with a rather astute statement made by A.B.A. during our interview:

> I think in general more time should be allocated to practicing and expanding on your critical reading and writing skills anyway in engineering, but it's just not because there's so much technical knowledge you have to learn that it's hard to squeeze in a writing paper in there as well.

A.B.A. held a unique status within the ENGEN170 cohort: at the time of the intervention, she was in her third year of engineering studies and taking the course after having missed the opportunity to do so in her first year. A.B.A.'s status gave her greater insight into how communication skills currently fit into engineering education as one of the learning outcomes. Her comment reflects the existing reality within the University of Waikato's engineering programmes, which I highlighted at the beginning of this thesis: previous reliance on a bolt-on approach to developing critical reading, research, and academic writing skills resulted in some engineering students making minimal progress. However, the heavy courseload makes it unlikely that the School of Engineering will add a communication-themed course to the list of prerequisites. Therefore, permanently embedding my intervention in ENGEN170 serves as a compromise — a step in the right direction — by dedicating at least some time to the development of discipline-specific academic literacies. Although, as my research findings have demonstrated, the time currently devoted to practicing the A-B-C-D Formula for Critical Reading needs optimisation and perhaps expansion. Participants' suggestions will factor into the revision of the critical reading online activities, which will be discussed in the next chapter.

'More Direct Feedback': The Desire for Detailed Guidance to Aid Learning

The study's feedback strategy, which provided students with formative feedback during the intervention workshop as well as on Assignment 2 submissions, was met with mixed responses from participants. While some of them appreciated the feedback, there were doubts as to the level of assistance it could provide in improving performance. The study also revealed that students' interaction with the different modes of feedback was inconsistent. In some participants' comments, requests were lodged for improvements to the feedback strategy, so any changes made for future iterations ought to consider the evidence. The discussion of this theme is supported by comments shared in the post-intervention survey and interviews, trends

in the results of the critical reading online activities, and the analysis of data collected via Moodle's tracking function.

This action research project employed a variety of formative feedback methods, to which participants expressed a range of attitudes. Specifically, the critical reading online activities depended mainly on automated feedback, but peer feedback and verbal group feedback also played a role in the workshop. Formative feedback on Assignment 2 submissions was shared via the critical reading rubric and the feedback comment library. Students shared their reactions to this feedback strategy during the post-intervention survey and interviews. In general, while participants valued the formative feedback provided, they also indicated that it should have featured more specificity. Since the types of feedback employed in the workshop and for the assessment were different, they are discussed separately in the paragraphs that follow.

Results indicate a desire among engineering students for more varied modes of feedback when practicing discipline-specific academic literacies. Some students expressed appreciation for the feedback received during the workshop; in particular, they shared positive remarks about the automated feedback. For example, Y.H.L. described the automated feedback as *helpful* because "it helped me to figure out where my weaknesses were and what I needed to really focus on while completing the tasks." Similarly, R.J.A. stated that it identified "what areas I am strong and weak in." However, participants identified some drawbacks of automated feedback, especially that it could be *a bit broad*, and advocated for different types of feedback playing a larger role in future iterations. E.D.W. reasoned that automated feedback does not feel *genuine*. He suggested increasing the amount of "direct feedback with the lecturer" and featuring peer feedback in *every lesson* because classmates would be able to apply a sharper eye "against other people's work than their own." The role of peer feedback was hindered during the workshop because time limitations, as identified in the previous theme, negatively impacted students' completion of the Parlay Ideas activity in Phase C, leaving many of them without peer feedback on their posts. In the cases where peer feedback was offered, not all students followed the guidelines or shared something constructive. This indicates that future iterations ought to offer a clearer model of expectations for peer feedback, especially if it plays a larger role in the intervention. R.J.A. added that the lecturer should "spend more time actually talking to the students," which could involve additional group feedback between online activities.

Among the attitudes expressed by participants towards the workshop's feedback, comments shared by A.B.A. proved to be particularly insightful. As mentioned earlier, this student was in her third year of engineering studies at the time of the intervention, having

previously missed the opportunity to take the ENGEN170 course. This factor is important because increased time in a tertiary learning environment would inform her attitude. A.B.A. spoke of the online activities' *limitations* due to a dependence on automated feedback because such designs "push [students] into a set answer." Meanwhile, *the goal* of having them practice the application of critical reading, she argued, is to have them "think about a subject and draw their own conclusions and have them deeply thought about and referenced" as they compose *unique answers*. Despite A.B.A.'s view that relying a fair amount on automated feedback was a somewhat *flawed* strategy, she acknowledged how uncommon it is for first-year engineering students to receive formative feedback:

> I think about learning a lot, and the best way to learn, for me at least, is interactive with immediate feedback. So your automated feedback is great for that. I think the best way to learn is you go try something, think about it, and then get feedback on what you did and what you can improve on, and then try again. But engineering is missing a lot of that, in that the feedback is often non-existent and definitely not immediate and you don't get to trial things out very much, which I don't think is a very great environment for learning.

Considering her greater level of experience in studying engineering compared to the rest of her ENGEN170 classmates and the comments expressed here, it could be argued that the critical reading online activities and their existing feedback strategy helped fill a gap where formative feedback in engineering education is concerned. Therefore, the University of Waikato's first-year engineering courses — and those available at other higher education institutions — ought to address this issue by making opportunities to practice discipline-specific academic literacies and receive formative feedback a permanent fixture.

However, the attitudes expressed by A.B.A. and the other participants indicate that my critical reading online activities could provide better guidance to students if they utilised an improved feedback strategy when embedded in ENGEN170 going forward. As mentioned earlier in this chapter, revisions to certain activities have been considered that would encourage greater interactivity. By facilitating more peer discussion and including more teacher-student dialogue about the learning process during the workshop, such changes would help the associated formative feedback align better with recommendations in the literature (Fernando, 2020; Hughes, 2017). In addition, brief revisions to the wording of automated feedback might allow me to offer more specific direction to learners about how to improve — that is, without taking away the "desirable difficulties" associated with working through challenges on their

own as part of long-term learning (Wiliam, 2017, p. 139). A series of links to supplementary learning resources relevant to the A-B-C-D Formula's phases and their subskills could be added to the paper's Moodle page. The automated feedback comments could direct students to specific ones based on their performance in the critical reading online activities. This way, the onus is still on each learner to pursue a path to improvement instead of being told exactly how to fix an error — a strategy that complements the kind of independent learning students must embrace as part of any programme in higher education.

Regarding feedback on written output, trends suggest that guidance provided by lecturers ought to be more precise and explicit. Some positive remarks were shared about the critical reading rubric and comments drawn from the feedback comment library and attached to Assignment 2 submissions. For instance, U.S.M. described the feedback received as "helpful because I was told what mistakes I had made in Task #1 so I was able to avoid them in the other tasks." Other participants pointed out that the comments identified aspects that *need to improve* and helped them *learn from errors*. However, the majority of participants expressed mixed or negative attitudes. They explained that Assignment 2's feedback was *too general*, leaving them questioning *how to improve*, so it ought to have been *more specific*. Comments from two participants summarised this issue effectively. A.W.M. claimed that feedback comments attached to Assignment 2 submissions "weren't very specific on what and where I did wrong and an example of how to fix this." Meanwhile, B.W.N. explained that the feedback "gave a general idea on how to improve" but was not helpful "with methods to overcome the issues." Together, the evidence represents a desire among engineering students for formative feedback on writing assignments to resemble line-by-line editing notes. They seem to expect university lecturers to identify exactly what was done incorrectly, where such errors occurred in their work, and how exactly they can fix those problematic areas to improve written performance. This desire contradicts Wiliam's (2017) recommendation on feedback, as mentioned in the previous paragraph.

However, there is the possibility of striking middle ground on this issue. Links to supplementary learning resources could come in handy here, too, as part of improving the feedback comment library to be more specific and offer more advice (McTighe & Frontier, 2022). As mentioned earlier in this thesis, Nordrum et al. (2013) encouraged formative feedback strategies that required students to act on feedback. Adding such a feature to the intervention would require its expansion, though, so the lecturer can guide students through the process of analysing their feedback on an earlier writing task and devising a plan of action that could tie into the completion of another upcoming assessment.

It is possible that some students' requests for highly detailed feedback are linked to their level of preparedness for the tasks. Perhaps their academic literacy skills were not quite as developed as expected, which could explain why they wanted to receive line-by-line editing notes. Moreover, students' level of preparedness can be linked to their self-awareness and their new identity as engineering students. They need to see the process of receiving, reviewing, and applying feedback as an opportunity to improve their assessment literacy as well as their written output. Since this process falls under the umbrella of independent learning at university, maybe the terseness of my feedback comments should be seen as a feature of the intervention instead of a bug. If the feedback received had identified the location of every error in Assignment 2 submissions and told participants exactly how to fix them, those writers would have been denied the chance to interpret the feedback and look at their work with a critical eye. Still, students new to university would benefit from some guidance to ensure they learn how to incorporate this process into their post-assessment routine in an effective manner. This assertion aligns with Robinson et al.'s (2013) position on students' dissatisfaction with feedback: such attitudes could be rooted in learners not having "the skills needed to decode and use the feedback supplied," so the teaching and learning of these study skills needs to become part of the university experience (p. 269). Perhaps having an academic literacies expert attached to the School of Engineering and working as a co-teacher alongside subject lecturers could help in this regard. This person's responsibilities could include leading elements of lessons embedded in engineering courses that focus on developing discipline-specific academic literacies and related skills for independent learning, as well as holding office hours so students can meet one-on-one to receive extra assistance with communication skills.

While acknowledging the importance of providing students with useful feedback, some data collected via Moodle's tracking function has shed light on the role of additional resources *feeding into* students' learning experience. As part of my intervention, several supplementary files were shared on the course's Moodle page for extra guidance, and students were advised to review them as part of independent study leading up to the completion of Task #1. The following list identifies each resource and the number of students (out of 221 enrolled across both campuses) noted as having viewed it before that task's deadline:

- Covering Letter about the Research Project: 47 students
- Task Words Chart: 66 students
- Additional Guidance for Academic Writing: 55 students
- APA referencing help sheet: 61 students

- Task 1 – Model Text: 109 students
- Critical reading rubric: 74 students
- Copy of lecture slides: 40 students.

It is interesting to note that the model text was the most popular among the supplementary files shared, suggesting that students new to university studies are eager to see exemplars that meet an assessment's expectations and use them to aid the production of their own work. Model texts had not been shared with students enrolled in this course before my intervention was added; this data indicates that it is desirable for this resource to remain a part of the intervention for future iterations. Moreover, model texts ought to become a staple in any first-year engineering course where students are required to produce discipline-specific texts for the first time. In contrast, these numbers also reveal that a considerable number of students opted not to use the supplementary files made available to them or have such information inform their work on Task #1.

In addition, Moodle's tracking function allowed me to note the number of students who viewed the formative feedback received on Task #1 before the deadline for Assignment 2 – Part 2. Twenty-one Tauranga students and 77 Hamilton students took the time to review their feedback comments; together, they represent only 49.7% of students who submitted a text for Task #1. It is concerning that half of the students chose not to review their feedback and factor it into their writing process before submitting the remaining two texts for Assignment 2. The trends associated with students accessing supplementary files and their feedback comments might undermine my idea to supply students with links to supplementary learning resources as part of improving the formative feedback strategy. If fewer than half of the students are utilising the guidance already available to them, it may not be enough to just pile on even more resources. Therefore, expanding the intervention to provide dedicated time for acting on feedback could be crucial to the success of future iterations.

My participants' desire for lecturers to serve a double role as their editors comes with some irony and highlights some ignorance of institutional culture. The irony is that, by embedding my intervention in ENGEN170, these students were the beneficiaries of more feedback on Assignment 2 than any previous cohort. Prior to my study, only summative grading of this assessment was done. The lecturers had dedicated some class time to reviewing each task's instructions with the cohort. Then students attended a writing workshop led by CeTTL staff, which offered generic guidance, and a Frequently Asked Questions section was posted to the course's Moodle page. Those students were not provided any samples that

modelled expectations, and the assignment's marking guide was not shared with them in advance. All three tasks were submitted at the same time; alongside the summative grade, students typically received a few sentences of general feedback addressing all three tasks together. In contrast, my intervention's cohort benefitted from online practice, a collection of supplementary resources, and ample formative feedback on top of the normal summative grading method devoted to Assignment 2. Despite these facts, my participants want even more formative feedback of greater detail and variety. Granted, they would not have been aware of how the assessment was handled previously.

Nonetheless, this situation suggests a lack of awareness of the tiers of assistance available to undergraduate students at the University of Waikato. In turn, the issue is relevant to applications of the AL model since it concerns itself with the influence of institutional culture on students' reading and writing practices and their learning process (Lea & Street, 1998). For example, if students do not understand their feedback or why a particular grade was received, the normal practice at university is to meet with the lecturer during office hours to discuss the matter or engage in private correspondence via email or Moodle. Alternatively, if feedback drew attention to aspects of their work requiring improvement, they could book a Student Learning consultation, attend a specialised workshop, or use other services and tools made available through CeTTL. It is unclear whether my participants were ignorant of these options available to aid their learning or merely expected their lecturer to be the sole source of feedback and guidance. On top of that, many of them did not access the supplementary files before the deadline nor the formative feedback comments attached to submissions. Considering these cases, it seems that some engineering students are hungry for better feedback, but engagement with the guidance currently available to them is sometimes lacking.

Despite multiple modes of formative feedback applied throughout the intervention, participants had a poorer perception of it than expected. Overall, these results suggest the existence of limitations within the feedback strategy — especially the level of specificity in the feedback comment library and the overreliance on automated feedback — thus rendering formative feedback less helpful to students than anticipated. Granted, after analysing students' reasons behind their perceptions, it is possible that there exists a lack of understanding of the nature of comment libraries for formative feedback (i.e., quickly applied so not customised to each student or text). Revisions to this intervention could incorporate an improved feedback comment library, which would help address some lingering issues. In addition, the wording of automated feedback could be amended to offer more direction, and the workshop could be adjusted to incorporate more instances of peer feedback and verbal group feedback.

Formative feedback served an integral purpose in this intervention. Future iterations with an improved feedback strategy should also feature moments that raise students' awareness of assessment strategies and feedback practices in higher education. Educators could even tie these matters to the role that independent study plays in higher education. There is an opportunity here to use my intervention to socialise new undergraduate students into how assessment is done at university and how interpreting feedback is their responsibility as part of independent study. Future cohorts may benefit from an explanation of the kinds of feedback typically offered in university courses. Some sort of scaffolded training could also be added to direct students in interpreting their feedback and accessing other types of assistance available within the institution. For instance, class time could be dedicated to having all students view and analyse the feedback comments received on Task #1, which could enhance their written output for the rest of Assignment 2. This strategy would have helped in those few instances, as identified in the post-intervention survey, when students could not find their feedback or did not recognise it as being feedback. However, implementing this idea would require expanding the intervention (e.g., incorporate a second workshop). In short, this study's findings have demonstrated that engineering students have high expectations where feedback is concerned. Revisions to the intervention need to take this into account while also creating space to help new cohorts understand what to expect from feedback practices in higher education and what other guidance is available to aid their learning.

'As an Engineer': Critical Reading and Students' Budding Professional Identity

The research findings yielded vital insights on student attitudes towards critical reading within engineering education and the role that such skills will play in their future career. Also, the way participants communicated their views on academic literacies and their understanding of their chosen field revealed some surprising trends related to their budding professional identity. In turn, these attitudes can be associated with institutional culture and have implications for the design of first-year engineering courses. The discussion of this theme, which ties these elements together, is supported by evidence from the surveys and interviews, as well as trends in Assignment 2 submissions and the results of the critical reading online activities.

The cohort of undergraduate engineering students that participated in my study exhibited an array of attitudes towards critical reading and its role in engineering education and associated career paths. This was made evident in previous chapters. For instance, the initial survey found that participants viewed critical reading as more important for after graduation than while at university. Then in the post-intervention survey, a small difference in attitudes

was detected, with participants expressing the belief that critical reading was more important to their engineering studies than perceived before. Meanwhile, they viewed critical reading skills as slightly less important to their future career than before. However, these changes in attitudes were not statistically significant.

In general, survey comments revealed that participants held mostly positive attitudes of critical reading, indicating that they view this skill as integral to engineering studies. Most comments tied critical reading directly to a necessary component of the students' chosen discipline — that is, they could not meet the reading and writing expectations of their programme without developing this skill and its related subskills. For instance, U.S.M. connected critical reading skills to engineering students' ability to *read efficiently*, determine whether texts are *relevant*, and establish an *understanding* of the content so it can then *be easily paraphrased*. B.W.N. pointed out that their success depends on "accurate and relevant information to perform tasks" and that employing the A-B-C-D Formula "helps to identify this information." In addition, D.Y.B. described critical reading as "important when learning and communicating in an academic engineering environment as I will need to be able to effectively write academic assignments." By having students practice the formula's phases via the critical reading online activities within the context of the engineering discipline, the intervention not only influenced the development of their academic literacies but also how they viewed the role these skills would play throughout their studies. Therefore, by embedding the intervention in ENGEN170, this discipline-specific teaching and learning context directly influenced students' meaning making and identity as learners. As noted earlier in this thesis, the student voice is not always a prominent source of data in research applying the AL model. However, the insights identified here (as well as others gained through this study) on attitudes towards critical reading contribute to a more thorough understanding of its role in an engineering context, thus demonstrating the importance of the student voice. Going forward, it is recommended that more researchers harness the student voice and study attitudes towards the development of academic literacies in various STEM contexts.

In addition to the insights gleaned from those survey results, interview participants expressed a variety of opinions about developing critical reading as part of ENGEN170. Some students entered the programme with an existing positive relationship with academic reading and writing or at least acknowledged their importance to university studies; therefore, they had a positive attitude towards the practice of these skills in a discipline-specific context. For instance, R.J.A. expressed being *excited* because she had "always enjoyed English at school," so practicing critical reading skills as part of engineering studies "joined the two interests" and

ensured she was prepared for the "need to do proper research." E.D.W. explained that such practice was *expected* and that critical reading skills are "extremely relevant for that level of education."

Meanwhile, initial reactions of a less-than-positive nature towards such practice were also evident among interview participants, but the intervention proved to possess the power to change attitudes. For instance, the explicitness associated with the intervention helped sway one interview participant who was without *any strong feelings* initially. R.C.R. explained that "given a bit of time and explanation about the skill set that engineering requires, particularly the non-technical skill set, I thought it made perfect sense that we were learning critical reading skills." He added that, not only did the intervention contribute to the university's holistic purpose of helping students "become our own thinkers," but also the skills it developed are *extra important* due to the level of *responsibility* associated with a job in engineering. Secondly, there is always the chance that some students did not enjoy studying English in their younger years so may hold a more negative attitude initially to practicing critical reading. As a case in this point, V.I.S. uttered, "Oh great, we're doing English" sarcastically to represent his initial reaction to the intervention. Later, though, he recognised the *opportunity* it offered, so he *downloaded* a copy of the lecture slideshow. Only a few weeks later during our interview, he expressed the view that the A-B-C-D Formula was *already embedded* into his studies, and that applying critical reading skills would *become a habit*. As examples here demonstrate, the critical reading intervention had a positive influence and can improve attitudes by helping students recognise the link between academic literacies and their chosen discipline.

Even though evidence suggests that the intervention had a positive impact on some students' attitudes towards practicing critical reading for discipline-specific academic writing, the minor trend of negative attitudes is also revealing. Survey comments were received from a small number of participants who view critical reading as only a peripheral part of their university education. For example, R.J.A. noted that "maths, physics and programming take up most of the priority," while M.H.K. suggested that "the only paper this applies to is ENGEN170." The position that these skills are of low priority versus mathematics and sciences reinforces findings established in Strauss and Grant's (2018) research. Their study found that engineering students are reluctant to seek assistance with discipline-specific writing skills, leaving them unprepared for related demands in their industry. Meanwhile, engineering lecturers lack the training and/or willingness to teach academic literacies effectively because they are "not the experts in that area" (Strauss & Grant, 2018, p. 5). It is possible that such strategies of avoidance where academic literacies are concerned are tied to enduring negative

attitudes towards language and literacy studies. While in the minority, the fact that some of my participants maintain a negative attitude towards developing critical reading for academic writing may reflect their experience during the intervention, or it could be a preexisting position that developed during high school English classes or another off-putting learning experience. It is also possible that these few participants remain ignorant or dismissive of the role that communication and critical thinking skills will play in the rest of their programme and after graduation — despite efforts to inform them otherwise during the intervention. Adjustments to attitudes may be key to achieving the higher level of literacy described by Flower et al. (1990), which is needed to contribute to professional engineering discourse. While the intervention is a step in the right direction, changing these negative attitudes would likely require a more extensive project. If academic literacies practice was woven throughout first-year engineering courses and those moments also cultivated professional identity, the cohort could end the year with a more explicit understanding of the role of communication in the discipline and be ready to apply those skills throughout the rest of the programme and beyond.

In a broader sense, it is possible that some survey comments can link attitudes on developing academic literacies to institutional culture — and, by extension, stereotypes associated with the engineering sector. As mentioned above, some attitudes highlight the fact that, at an institutional level, low priority is placed on developing academic literacies, especially within engineering programmes. In turn, this may have influenced meaning making and students' identity as engineering students. Most of the negative or mixed comments were phrased in such a way that suggests these students believe academic literacies to be of lesser importance within the engineering discipline, and the application of such skills would not be required often after graduation. In addition to the comments shared in the previous paragraph, which are evidence of this phenomenon, T.R.S. expressed the belief that his future in engineering would not require much reading because it would be "more just writing code." Meanwhile, E.C.Y. pointed out that, while writing skills are *very useful*, he envisaged a *more hands on* experience of engineering in which he would only be "required to write sometimes." Even some positive comments hinted at the development of academic literacies being seen as a low priority in engineering education, which would affect performance in the professional sector in turn. For instance, B.C.S. described the following reality: "engineering is more than testing materials and completing math calculations. There is much critical reading and writing skills needed that often get overlooked and are very beneficial out in the workforce." It seems that a small portion of new undergraduate students view academic literacies development as merely a box that needs ticking instead of something essential to a higher level of achievement

in their studies and professional future. It is possible that institutional culture is partly responsible for such attitudes, but they may predate the students' arrival at university. Instead, these attitudes could have formed during prior educational experiences or through ad hoc interactions with the engineering profession that have affected perceptions of it. Alternatively, they may be grounded in how the engineering sector labels and promotes itself.

Collectively, the comments suggest that these students viewed the intervention as something novel within engineering education — that is, it did not align with their expectations of what engineering study would involve. These findings correlate to earlier analysis of existing literature that found few studies connect engineering education to the AL model or reading-to-write, suggesting a possible link between the lack of cross-disciplinary collaboration and students' expectations. The students' comments also make me consider whether institutional and/or industry-wide marketing of engineering education has led them to believe that academic literacies would not play a significant role in their chosen discipline. Therefore, having to participate in an intervention that defied their expectations for the programme could have contributed to some negative attitudes.

Addressing negative attitudes towards academic literacies development at the University of Waikato requires acknowledgement at an institutional level that the problem might be related to the design of engineering curricula. For instance, a recent study conducted at this institution found that engineering faculty and engineering employers viewed the competency of written communication as among the most important, yet one of the greatest gaps was observed when these attitudes were compared to graduates' performance of this competency — a discrepancy that prompted employers to recommend that the university "incorporate more interdisciplinary approaches to learning" (Khoo et al., 2020, p. 109). My intervention contributes a potential solution to the problem, but it (and others that build on it) ought to be permanently embedded in the curriculum in order to address the discrepancy.

Other literature suggests that this problem is not an isolated one. Research conducted across New Zealand and beyond has drawn connections between studying and/or teaching engineering and negative attitudes towards communication skills development (Emerson, 2019; Goldsmith & Willey, 2016; Kovac & Sirkovic, 2017; Strauss & Grant, 2018). When factoring in the minimal number of studies found that link engineering education to the AL model or reading-to-write, it could be argued that a comment shared by Riemer (2002) from more than two decades ago still rings true today: "Language and communication skills are recognised as important elements in the education of the modern engineer [but] there seems to be limited implementation of English courses globally" as part of engineering education (p.

