A narrative inquiry of women international students in engineering programs in Australia

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Declaration of Authorship

I, Wenqian Gan, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Engineering and IT at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Signed:

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Abstract

The underrepresentation of women in engineering is a longstanding issue due to various structural and cultural barriers. Despite growing numbers of women engineers in non-Western nations, existing research is primarily situated in the Western context. Within Australia, women international students have exhibited the highest growth rate in engineering over the past 10 years. A closer look into this population is warranted, to enable deeper understanding on how cultural context influences engineering participation.

This research examines the pathways and experiences of women international students in engineering. Existing literature on this population typically assumes linear pathways and treats them as a homogeneous population. These approaches do not account for the multiplicity of journeys and intersection of identities. In this study, narrative inquiry is adopted as a methodology to foreground under-represented individuals' voices and experiences.

Through semi-structured interviews, narratives were collected from six participants across different engineering disciplines and home countries. Each participant's engineering story is featured in this thesis along with an analysis based on the Personal, Practical and Methodological dimensions. The Personal dimension addresses why these narratives matter to the researcher personally; the Practical dimension addresses how this study makes a difference to practice; the Methodological dimension addresses how this research contributes to theoretical understandings of narrative inquiry as a methodology.

The findings highlight how individual motivations are intertwined with familial and social expectations. They challenge the notion of the 'leaky pipeline,' and reassert that there is no one-size-fits-all approach to addressing challenges faced by students.

Stereotypes about engineering lead to certain demographic groups continuing to dominate the profession. However, there is a both a business and social justice case for a more diverse engineering workforce that better represents the society from which it is drawn. Through narrative methodology, this study sheds light on ways to attract and retain diverse individuals within engineering, informs pedagogical approaches within higher education, and presents recommendations for practitioners, policymakers and researchers.

Chapter 1

Introduction

In this chapter, I discuss how my background and experience influenced my approach to this study. This covers areas such as my cultural, educational and familial background, and how I came to conduct this research. I then outline the research aim (or as explained later, the research puzzle), which is to understand how women international students came to do engineering. I also locate my thesis methodologically, which briefly explains how I intend to address the research question. I then discuss why this research is significant, introducing a number of reasons that will be expanded upon in later chapters, such as the need to acknowledge the experiential knowledge of minoritised groups. This chapter ends with a detailed presentation of the thesis structure.

1.1 Personal Context

As a Malaysian, I was raised in a multicultural and multilingual environment. At school, I interacted with my friends in Mandarin. At home, I conversed with my grandparents in Hokkien, a Mandarin dialect. At other times, I ordered food in Cantonese and filled in official forms in Malay. Recognising the importance to be fluent in English, my parents spoke to me in English at home, despite it being their third language. From 6 to 16 years old, I attended additional English lessons every weekend. My mum often bought me English storybooks.

As a child, I remember being led to the English section of the bookstore to pick books I was interested in (which I mostly judged by cover). With some influence from my mum, I came to have

a favourite author – Jacqueline Wilson. For context, Wilson is an English writer known for children's novels. Many of her novels feature themes such as divorce and adoption, and most of her stories are situated in the present-day United Kingdom. Despite having zero ideas about the United Kingdom (from climate to localities to popular snacks), I was engrossed in the characters' stories and Wilson's depiction of familial relationships.

As much as I enjoyed Wilson's novels, I soon had to transition away from them. As my English teacher put it, "the story is suitable for your age but not your English level." At that time, I was attending additional English lessons with teenagers two-to-three-year groups above me, thanks to my parents' vision for early education. Wandering over to the young adult section in the bookstore for the first time, I noted two main genres: coming-of-age novels featuring bright, colourful covers; and crime fiction featuring dark, gothic covers. Neither appealed to me, but I gave coming-of-age novels a try, thinking it would be easier to relate to the lives of girls my age. To my disappointment, they often featured American teenagers' preoccupation with fashion and dating, far from what my teenage life looked like.

While these novels may have been intentionally dramatised to appeal to their target readers, I realised much later how these novels impacted me when I watched a TED talk titled *The danger of a single story* (2009) by Chimamanda Ngozi Adichie, a Nigerian writer. In her talk, she spoke about how she grew up reading British and American children's books, just like I did. When she started writing, all her characters were white and blue-eyed, played in snow, and ate apples although there was no snow in Nigeria, and they ate mangoes. Adichie's words struck a chord with me:

> Because all I had read were books in which characters were foreign, I had become convinced that books by their very nature had to have foreigners in them and had to be about things with which I could not personally identify. (Adichie, 2009, 1:40)

According to an Annual Report in 2021 on ethnic representation within UK children's literature, 15% of children's books published in the UK featured characters of colour, and 8% featured a main character from an ethnic minority background (Centre for Literacy in Primary Education, 2021). These numbers are far lower than the percentage of children of primary school age in England from a minority ethnic background, which stands at 33.9%. An analysis of young adult fiction

titles published in the UK from 2006-2016 showed that 8% of young adult authors were authors of colour (Bold, 2018).

For me, it is not just about being unfamiliar with where the characters lived, how they looked and what they did. After all, books provide a window to experience "people, cultures and worlds beyond your own" (Centre for Literacy in Primary Education, 2021, p. 8). However, growing up with a dominant set of stories that I do not relate to meant it was much harder to articulate and validate my thoughts and feelings. As part of a minoritised population, it then becomes too easy to silence the voice that does not fit the narrative of the majority.

As an international student in Australia and a woman in engineering, this voice manifests itself as feelings of unbelonging, uncertainty and unsettlement. Why do I feel a greater sense of belonging in certain women in engineering communities compared to others? Why do I find it easier to be friends with men with shared cultural backgrounds compared to White women? Is my interest in the social aspects of engineering attributed to my gender or other aspects of my identity? Would I have assimilated better if I grew up watching American shows and listening to English songs?

Life overseas continued while I was seeking these answers. I completed my undergraduate thesis on an engineering education topic, and was given the opportunity to present my work at an engineering education conference. I expected to find answers there, but I left with more questions. Why weren't there any presentations about international students? Why weren't there more papers on women in engineering? A few chats with conference attendees suggested there is a lack of research in this area (at least in the Australian context). In the coming months, I compared PhD programs, spoke to potential supervisors, wrote research proposals, and eventually started my PhD on women international students in engineering. This personal context can be considered as my positionality in this thesis, which I will further describe in the next section.

1.2 Research Aim

While an Introduction chapter typically outlines the research questions, I will withhold doing so due to my choice of methodology, narrative inquiry, which I will explain in greater depth in Chapter 3: Methodology. Instead, I will outline some aspects of my 'research puzzle' (Clandinin, 2016)

to guide readers in understanding the focus of the research. In particular, I will outline the *who* (research participants), the *what* (research aim), and the *how* (research methodology) of the project.

Firstly, the *who*. This research focuses on a specific population - women international students who are enrolled in an undergraduate engineering degree in an Australian institution. In the context of this research, "international students" refers to students paying international student fees to their respective institutions. This population is chosen for personal and practical reasons. Due to my personal experience as a woman international student from Malaysia who completed a Bachelor of Mechanical Engineering at the University of Sydney, I believe my positionality allows me to access this population's stories and interpret them in nuanced ways. As I will discuss in Chapter 2: Literature Review, there is also a need for more research on this population within a specific context to advance and diversify our understanding of minoritised populations, and to develop sustainable support systems.

Secondly, the *what*. My research starts with a broad aim, which includes understanding how this population came to do engineering and their experiences during their studies. I wanted to better understand their pathways prior to university (such as the interplay between earlier education and familial influence on their interest and motivation), their perceptions of engineering (and how it is shaped and changed over time internally and externally), and their future aspirations (including post-study plans and dreams). While a broad aim may appear to dilute the scope of the research, it allows space to curate 'bottom-up' accounts of minoritised populations without "aligning with existing developmental or educational models" (Cruz & Kellam, 2018, p. 575) which are primarily informed by Western epistemologies. The next section will expand on how Western epistemologies inform my research.

Finally, the *how*. This research involves collecting, interpreting, and presenting narratives from my research participants. Chapter 3: Methodology outlines key features of narrative inquiry that make it distinct from other methodologies, but one feature that I would like to highlight upfront is that narrative inquiries do not lead to final answers. They are framed to "engage audiences to rethink and reimagine the ways in which they ... relate to others" (Clandinin, 2016, p. 51). This feature does not mean that narrative inquirers do not attend to 'so what?' questions. Rather, the 'so what?' section would be a list of topics for further discussion rather than a list of recommendations to implement.

In summary, this research:

- Focuses on women international students who are enrolled in an undergraduate engineering degree in an Australian institution
- Starts with a broad aim to understand how women international students came to do engineering, as well as their experiences in studying for the degree
- Involves collecting, interpreting, and presenting narratives from women international students

In the next section, I continue my narrative on how I navigated my positionality to situate my research.

1.3 Research Beginnings

In the first year of my PhD, my main job was to read. While swirling in endless literature, I felt a sense of déjà vu, like I was back to reading one of Wilson's books or the coming-of-age novels that I could not relate to. At times, like in Wilson's novels, I understood the sentiment and argument of the literature, but did not have sufficient factual background or experiential knowledge of the context. At other times, the literature on a population I was supposedly familiar with (international students or women in engineering) felt as foreign as a coming-of-age novel about American teen life.