99). To this day, engineering students at the University of Waikato are not required to enrol in an academic writing course as part of undergraduate studies. This means that the responsibility to develop discipline-specific academic literacies throughout the programme is currently borne by engineering lecturers (with occasional assistance from CeTTL tutors and librarians) or shouldered by the students themselves as part of independent study. It is a situation that may be feeding negative attitudes among some students. Acknowledgement of this reality at an institutional level must be accompanied by action, too. Having engineering programmes place more emphasis on developing students' communication skills throughout their studies would be a step in the right direction. Since this would clarify for new cohorts the vital role communication plays in being a successful engineer, perhaps it would improve attitudes towards practicing academic literacies and have positive connotations for their budding professional identity, too.

Granted, it is also possible that new cohorts of engineering students arrive at university with minimal understanding of their chosen discipline and what a career in engineering really involves. This possibility was first made evident during the critical reading online activities, specifically as students completed the Dotstorming activity. Many of them seemed to possess minimal knowledge of *what engineers do (job opportunities)*; posts in this category appeared vague or included only a few details. Some participants focused on a good salary being associated with this field. Generally, though, it was rare for a participant to contribute to this activity with details of the professional duties they may be required to fulfil within different kinds of engineering firms. This performance trend continued in submissions for Task #3 of Assignment 2. A focus on salary expectations (instead of job opportunities and related duties) and the presence of disorganised ideas could have impacted their ability to persuade readers to pursue an engineering career. Perhaps this lack of awareness among some students of what their future jobs will entail explains, in some cases, the underdeveloped understanding of the important role that communication will play within that career path. Dedicating more time to cultivating first-year students' identity as future engineers could help alleviate this issue — a strategy that also aligns with the principle of explicit teaching when applying the AL model. Future iterations of the intervention could tackle this issue by tying together the practice of academic literacies, discussion of their role in engineering studies, and professional identity development. However, doing so would require an increase in the time budget so the intervention can be expanded. Changing the purpose of Task #3 would also work in this strategy's favour. A new version of instructions could have students explore definitions of *engineer* and *engineering*, as well as summarise the skills required for and duties associated

with job opportunities in their specialty. Together, these proposed changes could nurture the students' budding professional identity and clarify the role of communication in this field.

On a related note, regarding identity, an interesting trend emerged wherein some members of the cohort were already applying a professional title to themselves instead of identifying as students. During the analysis of the post-intervention survey question in which participants were asked about the importance of critical reading skills in engineering studies, it was found that 12 of the 30 respondents either identified themselves as *engineers* or phrased their answers in third-person and identified the subject as *engineers*. They used such words/phrases as *engineers*, *we*, *as an engineer*, and *I'm an engineer* even though the question was asking about the importance of critical reading within their studies. It seems some students were already identifying themselves as engineers even though they were mere weeks into their engineering programme and the majority of them joined it straight from secondary school, thus possessing no real-world professional engineering experience. Moreover, the same responses connected critical reading to professional expectations and responsibilities. For example, the following phrases were featured in their reasoning:

> *career opportunities*
> *communicating with stakeholders and others within the team*
> *get the information across to the markets effectively*
> *out in the workforce*
> *understand what the stakeholder requires*
> *writing to or for a client*

The fact that this kind of language is being used suggests that some students view the study of engineering as something that makes them an engineer, despite not having earned the degree and the professional title that comes with it.

It is important to note that this attitude is not something taught in first-year engineering studies. While the cohort will learn about ethics and professional responsibilities in greater detail later in the programme, it is surprising to discover that some students seem to be arriving at university having already established their own definition of an engineer and count themselves as exemplars. Interestingly, this identity-related trend among new engineering students is not unique to this study. Another by Lakin et al. (2020) found that 53% of their participants, who were first-year engineering students at an American university, considered themselves to be engineers already. In that study, their reasoning related to mindset or skillset; this raised concern because such views of engineering practice "may conflict with the institutional definitions of engineers, which emphasises key bureaucratic points along the trajectory to becoming an engineer," including earning professional credentials and procuring

licences (Lakin et al., 2020, p. 227). However, the root of this trend among my study's participants remains unknown, leaving me to speculate on its origins.

If these beliefs cannot be attributed to the current programme design, other influences must be considered. The term *engineer* is used widely in New Zealand, but incoming undergraduate students may not be aware of the distinction between its general usage and the more elite group of *professional engineers* they aspire to join by earning an engineering degree. The influence of its common usage could explain why some of my participants were already identifying themselves as engineers. Perhaps the way engineering education is promoted to students as an option for their future is partly responsible for this phenomenon. It could also be that secondary school curricula applies the terms *engineer* and *engineering* in ways that do not align with the real-world profession, leading to first-year engineering students identifying themselves as engineers from the onset of studies. In turn, misconceptions about the engineering profession may be tied to some students' negative attitudes towards developing discipline-specific academic literacies at university. This could explain the state of denial expressed by a minority of participants at the considerable role communication would play in an engineering career. While the roots of these ideas on identity remain somewhat obscured, it appears they are linked to how the discipline of engineering is defined and the role of academic literacies within it. In turn, this relates to existing trends in academic literacies research. As identified by Lillis and Tuck (2016), identity is found to be "a significant dimension in academic writing," yet the writing requirements placed on students are often perceived as "opaque and obscure" (p. 33). Perhaps these trends exist in engineering because communication skills development is not prioritised and ideas on professional identity are not addressed extensively in the first year of studies.

Overall, my identity-themed findings support the idea that any misconceptions ought to be addressed explicitly in the curriculum — via embedded academic literacies interventions like the one created for this project — as new students begin an engineering programme. This strategy could also address the existing dissidence by refining the students' perceptions of their professional identity. More broadly, these findings relate to legislation (i.e., the Chartered Professional Engineers of New Zealand Act 2002) and more recent moves to further regulate the engineering industry and have *professional engineer* designated as a protected term (Engineering New Zealand, 2023; Ministry of Business, Innovation & Employment, 2022; Office of the Minister for Building and Construction, 2021). Although stalled due to a change of Government (Engineering New Zealand, 2024), amending the regulations is meant to ensure the title is held only by professionals who have earned it — not claimed by students hoping to

gain it in the future. Infusing my academic literacies intervention with explicit discussion of professional identity could harmonise perceptions with institutional and industry definitions.

This theme on student attitudes towards developing academic literacies and the link to their budding professional identity has highlighted realities in which hurdles must be overcome. There is a final silver lining to discuss, though. In response to the post-intervention survey's last question, almost all participants acknowledged the importance of communication to their professional future. Comments detailed how the context of the engineering discipline influences meaning making and the participants' identity as future professionals (refer to Table 5.4 in the previous chapter for examples). As demonstrated in the sample of comments shared earlier, most participants' perceptions of the field of engineering indicate their understanding that the development of academic literacies, particularly critical reading, will allow them to fulfil certain professional obligations. These range from the ability to communicate and interact with others effectively in professional situations to meeting the professional reading, research, and writing obligations of their future career. In fact, many comments touched on multiple factors for which critical reading will be important in future jobs, suggesting that the participants understand the multifaceted benefits of developing this skill.

Therefore, embedding the AL model in ENGEN170 has influenced participants beyond just how they practice critical reading for academic writing and their attitudes towards that aspect of their education. These survey comments indicate that the intervention had a positive impact on student attitudes towards critical reading's role in their future. It has clarified for most of them that effective communication is integral to success in the engineering field due to the variety of professional tasks requiring such skills. This understanding of what their future holds motivates them to invest in this aspect of their education since it will also define who they may become after graduation. In turn, these findings clarify for the University of Waikato — and other higher education institutions offering engineering programmes — the importance of making a revised intervention a permanent fixture in first-year courses like ENGEN170. This is because it would serve a vital function in developing discipline-specific communication skills among new engineering students and nurture their identities, too. In the next chapter, I will factor into intervention refinements the concept of identity and its link to developing academic literacies in engineering education.

Summary of Chapter

This chapter has discussed the combined results of my study via five themes. They identified strengths and weaknesses in my action research intervention and how these relate to

the teaching and learning of academic literacies within undergraduate engineering education. The themes have also allowed me to consider other factors at play concerning students' attitudes and their evolving identity, which were discovered through the data collection. Together, these themes have brought into focus the bigger picture in which my intervention took place. This discussion has afforded me the opportunity to tease possible improvements for my critical reading intervention as well as some broader ideas for developing communication skills throughout engineering programmes.

This thesis' final chapter will identify and explain the selected refinements made in the design of the intervention for its future use at the University of Waikato. The improved design will feature an updated version of the critical reading online activities. This model is presented to other practitioners interested in following a BL-infused AL model to develop critical reading for academic writing. The next chapter also offers broader recommendations to this university and other higher education institutions where academic literacies and engineering education are concerned.

Chapter 7: Recommendations and Conclusions

Built around the AL model, this study has examined how undergraduate engineering students' critical reading skills may be enhanced by online practice of the A-B-C-D Formula as formative assessment. It has also explored how this online practice influences student attitudes towards critical reading and the academic writing process. These aims were achieved by embedding an action research intervention in ENGEN170, collecting data throughout this process, and discussing students' performance alongside their attitudes via five themes:

1. the need to practice academic literacies in advance of an assessment;
2. students' desire for varied and interactive learning experiences;
3. the need for plenty of time dedicated to practice;
4. the expectation of receiving high-quality feedback;
5. connections between the intervention and students' budding professional identity.

As established in Chapter 3 of this thesis, my action research cycle ends with a final stage of re-planning. These five themes have inspired further refinements to the intervention and recommendations applicable to the wider engineering education sector. In particular, this study's findings have revealed a need to revise the critical reading online activities and other intervention resources, as well as expand the intervention to include a second workshop. The themes have also highlighted the demand for engineering programmes to shift from a bolt-on approach to embedded academic literacies teaching and learning, as well as the need to address the role of academic literacies in the discipline explicitly as part of professional identity development. This chapter will convey ideas for improving the intervention's lecture and workshop activities. Plans for expanding the intervention and improving its formative feedback strategy are also revealed. A few limitations and considerations associated with the study are highlighted. Then the chapter concludes with a discussion of implications and recommended pathways for future research connecting the AL model and engineering education.

Recommendations to Improve the Intervention

By using action research as this study's methodology, it has found that several steps can be taken to improve the intervention's overall design and its teaching and learning resources. One of the key steps is to make changes to the existing design so that more interaction and collaboration can be incorporated into students' practice of the A-B-C-D Formula for Critical Reading. Refinements to the activities can also create more opportunities for reflection and

facilitate more varied forms of feedback. Together, these improvements are strongly supported through sociocultural theories of learning and literature on the AL model, which highlight that a social learning environment and scaffolding techniques support students through the learning process and help them reach a higher level of understanding (Lea, 2008; Lea & Street, 2006; Pritchard & Woollard, 2010; Tavassolie & Winsler, 2018; Vygotsky, 1978; Wingate, 2006).

Secondly, it is recommended that the intervention be expanded to include a second two-hour workshop. This addition would address the existing time crunch and facilitate better quality practice of my reading-to-write formula. For instance, this second workshop could provide dedicated time for students to act on their feedback and complete a small number of redesigned activities shifted from the original workshop.

Thirdly, findings indicate that the revised, expanded intervention ought to provide moments that raise students' awareness of two elements linked to academic literacies and the engineering discipline. One of these has to do with assessment strategies and feedback practices in higher education. The intervention provides an opportunity to make explicit to new undergraduate students how assessment is done at university and the importance of interpreting feedback as part of independent study. The second element involves students' budding professional identity. By expanding the intervention, time can be dedicated to improving students' awareness of what future jobs in engineering could involve, especially where communication skills are concerned. A new writing prompt for Task #3, as mentioned in the previous chapter, would aid this strategy, while other moments could provide opportunities to discuss the essential role of communication skills in their engineering studies and future careers. Together, these improvements to the intervention may help address existing prejudices held by some students towards having to develop critical reading skills as part of ENGEN170 and perhaps lead to better written output on assignments, too.

In connection with these key steps, an improved formative feedback strategy would play a role in the revised and expanded intervention. It will honour students' requests for more varied modes of feedback, greater specificity in comments, a clearer model of expectations for peer feedback, and more peer discussion, verbal group feedback, and teacher-student dialogue. Satisfying these needs will involve revising the feedback comment library to be more specific, offer more advice, and draw connections to supplementary learning resources.

Lastly, permanently embedding the improved intervention in ENGEN170 would help the University of Waikato's undergraduate engineering programmes better align with requirements set forth by the Washington Accord. It would ensure that future cohorts benefit from class time dedicated to the practice of critical reading and its application in discipline-specific academic

writing. The subsections that follow will detail how all these recommended changes to the invention can be implemented, thus satisfying the need for a re-planning stage and marking the end of my action research cycle for this thesis.

Improvements to the Lecture

Recommended improvements to the intervention begin with its lecture since this lesson introduces students to the A-B-C-D Formula for Critical Reading. Its current ties to Task #1 of Assignment 2 can be maintained, as can the lecture's slot in ENGEN170's timetable (e.g., Week 2 of the course). However, a few minor changes to its slideshow should be made and additional support offered before the workshops.

Firstly, it is suggested that the concept of identity and its link to developing academic literacies in engineering education be factored into the lecture. This could involve a brief yet explicit mention of professional identity near the start of the lecture. A corresponding slide could be added after the one that defines important terms (see Appendix E). This would allow comments on professional identity to be framed around the following question: Why do I need to learn about this? One way of providing students with an answer is through something I have dubbed the *baby bird metaphor*, which is quite apt for an audience of students in New Zealand, a country known for its affection for feathered friends. The lecturer could spend a couple of minutes offering commentary on developing a professional identity (see Figure 7.1). A new slide would be added to the lecture's slideshow to support this commentary. By employing this metaphor, there is an opportunity for the lecturer to be creative by using images of birds on the new slide, which would be symbolic of the transformation that occurs for each student between their first days at university through to graduation and establishing a career in engineering. This addition to the lecture, while brief, could contribute to students' development of a professional identity. Since some of this study's participants were already referring to themselves as *engineers* instead of *engineering students*, this addition could help harmonise their existing perceptions with institutional and industry definitions and potentially soften preexisting negative attitudes towards academic literacies development as part of their engineering studies.

Secondly, a couple of minor changes to the end of the lecture are recommended. The slide sharing additional information and resources should be updated to include mention of a link shared on Moodle that breaks down the techniques of paraphrasing and summarising. A solid option for this resource would be a webpage prepared by the University of Auckland since it provides sound guidance supported by examples, thus setting expectations for tertiary-level assessments. Alternatively, the School of Engineering could work with academic literacies experts at the University of Waikato to produce a resource that breaks down these techniques

but with examples customised to the engineering discipline. This same lecture slide advises students to read the formative feedback they receive for Task #1, so this would be an ideal moment to add a disclaimer about independent study. The lecturer ought to explicitly mention that students are expected to dedicate some of their free time to strengthening their discipline-specific academic literacies. This allows them to learn to interpret any feedback received and devise a strategy to incorporate its guidance into future written submissions.

Figure 7.1

Model Script for Commentary on Identity, Featuring the Baby Bird Metaphor

> You may be wondering why you need to learn about things like academic literacies when you've come here to study engineering. The fact is that communication skills are an integral part of your chosen discipline. Communicating effectively through writing is essential to your success here at university, but the kind of writing you did in the past doesn't necessarily align with the writing conventions of your programme. A big part of academic writing is learning how to critically read scholarly sources and use them to support your own ideas, which is why we dedicate time to developing these skills. To help you understand this, I want you to think of your current self as a baby bird just emerged from your egg. You've got some natural instincts, but that doesn't mean you can currently survive on your own. You're reliant on your parents and other birds in your flock, who will teach you how to fly, find food, build a nest, navigate, and even sing. Just like a baby bird, you've all gathered here with the aim of becoming an engineer someday, but that doesn't mean you're a professional engineer yet. You're still engineering students at the beginning of a journey that will span years. During this period of growth, you'll gain knowledge, use tools, manipulate materials, complete experiments, design products, and demonstrate your learning of all this through written reports and other assessments that will require communication skills. In fact, I'd argue that communication skills are one of the foundation stones on which your future successes will rest. Just as the baby bird is taught to sing, I am here to help you learn to write like engineers. Then, after you graduate, are properly accredited, and gain employment in the engineering field, you'll continue to grow and adapt your communication skills to meet the various needs of employers, clients, and stakeholders. Your journey to become a professional engineer starts with the courses you'll take this year, and learning to communicate like an engineer begins now. Before you can write, though, you need to learn about the steps that begin that process. One way to help you remember these steps and build them into your routine is something called the A-B-C-D Formula for Critical Reading.

Lastly, when the lecturer posts a PDF copy of the lecture slides to Moodle at the end of the week, a Moodle announcement should also be shared that reminds students to review the lecture slides before attending the first workshop. Prompting students in this way is intended to decrease the chances that any of them have forgotten details taught in the lecture since they will need to apply them in the workshop. This Moodle announcement could serve a dual

purpose by also reminding the cohort of the Task #1 submission deadline scheduled for the near future. It is recommended that this deadline continue to be scheduled for the end of the same week during which the lecture is delivered. For example, students could be required to upload this text to Moodle on Sunday evening, with Week 3 classes starting the next day. Therefore, the Moodle announcement prompting them to review the lecture slides and reminding them of the deadline could be posted on Friday afternoon.

Improvements to the Workshop

Based on this study's findings, a variety of improvements to the workshop are advised to further enhance students' practice of the A-B-C-D Formula via the critical reading online activities. Firstly, the evidence indicates that participants did not have enough time to complete the online activities; this was noted as the primary limitation of their design, so it must be addressed during their revision. As a result, some activities are redesigned and/or removed from this workshop. Granted, the key steps and recommended actions introduced in the lecture still play a role in students' practice of the formula. Some of them are covered in the extra workshop instead, which provides for the intervention's recommended expansion and is outlined in the next subsection. Activities in the first two phases should undergo some simplification to allow for the redistribution of time. This ensures that more time can be provided for the completion of Phase C and Phase D activities, which are the more complex and productive ones. Together, these changes help address the time crunch that occurred when the intervention was first embedded in ENGEN170.

In addition, some overall simplification of the workshop's design allows the critical reading online activities to focus on practice in connection with Task #2 only. The extra workshop features some practice in connection to Task #3 to compensate for this change. The remainder of this subsection specifies the changes made to activities that will feature in the new version of the workshop. These descriptions are paired with images of the revised activities, which can serve as a model for other educators to replicate and customise to their own teaching practice.

For Phase A, small changes are made to reduce the amount of time it will take students to complete its activities. For example, in the first activity, the number of terms/phrases and their corresponding meanings are reduced. Percentage ranges associated with the activity's automated feedback are adjusted to suit the new number. Refer to Figure 7.2 to see a model of this revised first activity. In addition, one of the multiple choice activities is eliminated, and their order is changed to a more logical sequence. Other educators can adapt the models of these multiple choice activities, as seen in Figure 7.3, for their own teaching practice.

Figure 7.2

The First Activity of Phase A (Revised)

DEFINITION MATCHING: As part of analysing task instructions, ensure your understanding of all terms and phrases within them. We will do this now for your writing task. Drag the terms/phrases into the correct boxes to match with their meaning. (answers displayed here in bold)

- **discuss** = write about the most important aspects of (probably including some criticism); give arguments for and against; consider the implications of
- **historical and societal factors** = elements from the past or within human society that contribute to a particular result (i.e., the invention)
- **in the 20th or 21st century** = from the year 1900 to the current date
- **invention** = something that has been designed or created for the first time
- **significant impact** = important or noticeable effect
- **society** = a large group of people, living in the same area, who share the same traditions, customs, laws, etc.

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 49%	Your understanding of the terms/phrases in Task #2 is insufficient to attempt any writing at this time. Please study the answers and seek help from your lecturer.
50% - 65%	Your understanding of the terms/phrases is flawed. Study the answers before attempting Task #2.
66% - 82%	You have a moderate understanding of the terms/phrases in Task #2. Due to multiple errors, you should review the answers and take notes before continuing.
83% - 99%	Your understanding is strong with only minor errors present. Review the answers before continuing.
100%	Perfect! You have an excellent understanding of the terms/phrases in Task #2.

Figure 7.3

The Three Multiple Choice Activities of Phase A (Revised)

MULTIPLE CHOICE: Next in your analysis, you need to determine how the text must be written in order to satisfy certain requirements identified in the task instructions. For each of the following questions, select 1 answer. (answers displayed here in bold; a corresponding automated feedback comment is listed under each option)

1. What task word is used in the instructions for Task #2?
   (Reminder: task words are verbs or phrases appearing in writing prompts that tell you exactly what kind of writing is required)

   a) comment on
   - ↳ This task word does not appear in the instructions for Task #2. Please read it again more carefully.

   b) discuss
   - ↳ Yes, this is Task #2's task word. Refer back to its definition to understand exactly what that means for your writing.

   c) identify
   - ↳ It is understandable that you chose this task word because Task #2 asks you to name the inventor. However, this word does not actually appear in the instructions and is not the main task word.

   d) summarise
   - ↳ This task word does not appear in the instructions for Task #2. Please read it again more carefully.

   e) give examples
   - ↳ This task word does not appear in the instructions for Task #2. Please read it again more carefully.

2. When composing Task #2, what text type is required and how will this influence your voice as its writer?
   a) I will be writing an expository text describing the process followed to invent the product.
      ↳ This answer does not match details for Task #2. Read its instructions again, paying more attention to the details.
   b) The text must provide my opinion of the invention, so I will write using first-person perspective.
      ↳ This answer does not match details for Task #2, and first-person perspective should generally be avoided in academic writing. Read the instructions again, paying more attention to the details.
   c) I'm writing a narrative text about an invention, telling the story of how it was created and how it has been improving society.
      ↳ This answer does not match details for Task #2. Read its instructions again, paying more attention to the details.
   d) It will be an argumentative text, so it must present sound reasons in support of my discussion of the invention. The voice should be formal, using third-person perspective.
      ↳ Yes, this choice correctly identifies the text type and its influence on your voice. Consider these requirements when organising your ideas into paragraphs.

3. Task #2 requires you to write about an invention. The instructions identify several details that must be included in the text. What would be the best way to cover all required points within the word count limit?
   a) The first paragraph identifies the invention, the year it was created, and by whom. This paragraph also includes a statement about the invention's significance. The second paragraph discusses the contributing factors, as supported by evidence. A final paragraph ties these factors to the invention's impact on modern society, thus connecting all details back to the statement from the first paragraph.
      ↳ Of the options present, this is the best one because it meets all of the instruction's requirements, satisfies the necessary research component, and organises the text in a way that follows academic conventions.
   b) The first paragraph identifies the invention and provides some historical details about its creation, as supported by evidence. Next, a point-form list presents information about contributing factors, with each point including a citation. Finally, a closing sentence states how those points account for the invention's impact on modern society.
      ↳ This is the weakest option because it deviates the most from expectations. Listing points does not create a discussion, and point form should not be used in a short academic text unless called for explicitly in the instructions. On top of this poor organisational method, there is an overreliance on source content and underdevelopment of the writer's voice.
   c) The text is organised in a single paragraph. The first sentence identifies the invention, the year it was created, and by whom — details that are supported by evidence. This is followed by several sentences summarising the invention's history and various uses in society. The last few sentences argue why the invention has played an integral part in modern society, and this argument is based on statements from famous sources.
      ↳ This option is not desirable because such a text would feature poor organisation and use sources in inappropriate places. Since this option also mentions different task words, the resulting text would not meet all content expectations.

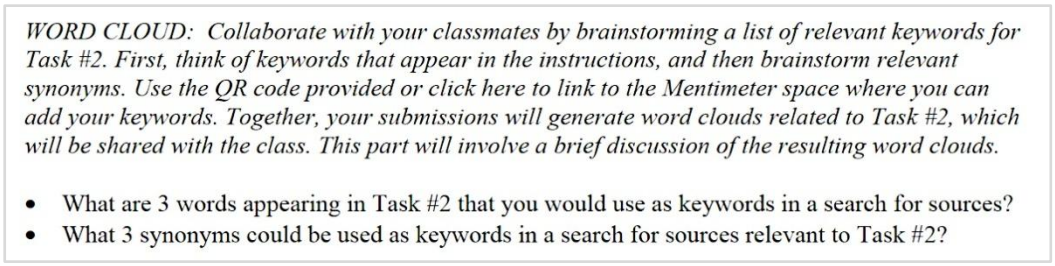
Even though automated feedback for Phase A activities was programmed to explain why incorrect answers were wrong, evidence gained through this study indicates it would be worth pausing a moment after completing the phase to address any questions from students. This additional opportunity to seek clarification might aid students' understanding of instructions and expectations as they began working on the task later. It also serves to increase interactivity during this part of the workshop.

Factoring in all these recommended changes, the amount of time allotted to Phase A's practice in the workshop is now estimated at less than 10 minutes. It is recommended that other practitioners use the H5P tool in Moodle since it proved fit for purpose in Phase A during the intervention. Within its *Quiz (Question Set)* option, the *Drag the Words* question type should be selected for the definition matching activity. This question's automated feedback can be programmed using the *Overall Feedback* menu, which allows the user to define score ranges and corresponding comments. When adding the remaining three Phase A activities to the question set, the *Multiple Choice* question type is suitable. As each question's available options are programmed, the related automated feedback can be added to the *Message displayed if answer is selected* field under the *Tips and feedback* menu.

Revisions to Phase B's online activities begin with a reordering. Since this workshop is now linked to Task #2 only, changing the order of this phase's activities provides a more logical progression of practice. This means the phase begins with the word cloud activity, followed by the keyword searches activity. Minor changes to the word cloud activity adjust its focus to Task #2, as evident in Figure 7.4 below.

Figure 7.4

The Word Cloud Activity of Phase B (Revised)



It is recommended that the external Mentimeter tool still be used to generate word clouds for this activity since it worked well for students during the intervention. The time limit of 10 minutes can remain since this proved sufficient. Meanwhile, only two small changes are made to the keyword searches activity. In both instances, different words are selected as answers. There had been comments from participants about being able to use process of elimination to complete some activities, so these changes aim to make this activity slightly more challenging for students. This way, H5P's *Drag the Words* interactive task can still be used, and the ability to provide automated feedback via its *Overall Feedback* menu is maintained. Other educators can refer to Figure 7.5 on the next page as a model of how to make such an activity sufficiently challenging yet still possible for students to complete in less than five minutes.

Figure 7.5

The Keyword Searches Activity of Phase B (Revised)

KEYWORD SEARCHES: For this second part of Phase B, drag the words into the correct boxes to complete the example keyword searches that go with Task #2. This part should take you less than 5 minutes. (answers displayed here in bold)

TASK #2:
Briefly discuss one invention made in the 20th or 21st century that has had a significant impact on society. Include in your answer the name of the inventor, if possible, several historical and societal factors that contributed to the invention, and the impact it has had on modern society.

KEYWORD SEARCH #1:
"20th century **inventions**" + impact
KEYWORD SEARCH #2:
microwave + "development factors" + "impact on **society**"
KEYWORD SEARCH #3:
smartphone **+ development** + society + **impact OR** effects
KEYWORD SEARCH #4:
"social media" + "**effects on** society" + **development OR** history
KEYWORD SEARCH #5:
plastics + "**material** development" + society **OR history** + "environmental **impact**"

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 50%	Your understanding of how to do keyword searches is weak. You should consider arranging a tutorial with a librarian.
51% - 79%	The keyword searches you've created here are flawed. Please review the rules taught during the lecture.
80% - 99%	Your understanding of keyword searches is strong, but there are minor errors present. Review the answers before continuing.
100%	Perfect! You've got an excellent understanding of how to put keyword searches together.

Next in Phase B, the collaborative brainstorming activity completed via the external Dotstorming tool, which proved the source of behavioural issues during the intervention, is replaced by an activity that serves a similar purpose but is executed differently. This new activity requires the teacher to organise students into small teams (3-4 students per group), with each team electing a leader to represent them. The leaders link to a new Mentimeter space and input the team's answers to prompts. Within this new Mentimeter space, three slides are created, each using a different question type. Refer to Figure 7.6 on the next page to see the new instructions for this team-based Mentimeter activity. By having students complete this activity in small groups, they can learn from each other in a way that is collaborative and scaffolded by the teacher, thus aligning it with Vygotsky's (1978) concept of the zone of proximal development and other literature on social learning (Lea & Street, 2006; Pritchard & Woollard, 2010; Tavassolie & Winsler, 2018).

For the first slide, teams are asked to rank inventions by their appropriateness as a topic for Task #2. Using their existing knowledge of these inventions, teams must agree on answers

so the leaders can quickly input the information. Then the teacher can comment on the trends and offer the class some verbal feedback. It is recommended that Mentimeter's *Ranking* question type be used for this slide. If other practitioners adapt this activity's first part for their own purposes, they are advised to include between six and eight possible topics to make it sufficiently challenging. One or two options should fall just outside the parameters of the associated writing prompt or would be considered poor choices. This ensures the teacher has something to comment on regardless of trends in the groups' choices. This moment can also be used to ask the leaders if the teams have any questions before continuing with the next slide in the activity.

Figure 7.6

The New Team-Based Activity that Concludes Phase B

KNOWLEDGE AND GAPS: For this last part of Phase B, form small teams (3-4 students per group) and select a leader to represent each team. Team members will work together to make decisions about the following: (a) appropriateness of possible topics based on existing knowledge, (b) the difficulty involved in answering certain questions through research, and (c) the relevancy and appropriateness of types of resources that could fill gaps in your knowledge. Use the QR code provided or click here to link to the Mentimeter space, where leaders will input the teams' choices. This part will take about 10-15 minutes. Please note: Leaders will be given the opportunity to ask questions on behalf of their teams that may arise during this activity. A leader may also be called upon to explain the team's choices as part of whole class discussion during this activity.

- Based on existing knowledge, rank the inventions by their appropriateness as a topic for Task #2:
  - 3D printer
  - automobile/motorcar
  - desktop publishing software
  - flash memory
  - lithium-ion batteries
  - Scotch tape
  - Velcro
  - vertical farming systems
- As a team, choose a strong topic for Task #2 from the earlier list. Consider the following questions that need answering through research. Which question do you think may be most challenging to answer?
  - Who invented it?
  - When was it invented?
  - What historical and societal factors contributed to its invention?
  - What impact has the invention had on modern society?
- Rate these types of resources, which could be used as sources for Task #2, based on their relevancy and appropriateness. For each resource, use any number in the scale of 1-5, with 1 meaning it's not relevant/appropriate and 5 meaning it's highly relevant and appropriate. Numbers can be used more than once.
  - books about the history of engineering
  - encyclopedia entries
  - engineering blogs
  - engineering textbooks
  - journal articles
  - online videos (e.g., YouTube, Ted Talk)

The second slide in this Mentimeter activity requires teams to consider questions about their topic that need to be answered through research, choosing one that they think may be most

difficult to answer. This slide should be designed using the *Multiple Choice* question type, and the questions ought to tie directly to the writing prompt's content requirements. As results of the teams' choices are displayed, the teacher can elicit explanations from the leaders and comment on their responses, which would serve as a fitting segue into this activity's final slide.

A third slide completes this new team-based Mentimeter activity and marks the end of Phase B's practice in the workshop. Teams are instructed to rate types of resources that could be used as sources for Task #2. In rating these resources, teams must consider their relevancy and appropriateness, assigning a number to each one within the scale provided. Other practitioners are advised to use Mentimeter's *Scales* question type if adapting this part of the activity for their own use. It is recommended that they include between four and six types of resources, some of which would likely be ideal sources for the assignment while one or two others would be considered less relevant or even inappropriate for use in academic writing. As the results are displayed, the teacher can ask leaders to explain the choices made and offer verbal feedback to the class. Together, the three parts of this new Mentimeter activity should take 10-15 minutes to complete. In accordance with this study's findings, this design ensures that students' practice of my formula involves more peer interaction and teacher-student dialogue. The familiarity of the Mentimeter tool should help this new activity function smoothly within the series while offering greater control to the teacher, thus eliminating the kinds of behavioural issues that arose during the intervention when Dotstorming was used.

Changes to Phase C's online activities are more significant than those for the earlier phases. Feedback from participants highlighted this phase's level of difficulty; students suggested that improvements ought to ensure their understanding of expectations and ability to complete the activities within a reasonable timeframe. Revisions to the designs of the first two activities are made to address these issues. In addition, Phase C's last activity is removed from this workshop, but a reimagined version of it will feature in the second workshop instead as part of the intervention's expansion.

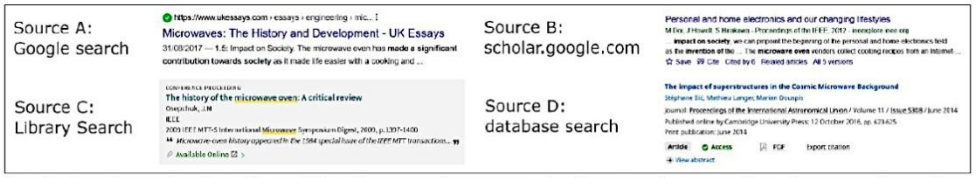
The first online activity in Phase C requires students to examine search results and complete a short text that analyses each one's relevancy and appropriateness in connection to Task #2. This drag and drop activity proved a challenging one for some students to complete during the intervention. It is possible that the point-form design of the text made it harder to understand, and interview data pointed to confusing syntax, too. Redesigning this activity to present the analysis in full sentences should reduce students' confusion and allow them to focus more on analysing the search results instead of trying to understand what is written about them. Therefore, I have converted the point-form design; the short text now features a more consistent

structure of sentences organised in small paragraphs. The first of these paragraphs also has two fewer blanks than the previous version, allowing it to serve more as a model of how details are organised in the paragraphs. The activity's automated feedback is also adjusted with new percentage ranges. Refer to Figure 7.7 to see the revised version of this Phase C activity.

Figure 7.7

The Analysis of Search Results Activity of Phase C (Revised)

ANALYSIS OF SEARCH RESULTS: The photo below shows four search results using the following keyword search: "microwave oven" + invent* OR development + "impact on society"
(Note: All sources in the photo were found on the first page of their respective search results. The sources were found using the Google search engine, Google Scholar, the University of Waikato Library Search tool, and the Cambridge Core database.)



Look closely at the details visible about each source. Analyse each source's relevancy (based on key words) and appropriateness – that is, details indicating it is either scholarly, secondary, or inappropriate as a possible source for Task #2. Complete the summary by dragging and dropping the words/phrases into the boxes. Then click the Check button to see your results. If any choices were wrong, click the Show Solution button to note the correct answer. Be sure to read the automated feedback before continuing to the next part of Phase C. (answers displayed here in bold)

Source A is relevant because the text discusses the microwave oven's history, development, and impact on society. However, this source is **inappropriate**. Its author is not noted, and it was published on an essay-sharing website. This means the content may be **unreliable**, and questions of plagiarism could be raised by using this kind of resource.

Source B is **somewhat** relevant because the article focuses on various electronics' impact on society, and the microwave oven is used **as an example**. It appears this source is **appropriate** and scholarly, having been **written by experts** and published as part of a proceedings. However, its lack of exclusive focus on the chosen invention means it shouldn't be the main source for Task #2.

Source C is **highly relevant** because it focuses on the microwave oven's history. This review would establish **facts** and highlight inconsistencies from past publications. This source is **scholarly and** appropriate because it was written by **an expert** and published as part of a conference proceedings.

Source D is **not relevant** because the article deals with microwaves within the context of **astronomy** instead of the product used in people's kitchens. This source is **scholarly** because it was written by **experts** and published as part of a **proceedings**, but it's still not appropriate as a source for Task #2.

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 49%	You have not met the expectations for this activity. Please take notes on the answers so you can review them in your own time. You should book a consultation with the CeTTL team to improve your research techniques.
50% - 72%	You've made a fair attempt here, but there are noticeable errors. It's recommended that you review the answers and consider seeking out CeTTL resources to help you do research more effectively.
73% - 99%	You performed strongly in this activity, but your ability to evaluate search results could still improve slightly. Please review the answers and take any notes you think may be helpful.
100%	You demonstrated first-rate research skills in this activity. Keep up the excellent work and continue to follow the formula as you evaluate search results for future writing tasks.

It is recommended that other practitioners use the H5P tool in Moodle if adapting this 10-minute activity for their own purposes. Starting with its *Column* option allows the user to stack features together. The activity's instructions can be added at the top of the column using a *Text* content section, followed by an *Image* content section to display the picture of the search results. The third content section in the column can be a *Drag the Words* interactive task, with its *Overall Feedback* menu used to program the automated feedback.

Phase C's second online activity also requires considerable revision. Insights gained through this study suggest that the design of the Parlay Ideas activity ought to feature more guidance as the students practice its associated skills, and the time crunch needs to be addressed here, too. Minor editing to the instructions for Step One of this activity helps clarify how students should write their posts. However, most of the changes made to this activity are not outwardly visible in its instructions (see Figure 7.8 on the next page). Instead, the majority of changes needed to improve this activity can be fulfilled in a few steps. Firstly, the complexity of the activity can be reduced by cutting the workload in half. By having students analyse only one excerpt in this activity and complete the related peer feedback step, more students are likely to finish both steps within the time allotted.

Secondly, the slideshow used to support the workshop can be updated to feature clearer modelling of expectations. The first reading from the activity's previous version would come in handy here. For example, that excerpt (or a portion thereof) could be displayed on a slide, with some of its words/phrases highlighted using different font colours. These would correspond to a list of tips and brief examples, appearing next to the excerpt on the slide and demonstrating how to write an analysis of an excerpt. The tips could share guidance on summarising and paraphrasing techniques and recommend language that could tie the excerpt's details to Task #2. Alternatively, the slide could feature a model paragraph analysing the excerpt, with sentence frames and/or certain details highlighted. Before students begin this activity, the teacher ought to review the instructions for its first step and discuss this slide with them as part of modelling expectations. Once half of the allotted time has passed, the teacher can call students' attention to the instructions on providing peer feedback, with the slideshow sharing further tips and models of how to do so in a constructive manner that also abides by professional etiquette. It is believed that this combination of changes could result in better quality output from students in both steps.

Thirdly, it is recommended that a few minutes be devoted to a post-activity discussion. The teacher, who can view student posts on Parlay Ideas as they are submitted, could use this moment to share verbal feedback with the whole class based on trends observed in their

performance. This additional teacher-student interaction could prompt reflection at the end of the activity, raising students' awareness of their strengths and weaknesses associated with critical reading and analytical writing, before they proceed to the next phase. While the instructions for this Phase C activity still mention a time limit of 30 minutes, it is likely that the teacher will need an additional 5-10 minutes to talk about the modelling with the class and engage in post-activity discussion.

Figure 7.8

The Analysis of an Excerpt Activity of Phase C (Revised)

ANALYSIS OF AN EXCERPT: This second part of Phase C is a reading and discussion activity, which will help you analyse an excerpt related to Task #2. Click here to go to Parlay Ideas and log in using your email account. Then you'll enter the page where you'll see the reading and instructions on the left. On the right is where you'll compose your analysis for Step One. Once submitted, you'll proceed to the Discussion section of the page where you'll complete Step Two. If a classmate's post has already received a reply, you must choose someone else; this strategy ensures everyone receives peer feedback. You should be able to complete this whole task in 30 minutes.

> Cutting across these examples is our core argument that plastics can only be understood in terms of the wider networks and relations of which they are part. To elaborate: while fundamental social changes and much of what is taken for granted today would not, perhaps could not, have happened without plastics, the mere existence of plastics does not fully account for their ubiquity in contemporary economic and social life. In the case of food packaging, for example, the properties and qualities that make plastics a useful and suitable material do not fully explain their widespread use. While this is no doubt an important part of the story, a more comprehensive account requires attention to a range of other factors, including the rise of supermarkets, legacies of urban planning and housing development, related technological developments (e.g. the microwave), and shifts in societal and domestic divisions of labour. Any attempt to bring about changes in the use and disposal of plastics must be grounded in understanding how things come to be as they are in the first place (cf. Molotch, 2004; Miodownik, 2014). This requires attention to the services that plastics provide as well as a more general recognition of the 'whole' picture and understanding that stabilised socio-technical arrangements cannot be 'undone' by changing one piece of the jigsaw.
>
> A socio-technical approach to plastic packaging challenges a linear view of social change following technological innovation. Our analysis suggests it cannot be assumed that dispensing with plastics or replacing them with other materials is the best solution to the problems associated with single-use plastics. In the case of The Body Shop, for example, the issue had far less to do with technologies and materials than with the legal requirements that made it difficult to reuse and refill packaging, plastic or otherwise. It seems credible to suggest that addressing the regulatory context of packaging is an important lever of change. Similarly, the Frito-Lays example highlights how existing norms, meanings and expectations require attention in order for new materials and technologies to successfully reconfigure practices in a more sustainable register. In both cases, the services that plastics provide – freshness, convenience, safety, accountability and affordability – are key. While commercially and culturally significant, these categories cannot be assumed to have a priori meaning (cf. Jackson et al., 2019). They are inherently malleable and historically variable, meaning that changing societal standards and societal expectations influence trajectories of technological development and *vice versa* (cf. Evans and Mylan, 2019). Accepting that the contemporary standards and expectations that drive the use of plastics are the outcome of socio-technical processes of co-evolution (Shove, 2003), it follows that solutions and change require more than 'getting the technology right' and then encouraging consumer acceptance. They require attention to questions of cultural appropriateness, their contingency, and their complex relationships with technological innovation.

This excerpt was taken from page 7 of the following journal article:
Evans, D. M., Parsons, R., Jackson, P., Greenwood, S., & Ryan, A. (2020). Understanding plastic packaging: The co-evolution of materials and society. *Global Environmental Change, 65*, Article 102166, 1-8. https://doi.org/10.1016/j.gloenvcha.2020.102166

STEP ONE: To analyse this reading, address the following 4 requirements. Write in full sentences, grouping your answers together into a paragraph of 100-125 words.
a) Summarise the focus of this excerpt in 1 sentence.
b) How is this excerpt connected to Task #2?
c) Describe how you could paraphrase some content from this excerpt to satisfy one of Task #2's requirements.
d) What is one of this excerpt's weaknesses in relation to Task #2?

STEP TWO: Choose a classmate's post to read and then reply to it. Share your answers to the following 2 questions as a form of peer feedback. Writing in full sentences, this feedback should be about 75 words.
a) What is another way that this excerpt is connected to Task #2? Identify it for your classmate.
b) How could this other connection be used as part of the assignment? Recommend to your classmate what to do.

As the last phase to be practiced online in this workshop, Phase D is also changed considerably in reaction to this study's findings. The improvements start with the removal of

its first online activity since its design seemed to contradict the highly individualised nature of integrating source content into one's own writing. This activity's removal is also motivated by the fact that, during the intervention, many students either failed it or left it incomplete due to time limitations. Instead, the intervention's expansion to include a second workshop will feature a reimagined version of this activity, meaning students will still gain guided practice of the associated skills.

To end the improved workshop, Phase D's last activity remains the one during which students practice using reporting verbs and following APA format, but a few revisions are made to its design. Some of these changes can be observed in Figure 7.9 below.

Figure 7.9

The Reporting Verbs & APA Format Activity of Phase D (Revised First Half)

REPORTING VERBS & APA FORMAT: Drag and drop the reporting verbs and parts of in-text citations into the correct boxes to complete the model text related to Task #2. Use the picture to guide your choices. Then drag the remaining words below into the correct boxes to complete its reference list. Use the formulas you learned as a guide. (answers displayed here in bold)

One main historical factor contributed to the invention of the microwave oven, and its creation has had a considerable impact on society in turn. **The review by** Osepchuk **(2009)** traced the development of this technology to the years around World War II, a time when work in magnetron power and radar can be tied to the microwave oven's invention. The **suggestion** here is that the military-industrial complex, in its efforts to develop new means to end the war, ended up giving people the means to thaw frozen food quickly or reheat leftovers. However, years passed before the countertop microwave became prolific in households because initial prices per unit were steep **(Osepchuk, 2009)**. It is possible that post-war families hoping to return to their normal pre-war lifestyle were hesitant to embrace something new, or they instead chose to invest in a fallout shelter in reaction to the Cold War. **According to** Osepchuk (2009), concerns were also expressed in those early years that to nuke one's food, as the inaccurate saying goes, could come with harmful radiation. The review **indicates** that, with the establishment of product testing and a drop in prices, American-made microwaves became popular in the late 1960s and early 1970s (Osepchuk, **2009**). Doi **et al.** (2012) **described** home appliances like the microwave as markers of "wealth and status in the community" at the time **(p. 1648)**. These **authors** even **linked** such inventions to women's liberation. Although the microwave oven started as a product of an age of unspeakable savagery, it now has a place in most homes around the world and is a symbol of convenience and ease in a fast-paced, innovative society.

AUTOMATED FEEDBACK COMMENTS FOR THIS HALF OF THE ACTIVITY	
0% - 50%	Your understanding of how to incorporate and cite sources is weak. You should consider arranging a tutorial with a librarian or CeTTL expert.
51% - 79%	Your use of reporting verbs and in-text citations here is flawed. Please review the guidance about incorporating source content in your writing.
80% - 99%	Your efforts to incorporate and cite source content is strong, but there are minor errors present. Review the answers before continuing.
100%	Perfect! You've got an excellent understanding of how to use reporting verbs and include in-text citations.

Minor editing to the first half of this activity means it now has two more blanks than the previous version and is slightly more challenging, making it less likely to be completed by process of elimination. Meanwhile, the reference list portion of this activity remains the same as it was during the intervention (see Figure 7.10).

Figure 7.10

The Reporting Verbs & APA Format Activity of Phase D (continued)

References

Doi, **M.,** Howell, **J., &** Hirakawa, S. **(2012).** Personal and home electronics and our changing lifestyles. ***Proceedings*** *of the* ***IEEE, 100***(Special Centennial Issue), 1646-1656. https://doi.org/10.1109/JPROC.2012.2187128

Osepchuk, J. M. **(2009).** The history of the microwave oven: **A critical** review. ***2009 IEEE*** *MTT-S International Microwave* ***Symposium*** *Digest*, **1397-1400.** https://doi.org/10.1109/MWSYM.2009.5165967

AUTOMATED FEEDBACK COMMENTS FOR THIS HALF OF THE ACTIVITY	
0% - 50%	Your understanding of APA format is weak. Please arrange a tutorial with a librarian or CeTTL expert. This will help improve your referencing techniques before you attempt future writing tasks.
51% - 79%	Your application of APA format here is flawed. Please review the guidance about referencing source content before attempting your next writing task.
80% - 99%	Your referencing technique is strong, but there are minor errors present. Review the answers and APA formulas provided before continuing with your next writing task.
100%	Perfect! You've got an excellent understanding of how to apply APA format in a reference list. You're ready for your next writing task.

Two other changes can improve students' experience of this workshop's final critical reading online activity. As stated earlier in this chapter, a Moodle announcement shared after the revised lecture would prompt students to review its slideshow before attending the first workshop, with the intention that this could improve recall of APA formatting rules. In addition, the slideshow used to support the workshop can be amended to briefly display related models, such as those shared in the lecture slides, thus serving as a further reminder. Secondly, the removal of Phase D's first activity means that its time is reallocated to this activity, creating a cushion that should alleviate some of the time pressure at the end of the session.

Other practitioners looking to adapt this activity for their own purposes should use the H5P tool in Moodle. This 15-minute activity can be recreated using its *Column* option to stack features together, starting with an *Image* content section to display the picture of the search results. This is followed by a *Drag the Words* interactive task for the model text portion focusing on reporting verbs and in-text citations. Its *Overall Feedback* menu can be used to program the automated feedback for this half of the activity. The column's third content section can be a *Drag and Drop* interactive task. When programming this task, the *Settings* step will

need a background image of the incomplete reference list so drop zones and droppable elements can be added to it during the *Task* step. Again, the automated feedback can be programmed using the *Overall Feedback* menu.

The revised set of critical reading online activities now dedicates 95 minutes to the practice of the A-B-C-D Formula for Critical Reading. Considering that two hours are allocated to workshop sessions, this leaves plenty of *wiggle room*, as one of the participants put it, to address questions that may arise, provide extra time to complete an activity if needed, and discuss the activities as students work through them. These teacher-student and peer interactions are crucial for clarifying the knowledge and skills learners already possess and those that require further enhancement to effectively apply the formula in other contexts going forward (Lea & Street, 2006). It is recommended that any time remaining at the end of the workshop be dedicated to reflective discussion. The teacher could elicit opinions of the online practice experience, asking students to identify which of the activities was most helpful to them and why. Having students reflect on the practice of literacies, as established in Chapter 2's synthesis of literature on the AL model, is one of the recommended methods for applying its principles in the classroom, and concluding online practice of the formula in this social way aligns with ideas for the "thoughtful integration" of BL (Garrison & Kanuka, 2004, p. 96). Also, as Fang et al. (2023) recently noted, reflecting on the completion of online learning activities "can elevate students' awareness of their learning and growth" (p. 14).

Students could also use these last moments to review and take notes on the automated feedback received and ask questions about these comments. The teacher could point the class to some links to additional resources shared through Moodle, which could serve as independent study materials or provide additional practice. Other practitioners could explore the addition of an optional forum activity completed outside of class time, during which students post questions, discuss the experience, and gain further peer feedback or guidance from the teacher when requested.

Regarding scheduling of this workshop, its slot in the week immediately following the submission of Task #1 ought to be maintained. This way, students will be practicing the A-B-C-D Formula while waiting for Task #1's formative assessment results. For example, the workshop could be embedded in Week 3 of ENGEN170, and Task #1's formative assessment results could be released to students by that Friday. However, the deadline for Assignment 2 – Part 2, which was scheduled for the Sunday at the end of Week 4 during this study's intervention, may require adjustment for future iterations. This will depend on the scheduling of the extra workshop as part of the intervention's expansion.

Expansion of Intervention with Extra Workshop

Despite the level of success achieved in enhancing participants' critical reading skills via online practice of the A-B-C-D Formula, this study has revealed that it would be in undergraduate engineering students' best interest to expand the intervention. The inclusion of a second workshop would satisfy numerous needs, as highlighted by this study's findings. With the critical reading online activities revised to now focus solely on Task #2, a second workshop ensures that future ENGEN170 cohorts would benefit from dedicated practice time associated with Task #3. Aligning with the embedded academic literacies approach, this plan would demonstrate to students the adaptability of the formula since it is used in connection with all aspects of Assignment 2. Comments shared by participants indicate that more time dedicated to the development of critical reading is needed so they are better prepared to apply these skills in academic and professional writing tasks. The intervention's expansion would satisfy this expectation. Adding a second workshop would also smooth students' transition to undergraduate studies and raise their awareness of important matters in a practical way. For instance, a portion of the expansion could familiarise students with assessment and feedback practices in higher education. A scaffolded exercise in interpreting and acting on feedback would activate the zone of proximal development, providing students the opportunity to learn from peers and the lecturer with the aim of pushing their academic writing forward (Pritchard & Woollard, 2010; Tavassolie & Winsler, 2018; Vygotsky, 1978). Such an exercise could help students build these actions into their post-assessment routine as part of independent study. More opportunities to discuss and reflect on their learning would benefit engineering students, too. This could contribute to professional identity development, deepen their understanding of the role of academic literacies in their studies, and enhance their communication skills overall, which are essential preparations for their future careers. This section will outline a plan for a second workshop so the intervention's expansion can meet all these needs.

It is recommended that a second two-hour workshop be added to the intervention, ideally taking place within a week of the first workshop during which students complete the critical reading online activities. For example, if the first workshop is embedded in ENGEN170 during Week 3, then the second one could be scheduled early in Week 4. With Task #1's formative assessment results released to students on Friday of Week 3, they can use the weekend to review the feedback received and begin work on Task #2. An announcement could be posted to Moodle on the Friday, notifying students that the formative feedback is available. This same announcement could prompt them to complete two homework tasks in preparation for the second workshop. Firstly, it is suggested that students re-read the PDF called Task #1 – Model

Text, which had been shared at the beginning of the intervention as part of the collection of supplementary resources. The announcement can share the following two questions to guide their use of this resource: (a) What is one quality or feature in this text that you should adopt to improve your own writing? (b) What is one way that this model text could be improved? The announcement should instruct students to take notes and be prepared to share answers during the next workshop. Secondly, the announcement can instruct students to follow the key steps and recommended actions for Phase A to complete an initial analysis of Task #3's instructions. They should bring notes on this analysis with them to the second workshop.

It is recommended that the additional workshop begin with a warm-up discussion, during which students share their answers to the two questions from the Moodle announcement that prompted their reflection on Task #1 – Model Text. The teacher can elicit responses from students and offer further commentary related to the details they share. This warm-up discussion, which would take about 10 minutes, could lead into a small group discussion activity during which students review the formative feedback received on Task #1. The teacher could instruct the class to go to the course's Moodle page and reopen their Task #1 submission so they can view the formative feedback received, and then the class would organise themselves into teams of 3-4 people, electing one student per team as its representative.[24] Instructions shared in a slideshow can prompt the teams to discuss how to interpret the comments applied to their submissions and where any related issues may be located within those texts. Team members would then offer suggestions to each other on how to improve their written output for Assignment 2 – Part 2 by acting on the formative feedback received for Task #1. The teacher would circulate during this time, offering assistance to the teams if the need arises. If a group struggles to comprehend a particular feedback comment, locate related issues within a submission, and/or offer specific advice, the team's leader can send a specific question to the teacher, using either Moodle's private messaging tool or another online question-gathering application. The slideshow should point out that submitting questions to the teacher should be a last resort for teams after they have had time to work together to interpret their feedback and devise action plans. Towards the end of this activity, the teacher can examine these questions for trends, offering clarification to the whole class and sharing advice. It is suggested that 20-25 minutes be dedicated to this small group discussion activity.

[24] Since many activities during this second workshop involve students working in these teams, it is recommended that the teacher instruct them to change representatives after each activity. This way, most students – if not all of them – will have the opportunity to take on the leadership role, gaining practice in explaining answers or asking for clarification on behalf of others. This strategy ensures balanced practice of oral communication.

This opportunity for guided analysis of formative feedback received on Task #1 offers numerous advantages within the improved, expanded intervention. The activity would introduce more interactivity to the intervention, ensuring students benefit from more peer feedback and teacher-student dialogue, while also prompting them to reflect on their recent writing performance. Together, these features can help students move through the zone of proximal development, analyse their existing writing skills, and internalise the knowledge gained from the feedback, which could enhance their written output for the rest of Assignment 2 (Pritchard & Woollard, 2010; Vygotsky, 1978). This activity is also an ideal moment for the teacher to address any lack of understanding among new undergraduate students of the nature of comment libraries for formative feedback (i.e., applied quickly so not customised to each student or text), as well as any lack of awareness of the tiers of assistance available to them at the institution.

Next in the second workshop, it is recommended that an activity be included so students gain condensed practice of the first two phases of the A-B-C-D Formula for Critical Reading in relation to Task #3. However, issues with the writing prompt for Task #3 ought to be addressed before outlining this idea for practice. Based on participants' output during the study for this part of the assessment, as well as related attitudes linked to professional identity that were prominent in the data, it is suggested that Task #3's instructions be amended. Refer to Figure 7.11 below for the revised prompt for this task.

Figure 7.11

Revised Instructions for Task #3 of Assignment 2

As part of professional identity development, write a short report about your engineering discipline. This expository text will provide an overview of this career path, sharing information that covers the following details:

- Explain the meaning of the terms *engineering* and *professional engineer*, using industry-standard definitions. Summarise the impact (past and present) that professional engineers have on New Zealand society.
- Identify your engineering specialty. Describe the duties and associated skills of engineers working in this particular field.
- Explain the role of communication in this career path, giving examples of how such skills may be used.

Note: Sources for this submission must be limited to Chapter 1 of the *Engineering Your Future* textbook, other scholarly sources, and the official Engineering New Zealand website. If you are not an engineering student, please contact the lecturer so this writing prompt can be adapted to suit your discipline.

By changing the text type to a short report from an argumentative essay, Task #3 now aligns better with a prominent genre produced in engineering programmes and the corresponding industry. In addition, the new instructions set a clear purpose for the task by requiring students to gain a better understanding of their chosen discipline and the role communication will play in their career. Together, these features align well with Broussard's (2017) recommendations about genre, purpose, and authenticity in reading-to-write tasks. The task words used in this new prompt are ones included in the related PDF, which is shared on Moodle as part of the collection of supplementary intervention resources, so students can refer to this document when analysing the instructions. Content expectations for the old version of the prompt have been maintained, although the wording has been edited with the aim to improve students' understanding of them. These expectations have also been expanded slightly to draw specific attention to students' budding professional identity and the role of communication in engineering. This revised prompt also provides more explicit guidance on research expectations. It must be acknowledged that students new to engineering studies may not possess existing knowledge of this text genre. Therefore, an additional model text could be prepared and shared via Moodle to further scaffold students' completion of Task #3. The new model text may focus on another profession but otherwise demonstrate how to write a short report and meet the content expectations of the new prompt.

About 25 minutes should be dedicated to condensed practice of Phase A and Phase B in relation to this new writing prompt for Task #3. The teacher can begin this activity by having students return to their earlier teams and compare notes taken as part of their initial analysis of Task #3, which was completed as homework. Once students have had a few minutes to compare notes, the teacher should elicit answers from the groups to the following questions:

- What task words are present in these instructions?
- What type of text is required for Task #3, and how will this influence your voice?
- How could you organise this short report, ensuring you include all required details within the word count limit?

Asking these questions allows the teacher to confirm that the whole class has a solid understanding of Task #3's instructions. When discussing the last question, the teacher could use this moment to demonstrate in Microsoft Word how to format a short report. This shows students how each bullet point in the prompt could have its own section in the report, starting with a heading that identifies the theme of that section, thus ensuring that all content expectations are met. The teacher points out that space must be left to include short introduction

and conclusion paragraphs around these sections. An online lorum ipsum generator could be used to add filler text, showing students how to balance the word count appropriately across the parts of this text. They could repeat these steps on their own computers as the teacher demonstrates the creation of this short report template, which could ensure that the first report these engineering students submit is one featuring document formatting that meets professional standards. In total, this condensed practice of Phase A should take about 10 minutes.

The remaining 15 minutes is dedicated to additional guided practice in brainstorming since this study found that students would benefit from and appreciate such an opportunity. Brainstorming feeds into the reading-to-write process because writers transform source texts in order to support their own ideas (Flower et al., 1990). For this activity, the teacher could divide the room into three sections, assigning the small teams in each section one of the bullet points from Task #3. Teams would create keyword searches for their assigned point, and then representatives would send them to the teacher using Moodle's private messaging tool. As they are received, the teacher copies them into a Microsoft Word document and displays it to the class so that verbal feedback can be offered. Small group verbal brainstorming can aid creative thinking and "produce more workable ideas," while the use of digital technology during the brainstorming activity facilitates the sharing of feedback, thus contributing to peer learning and "the development of self-evaluation" (Al-Samarraie & Hurmuzan, 2018, p. 84). Next, the condensed practice of Phase B can end with an online brainstorming activity related to Task #3's research requirements (see Figure 7.12 on the next page for its instructions). Students are directed to a new Mentimeter space designed for this second workshop. For its first slide, students consider types of resources for possible use as sources in Task #3, rating them based on their appropriateness. Mentimeter's *Scales* question type can be used for this slide. Eight types of resources are included but only some would be appropriate sources for Task #3 due to the rules set for its research requirements. It is recommended that the teacher display a copy of the writing prompt as students work on this Mentimeter activity. Then as the results are revealed, students are prompted to gather their earlier teams to compare their choices and discuss any inconsistencies. The teacher can also offer a brief amount of verbal feedback to the class at this time and answer any related questions.

Overall, this condensed practice of Phase A and Phase B ensures that students benefit from some teacher-student dialogue in relation to Task #3. However, these activities rely more on peer interaction. This intentional design choice gradually removes teacher support without making students feel like — as one of this study's participants put it — their scaffolds have been kicked out from under them.

Figure 7.12

Task #3 Online Brainstorming Activity

TASK #3 BRAINSTORMING: Working alone, make decisions about resources that could fill gaps in your knowledge and satisfy research requirements for Task #3. Use the QR code provided or click here to link to the Mentimeter space where you will input your choices. Be prepared to discuss this activity with the class.

Rate these types of resources based on their appropriateness as sources for Task #3. For each resource, use any number in the scale of 1-5, with 1 meaning it's not appropriate and 5 meaning it's highly appropriate. Numbers can be used more than once.

- AI-generated content
- books about professional communication
- encyclopedia entries
- engineering blogs
- engineering textbooks
- https://www.engineeringnz.org
- https://www.engineering-dictionary.com
- journal articles

With an hour remaining in the second workshop, there is plenty of time to devote to reimagined versions of two activities that were removed from the first workshop during its re-planning. The first of these involves the critical reading of an abstract with some questions to answer. This activity has been redesigned as a team-based activity and features a new abstract to align with the revisions made to the writing prompt for Task #3 (see Figure 7.13 on the next page for the instructions). It is recommended that 25 minutes be devoted to its completion, which should be sufficient for students to read the abstract and address the three questions.

The Mentimeter space created for this second workshop, as mentioned on the previous page, should have two additional slides to facilitate the completion of this activity's first two questions. Teams start by selecting words/phrases from the abstract that demonstrate its connection to Task #3. Mentimeter's *Word Cloud* question type can be used for this slide, with four responses allowed per team. While displaying the resulting word cloud, the teacher can offer verbal feedback to the class. It would be advantageous to prepare a handout containing a copy of the writing prompt for Task #3 followed by a copy of this abstract. This page can be given to each student to make the activity easier to complete, keeping the classroom's screen free to display the Mentimeter space where the word cloud is generated. Next, the teams judge the abstract to determine which part of Task #3's content expectations could be addressed by using the article as a source. Mentimeter's *Multiple Choice* question type can be used for this slide, and six options are included. Teams would have to agree on one choice from among these options for leaders to submit, and then trends could be discussed as a class.

The third question connected to this critical reading of an abstract can be addressed offline as a small group discussion. The question prompts the teams to determine a likely

weakness of the source in relation to Task #3 based on its abstract. Once they agree on a weakness and how to explain it, their leaders share these answers with the class, which allows the teacher to provide verbal feedback.

Figure 7.13

Critical Reading of an Abstract Activity

CRITICAL READING OF AN ABSTRACT: In connection with Phase C, read the abstract provided and answer the questions to determine how the article might be connected to Task #3. For each of the following questions, collaborate with your team to agree on answers. After completing each question, leaders will share the teams' choices. For the first two questions, this is done in the Mentimeter space, which leaders can access via the QR code provided or by clicking here. The third question involves a class discussion. This activity will take 25 minutes to complete.

Engineering graduates require an ever-increasing range of skills to maintain relevance with the global environment of the new millennium. Communication skills are a vital component of this, recognised by academia and industry alike. English language skills are also important given its widespread status across the globe as a *lingua franca*. Indeed, multilingual skills are considered a salient element in the make-up of the new global engineer. English for specific purposes focuses the learner's attention on the particular terminology and communication skills required in the international professional field. Communication skills development is discussed in the paper, with examples given of different methods of teaching and assessment. The impacts on communication skills development include various elements, including gender equality. A lack of sufficient communication skills serves only to undermine the image of the engineer, but this can be tackled by engaging features of emotional intelligence (EQ) in the education of engineers. EQ offers various components that can improve communication skills and emphasise a more experiential approach to learning.

SOURCE: Riemer, M. J. (2002). English and communication skills for the global engineer. *Global Journal of Engineering Education*, *6*(1), 91-100.

1. **What are some words/phrases from this abstract that demonstrate its connection to Task #3?** Agree on 4 with your team and have your leader submit them. The resulting word cloud will be shared with the class and its trends discussed briefly.

2. **Based on the content of the abstract, which part of Task #3's content expectations could this source be used to address?** Agree on 1 choice with your team and have your leader submit it. Then trends can be discussed as a class.
   a) Explain the meaning of the terms *engineering* and *professional engineer*, using industry-standard definitions.
   b) Summarise the impact (past and present) that professional engineers have on New Zealand society.
   c) Identify your engineering specialty. Describe the duties and associated skills of engineers working in this particular field.
   d) Explain the role of communication in this career path, giving examples of how such skills may be used.
   e) More than one. Based on its abstract, there is potential for this article to be used as a source to satisfy multiple content expectations.
   f) None. Based on its abstract, the article does not appear directly connected to any of Task #3's requirements.

3. **Based on the content of the abstract, what is one of this source's weaknesses in relation to Task #3?** Agree on a weakness with your team and how to explain this to the class. Then your leader will identify the weakness and share the team's justification as part of a class discussion.

This second workshop can end with an activity that provides students the opportunity to practice their paraphrasing skills. The teacher can start the activity by playing an eight-minute

video prepared by Monash University about correct paraphrasing technique for academic writing. Students are instructed to take notes on the guidance provided while watching it.

The next step involves students drafting a short paragraph related to the last point of Task #3, which requires them to explain the role of communication in an engineering career. It is advised that the teacher provide the following guidelines for this text's content expectations:

- Sentence 1: A topic sentence that ties the paragraph to the last point of Task #3.
- Sentence 2: A sentence that communicates the idea from the quotation displayed, which has been paraphrased in your own words, and ends with a correct in-text citation.
- Sentences 3-4: Further explanation or analysis in your own words, expanding on the idea from the source.

Once the teacher provides this guidance, a short quotation is displayed for 15-20 seconds, during which time students must read it without taking notes. Then its reference is displayed so students can note the required details for an in-text citation. Since Task #3 stipulates the use of Chapter 1 of the *Engineering Your Future* textbook as an acceptable source, the quotation displayed could come from this resource. Figure 7.14 shares a recommended quotation, taken from page 17 of the textbook, and the corresponding reference. After students read the quotation and copy details for an in-text citation, they are granted up to 10 minutes to draft their sentences. The paragraph's content expectations can be displayed during this time as a reminder of requirements.

Figure 7.14

Quotation and Reference for Paraphrasing Source Content Activity

Quotation to be paraphrased:	This source's reference:
"being able to communicate technical ideas in non-technical language"	Dowling, D., Hadgraft, R., Carew, A., McCarthy, T., Hargreaves, D., Baillie, C., & Male, S. (2020). *Engineering your future: An Australasian guide* (4th ed.). John Wiley & Sons Australia, Ltd.

For this activity's third step, students exchange their paragraphs with a partner sitting next to them. The pair read each other's draft and provide verbal feedback on the quality of paraphrasing in Sentence #2, based on guidance from the video, as well as the correctness of the in-text citation. Additional verbal feedback on writing mechanics (e.g., sentence structures, grammar, punctuation, spelling, vocabulary choices) and how well the paragraph meets overall expectations outlined for this activity can also be offered during this time. The teacher can display a list of these directions for the peer feedback portion of this activity. Together, the

three steps of this final activity should take about 25-30 minutes, at which point the workshop session reaches its end.

These last two activities for the second workshop provide students with condensed practice of Phase C and Phase D. They create opportunities for students to critically read an abstract as part of determining the article's potential as a source, use paraphrasing skills to connect source content to their own ideas, and gain further experience in applying APA format when writing. This rounds out their practice of the formula in connection with Task #3. As with the first half of this workshop, interactivity and peer feedback play a considerable role in these activities. The design choices were influenced by this study's findings, and the end result is an expanded intervention that satisfies students' need and desire for additional time dedicated to the practice of the A-B-C-D Formula for Critical Reading.

Figure 7.15

Additional Resources to Encourage Independent Study of Engineering Communication

Bakos, J. D. (1997). Communication skills for the 21st century. *Journal of Professional Issues in Engineering Education and Practice*, *123*(1), 14-16. https://doi.org/10.1061/(ASCE)1052-3928(1997)123:1(14)

Ellis, R. (1999). *Constructive communication: Skills for the building industry*. Routledge. https://doi.org/10.4324/9780080573519

Lappalainen, P. (2009). Communication as part of the engineering skills set. *European Journal of Engineering Education*, *34*(2), 123-129. https://doi.org/10.1080/03043790902752038

Rau, G. (2019). *Writing for engineering and science students: Staking your claim*. Routledge. https://doi.org/10.4324/9780429425684

Rothwell, E. J., & Cloud, M. J. (2016). *Engineering speaking by design: Delivering technical presentations with real impact*. CRC Press. https://doi.org/10.1201/b18699

Wang, J. X. (2008). *What every engineer should know about business communication*. CRC Press. https://doi.org/10.1201/9780849383977

With plans for the intervention's expansion now shared, only two related details remain unsettled: how to encourage students' ongoing development of academic literacies for the benefit of their engineering studies, and when to schedule the deadline for Assignment 2 – Part 2. It is suggested that the first of these matters be resolved through a Moodle announcement. After the second workshop, the lecturer can share a message with the cohort, encouraging them to engage in more independent study of engineering communication (Robinson et al., 2013). The announcement can direct them to a list of additional resources that are accessible through the institution's library (see Figure 7.15). The resources included in this list are selected specifically because they are customised to the engineering discipline and cover a wide array

of communication skills. Regarding the second matter, the course convenor can determine when to set the assessment deadline. If this second workshop is embedded in ENGEN170, the Sunday at the end of Week 4 may remain an appropriate deadline for Assignment 2 – Part 2, or it could be delayed slightly. This will depend on the scheduling of the second workshop since several days at least should separate it from the deadline, thus giving students sufficient time to complete the two tasks and submit them through Moodle. Granted, the deadline should not be set much later than this to avoid stacking it with those for other assessments.

Refining the Formative Feedback Strategy

Part of this action research project's final stage of re-planning involves making improvements to the intervention's formative feedback strategy. Some of these changes were discussed earlier in this chapter when the revised critical reading online activities and the design of the second workshop were shared. Many of those changes ensure that future cohorts can benefit from more varied modes of feedback and an increase in peer discussion and teacher-student dialogue. They will also receive clearer guidance about expectations for peer feedback. However, in the instances where automated feedback is still used, only a few minor changes have been made and were identified already. Such feedback was always intended to be brief and limited to commenting on student performance and suggesting a direction to make progress in the future. This ensures students can read automated feedback comments quickly before moving on to the next stage in their practice of the A-B-C-D Formula for Critical Reading. It is believed that the improved balance of automated feedback, peer feedback, and teacher-student dialogue about the practice enriches the intervention's formative feedback strategy and will be welcomed by future cohorts. This leaves two matters for discussion here: the misalignment of students' expectations of feedback and educators' feedback practices in higher education, and strategies for improving the feedback comment library.

Firstly, this study draws attention to the gap that exists between incoming undergraduate students' expectations of feedback and the methods typically employed by lecturers when providing feedback. This phenomenon is not unique to this study. Other research has found that new university students question the sufficiency of feedback, particularly because they are not provided feedback on drafts and/or may expect written comments to be constructive, personalised, detailed, and extensive (Brinkworth et al., 2009; Crisp et al., 2009; He et al., 2024; Holt et al., 2024; Robinson et al., 2013). Similarly, trends in my survey responses, as identified in Chapter 4, suggest that many students are struggling to adapt to a new relationship with feedback at the university level. Some students may even lack awareness or understanding of the various ways feedback can be provided. It is possible that past educators (e.g., high

school teachers) used a more targeted approach to feedback to help them improve certain literacy skills. Students may have been given detailed, individual feedback on past assignments, possibly with line-by-line notes highlighting specific errors made and/or how to improve. This kind of interaction can make a student's path to improvement dependent on the teacher's direct guidance.

However, it may not be standard practice among engineering lecturers to meet these kinds of feedback expectations when teaching first-year undergraduate students. Minimal literature is available that focuses on feedback practices employed in engineering education, but key insights can be drawn from a couple of recent studies. For example, a critical review of assessment and feedback practices in engineering education found that many engineering lecturers' practices are not effective at fostering the competencies — including communication skills — that would make graduates employable (Subheesh & Sethy, 2020). Another review of 99 engineering education studies published between 2000 and 2017 found that only 26% of them focused on the use of summative grading and formative feedback to assess students' performance; just a fraction of these (7%) explicitly mentioned the use of formative feedback, with rubrics most often being the means of sharing it with students (Cruz et al., 2020).

Connecting this to engineering education at the University of Waikato and its ENGEN170 course, it is worth recalling how Assignment 2 was graded before the inclusion of my intervention. Formative feedback was not provided on Assignment 2 previously; instead, a few summative comments covering the assignment's three tasks were shared alongside the grade. Once my formative feedback strategy was introduced as part of the intervention, it still did not meet some participants' expectations for feedback. Therefore, undergraduate students ought to adapt their expectations about feedback to better align with assessment practices at university.[25] They should learn how to interpret feedback comments provided (or ask further questions, if needed), analyse their own writing to find evidence matching those comments, reflect on their strengths and weaknesses, and design a path that will allow them to make improvements (either independently or with assistance). Granted, incoming university students ought to be informed of such expectations where feedback is concerned and taught how to interpret various kinds of feedback offered by university lecturers so they may follow its guidance independently. The addition of a disclaimer at the end of the intervention lecture about independent study helps satisfy this need; it clarifies for students the expectation of

[25] Although, it is also worth acknowledging that there is room for improvement in the assessment and feedback practices employed within engineering education, as indicated by the two studies cited on this page.

dedicating some time to improving academic literacies, including the ability to interpret and incorporate feedback into future written output. Later, an activity at the beginning of the second workshop guides students through the analysis of formative feedback received on Task #1, with the aim that this will become part of their post-assessment routine.

In addition to these improvements to the intervention's formative feedback strategy, it is important that Assignment 2's feedback comment library be reviewed. In accordance with this study's findings, the feedback comment library ought to be more specific, offer more advice, and draw connections to supplementary learning resources. Such improvements could have a positive impact on learner autonomy. The first step in achieving this aim is to revise existing comments to offer more specific guidance on how to address certain issues and better meet criteria. Currently, a series of comments exist that align with the critical reading rubric's five assessment criteria and five proficiency levels. The comments identify strengths and weaknesses based on students' written output, include phrasal links to the rubric's performance descriptors, and suggest how they may improve the application of the A-B-C-D Formula for Critical Reading in the future. A new set of QuickMarks was created around this feedback comment library to make it easy to drag and drop individual comments onto submissions in Feedback Studio. Therefore, revisions should target comments used when a student achieves a low proficiency level for the criteria. An additional sentence could be added to each of these comments that directs students to specific, supplementary resources that may help them improve in that area. Since QuickMarks allows for links to be embedded in comments, this is an ideal way to recommend resources while maintaining the readability of the feedback. To improve the feedback comment library, the next step is determining which resources to recommend. Figure 7.16 on the next page shares examples of improved comments that guide students to some chosen resources. In four of the five improved comments, a hyperlink leads students to a University of Waikato-based resource. Other hyperlinks direct students to external resources, which offer appropriate and useful guidance on academic literacies. The inclusion of links to additional resources in Assignment 2's feedback comments should encourage independent study since they direct students to a means to resolve a problem in their writing. Then they can draw on the knowledge gained when applying the A-B-C-D Formula in future writing assignments.

Regarding feedback, future cohorts will also benefit from the intervention's expansion to include a second workshop because part of it scaffolds students' interactions with formative feedback from Assignment 2. The activity allows them to conduct a guided analysis of their Task #1 submissions and discuss strategies for improvement with their peers. If ENGEN170

can be further adapted to accommodate this additional workshop in the future, it could serve as a bridge between students' familiarity with receiving highly detailed feedback in high school (i.e., line-by-line editing notes) and the feedback practices typically employed at higher education institutions.

Figure 7.16

Improved Formative Feedback Comments for Assignment 2

- **LACKING QUALITY SOURCES** Your text did not meet the research requirements. Please follow the critical reading formula more closely for the next writing task to ensure you meet the expectations of university study. It may help to study the library's information on choosing the right sources, and you could start future searches for scholarly sources with the university's links to resources for your engineering specialty.
- **INTEGRATION NOT ACHIEVED** It seems you've spent little effort on Phase D of the formula because source content is not well connected to your ideas. Where is your own analysis? What is your position in this text? It would help to study Student Learning's resources on argument and voice, while another resource on voice in academic writing shares a useful example about supporting a position with evidence. You should also book a CeTTL consultation to get help with academic writing skills because you haven't met university expectations here.
- **FAULTY REFERENCING** Most of your text doesn't follow referencing conventions. In academia, this is a serious error that could result in consequences if repeated. Please review Phase D and the rules of this referencing system and seek help from a CeTTL expert. It is also recommended that you refer to the university's guides on APA reference formatting and examples.
- **SIG. PLAGIARISM = WARNING** You've plagiarised a significant portion of this text instead of demonstrating your own writing ability. This is a warning; future offences could involve additional consequences. Please book a CeTTL consultation to learn more about the types of plagiarism and how to avoid it. You can also refer to the university's information on plagiarism and APA's plagiarism guidance.
- **FAULTY ORGANISATION** You've used source content in a few inappropriate places here. This has negatively affected the text's organisation, making the logic of your position hard to follow. You should complete the short video lesson on academic paragraphing and review how to build clear paragraphs.

Note. These comments are some of the ones used when students achieve low proficiency for the criteria. In each instance, sentences containing hyperlinks are the ones that have been added to improve the comments.

There is potential for further improvements to the intervention's formative feedback strategy, but these must wait for a later date. As the revised, expanded intervention is taught to each new cohort, the lecturer could keep a teaching log of observations. Such notes would aid efforts to make any further refinements to the overall design, including the formative feedback strategy. One option is the addition of new comments to the feedback comment library based

on trends in student performance. This is dependent on the School of Engineering greenlighting my recommendation to permanently embed the revised, expanded intervention in the ENGEN170 course curriculum.

The Revised, Expanded Intervention as a Permanent Fixture

Plans for fine-tuning and expanding this study's critical reading intervention were shared in earlier subsections, so it remains to discuss the role this improved intervention should have in ENGEN170's future. Permanently embedding it in the course is recommended for several reasons. Firstly, the development of communication and critical thinking skills are among the requirements set forth by the Washington Accord. Since New Zealand is a signatory country, undergraduate engineering programmes offered by its higher education institutions must meet these expectations to maintain accreditation. Ensuring that future cohorts are given dedicated class time to practice critical reading and its application in discipline-specific academic writing would help the University of Waikato's engineering offerings better align with the Accord's requirements. Green (2020) pointed out that the effective development of disciplinary literacies requires "an expansion and a conscious planning of the academic literacy work carried out by disciplinary academics in their programmes" (p. 48). However, as stated in Chapter 2 of this thesis, other research has found that engineering lecturers do not always possess the willingness or aptitude to design and teach lessons on academic literacies (Strauss & Grant, 2018). Instead, an original intervention designed by an academic literacies expert and refined through action research is already available. ENGEN170's convenor ought to take advantage of this reality since it will improve the standard of teaching offered to future cohorts enrolled in the course and contribute to ongoing accreditation of the university's engineering programmes.

Secondly, permanently embedding the intervention in the course ensures students benefit from its numerous other features. For instance, the intervention's use of BL facilitates new undergraduate students' early exposure to the kinds of online learning tools commonly utilised in higher education. Refinements made to the critical reading online activities and other features ensure that future cohorts will benefit from a diverse formative feedback strategy. The expanded intervention also provides students with practice opportunities in interpreting formative feedback received — an activity that raises their awareness of the assessment strategies and feedback practices typical in tertiary studies as well as the need to build this step into their independent study routines. In addition, the improved design features more explicit development of students' budding professional identity as future engineers with the aim of ensuring deeper understanding of the role of communication skills in that career path. Therefore, the revised intervention offers a robust set of rewards to students enrolled in

ENGEN170 and sets a positive tone in the earliest weeks of their university experience for the kinds of learning and growth their chosen path can offer them.

Thirdly, my action research project has demonstrated the effectiveness of establishing partnerships between engineering lecturers and academic literacies experts. The gains reaped from such an arrangement do not have to stop with ENGEN170, though. The University of Waikato would benefit from further revisions to its engineering curricula involving the expansion of relationships between subject lecturers and academic literacies experts. For example, the institution could follow a model similar to that used at the University of Adelaide, where two of the chemical engineering undergraduate courses were "delivered jointly by engineering lecturers and communication specialists" (Yong & Ashman, 2019, p. 21). Specifically, my study's improved and expanded intervention, using the revised materials shared in this chapter, could be permanently embedded in ENGEN170 and an academic literacies expert attached as co-teacher. This would ensure that every new cohort of undergraduate engineering students learns the A-B-C-D Formula for Critical Reading and practices applying it to Assignment 2 during the first weeks of tertiary studies. Then, to ensure that the university's engineering programmes continue to embed academic literacies in the courses covered in Years 2-4, further revisions to lessons and assessments may be necessary. This would create opportunities for the academic literacies expert to return in the other engineering courses as a co-teacher or workshop tutor, reminding students of the formula and discussing how to adapt what was learned previously to help them meet expectations of new assessments. With sufficient time dedicated to students' academic literacies development year on year as part of their engineering education, it is possible that this pathway could improve their attitudes and raise awareness of the essential role of communication skills in the engineering profession. At the very least, establishing partnerships between subject lecturers and academic literacies experts to improve curricula is likely to help close the gap, as noted by Khoo et al. (2020), between the level of communication competency students achieve by graduation and that required by engineering employers.

Adapting the Intervention to Other Contexts

Engineering lecturers and programme leaders at other institutions are advised to adapt my revised, expanded intervention for their use and have an academic literacies expert join their team. These changes could fuel numerous research projects while also having a positive impact on teaching and learning. The intervention design is best suited for embedding in first-year engineering courses, ideally those taught during the first semester of study. It is currently intended to align with a writing assignment comprising three short discipline-specific texts, all

of which must be supported by scholarly sources and completed individually. Therefore, other educators are advised to select a similar assessment to which they can attach this intervention. Alternatively, two separate writing assignments completed individually within the first half of the same course could also work, provided both workshops are adapted to scaffold students' completion of the second of these two submissions. That way, it is still possible for students to review feedback received on the first submission during the second workshop. When selecting the writing assignment(s) connected to the adapted intervention, it is preferable that it work with the existing critical reading rubric and associated feedback comment library. By eliminating or minimising the need to revise these formative feedback resources, this simplifies the educators' workload and reduces the likelihood that other teaching and learning resources will require substantial changes when used in the adapted intervention to feed into the formative assessment of students' written output.

Adapting the teaching and learning resources designed for this intervention should be relatively easy for most educators; however, it would be advantageous for engineering lecturers at other institutions to partner with an academic literacies expert when customising my materials to their courses and teaching them, at least for the first one or two iterations. This strategy ensures that the partners can support and learn from each other when trying something new for the first time; later, they could discuss the option of having the engineering lecturer take over teaching and formative assessment duties associated with the intervention. Although, engineering departments are encouraged to maintain relationships with their academic literacies experts, growing these partnerships and devising similar interventions that provide undergraduate engineering students opportunities to practice a variety of communication skills leading up to related assessments throughout their programmes.

Once a partnership is established, the engineering lecturer and academic literacies expert should coordinate the adaptation of my intervention's teaching and learning resources for a chosen first-year course. The aim is to remove content specific to ENGEN170's Assignment 2, replacing it with details relevant to the writing assignment(s) that the adapted intervention will support. Firstly, this involves duplicating the lecture slideshow shared in Appendix E, applying the improvements to it as recommended earlier in this chapter, and adjusting any course- or assessment-specific content (e.g., task instructions, examples, models, images) to align with the first text to be composed by students, which the adapted lecture will support.

Next, a similar process should be followed to adapt the revised critical reading online activities and related plans for the two workshops. Models of these online activities, which were shared earlier in this chapter, can serve as the starting point as the partners duplicate their

designs, either in Moodle or another LMS that supports the use of H5P. Whichever educator from the partnership is chosen to lead the intervention lessons will also need to create accounts with Mentimeter and Parlay Ideas so they can be used for the related online activities in the workshops. If any of these three online learning tools are unfamiliar to either member of the partnership, it is recommended that they seek professional development training and assistance from an e-learning expert at their institution when adapting the online activities and programming related automated feedback. It is also worth noting that some guidance on using these tools is readily available: H5P's Forum, Mentimeter's Help Center, and Parlay Ideas' Professional Development page are helpful resources to educators new to using these interactive platforms in their classrooms. As with the lecture slideshow, the partners will need to change any task instructions, examples, models, and images used in my plans for the two workshops to suit the second (and third) writing task attached to their adapted version of the intervention. When dealing with H5P activities that require set answers, it is recommended that the partners word their questions and answers as closely to mine as possible to avoid changing the automated feedback, if possible. Again, this minimises the workload associated with the adaptation process. If the partners struggle to find suitable excerpts and abstracts for use in their adapted intervention, seeking assistance from an academic liaison librarian is advised.

A few additional details must be considered when adapting my critical reading intervention for use in other courses. Firstly, the partners will need to consider what supplementary intervention resources they wish to share with students via their LMS, as well as what links to independent study resources to post. It is recommended that students have access to a copy of the critical reading rubric in advance. Since many of my participants also made use of the model text I shared, it is advised that academic literacies experts compose one that aligns with the first text students must compose in connection with the adapted intervention; input from engineering lecturers will ensure that any models produced align with disciplinary conventions and assessment expectations. Once teaching and learning resources have been adapted for their chosen context, the partners ought to test the functionality of all online activities and links to resources before they are used by students. Lastly, the partners will have to make decisions about working the intervention into the course's timetable and any adjustments to the related assessments' deadlines.

Limitations and Considerations

As established in this thesis, following an action research methodology to investigate how a BL-infused AL model can be embedded in an engineering course has yielded a wealth

of findings. Insights about students' practice of critical reading and their attitudes towards the reading-to-write process will have value to the University of Waikato and its School of Engineering team, as well as other subject lecturers and academic literacies experts at higher education institutions around the world. However, a few limitations and considerations associated with this study should be addressed.

The first issue that ought to be mentioned is the fact that the revised, expanded intervention remains untested in the classroom. This is because my action research project ends with a phase of re-planning instead of taking further action by implementing the improved plan and observing its effects in the classroom. Other practitioners may perceive this project as incomplete action research, but it is part of an evolving set of ideas and practices. It is worth reminding readers that earlier versions of materials were used during my previous role as an EAP teaching fellow within the University of Waikato's transnational engineering programme in China. Changes made in preparation for this project and as a result of this study's findings are based on evidence as well as guidance from established literature. Therefore, the wider context must be factored into consideration. This means my choice to end with a re-planning phase does not constitute a methodological flaw or limitation in the traditional sense, but I would be remiss if I did not acknowledge the untested nature of the improved intervention here.

It is also important to consider that the decision to expand the intervention to include a second workshop will require more significant changes to the course. Even though this study's findings indicate that such an expansion is necessary, the impact it will have on ENGEN170's timetable and curriculum ought not be ignored. Specifically, it is likely that reducing and/or cutting two hours of existing content will be necessary to make room for the expansion. Alternatively, a flipped classroom approach to learning two hours' worth of engineering content could be considered as part of a solution, or it could be assigned as independent study and assessed via the completion of an online task (e.g., quiz, discussion forum, short video presentation). Negotiation with the course convenor and support from other departmental leaders will be required to make the expansion of my intervention work and ensure that changes made will not negatively impact the engineering programmes' ability to maintain accreditation. Granted, this dynamic is to be expected for an embedded intervention functioning within accredited programmes.

Thirdly, despite the richness of the data, participation rates and logistical factors may have limited the spread of perspectives captured in the data. Such variables were out of my control because the study relied on human participants as sources, and it had to function inside boundaries set by the course convenor. For instance, there is a considerable disparity between

the numbers of students who completed the study's two surveys, rooted in the fact that participation was incentivised but not mandatory. Similarly, the number of interview participants was lower than anticipated despite offering incentives. There was still a strong demographics spread within the group of interview participants, though. They were of different genders and ages. Several of them were high school leavers, while one was more than halfway through the degree programme, and another was a mature student with some professional experience but was attending university to update qualifications. The diversity within this study's small group of interview participants has ensured that the qualitative data gained by conversing with them is valid and useful. In addition, the course convenor put restrictions on the amount of classroom time that could be dedicated to the intervention. This prevented the inclusion of a scaffolded activity during which students could have created a revision plan for Task #1 based on the formative feedback received and then resubmitted that text with the improvements made. Without such an activity built into the intervention, it is unlikely that students would have gone through the rewriting and resubmission process voluntarily. Deprived of revised Task #1 texts, this study was unable to assess improvements made thus measure the impact of the formative feedback on written output. Such an opportunity is something that could fuel future research, so other educators should consider including this kind of activity if they adapt my expanded intervention design for their own practice.

Implications for the Engineering Discipline and Beyond

This study offers several important contributions to the field of academic literacies research. Firstly, its findings set the groundwork for a revamp of engineering education, from improvements in individual courses to those that could impact departmental staffing and institutional priorities. In addition, these findings are more broadly applicable to other disciplines where critical reading's function within the academic writing process is pertinent yet currently does not receive due attention from subject lecturers therefore remains underdeveloped within the student population. The systematic, practical, and adaptable nature of the A-B-C-D Formula for Critical Reading and its corresponding practice workshops could be instrumental in addressing this gap in higher education offerings. The fact that these original teaching and learning resources are shared within this thesis and guidance is provided on how to adapt them to other contexts should also stand out to readers. By making these materials easily accessible and encouraging other educators to use them, my thesis satisfies the need for greater explicitness, specificity, and information on implementation in studies that apply the AL model. This project also demonstrates the value behind educators from disparate specialties

establishing collaborative working relationships, thus encouraging a dismantling of the siloed departmental structure often in place at large institutions. In this final section, these various contributions are highlighted, as well as the opportunities that exist for additional research expanding on the original ideas explored in this thesis.

Following the AL model, this study has explored the influence of the A-B-C-D Formula on undergraduate engineering students' critical reading skills, as well as their attitudes towards critical reading and the academic writing process. The action research intervention, which used BL to provide students with online practice of this original reading-to-write formula, proved effective at enhancing some aspects of critical reading and its application in academic writing, but there remains room for improvement in students' performance. The study found that most participants, while viewing the practice opportunities as a positive learning experience, recognised their critical reading skills still need improvement even after completing the online activities. It is possible that completing the online activities enhanced the cohort's awareness of the critical reading skills required for academic writing, altering their expectations for their own skills. This reinforces the need to provide new undergraduate students with practice opportunities in advance of assessments to ease the transition to tertiary studies and clarify expectations. My intervention also helped this cohort acknowledge the importance of academic literacies in their studies and future engineering career. Together, these results suggest that a one-time offer of teaching and learning academic literacies in a first-year engineering course is insufficient considering the importance that communication and critical thinking play in engineering education and related professions. Engineering faculty at the University of Waikato and other institutions ought to consider this reality. It is recommended that they expand the amount of time dedicated to developing communication skills among undergraduate students enrolled in their programmes. While these implications relate directly to the study's two research questions, additional wisdom is gained through this study that is valuable to the engineering education sector.

Among its other outcomes, this research has identified that undergraduate students are beginning their university education with an understanding that it will present new challenges where academic literacies are concerned. However, they arrive with the expectation of receiving further guidance and practice opportunities in order to navigate assessments in their new learning context. Not all undergraduate programmes are designed to address these needs sufficiently. For instance, this study's participants were just starting undergraduate engineering studies when they took part in my intervention. As suggested by initial survey results, they had arrived at the University of Waikato with the expectation that their lecturers would help them

develop the critical reading and academic writing skills necessary to tackle their engineering assignments. I was not their subject lecturer, and the discipline-specific guidance and practice gained through my intervention was a new feature. These facts require consideration from course convenors and other leaders within the departmental and institutional hierarchy. It suggests that habits of the past — that is, relying on students to do independent study or avail themselves of services and resources provided by the library or CeTTL in order to develop academic literacies — no longer align with expectations held by new generations of undergraduate students. They are entering university anticipating that an embedded approach will be followed. To meet that expectation and better serve new cohorts, higher education institutions ought to implement the AL model in first-year undergraduate courses. This way, new students develop the discipline-specific reading and writing skills essential to success at the tertiary level. As suggested earlier, academic literacies experts should become co-teachers alongside subject lecturers, functioning as part of faculty teams within each department or division. They would support updates to curricula to embed the AL model in courses and ensure students practice discipline-specific academic literacies in advance of assessments. The University of Waikato is positioned to pilot this plan in its engineering programmes, starting with permanently embedding my improved, expanded intervention in ENGEN170. Then the academic literacies co-teacher role would be expanded to help in other courses. Practitioners at other institutions could follow suit with ease by utilising the models shared in this chapter, adapting the revised intervention to suit their programmes' needs. Further research could be conducted as curricula is adapted to gauge the impacts on teaching and learning.

In addition, the combined discussion in this thesis highlighted a rise in students' self-awareness regarding the complexities of applying critical reading to academic writing at university. This is an important revelation for this study since it relates to the concept of identity. By permanently embedding my improved and expanded academic literacies intervention in ENGEN170, there is great potential for it to contribute to the socialisation of new cohorts as they learn to identify as engineering students. They are not blank slates when they arrive at the University of Waikato. Therefore, it is the duty of subject lecturers and academic literacies experts to work together to address and correct students' misassumptions — especially regarding the important role of communication in engineering education and how much practice is needed to develop those skills so they meet professional standards. Educators at all universities should acknowledge that first-year engineering students will arrive with foundations of differing quality. This will affect how they build their discipline-specific academic literacies, establish their new identity as engineering students, and grow into a future

identity as professional engineers. It is recommended that other practitioners find ways of nurturing undergraduate students' learner identity in an explicit manner. An embedded AL model would suit such an aim and facilitate future research on students' evolving identity.

Overall, placing greater emphasis on academic literacies in engineering programmes would create numerous opportunities for innovative research. In fact, the adaptability of the A-B-C-D Formula for Critical Reading and the corresponding practice workshops means these teaching and learning resources are well suited for developing academic literacies across many disciplines. For example, teacher-researchers have the option of adapting the revised intervention plans shared in this chapter for use in other STEM contexts and studying the related effects. Other educators can adapt these resources to their own teaching contexts in an effort to improve students' critical reading skills. If enough programmes embrace the plans, academic literacies research could be conducted division-wide or even across divisions at a university. In addition, it would be possible to conduct longitudinal studies on the impact of such changes to teaching and learning. These studies could also examine the effects on student attitudes and their development of a professional identity.

Moreover, in partnering with the School of Engineering to undertake this study, I have demonstrated the importance of relationship building as part of embedding academic literacies teaching and learning in the disciplines. Academic literacies experts around the world need to explore spaces within their institutions where they currently hold low influence by offering their services to subject lecturers as problem solvers. This strategy not only reinforces the value that academic literacies experts bring to their universities but also helps break down the siloed nature of institutional culture.

Once a cross-disciplinary partnership is established to initiate curricular modifications, the alliance itself could become a subject of study via collaborative autoethnography. As a model of such research, readers can look to a paper I co-authored with ENGEN170's course convenor about the partnership formed to make my action research possible (see Busteed & Gavin, 2023). That paper shared valuable insights on how to make such collaborations work, including the importance of the following: (a) effective communication between collaborators and all affected parties; (b) setting realistic goals and being strategic about time management; (c) being flexible and adaptable when negotiating aspects of the project; and (d) being forward thinkers and taking steps to disaster-proof the intervention (Busteed & Gavin, 2023). Other practitioners are encouraged to explore the critical reflections we shared in that paper and then build reflexive practice into the cross-disciplinary partnerships they establish at other institutions.

Each educator who follows one of these paths will shrink the existing gap in the literature where academic literacies development in the engineering discipline is concerned. Once a greater array of literature is available, those experts could organise professional development seminars. These opportunities might encourage engineering lecturers to participate more in the teaching of communication skills or, at the very least, help them recognise the advantages of collaborating with an academic literacies co-teacher. Institutions that support any of these endeavours will not only increase research output but also create opportunities to strengthen their engineering programmes. Doing so would ensure that graduates are competent in all requirements set by the Washington Accord and prepared to meet professional communication standards of the engineering field. For my part, this thesis serves as a bridge between the fields of academic literacies and engineering by developing the communication skills of students who will build the tools and world of our future, and I encourage other teacher-researchers to build other bridges like it.

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Appendix A: The Critical Reading Rubric

ASSESSMENT CRITERIA:	ACHIEVED WITH EXCELLENCE	ACHIEVED WITH MERIT	MODERATE ACHIEVEMENT	ACHIEVED WITH FAULTS	EXPECTATIONS NOT ACHIEVED
Chosen Sources & their Quality	Two or more sources were used in this text. All of them are relevant and appropriate, meeting the requirements of the assignment.	Two or more sources were used, but they are not all appropriate and/or relevant. Most of the assignment's research requirements were met.	One source was used in this text. It is relevant and appropriate. The writer should have spent more time looking for additional sources to use.	One source was used, but its appropriateness and/or relevance is questionable. The writer did not use enough sources of quality in the text.	All sources are irrelevant, inappropriate, or missing. Research requirements were not met.
Conventions of Using Source Content	Paraphrasing integrates source content seamlessly into the text. A position is presented clearly, with experts' viewpoints providing excellent support to the writer's ideas. A maximum of one quotation is included.	Source content is integrated well, but paraphrasing needs minor improvement. The support it offers to the writer's ideas is strong, but analysis of source content could be improved slightly. There is one too many quotations in the text.	Sentences featuring source content are sound, but paraphrasing needs revision. It is not always clear how source content supports an idea. Deeper analysis would clarify the writer's position versus experts' viewpoints. Several quotations are included in the text.	The integration of source content features many errors and/or flawed paraphrasing. Source content offers weak support to the writer's ideas. Analysis rarely follows experts' viewpoints, which weakens the position. Quoting may be used extensively.	Source content is not integrated throughout the text. Most or all of it is disconnected from the writer's ideas, and the quality of analysis does not meet the level required. Quoting may be used primarily instead of paraphrasing.
In-text Citations and Reference List	Correct presentation of in-text citations, as well as alignment between the in-text citations and the reference list. Reference list reflects correct referencing conventions.	In-text citations and the reference list are mostly correct. Minor errors in conventions in the text and/or reference list are noted. All sources cited in the assignment are in the reference list.	Several errors in the presentation of in-text citations and the reference list. Not all sources are cited in the body, or a source is missing from the reference list.	The writer has not followed citation rules in the majority of the text. The reference list is missing or incomplete.	The writer has not made any attempt to cite sources in the body, and the reference list is missing.
Evidence of Plagiarism	The text exhibits no evidence of plagiarism, including collusion.	There is no plagiarism, but minor errors in the writer's paraphrasing and/or quoting technique are evident.	Minor plagiarism is noted. A review of the rules on using source content needs to be undertaken.	Significant evidence of plagiarism is noted.	Serious evidence of plagiarism is noted, with 40% or more of the text being stolen content.
Organisation of Source Content	The text is organised logically with all source content appearing in appropriate places.	Source content within the text appears in appropriate places, but minor errors are evident in the text's logic.	There is some evidence of organisation and logic, but source content appears in a topic sentence or concluding sentence.	Source content appears in inappropriate places more than once. The resulting text has weak logic due to several organisational errors.	Source content is dropped into the text in many inappropriate areas. There is no evidence of the level of organisation required.

Appendix B: Copy of Ethical Approval

Te Wānanga Toi Tangata
Division of Education
The University of Waikato
Private Bag 3105
Hamilton,
New Zealand, 3240

Division of Education Research
Ethics Committee (DEREC)
fedu.ethics@waikato.ac.nz
www.waikato.ac.nz

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

2/11/2022

Dear Sheila Busteed

Division of Education Research Ethics Committee Application Approved
FEDU068/22

I am pleased to advise you that your ethics application for the project entitled "Academic literacies and the A-B-C-D Formula: Engineering students' use of online activities for critical reading skills development" was approved by Te Wānanga Toi Tangata Division of Education Research Ethics Committee on November 2nd, 2022.

Please be aware that the Te Wānanga Toi Tangata Division of Education Research Ethics Committee must be advised (by memo) of any changes to the details recorded in your ethics application. Please send any such advice to fedu.ethics@waikato.ac.nz. You will receive a memo of approval once the change(s) has been considered.

Kind regards

PJ Frawley

Chair
Te Wānanga Toi Tangata Division of Education Research Ethics Committee (DEREC)

Appendix C: Covering Letter about the Research Project

PhD candidate Sheila Busteed is conducting action research involving the creation of a teaching intervention embedded in ENGEN170. As students enrolled in this paper, you will serve as the study's participants for the next few weeks.

In this study, we will trial a new method for the teaching and learning of academic literacies. Designed specifically for engineering students, the method will focus on critical reading and its application in academic writing. During a brief lecture, Sheila will introduce you to the A-B-C-D Formula for Critical Reading, and then you will practice its four stages in a series of online activities. This method is designed to further develop your critical reading skills and prepare you for the completion of Assignment 2.

Sheila's research will collect data through the following means:

- your submissions for Assignment 2
- your answers to the critical reading online activities
- classroom observations noted in a teaching log
- 2 surveys *(voluntary)*
- an interview *(voluntary; capped at 15 students on a first-come basis)*

Because Sheila's lecture and online activities are embedded in your class schedule, your participation in them is expected. However, you still have rights as volunteer participants in this study, including the right to opt out of having your data used. If you wish for your Assignment 2 submissions and answers to the online activities to be removed from Sheila's data set, you must email her at sb319@students.waikato.ac.nz to opt out. The subject line of this email should be "Opting out of your study". The body of the email must include your full name, student ID number, and the following statement: *This email serves as notice that I am opting out of your critical reading study and do not wish for any of my data to be used.* If you opt out of the study, this means you would not voluntarily participate in the surveys or interview, either.

While the surveys and interview are voluntary, your completion of them will qualify you to win prizes. When you complete a survey, your name will be added to a draw for one of 10 gift certificates valued at $10. If you complete both surveys, your name goes into that draw twice. Interview participants who also completed both surveys will automatically receive a gift certificate valued at $25.

You will receive formative feedback throughout the study's stages. While Sheila will lead this study, she is not employed as an ENGEN170 teacher so your participation in this study will not affect your grades.

Contact information:
Sheila Busteed (researcher) sb319@students.waikato.ac.nz
Laura Gurney (PhD supervisor) laura.gurney@waikato.ac.nz

Appendix D: Informed Consent Sheet

1. I understand that my participation in certain tasks linked to this study is expected because they are embedded in the ENGEN170 schedule. These include the completion of Assignment 2 (both parts), attending the researcher's lecture, and completing the critical reading online activities. I understand that my participation in the surveys and interview is voluntary.
2. I consent to the researcher collecting data produced in connection to this study.
   ALTERNATIVE: I understand that I have the right to withdraw from the researcher's study at any time. If I choose to opt out of the study, this means my data would not be used. I understand that I must email the researcher (as outlined in the project's covering letter) to opt out of this study.
3. I agree that the researcher can read my Assignment 2 submissions and provide me with formative feedback via Moodle. I understand that the researcher will not be assigning grades in this paper.
4. I understand that the information and data collected during the study will be used in the researcher's doctoral thesis. I consent to her selecting quotations from Assignment 2, my survey answers and/or the interview. I understand that this information is no longer confidential since it is reported in the researcher's thesis and that it may also be used in other journal publications and/or presentations. In these instances, I agree that the researcher should remove possibly identifiable information from excerpts to ensure anonymity.
5. I agree that my name should be replaced by initials in any data sets in order to protect my identity. While the researcher will do her best to protect my anonymity, I understand that she cannot fully guarantee this.
6. If I choose to participate in the interview, I consent to the researcher videoing this conversation. I understand that I have the right to refrain from answering any question asked during the interview. I understand that I cannot withdraw data after I have approved the transcript.
7. I understand that the researcher will provide me with information on the study during classroom sessions and via Moodle. I agree to contact the researcher via email or through Moodle if I have questions or issues with participating in this research. I understand that, if a dispute cannot be resolved between me and the researcher, then I may contact her research supervisor.

Contact information:
Sheila Busteed (researcher) sb319@students.waikato.ac.nz
Laura Gurney (PhD supervisor) laura.gurney@waikato.ac.nz

Appendix E: Intervention Lecture Slides

Slide 1 of 17:

The A-B-C-D Formula for Critical Reading

DEVELOPING CRITICAL READING SKILLS FOR ACADEMIC WRITING

LESSONS & ONLINE ACTIVITIES CREATED BY:

Sheila Busteed

AS PART OF A PhD ACTION RESEARCH PROJECT, 2023

University of Waikato, Division of Education

Dr. Laura Gurney (SGR Chief Supervisor) and Dr. Martin Atkins (SGR Supervisor)

Slide 2 of 17:

Outline of lecture

1. Defining important terms
2. Introducing the formula
3. Phase A – steps and actions
4. Phase B – steps and actions
5. Phase C – steps and actions
6. Phase D – steps and actions
7. Additional information and resources

Slide 3 of 17:

Defining important terms

academic literacies

- term connects to student reading and writing, specifically a way of understanding "the relationship between language and learning in higher education" (Lea, 2017, p. 148)
- encompass such skills as the ability to critically read content within one's discipline and produce texts on such topics while following the genre conventions of that field
- related research (Lea & Street, 1998, 2006; Lillis & Scott, 2007) looks at the intersecting social relationships that influence not only how students in higher education develop the literacy skills needed to succeed but also their identity as learners and future professionals in their discipline

reading-to-write process

- concerns "the complex interaction that occurs when students are reading to create texts of their own" (Flower et al., 1990, p. 3)
- goes beyond reading comprehension; involves the interpretation of source content to suit your own purpose for writing and the integration of your own ideas with those from sources

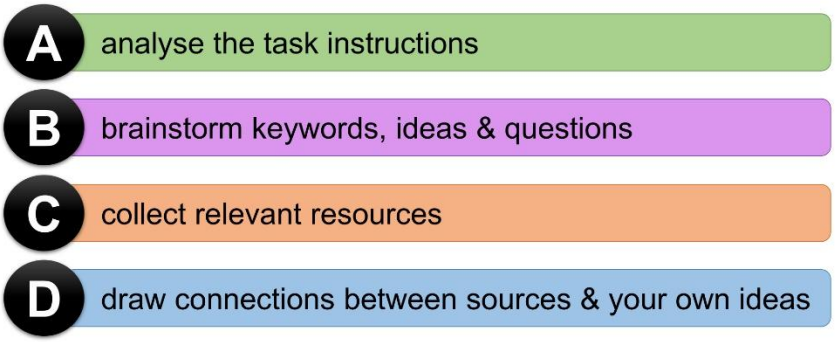
critical reading

- the practice of analysing and evaluating resources to determine their potential as referenced sources within a piece of academic writing (definition applicable to this project)

Slide 4 of 17:

Introducing the formula

The A-B-C-D Formula for Critical Reading contains four phases:



- Formula designed to help with reading-to-write process
- Each phase of formula further divided into key steps / recommended actions
- Lecture breaks down each phase in relation to Assignment 2 – Part 1

Slide 5 of 17:

Phase A – steps and actions

Begin every writing assignment by analysing the task instructions:

In the light of this article, what invention, technology or software is not yet favourable but you believe is likely to grow and become economically pervasive like the telephone? In your answer, explain the effect you think this will have on society. Justify your answer.

STEP ONE: ensure understanding of all terms/phrases within this context

↳ What is meant by *not yet favourable* or *economically pervasive*?

not yet favourable: emerging; not yet established or used commonly

economically pervasive: widely available in the market; can be purchased readily, and commonly used or owned

★ *TIP: Use the New Zealand Oxford Dictionary or Cambridge Learner's Dictionary for everyday vocabulary. Use an engineering dictionary for technical terminology. Make sure any definition you follow makes sense within the context of the task.*

Still not sure? Ask for clarification!

Slide 6 of 17:

Phase A – steps and actions

STEP TWO: examine instructions for details identifying what/how to write

In the light of this article, what invention, technology or software is not yet favourable but you believe is likely to grow and become economically pervasive like the telephone? In your answer, explain the effect you think this will have on society. Justify your answer.

What task word is used in the instructions?

↳ ***explain*** + ***justify*** → look up their meanings in TaskWordCharts.pdf

Who is the intended audience?

↳ ***In the light of this article*** → written to potential investors and industry professionals

When composing Task #1, what text type is required and how will this influence your voice as its writer?

↳ task words + ***you believe*** + ***you think*** → blend of expository and argumentative styles

↳ voice = formal, using third-person perspective

★ *TIP: Once you know the answers to such questions, use this information to plan how to organise your text. Keeping this plan in mind will aid you when completing the next phases of the formula.*

Slide 7 of 17:

Phase B – steps and actions

Next, brainstorming will help you think of ideas and prepare you to do the research.

STEP ONE: select specific topic to write about + do some brainstorming about it

- do a Google search of inventions within the last year
- look at Gartner Hype cycle for this year
- create point-form list, chart, or mind map about chosen topic

★ *NOTE: The following example chart uses a topic from 2003. At that time, this kind of software was just emerging. You must choose a topic from something emerging in 2023 or 2022.*

CHOSEN TOPIC: Open-source learning management systems		
My existing knowledge on this topic	Questions that need answering through research	Where to find information to fill gaps in knowledge
• some universities already using LMSs; mostly commercial ones • LMSs help educators share resources and exercises online • LMSs already linked to flexibility in ways of learning	• What makes an open-source LMS unique? • Who are some early leaders in open-source LMS design? • What impact could this software have on the education sector and society?	• academic journals and conference proceedings about computer-assisted learning • textbook or encyclopedia about education or software engineering • tech blogs discussing new LMSs

Slide 8 of 17:

Phase B – steps and actions

STEP TWO: brainstorm keywords and synonyms to aid search for resources

KEYWORDS: words (usually nouns) that you type into a search engine, database, or computer in order to find information that contains that word

What are 3 words appearing in Task #1 that could be used as keywords in a search for sources? → ***software***; ***not yet favourable***; ***effect on society***

What 3 synonyms could be used as keywords in a search for sources relevant to Task #1? → ***learning management system***; ***emerging***; ***societal impact***

★ *TIP: A keyword search is most effective when multiple keywords are used in combination with symbols. Some examples are listed below.*

KEYWORD SEARCH #1: "emerging software" + "effect on society"

KEYWORD SEARCH #2: "learning management system" + open-source + impact

KEYWORD SEARCH #3: "learning management system" OR LMS + open-source + effect + societ*

Slide 9 of 17:

Phase C – steps and actions

Thirdly, search for resources and sort through the results to find viable sources.

STEP ONE: analyse search results → determine relevancy and appropriateness

- ↳ relevancy → look at visible details, focus on key words
- ↳ appropriateness → scholarly, secondary or inappropriate? expertise of author(s)?

Source A: Google search

https://www.softwareworld.co › what-is-an-lms-complet...

What is an LMS? – Learning Management System Guide

15/01/2001 — Learn all about LMS (Learning Management System). Here you can find LMS ...

The **Open Source LMS Software allows freedom, peer review, and knowledge sharing.**

😐 somewhat relevant

☹ inappropriate; no author

Source B: Google Scholar

Open courseware and shared knowledge in higher education

TE Malloy, GC Jensen, A Regan, M Reddick - Behavior Research Methods ..., 2002 - Springer

... For an on-line course, however, the **LMS**, in **effect**, is the ... use of free and **open source** solutions in education" (mission ... a different **LMS**—to switch course content easily from one **LMS** to ...

☆ Save 99 Cite Cited by 27 Related articles All 9 versions

☺ highly relevant

☺ scholarly; expert authors

Source C: Library Search

Experiences with Learning Management Systems in 113 European Institutions

Morten Flate Paulsen

International Forum of Educational Technology & Society

Educational technology & society, 2003, Vol.6 (4), p.134-148

❝ ...://www.nettskolen.com/in_english/webedusite/index.html). It analyses the experiences of European institutions with the Learning Management Systems that they have purchased or developed themselves... ❞

PEER REVIEWED

Full text available ›

☺ relevant

☺ scholarly; expert author

😐 not good as main source

Slide 10 of 17:

Phase C – steps and actions

STEP TWO: read abstract (if available) → determine article's connection to task

This article presents the major findings from six regional analyses conducted within the framework of the European Web-edu project (http://www.nettskolen.com/in_english /webedusite/index.html). It analyses the experiences of European institutions with the Learning Management Systems that they have purchased or developed themselves. Data was collected from in-depth interviews with 113 European experts, usually the systems managers in the institutions, in 17 countries. The analyses of the interviews revealed as many as 52 different commercial and 35 self-developed LMS systems. The article presents the data from these interviews and includes a series of important findings from the study. One conclusion is that there is a host of commercial and self-developed systems that seem to work satisfactorily in various educational institutions throughout Europe. The systems are not able to handle all the functions the institutions want, and they can be improved in many ways. But most systems encountered in the analyses seem to be good enough for handling online education successfully. Another conclusion is that the European market is not dominated by the American LMS systems. In countries that do not use English as the first language, locally developed LMS systems have successfully ousted the American products. Remarkably, a large number of the LMS systems used in Europe are commercial systems developed locally, or self-developed systems built by the institutions.

This abstract was taken from page 134 and corresponds to the following journal article:
Paulsen, M. F. (2003). Experiences with learning management systems in 113 European institutions. *Educational Technology & Society*, *6*(4), 134-148. http://ifets.ieee.org/periodical/6_4/13.pdf

What 4 keywords from this abstract best demonstrate its connection to Task #1?

↳ learning management systems; throughout Europe; online education; locally developed

Based on the abstract's content, how could this source be used to address Task #1?

↳ identify current types of LMSs and uses → contrast with open-source LMSs

Based on the abstract's content, what is one of this source's weaknesses in relation to Task #1?

↳ focuses on commercial LMSs or those developed internally by educational institutions → limited relevance when writing about open-source LMSs

Slide 11 of 17:

Phase C – steps and actions

STEP THREE: read + analyse resources → determine how to use as sources

★ *The analysis below, shared as an example, was done using the following potential source:*

Malloy, T. E., Jensen, G. C., Regan, A., & Reddick, M. (2002). Open courseware and shared knowledge in higher education. *Behavior Research Methods, Instruments, & Computers*, *34*(2), 200-203. https://doi.org/10.3758/bf03195443

How would you summarise the focus of this article in 1 sentence?

- The article compares open-source LMSs to proprietary ones, discussing how their differences impact the education sector and the sharing of knowledge.

How is this article connected to Task #1?

- It shares information about my chosen topic that could be used to explain why it will become economically pervasive soon and how it will trigger changes in education and society.

How could you paraphrase some content from this article to satisfy one of Task #1's requirements?

- Several details on page 202, in particular, could be paraphrased to explain how open-source LMSs could create better connected communities, which would be an effect on society.

Slide 12 of 17:

Phase D – steps and actions

Lastly, start drafting sentences that connect content from sources to your own ideas.

STEP ONE: select quotations from sources + link to brainstorming notes

- evidence that supports your existing knowledge
- details that answer questions you raised

BRAINSTORMING NOTES:	QUOTATIONS FROM SOURCES:
some universities already using LMSs; mostly commercial ones →	"the 113 institutions had experiences with 52 different commercial systems" (Paulsen, 2003, p. 138)
What makes an open-source LMS unique? →	"more flexible, cost effective, and pedagogically promising" (Malloy et al., 2002, p. 201)
What impact could this software have on the education sector and society? →	"developments at one institution that are created by single individuals can be adopted and altered to fit the particular context of teachers at other institutions" (Malloy et al., 2002, p. 202)

★ *TIP: Paraphrase most of your selected quotations when writing your text. Direct quotations are rarely used in academic writing within the engineering discipline.*

Slide 13 of 17:

Phase D – steps and actions

STEP TWO: ensure source content is properly cited within your sentences

- ↳ reporting verbs → common words/phrases that help introduce source content
- ↳ in-text citations → important details that identify the source and link to its reference

> While proprietary LMSs are triggering a corporatization of higher education, **Malloy et al. (2002) argued** that the flexibility of open-source LMSs will help educators maintain the "classroom tradition of free thought and individual expression" **(p. 200)**. This will make them the more desirable choice and lead them to become economically pervasive soon. Of course, educators must still face change by learning to use the platform and adapting curriculum to it (**Malloy et al., 2002**).
>
> In addition, an open-source LMS will enable students to carry the library home with them or to any space where they choose to study. This is because the instructor would upload or link electronic resources to the platform (**Depow, 2003**; **Malloy et al., 2002**). As a result, the campus library could change drastically, with digital resources replacing old print ones and fewer librarians retained.
>
> **According to Malloy et al. (2002)**, open-source LMSs have the potential to create better connected communities: the education sector of the future could involve improved teacher-student communication, more peer interaction, and the sharing and adapting of resources across institutions and borders. Of course, all of this depends on students being able to afford a personal computer and access to the internet. Lower-income households and developing nations may be left behind as the wealthy embrace this new way of learning.

- Common reporting verbs include **according to**, **argued**, **described**, **found**, **indicated**, **reported**, **showed**, **stated**, and **suggested**.
- For APA format, an in-text citation must include the **author's surname** and **year of publication** when paraphrasing, plus the **page number** if using a direct quotation.

★ *TIP: Use a variety of ways to cite source content, making sure they're all acceptable within your chosen referencing style. This ensures the text doesn't become too repetitive and dull.*

Slide 14 of 17:

Phase D – steps and actions

STEP THREE: add a bibliography that lists all sources used in your text

- ↳ list all entries in alphabetical order based on the author's surname
- ↳ use hanging indents if an entry is longer than one line

★ *The following formulas and examples are for the types of sources you're most likely to use:*

- ***BOOK (ONE AUTHOR):***

Surname, Initial. (Year of publication). *Title of work*. Publisher.

Florman, S. C. (1976). *The existential pleasures of engineering*. St. Martin's Press.

- ***BOOK (TWO AUTHORS), EDITION OTHER THAN THE FIRST:***

Author, A., & Author, B. (Year of publication). *Title of work* (edition). Publisher.

Horowitz, P., & Hill, W. (2015). *The art of electronics* (3rd ed.). Cambridge University Press.

- ***JOURNAL ARTICLE (PUBLISHED ONLINE):***

Surname, Initial. (Year of publication). Title of article. *Title of Online Periodical*, *volume number*(issue number if available), page range. https://www.webaddress.com/full/url/

Paulsen, M. F. (2003). Experiences with learning management systems in 113 European institutions. *Educational Technology & Society*, *6*(4), 134-148. http://ifets.ieee.org/periodical/6_4/13.pdf

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Phase D – steps and actions

- ***CHAPTER IN AN EDITED BOOK (PUBLISHED ONLINE WITH DOI):***

Author, A., Author, B., Author, C., & Author, D. (Year of publication). Title of chapter: Capital letter also for subtitle. In A. Editor & B. Editor (Eds.), *Title of work* (page range of chapter). Publisher. https://doi.org/10.0000/0000

Steffen, B., Gossen, F., Naujokat, S., & Margaria, T. (2019). Language-driven engineering: From general-purpose to purpose-specific languages. In B. Steffen & G. Woeginger (Eds.), *Computing and software science* (pp. 311-344). Springer. https://doi.org/10.1007/978-3-319-91908-9_17

- ***ENTRY IN A REFERENCE BOOK (PUBLISHED ONLINE WITH DOI):***

Surname, Initial. (Year of publication). Title of entry. In Initial. Editor's Surname (Ed.), *Title of reference work* (volume number if available, page range of entry). Publisher. https://doi.org/10.0000/0000

Day, L. (1990). Plastics. In I. McNeil (Ed.), *The encyclopedia of the history of technology* (pp. 217-220). Routledge. https://doi.org/10.4324/9780203192115

- ***WEBPAGE:***

Surname, Initial. (Year of publication, Month Day). *Title of page*. Name of Website. https://www.webaddress.com/full/url/

Hill, P. (2019, January 29). *How good writing skills can benefit your engineering career*. Engineering Management Institute. https://engineeringmanagementinstitute.org/good-writing-skills-engineering-career/

★ *TIP: If you're referencing a type of source not listed here, visit one of the links provided through Moodle about APA format to see formulas and examples of what to do.*

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Additional information and resources

Assignment 2: Task #1 deadline is coming up soon!

- ↳ TGA students = Monday, 6 March 2023 at noon
- ↳ HAM students = Sunday, 12 March 2023 at 5 p.m.

Additional files to use while working on Task #1 (all available on Moodle):

- APA referencing help sheet → helps with correct in-text citations and referencing
- Task1-ModelText → example submission demonstrates writing expectations
- Critical Reading Rubric → shows how I will assess your application of critical reading skills

Submit text as Word.doc or PDF in the correct dropbox on Moodle. Formative feedback will be provided within a few days after the deadline.

- ↳ Read feedback → apply this guidance to rest of Assignment 2
- ↳ How to look at your formative feedback in Turnitin Feedback Studio: https://www.waikato.ac.nz/teaching-and-learning/student-learning/help-with-technology/turnitin-for-students

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Lea, M. R. (2017). Academic literacies in theory and practice. In B. V. Street & S. May (Eds.), *Literacies and language education – Encyclopedia of language and education* (3rd ed., pp. 147-158). Springer. https://doi.org/10.1007/978-3-319-02252-9_19

Lea, M. R., & Street, B. V. (1998). Student writing in higher education: An academic literacies approach. *Studies in Higher Education*, *23*(2), 157-172. https://doi.org/10.1080/03075079812331380364

Lea, M. R., & Street, B. V. (2006). The "academic literacies" model: Theory and applications. *Theory into Practice*, *45*(4), 368-377. https://doi.org/10.1207/s15430421tip4504_11

Lillis, T., & Scott, M. (2007). Defining academic literacies research: Issues of epistemology, ideology and strategy. *Journal of Applied Linguistics*, *4*(1), 5-32. https://doi.org/10.1558/japl.v4i1.5

Malloy, T. E., Jensen, G. C., Regan, A., & Reddick, M. (2002). Open courseware and shared knowledge in higher education. *Behavior Research Methods, Instruments, & Computers*, *34*(2), 200-203. https://doi.org/10.3758/bf03195443

Paulsen, M. F. (2003). Experiences with learning management systems in 113 European institutions. *Educational Technology & Society*, *6*(4), 134-148. http://ifets.ieee.org/periodical/6_4/13.pdf

Appendix F: Critical Reading Online Activities

The following activities are the original designs for this study's action research intervention, and they were made available to students through Moodle. Some of them are produced using H5P to facilitate automated feedback, while a couple other tools are used, too.

PHASE A: ANALYSE THE TASK INSTRUCTIONS
There are five parts to Phase A, which will determine how well you understand the task instructions. After completing each part, click the Check button to see your results. If your choice was wrong, click the Show Solution button to note the correct answer. Be sure to read the automated feedback before navigating to the next part using the arrow button. You should be able to finish Phase A in 10 minutes or less.

1. *DEFINITION MATCHING: As part of analysing task instructions, ensure your understanding of all terms and phrases within them. We will do this now for your writing task. Drag the terms/phrases into the correct boxes to match with their meaning.* (answers displayed here in bold)

   - **historical and societal factors** = elements from the past or within human society that contribute to a particular result (i.e. the invention)
   - **discuss** = write about the most important aspects of (probably including some criticism); give arguments for and against; consider the implications of
   - **significant impact** = important or noticeable effect
   - **in the 20th or 21st century** = i.e. from the year 1900 to the current date
   - **invention** = something that has been designed or created for the first time
   - **technically competent** = having sufficient skills and knowledge related to the technology, machines and methods of a particular science or trade
   - **field** = a subject or area in which someone works; a profession
   - **discipline** = a particular area of study, especially a subject studied at college or university
   - **in this role** = in the job or profession identified earlier (i.e. an engineer)
   - **persuasive argument** = a reason or reasons presented in writing meant to convince the reader of an idea

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 49%	Your understanding of the terms/phrases in Task #2 and Task #3 is insufficient to attempt any writing at this time. Please study the answers and seek help from your lecturer.
50% - 69%	Your understanding of the terms/phrases is flawed. Study the answers before attempting Task #2 or Task #3.
70% - 79%	You have a moderate understanding of the terms/phrases in Task #2 and Task #3. Due to multiple errors, you should review the answers and take notes before continuing.
80% - 99%	Your understanding is strong with only minor errors present. Review the answers before continuing.
100%	Perfect! You have an excellent understanding of the terms/phrases in Task #2 and Task #3.

2. *MULTIPLE CHOICE: Next in your analysis, you need to determine how the text must be written in order to satisfy certain requirements identified in the task instructions. For each of the following questions, select 1 answer.* (answers displayed here in bold; a corresponding automated feedback comment is listed under each option)

- What task word is used in the instructions for Task #2?
  (Reminder: task words are verbs or phrases appearing in writing prompts that tell you exactly what kind of writing is required)
  a) comment on
    - ↳ This task word does not appear in the instructions for Task #2. Please read it again more carefully.

  b) discuss
    - ↳ Yes, this is Task #2's task word. Refer back to its definition to understand exactly what that means for your writing.

  c) identify
    - ↳ It is understandable that you chose this task word because Task #2 asks you to name the inventor. However, this word does not actually appear in the instructions and is not the main task word.

  d) summarise
    - ↳ This task word does not appear in the instructions for Task #2. Please read it again more carefully.

  e) give examples
    - ↳ This task word does not appear in the instructions for Task #2. Please read it again more carefully.
- Task #2 requires you to write about an invention. The instructions identify several details that must be included in the text. What would be the best way to cover all required points within the word count limit?
  a) An introductory paragraph identifies the invention, the year it was created, and by whom. This paragraph also includes a thesis statement about the invention's significance. The second paragraph discusses the contributing factors, as supported by evidence. A final paragraph ties these factors to the invention's impact on modern society, thus connecting all details back to the thesis.
    - ↳ Of the options present, this is the best one because it meets all of the instruction's requirements, satisfies the necessary research component, and organises the text in a way that follows academic conventions.

  b) The first paragraph identifies the invention and provides some historical details about its creation, as supported by evidence. Next, a point-form list presents information about contributing factors, with each point including a citation. Finally, a closing sentence states how those points account for the invention's impact on modern society.
    - ↳ This is the weakest option because it deviates the most from expectations. Listing points does not create a discussion, and point form should not be used in a short academic text unless called for explicitly in the instructions. On top of this poor organisational method, there is an overreliance on source content and underdevelopment of the writer's voice.

  c) The text is organised in a single paragraph. The topic sentence identifies the invention, the year it was created, and by whom — details that are supported by evidence. This is followed by several sentences summarising the invention's history and various uses in society. The last few sentences argue why the invention has

played an integral part in modern society, and this argument is based on statements from famous sources.

- ↳ This option is not desirable because such a text would feature poor organisation and use sources in inappropriate places. Since this option also mentions different task words, the resulting text would not meet all content expectations.

- Who is the intended audience for Task #3?

  a) your lecturer
  - ↳ Your lecturer isn't necessarily the text's intended audience even though this person reads the text in order to grade it. Read the instructions again and pay more attention to its details.

  b) other engineering students
  - ↳ This was a good guess, but the instructions state you're trying to encourage high school students to pursue a career in engineering, meaning they're not yet engineering students.

  c) high school students
  - ↳ Yes, they are identified as your audience in the first sentence of the instructions. Make sure the language you use will appeal to them.

  d) graduates already working in the engineering profession
  - ↳ While related to the subject matter, these people are not your intended audience. Read the instructions again and pay more attention to its details.

- When composing Task #3, what text type is required and how will this influence your voice as its writer?

  a) I will be writing a report, so my text must present the result of a process supported by data.
  - ↳ This answer does not match details for Task #3. Read its instructions again, paying more attention to the details.

  b) The text must recount my experience in engineering, so I will write using first-person perspective and share examples from the past.
  - ↳ This answer does not match details for Task #3, and first-person perspective should generally be avoided in academic writing. Read the instructions again, paying more attention to the details.

  c) I'm writing a narrative text from the perspective of a prospective engineer who wants to invent technologies that can improve society.
  - ↳ This answer does not match details for Task #3. Read its instructions again, paying more attention to the details.

  d) It will be a persuasive essay, so the text must present sound reasons that will convince the reader of my position.
  - ↳ Yes, this choice correctly identifies the text type and its influence on your voice. Consider these requirements when organising your ideas into paragraphs.

  e) The text must summarise various facts about engineering education and the professional pathways available after graduation, so it will be detailed yet succinct.
  - ↳ This answer does not match details for Task #3. Read its instructions again, paying more attention to the details.

PHASE B: BRAINSTORM KEYWORDS, IDEAS & QUESTIONS

There are three parts to Phase B, which will help you through the brainstorming process. This first part focuses on Task #2 and will take you less than five minutes.

1. *KEYWORD SEARCHES: Drag the words into the correct boxes to complete the example keyword searches that go with Task #2.* (answers displayed here in bold)

   TASK #2:
   Briefly discuss one invention made in the 20th or 21st century that has had a significant impact on society. Include in your answer the name of the inventor, if possible, several historical and societal factors that contributed to the invention, and the impact it has had on modern society.

   KEYWORD SEARCH #1:
   "20th **century** inventions" + impact
   KEYWORD SEARCH #2:
   microwave + "development factors" + "impact on **society**"
   KEYWORD SEARCH #3:
   smartphone **+ development** + society + **impact OR** effects
   KEYWORD SEARCH #4:
   "social media" + "**effects on** society" + history OR development
   KEYWORD SEARCH #5:
   plastics + "**material** development" + society **OR history** + "environmental **impact**"

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 50%	Your understanding of how to do keyword searches is weak. You should consider arranging a tutorial with a librarian.
51% - 79%	The keyword searches you've created here are flawed. Please review the rules taught during the lecture.
80% - 99%	Your understanding of keyword searches is strong, but there are minor errors present. Review the answers before continuing.
100%	Perfect! You've got an excellent understanding of how to put keyword searches together.

2. *WORD CLOUD: For this second part of Phase B, collaborate with your classmates by brainstorming a list of relevant keywords for Task #3. First, think of keywords that appear in the instructions, and then brainstorm relevant synonyms. Use the QR code provided or click here to link to the Mentimeter space where you can add your keywords. Together, your submissions will generate word clouds related to Task #3, which will be shared with the class. This part, which will take up to 10 minutes, will involve a brief discussion of the resulting word clouds.*

   - What are 3 words appearing in Task #3 that you would use as keywords in a search for sources?
   - What 3 synonyms could be used as keywords in a search for sources relevant to Task #3?

3. *WIKI: For this last part of Phase B, collaborate with your classmates by brainstorming a list of points related to Task #3. These points should relate to (a) existing knowledge on the topic, (b) questions that need answering through research, and (c) where to find information to fill gaps in knowledge. Click here to link to the wiki space where you can add your brainstorming points. This part will take about 10 minutes. Note: Practice good etiquette when adding to the wiki. Please don't delete another student's points; however,*

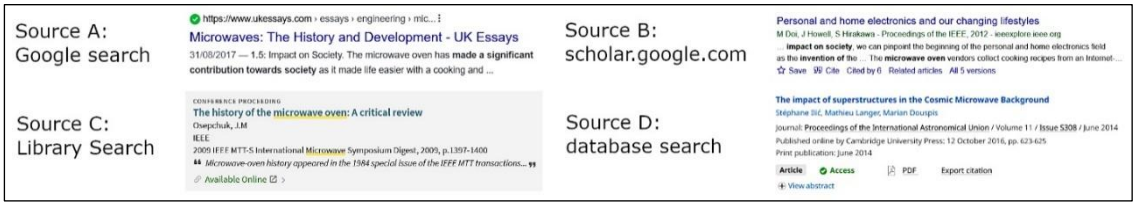
it's okay to expand on them, adding your own details to improve the point. The goal here is to contributed to the shared space so everyone in the class can benefit from these brainstorming notes.

Brainstorming Wiki for Task #3
This wiki space will help you do some collaborative brainstorming for Task #3. The links below each lead to their own section within the wiki. After moving to a section, click on the Edit tab. Add at least one point in each section, clicking Save after each entry. Be sure to read your classmates' contributions to avoid duplication or to add extra details to another's point after contributing your own.

- Existing knowledge on this topic
  Please list what you know below using bullet points.
- Questions that need answering through research
  Please list your questions below using bullet points.
- Where to find information to fill gaps in knowledge
  Please list possible sources below using bullet points. Try to be as specific as possible when describing the type of source you think would be relevant.

PHASE C: COLLECT RELEVANT RESOURCES
There are three parts to Phase C, which will help you sort through various resources to determine which ones could be used to satisfy research requirements. This first part focuses on Task #2 and will take up to 10 minutes to complete.

1. *ANALYSIS OF SEARCH RESULTS: The photo below shows four search results using the following keyword search:* "microwave oven" + invent* OR development + "impact on society" *(Note: All sources in the photo were found on the first page of their respective search results. The sources were found using the Google search engine, Google Scholar, the University of Waikato Library Search tool, and the Cambridge Core database.)*



Look closely at the details visible about each source. Analyse each source's relevancy (based on key words) and appropriateness – that is, details indicating it is either scholarly, secondary, or inappropriate as a possible source for Task #2. Complete the summary about the four sources by dragging and dropping the words/phrases into the boxes. After completing this part, click the Check button to see your results. If any choices were wrong, click the Show Solution button to note the correct answer. Be sure to read the automated feedback before continuing to the next part of Phase C.
(answers displayed here in bold)

ANALYSIS OF SEARCH RESULTS:
Source A = relevant → text discusses microwave's history, development, and impact on society; **inappropriate** → author not noted + published on an **essay-sharing** website (content may be **unreliable** + questions of **plagiarism** could be raised by using this kind of resource)

Source B = **somewhat** relevant → article focuses on various electronics' impact on society + microwave oven used **as an example**; scholarly → **written by experts** + published as part of a proceedings; **appropriate** but lack of exclusive focus on chosen invention means it shouldn't be main source for Task #2
Source C = **highly relevant** → article focuses on history of microwave oven + as a review, it would establish **facts** and highlight inconsistencies from past publications; **scholarly and** appropriate → written by **an expert** + published as part of conference proceedings
Source D = **not relevant** → article deals with microwaves within the context of **astronomy** instead of the product used in people's kitchens; **scholarly** → written by **experts** + published as part of a **proceedings**, but still not appropriate as a source for Task #2

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 49%	You have not met the expectations for this activity. Please take notes on the answers so you can review them in your own time. You should also book a consultation with the CeTTL team to help improve your research techniques.
50% - 74%	You've made a fair attempt here, but there are noticeable errors. It's recommended that you review the answers and consider seeking out CeTTL resources to help you do research more effectively.
75% - 94%	You performed strongly in this activity, but your ability to evaluate search results could still improve slightly. Please review the answers and take any notes you think may be helpful.
95% - 100%	You demonstrated first-rate research skills in this activity. Keep up the excellent work and continue to follow the formula as you evaluate search results for future writing tasks.

2. *ANALYSIS OF EXCERPTS: This second part of Phase C is a forum activity, which will help you analyse two excerpts related to Task #2. In the forum are two links, each of which takes you to a subsection where you can read an excerpt and then write a brief analysis that answers the questions provided. You will do this for both excerpts. Then you'll reply to two classmates' posts — one in each subsection — and offer peer feedback that follows the guidelines provided. If a classmate's post has already received a reply, you must choose someone else; this strategy ensures everyone receives peer feedback. You should be able to complete this whole forum task in 30 minutes.*

READING #1:

The second semi-synthetic plastic was formed from the reaction between casein, the main protein in milk, and formaldelyde, announced in 1897 by Spitteler & Krische in Germany. The manufacture of the first casein plastics, giving a hard, horn-like material, began three years later and has continued ever since, being especially suitable for buttons. More important was the announcement in 1909 of the first thermosetting plastic by a Belgian who had settled in the USA, Leo Hendrik Baekeland. The German chemist Baeyer had observed in 1872 that phenol and formaldehyde formed a hard, resinous substance, but it was Baekeland who exploited the reaction to produce commercially Bakelite, a versatile material resistant to water and solvents, a good insulator, like other plastics, and one which could be easily cut and machined.

Chemists were now investigating the structure of such substances as cellulose, produced in plants, with long-chain molecules. This led to the notion that such molecules might be produced in the laboratory. Also there was a growing understanding of the relationship between physical properties and molecular structure, so that it might be possible to design large molecules to give materials of certain desired characteristics. More than any other, it was Hermann P. Staudinger in Germany who achieved an understanding of the processes of polymerization, or forming large molecules from repeated additions of small, basic molecules, upon which is largely based the staggering progress of the plastics industry since the 1930s. For this work Staudinger was awarded the Nobel Prize in Chemistry in 1953. The other great name in fundamental research in this field is Wallace H.Carothers, who was engaged by the Du Pont Company in the USA in 1928 to find a substitute for silk, imports of which from Japan were being interrupted by the political situation. Carothers developed a series of polymers known as polyamides; one of these mentioned in his patent of 1935 was formed from hexamethylenediamine and adipic acid. Production of this polyamide, known as Nylon, began in 1938 and the first nylon stockings appeared the following year; during the first year, 64 million pairs were sold.

This excerpt was taken from page 218 of the following encyclopedia:
McNeil, I. (Ed.). (1990). *An encyclopedia of the history of technology*. Taylor & Francis Group. https://doi.org/10.4324/9780203192115

READING #2:

Cutting across these examples is our core argument that plastics can only be understood in terms of the wider networks and relations of which they are part. To elaborate: while fundamental social changes and much of what is taken for granted today would not, perhaps could not, have happened without plastics, the mere existence of plastics does not fully account for their ubiquity in contemporary economic and social life. In the case of food packaging, for example, the properties and qualities that make plastics a useful and suitable material do not fully explain their widespread use. While this is no doubt an important part of the story, a more comprehensive account requires attention to a range of other factors, including the rise of supermarkets, legacies of urban planning and housing development, related technological developments (e.g. the microwave), and shifts in societal and domestic divisions of labour. Any attempt to bring about changes in the use and disposal of plastics must be grounded in understanding how things come to be as they are in the first place (cf. Molotch, 2004; Miodownik, 2014). This requires attention to the services that plastics provide as well as a more general recognition of the 'whole' picture and understanding that stabilised socio-technical arrangements cannot be 'undone' by changing one piece of the jigsaw.

A socio-technical approach to plastic packaging challenges a linear view of social change following technological innovation. Our analysis suggests it cannot be assumed that dispensing with plastics or replacing them with other materials is the best solution to the problems associated with single-use plastics. In the case of The Body Shop, for example, the issue had far less to do with technologies and materials than with the legal requirements that made it difficult to reuse and refill packaging, plastic or otherwise. It seems credible to suggest that addressing the regulatory context of packaging is an important lever of change. Similarly, the Frito-Lays example highlights how existing norms, meanings and expectations require attention in order for new materials and technologies to successfully reconfigure practices in a more sustainable register. In both cases, the services that plastics provide – freshness, convenience, safety, accountability and affordability – are key. While commercially and culturally significant, these categories cannot be assumed to have a priori meaning (cf. Jackson et al., 2019). They are inherently malleable and historically variable, meaning that changing societal standards and societal expectations influence trajectories of technological development and *vice versa* (cf. Evans and Mylan, 2019). Accepting that the contemporary standards and expectations that drive the use of plastics are the outcome of socio-technical processes of co-evolution (Shove, 2003), it follows that solutions and change require more than 'getting the technology right' and then encouraging consumer acceptance. They require attention to questions of cultural appropriateness, their contingency, and their complex relationships with technological innovation.

This excerpt was taken from page 7 of the following journal article:

Evans, D. M., Parsons, R., Jackson, P., Greenwood, S., & Ryan, A. (2020). Understanding plastic packaging: The co-evolution of materials and society. *Global Environmental Change, 65*, Article 102166, 1-8. https://doi.org/10.1016/j.gloenvcha.2020.102166

Note: When completing both steps of this activity, you are not allowed to copy and paste content from the excerpt into your posts. Use this opportunity to practice your paraphrasing skills.

STEP ONE: Answer the following 4 questions to analyse this reading. Write in full sentences, grouping your answers together into a paragraph of 100-125 words.
a) How would you summarise the focus of this excerpt in 1 sentence?
b) How is this excerpt connected to Task #2?
c) How could you paraphrase some content from this excerpt to satisfy one of Task #2's requirements?
d) What is one of this excerpt's weaknesses in relation to Task #2?

STEP TWO: Choose a classmate's post to read and then reply to it. Share your answers to the following 2 questions as a form of peer feedback. Writing in full sentences, this feedback should be about 75 words.
a) What is another way that this excerpt is connected to Task #2? Identify it for your classmate.
b) How could this other connection be used as part of the assignment? Recommend to your classmate what to do.

3. *MULTIPLE CHOICE: For this last part of Phase C, read the abstract provided and answer the questions to determine how the article might be connected to Task #3. For each of the following questions, select 1 answer. After completing each question, click the Check button to see your result. If a choice was wrong, click the Show Solution button to note the correct answer. Be sure to read the automated feedback before continuing to the next question. This part will take less than 10 minutes to complete.*
(answers displayed here in bold; a corresponding automated feedback comment is listed under each option)

This chapter presents a range of viewpoints on the social responsibilities of the engineering profession. These social responsibilities of the engineering profession are in many ways synonymous with macroethics. Analysis of the engineering code of ethics and educational requirements are used to support these arguments, and are compared with the perceptions of engineering students and working engineers. The social responsibilities of engineers include human safety and environmental protection in engineering designs. But it may extend further to include pro bono work and considerations of social justice issues. Research has found that perceptions of the professional social responsibilities of engineers vary across different countries/cultures, engineering disciplines (e.g., mechanical versus environmental engineers) and by gender. The impact of engineering education and broader college experiences on evolving notions of professional social responsibility will be described, in particular community engagement. Concerns about decreasing commitment to socially responsible engineering among college students, a so-called "culture of disengagement" will be presented, as well of the interaction of students' social goals for engineering and leaving engineering studies.

This abstract was taken from page 41 and corresponds to the following book chapter:
Bielefeldt, A. R. (2018). Professional social responsibility in engineering. In I. Muenstermann (Ed.), *Social responsibility* (pp. 41-60). IntechOpen. https://doi.org/10.5772/intechopen.73785.

- What 4 keywords from this abstract best demonstrate its connection to Task #3?
  a) engineering education; professional social; macroethics; arguments
    - ↳ There are loose connections between these keywords and Task #3, but there are better options in the abstract. Instructions want you focused more on a career in engineering, not engineering education. Also, the next two keywords are weak choices. Although you'll be presenting an argument in your essay, this word merely tells you what kind of text to write and is not linked to the topic, so it shouldn't be a keyword even though it appears in the abstract.

  b) engineering students; social justice issues; environmental protection; gender
    - ↳ This is probably the weakest set of keywords among the options. The first keyword is talking about a different group of students than those who will be your audience, and this isn't really connected to the writing topic. The remaining keywords don't have any obvious link to Task #3.

  c) working engineers; students; engineering disciplines; college experiences
    - ↳ There are several connections here, but a couple of these keywords could be better. The first keyword could be connected to your need to write about what engineers do and the job opportunities this field offers. The second keyword connects somewhat to your audience, not the topic you'll write about. The context in which the third keyword is used in the abstract is different from how these words are used in the task instructions. The last keyword doesn't have an obvious connection to Task #3.

  d) engineering; social responsibilities; community engagement; working engineers
    - ↳ This is the best set of keywords among the options. The first one connects to Task #3's overall topic. The next two keywords may relate to the requirement about the discipline's impact on society. The last keyword could be connected to your need to write about what engineers do and the job opportunities this field offers.
- Based on the content of the abstract, which aspect(s) of Task #3 could this source be used to address?
  a) (a) The impact that your discipline had/has on society (historical and current)
    - ↳ Yes, the chapter could be used to address this requirement, but there's a better answer to this question.

  b) (b) What engineers in this field typically do (job opportunities)
    - ↳ Yes, the chapter could be used to address this requirement, but there's a better answer to this question.

  c) (c) Other skills an engineer needs in addition to being technically competent, and where they might use these in this role.
    - ↳ There doesn't appear to be a connection between this requirement and the

source. Besides, the instructions state that you're meant to address this requirement using information from the textbook.

d) both A and B

- Correct! The abstract's content suggests that this chapter may be a viable source for addressing the first two requirements from the task instructions.

e) both B and C

- Only one of these requirements has a clear connection to the abstract.

f) None. Based on its abstract, the chapter would make a poor source since it does not appear directly connected to any of Task #3's requirements.

- The keyword analysis done earlier clearly indicated a connection, so this chapter could be used as a source when addressing at least one of the requirements.

- Based on the content of the abstract, what is one of this source's weaknesses in relation to Task #3?

a) It isn't an argumentative essay written to high school students.

- Published works don't need to be the exact same kind of text as the one you'll produce in order to make them viable sources. As a writer, it's your job to find small bits of relevant content within sources and use these to support your own original position.

b) The abstract doesn't mention additional skills needed for an engineering career.

- It's okay that this source doesn't connect to the task's third requirement; it's rare to find a single source that gives you everything you need. Besides, using multiple sources is one of the standards of academic writing, and the task instructions already state you'll need to use your textbook to address the third requirement.

c) I don't think it's clear how the source's discussion of engineers' social responsibilities will connect to the task's requirement about the discipline's impact on society.

- The abstract isn't going to give you everything you need; it's merely a summary of the chapter, so this isn't a weakness. You're meant to analyse an abstract to see if the rest of the text is worth reading. It's probable that this chapter's focus on social responsibility could be linked to Task #3, but you'll need read it to find the most relevant details and then decide if you want to weave those into your argument.

PHASE D: DRAW CONNECTIONS BETWEEN SOURCES & YOUR OWN IDEAS

There are two parts to Phase D, which will help you connect ideas for writing to supporting content from sources. This phase also provides practice in APA referencing techniques. After completing each part, click the Check button to see your results. If the Show Solution button appears, click it to note the correct answer. Be sure to read the automated feedback before continuing. You should be able to finish Phase D in 15 minutes or less.

1. *QUOTATIONS FROM SOURCES: Imagine you are getting ready to write your text for Task #3. You've found parts of sentences from various sources that could be useful. Each quotation below matches to a part of the task instructions, an idea, or an unanswered question raised during brainstorming. Drag and drop to match these to their corresponding quotation.* (answers displayed here in bold)

- **impact of engineering on society** = a) “engineering provides most of the same artifacts: shelter, energy and communications, manufacturing, water supply, extraction and use of resources, and disposal of waste” (Bugliarello, 1991, p. 76)
- **What are technical competencies in engineering?** = b) “organize, define, and understand a problem; gather, analyze, and interpret data; document and present the results; and project-manage the overall problem-solving process” (Korte et al., 2008, p. 6)
- **necessary non-technical skills** = c) “being able to communicate technical ideas in non-technical language” (Dowling et al., 2020, p. 17)
- **Why do engineers need strong communication skills?** = d) “it will be your job to create technical documentation, specifications, system requirements, manuals, warranty restrictions, and other parts of product documentation intended for third-party individuals, users, or technical support” (Hill, 2019, para. 6)
- **Idea: responsibilities that come with impacting society** = e) “engineering has a primary duty to protect public safety, health, and welfare” (Bielefeldt, 2018, p. 42)
- **engineering job opportunities** = f) “a substantial proportion of engineering graduates move out of engineering and apply their problem-solving skills in non-traditional fields such as medical logistics, political activism or merchant banking” (Dowling et al., 2020, p. 4)

AUTOMATED FEEDBACK COMMENTS FOR THIS ACTIVITY	
0% - 49%	Your understanding of how to connect sources to ideas is weak. You should consider arranging a tutorial with a librarian or CeTTL expert.
50% - 65%	The matching of ideas to source content here is flawed. Please review the guidance about selecting source content to support your writing.
66% - 99%	Your efforts to draw connections between ideas and source content is strong, but there are minor errors present. Review the answers before continuing.
100%	Perfect! You’ve got an excellent understanding of how to draw connections between source content and ideas for writing.

2. *REPORTING VERBS & APA FORMAT: Drag and drop the reporting verbs and parts of in-text citations into the correct boxes to complete the model text related to Task #2. Use the above picture to guide your choices. Then drag the remaining words below into the correct boxes to complete its reference list. Use the formulas you learned as a guide.* (answers displayed here in bold)

One main historical factor contributed to the invention of the microwave oven, and its creation has had a considerable impact on society in turn. The **review by** Osepchuk **(2009)** traced the development of this technology to the years around World War II, a time when work in magnetron power and radar can be tied to the microwave oven’s invention. The **suggestion** here is that the military-industrial complex, in its efforts to develop new means to end the war, ended up giving people the means to thaw frozen food quickly or reheat leftovers. However, years passed before the countertop microwave

became prolific in households because initial prices per unit were steep (**Osepchuk,** 2009). It is possible that post-war families hoping to return to their normal pre-war lifestyle were hesitant to embrace something new, or they instead chose to invest in a fallout shelter in reaction to the Cold War. **According to** Osepchuk (2009), concerns were also expressed in those early years that to nuke one's food, as the inaccurate saying goes, could come with harmful radiation. The review **indicates** that, with the establishment of product testing and a drop in prices, American-made microwaves became popular in the late 1960s and early 1970s (Osepchuk, 2009). Doi **et al.** (2012) **described** home appliances like the microwave as markers of "wealth and status in the community" at the time and even **linked** them to women's liberation **(p. 1648)**. Although the microwave oven started as a product of an age of unspeakable savagery, it now has a place in most homes around the world and is a symbol of convenience and ease in a fast-paced, innovative society.

AUTOMATED FEEDBACK COMMENTS FOR THIS HALF OF THE ACTIVITY	
0% - 50%	Your understanding of how to incorporate and cite sources is weak. You should consider arranging a tutorial with a librarian or CeTTL expert.
51% - 79%	Your use of reporting verbs and in-text citations here is flawed. Please review the guidance about incorporating source content in your writing.
80% - 99%	Your efforts to incorporate and cite source content is strong, but there are minor errors present. Review the answers before continuing.
100%	Perfect! You've got an excellent understanding of how to use reporting verbs and include in-text citations.

References

Doi, **M.,** Howell, **J., &** Hirakawa, S. **(2012).** Personal and home electronics and our changing lifestyles. ***Proceedings*** *of the* ***IEEE*****,** ***100***(Special Centennial Issue), 1646-1656. https://doi.org/10.1109/JPROC.2012.2187128

Osepchuk, J. M. **(2009).** The history of the microwave oven: **A critical** review. ***2009 IEEE*** *MTT-S International Microwave* ***Symposium*** *Digest*, **1397-1400.** https://doi.org/10.1109/MWSYM.2009.5165967

AUTOMATED FEEDBACK COMMENTS FOR THIS HALF OF THE ACTIVITY	
0% - 50%	Your understanding of APA format is weak. Please arrange a tutorial with a librarian or CeTTL expert. This will help improve your referencing techniques before you attempt future writing tasks.
51% - 79%	Your application of APA format here is flawed. Please review the guidance about referencing source content before attempting your next writing tasks.
80% - 99%	Your referencing technique is strong, but there are minor errors present. Review the answers and APA formulas provided before continuing with your next writing tasks.
100%	Perfect! You've got an excellent understanding of how to apply APA format in a reference list. You're ready for your next writing tasks.

Appendix G: Questions for the Initial Survey

1. **What major (stream) are you currently enrolled in?** *(choose one)*
   a) Chemical and Biological Engineering
   b) Civil Engineering
   c) Electrical and Electronic Engineering
   d) Environmental Engineering
   e) Materials and Process Engineering
   f) Mechanical Engineering
   g) Mechatronics Engineering
   h) Software Engineering
   i) Other, please identify: _____

2. **What is your current age?** *(choose one of the age brackets)*
   a) 16 years old or younger
   b) 17-18 years old
   c) 19-20 years old
   d) 21-24 years old
   e) 25-35 years old
   f) 36-40 years old
   g) 41+ years old

3. **What is your gender?** *(choose one that best suits how you identify)*
   a) female
   b) male
   c) transgender
   d) non-binary
   e) not listed
   f) prefer not to answer

4. **What is your first language (mother tongue)?** *(choose one)*
   a) English
   b) Te Reo Māori
   c) Afrikaans
   d) Arabic
   e) Cantonese
   f) Dutch
   g) Farsi
   h) French
   i) German
   j) Hindi
   k) Japanese
   l) Korean
   m) Mandarin
   n) Punjabi
   o) Russian
   p) Samoan
   q) Spanish
   r) Tagalog
   s) Tongan
   t) Urdu
   u) Other, please identify: _____

5. **How long have you been an English language user?** *(choose one that best describes your experience)*
   a) I started learning English less than 3 years ago.
   b) For 3-4 years.
   c) For 5-6 years.
   d) For 7-9 years.
   e) For 10 years or more.
   f) I've been using English my whole life.

6. **How would you rate your current writing skills?** *(choose one that best suits you)*
   a) My writing skills are excellent, so I'm confident I can meet the expectations of academic writing tasks at university.

b) Generally, I'm a fairly strong writer, but doing well on academic writing tasks at university is a little more challenging for me.
c) I'm satisfied with my writing skills overall, but I'm less confident that I can meet the expectations of academic writing tasks at university.
d) My writing skills are slightly weak, and I find academic writing tasks at university particularly challenging.
e) Overall, my writing skills need significant improvement, so I'm not confident I can meet the expectations of academic writing tasks at university.

7. **Which words/phrases best match your current understanding of the term "critical reading"?** *(choose up to three)*
   a) analyse and evaluate
   b) asking questions
   c) comprehension
   d) determine relevancy
   e) draw connections
   f) note-taking
   g) reflection
   h) research
   i) selecting quotations
   j) skimming and scanning
   k) summarise
   l) vocabulary expansion
   m) *I don't know.*

8. **How would you rate your current critical reading skills when applied during the academic writing process?** *(choose one)*
   a) I have excellent critical reading skills.
   b) My critical reading skills are fairly effective.
   c) My critical reading skills are satisfactory.
   d) I have slightly weak critical reading skills. I need some help to improve them.
   e) My critical reading skills are very weak, so I struggle to meet the basic requirements of academic work at university.

9. **Teachers should provide opportunities to practice critical reading leading up to academic writing assessments.** *(choose one)*
   a) strongly disagree
   b) moderately disagree
   c) slightly disagree
   d) neutral
   e) slightly agree
   f) moderately agree
   g) strongly agree

10. **How would you rate the importance of critical reading skills in your study of engineering?** *(choose one)*
    a) not at all important
    b) slightly important
    c) moderately important
    d) very important
    e) extremely important

11. **How would you rate the importance of critical reading skills in your future career?** *(choose one)*
    a) extremely important
    b) very important

c) moderately important
d) slightly important
e) not at all important

Appendix H: Questions for the Post-Intervention Survey

1. **The A-B-C-D Formula for Critical Reading helped me understand the academic literacy skills involved and how to use them.** *(choose one)*
   a) strongly agree
   b) moderately agree
   c) slightly agree
   d) neutral
   e) slightly disagree
   f) moderately disagree
   g) strongly disagree

   Why was the A-B-C-D Formula useful (or not)? Please explain your answer in 50 words or less. _____

2. **How would you rate the feedback you received throughout this critical reading teaching intervention?** *(choose one)*
   a) not at all helpful
   b) slightly helpful
   c) moderately helpful
   d) very helpful
   e) extremely helpful

   Why was the feedback helpful (or not)? Please explain your answer in 50 words or less, and identify which feedback you mean (e.g. from the online activities, rubric, and/or Assignment 2 comments). _____

3. **The online activities were an effective way to practice my critical reading skills in connection to the writing assessment.** *(choose one)*
   a) strongly disagree
   b) moderately disagree
   c) slightly disagree
   d) neutral
   e) slightly agree
   f) moderately agree
   g) strongly agree

   Why were the online activities effective (or not)? Please explain your answer in 50 words or less. _____

4. **Having completed the recent practice, how would you now rate your critical reading skills when applied during the academic writing process?** *(choose one)*
   a) I have excellent critical reading skills.
   b) My critical reading skills are fairly effective.
   c) My critical reading skills are satisfactory.
   d) I still have slightly weak critical reading skills. I need extra practice to improve them.
   e) My critical reading skills are still very weak, so I struggle to meet the basic requirements of academic writing.

5. **Other teachers should adapt the online activities for their courses so I can practice critical reading as part of other academic writing assessments.** *(choose one)*

a) strongly disagree
b) moderately disagree
c) slightly disagree
d) neutral
e) slightly agree
f) moderately agree
g) strongly agree

6. **Now that you've learned more about critical reading, how would you rate the importance of these skills in your study of engineering?** *(choose one)*
   a) not at all important
   b) slightly important
   c) moderately important
   d) very important
   e) extremely important

   Why have you rated their importance in your studies this way? Please explain your answer in 50 words or less. _____

7. **Now that you've learned more about critical reading, how would you rate the importance of these skills in your future career?** *(choose one)*
   a) extremely important
   b) very important
   c) moderately important
   d) slightly important
   e) not at all important

   Why have you rated their importance in your career this way? Please explain your answer in 50 words or less. _____

Appendix I: Questions for the One-on-One Interview

1. What did you think when you found out that you'd be completing critical reading online activities as part of your paper?
2. What was your experience like using the critical reading online activities?
3. Do you think enough time was provided to complete the online activities during class?
4. Do you think completing the online activities was a good use of class time? Or, if given the opportunity, would you rather have completed the online activities in your own time as online homework?
5. In what ways did the online activities affect your completion of the writing assignment?
6. Which of the online activities do you think helped you the most? Why?
7. Which of the online activities was most difficult for you to complete? Why?
8. How might the A-B-C-D Formula and the online activities influence your approach to the academic writing process through the rest of your programme?
9. How relevant do you think critical reading is for engineering students? Why?
10. Do you have any further/final suggestions for how these activities could be run in the future?

Appendix J: Feedback Comment Library

- **EXCELLENT SOURCES** You chose excellent sources to use in this text. Keep following the formula's guidance when seeking relevant sources for future writing tasks.
- **SOURCE APPROPRIATENESS** A source you've used isn't quite appropriate for this writing task. You would benefit from spending more time on Phases A and B of the formula to ensure you find more relevant sources in the future.
- **NOT ENOUGH SOURCES** You didn't use enough sources in this text. It is important to include viewpoints from multiple experts to ensure your position is well supported. In the future, dedicate more time to Phase C of the formula so you'll collect enough sources.
- **FAULTY SOURCE CHOICE** Ensure that your sources are more relevant and appropriate, too. More effort must be applied to satisfy research requirements and address all aspects of the task instructions.
- **LACKING QUALITY SOURCES** Your text did not meet the research requirements. Please follow the critical reading formula more closely for the next writing task to ensure you meet the expectations of university study.

- **SKILLED PARAPHRASING** You're very skilled at paraphrasing! Source content is seamlessly integrated while keeping details accurate. Continue to dedicate considerable time to Phase D for future writing tasks because engineers tend to favour paraphrasing over quoting.
- **DEEPER ANALYSIS NEEDED** Your sources lend strong support to your position, but your analysis could have been deeper. Remember that source content is used to support your own voice, not speak for you. Spending a bit more time on Phase D of the formula will help you. Engineers tend to favour paraphrasing over quoting.
- **QUOTE LESS** Try to include fewer quotations in future writing tasks. If the source content is key to your position, paraphrase it instead. Engineers tend to favour paraphrasing over quoting.
- **PROBLEMATIC INTEGRATION** The way you've integrated source content in this text needs revision. There are some issues with your paraphrasing skills, so you need to practice this more as part of Phase D of the formula.
- **WEAK PARAPHRASING** Your paraphrasing skills are weak, leading to many errors in the integration of source content. Spend more time on Phase D of the formula and consider seeking help with this skill before attempting future writing tasks.
- **TOO MANY QUOTATIONS** You're relying on quotations too much in this text. In the future, most source content should be paraphrased instead since this is favoured in the engineering field.
- **LACKING ANALYSIS** Experts' viewpoints seem to dominate this text, leaving little space for your own analysis. More space must be dedicated to your own analysis in the future to ensure you establish a strong voice as a writer.
- **INTEGRATION NOT ACHIEVED** It seems you've spent little effort on Phase D of the formula because source content is not well connected to your ideas. Where is your own analysis? What is your position in this text? You should book a CeTTL consultation to get help with academic writing skills because you haven't met university expectations here.

- **EXCELLENT REFERENCING** You've done an excellent job of citing sources, and you've followed conventions correctly in your reference list. Everything aligns and appears accurate. Keep following the tips from Phase D and other guidance on referencing sources when composing future texts.
- **STRONG REFERENCING** This is a strong attempt at following referencing conventions, but there are minor errors in your citations and/or reference list. Review the tips from Phase D and pay closer attention to every detail when using this referencing system in the future.
- **MISSING SOURCE & ERRORS** You forgot to identify a source in the body/reference list. There are some other referencing errors throughout the text, too. You need to review Phase D of the formula and the conventions of this referencing system. Seek help by booking a CeTTL consultation and/or using online resources as a guide.
- **FAULTY REFERENCING** Most of your text doesn't follow referencing conventions. In academia, this is a serious error that could result in consequences if repeated. Please review Phase D and the rules of this referencing system and seek help from a CeTTL expert.
- **REFERENCING NOT ATTEMPTED** You've made no attempt to cite your sources in this text. Where is your reference list? You must acknowledge the work and ideas of others in everything you do. Please book a CeTTL consultation to learn how to fulfil this responsibility. Otherwise, future academic violations like this will be met with consequences.

- **NO PLAGIARISM** There is no evidence of plagiarism in this text. Great job on following academic conventions! Continue using the formula to avoid plagiarising in future work.
- **IMPROVE P/Q TECHNIQUE** You need to improve your paraphrasing/quoting technique slightly to avoid possible issues with plagiarism in the future. Reviewing Phase D of the formula could help in this regard.
- **MINOR PLAGIARISM** You plagiarised some content in this submission, but the offence is minor. It's recommended that you review Phase D of the formula and seek guidance from online resources to learn more about your ethical responsibilities as part of academic learning.
- **SIG. PLAGIARISM = WARNING** You've plagiarised a significant portion of this text instead of demonstrating your own writing ability. This is a warning; future offences could involve additional consequences. Please book a CeTTL consultation to learn more about the types of plagiarism and how to avoid it.
- **40%+ PLAGIARISM** At least 40% of this text was plagiarised, meaning you've stolen a significant amount of content instead of demonstrating your own writing ability. The paper's convenor has been notified of this offence. You should book a CeTTL consultation to learn more about the types of plagiarism and your ethical responsibilities as a student.

- **EXCELLENT ORGANISATION** You've done an excellent job of organising this text in a logical way, using sources appropriately to express your position.
- **IMPROVE LOGIC** Your text uses source content in appropriate places, but its logic could be improved. You could consider glancing at CeTTL resources on academic writing before your next assignment.

- **IMPROVE ORG. & LOGIC** The organisation and logic of your text could use improvement, especially where sources are concerned. Please avoid using source content in a topic/concluding sentence. It may help to review model texts shared in class and/or refer to CeTTL resources on academic writing.
- **SUPPORT IDEAS + FIX LOGIC** In the future, be sure to refer to brainstorming notes while working on Phase D to ensure source content helps you answer questions and support your own ideas. Also, ensure each paragraph follows a linear logical progression with every sentence there to support your position.
- **FAULTY ORGANISATION** You've used source content in a few inappropriate places here. This has negatively affected the text's organisation, making the logic of your position hard to follow.
- **ORGANISATION NOT ACHIEVED** Your text needs significant revision to improve its organisation and repair its flawed logic. A big part of the problem here is that you're inserting source content in many inappropriate places. You should book a CeTTL consultation to learn how to structure an academic text using secondary research.

Appendix K: Code Key

CODES APPLIED IN THIS STUDY:

Magnitude Codes	Structural Codes	Concept Codes
• FB.MISS • MIXED • MODERATE • NEG • NEUTRAL • POS • QUOTE	• IMP • IV.STR • LIM	• CTXT • ID • INS.CUL • M.M. • SOC

CODE KEY:

- FB.MISS = feedback reported as missing/not found
- MIXED = mixed comment/attitude
- MODERATE = comment/attitude not overly strong
- NEG = negative comment/attitude
- NEUTRAL = neutral comment/attitude
- POS = positive comment/attitude
- QUOTE = full comment worth quoting in thesis
- IMP = ways to make improvements
- IV.STR = intervention's strengths
- LIM = limitations of materials
- CTXT = context of students' chosen discipline as related to reading and writing practices
- ID = students' identity (as learners and/or future professionals)
- INS.CUL = institutional culture's connection to student learning
- M.M. = meaning making (i.e., development of literacy skills)
- SOC = influence of social interactions with peers and teachers (also power relations)

Appendix L: Feedback Comments Used

Assessment Criteria & Feedback Comment Names:	Numbers of Students who Received Feedback Comment:		
	Task #1	Task #2	Task #3
Chosen Sources & Their Quality			
Excellent Sources	97	104	47
Source Appropriateness	35	45	61
Not Enough Sources	5	5	10
Faulty Source Choice	9	1	13
Lacking Quality Sources	40	24	35
Conventions of Using Source Content			
Skilled Paraphrasing	2	3	3
Deeper Analysis Needed	66	39	24
Quote Less	28	8	5
Problematic Integration	30	74	65
Weak Paraphrasing	2	1	0
Too Many Quotations	6	3	8
Lacking Analysis	5	15	8
Integration Not Achieved	2	0	5
In-text Citations and Reference List			
Excellent Referencing	2	0	0
Strong Referencing	100	89	99
Missing Source & Errors	32	34	27
Faulty Referencing	26	23	22
Referencing Not Attempted	5	3	8
Evidence of Plagiarism			
No Plagiarism	12	5	1
Improve P/Q Technique	101	68	35
Minor Plagiarism	83	108	117
Sig. Plagiarism = Warning	7	18	29
40%+ Plagiarism	0	0	0
Organisation of Source Content			
Excellent Organisation	2	4	4
Improve Logic	78	37	25
Improve Org. & Logic	90	71	61
Support Ideas + Fix Logic	8	62	74
Faulty Organisation	3	1	0
Organisation Not Achieved	0	0	0

Appendix M: T-test Results

Below are copies of the t-test results conducted in Excel. These t-tests used only the 22 students who completed both surveys, thus allowing for direct comparison.

t-Test: Paired Two Sample for Means

	IS-Q8	*PIS-Q4*	*IS-Q9*	*PIS-Q5*
Mean	**2.5**	**2.681818**	**5.772727**	**4.5**
Variance	0.261905	0.703463	1.136364	2.071429
Observations	22	22	22	22
Pearson Correlation	0.49923		-0.20174	
Hypothesized Mean Difference	0		0	
df	21		21	
t Stat	-1.16398		3.051593	
P(T<=t) one-tail	0.128744		0.003031	
t Critical one-tail	1.720743		1.720743	
P(T<=t) two-tail	**0.257488**		**0.006062**	
t Critical two-tail	2.079614		2.079614	

t-Test: Paired Two Sample for Means

	IS-Q10	*PIS-Q6a*	*IS-Q11*	*PIS-Q7a*
Mean	**3.545455**	**3.681818**	**3.545455**	**3.454545**
Variance	0.640693	0.989177	1.116883	0.926407
Observations	22	22	22	22
Pearson Correlation	0.407838		0.446861	
Hypothesized Mean Difference	0		0	
df	21		21	
t Stat	-0.64592		0.400381	
P(T<=t) one-tail	0.262662		0.34646	
t Critical one-tail	1.720743		1.720743	
P(T<=t) two-tail	**0.525324**		**0.69292**	
t Critical two-tail	2.079614		2.079614	