Initially, I attributed this feeling to my ignorance of historical events and the absence of a social science background. I addressed this discomfort as a challenge to learn, certain that it would subside with knowledge and time. As I familiarised myself with Western contexts and seminal papers, I decided that my worldview and lived experience were only valid to the extent of understanding my participants. The remainder that does not align with existing theories is relegated to anecdotal outliers that I compartmentalise as a researcher. However, I soon found myself returning to Adichie's statement, which I rephrased in my own terms:

> Because all I had read were literature in which researchers and participants were based in a Western context, I had become convinced that research by its very nature had to be in a Western context and had to be about things I could not personally understand.

I realised what I was missing was not merely the historical, political, and educational context of the literature I was reading. My inability to resonate with the literature was not solely attributed to my lack of awareness of political and social movements, nor was it due to my lack of intellectual ability to engage with these texts. I learned I was going through the effects of 'epistemological racism' (Kubota, 2020).

Highlighting that racism is often "conceptualized in terms of individual and institutional injustices" (Kubota, 2020, p. 712), Kubota conceptualised epistemological racism, another form of racism that "problematizes how racial inequalities influence our knowledge production and consumption in academe" (p. 712). According to Kubota, epistemological racism not only marginalises and erases the knowledge produced by scholars from minoritised groups. It also compels these scholars to "believe that the white Euro-American knowledge system is normal and natural" and "mold [their] ways of thinking into this framework" (p. 723), which further perpetuates the hegemony of white knowledge. As to why scholars from minoritised groups become complicit with knowledge systems that exclude us, Chen Kuan-Hsing offers a compelling reason in the context of colonisation and imperialisation.

In his book *Asia as Method: Toward Deimperialization* (2010), Chen observed that while previous colonials have been ex-colonised at the political level, they remain colonised at the cultural and psychic level. According to Lin's (2012) review of Chen's work, this colonised state leads to "deep-rooted desires, attitudes, beliefs, and cultural imaginaries [that] are often unconscious" (p. 158). Questioning the lack of development in work inspecting decolonisation at the level of the cultural imaginary, Chen draws attention to the "ongoing psychological complexes and cultural imaginations of the ex-colonized" (p. 158).

In discussing Chen's work in the context of critical education studies, Lin (2012) reflected on her positionality as a Hong Kong scholar located in post-British colonial Hong Kong, weaving in observations from her context to enrich Chen's argument. She shares her struggle negotiating with traditional and Western forms of knowledge, cultures, and ways of doing scholarship, which I resonated with as a Malaysian Chinese located in Australia.

One possible method to address the above struggle is to scrutinise our complicity with mainstream theories and selectively subscribe to alternative views. However, scholars have warned about the risks of essentialism (Kubota, 2020) and constraining ourselves within the "binary deadlock of either worshipping the West (e.g., following their theories, knowledge, epistemologies, cultures) or reacting against it (e.g., negating anything from the West)" (Lin, 2012, p. 173). This does little to liberate us from Western epistemologies. Instead, Chen builds on Stuart Hall's (1992) argument that we have been using 'the West as method,' and proposes the notion of 'Asia as method.'

> Using the idea of Asia as an imaginary anchoring point, societies in Asia can become each other's points of reference, so that the understanding of the self may be transformed, and subjectivity rebuilt. (Chen, 2010, p. 212)

Chen emphasises that 'Asia as method' is not the reverse of 'the West as method'. Instead, it involves acknowledging that our subjectivity constitutes elements of the West and multiplying our frames of reference to dilute our dependence on Western epistemologies and progress critical work. It is important to note that the work done by Kubota and Chen is not constrained by race or geography. Both scholars have discussed other forms of oppression and the importance of intersectionality in their respective works. I will expand on intersectionality in Chapter 2: Literature Review.

In the context of this research, the concept of epistemological racism and the arguments presented in *Asia as Method* foregrounds my critique of the literature. However, the scope of my thesis, which focuses on women international students' pathways and experiences with engineering, suggests a focus on their "social, cultural, institutional, linguistic, and familial narratives" (Clandinin, 2016, p. 18). In seeking to balance between my responsibility as a researcher to decentre from Western epistemologies and my positionality as a woman international student, I turned to narrative inquiry, which I will briefly introduce in the next section.

1.4 Narrative Beginnings

As a person of Asian descent conducting PhD research at an Australian university, I realised I was not wading through uncharted territory. Rather, I was trespassing an overmarked territory, saturated with stories of the dominant population. As a student, I rarely saw people like myself represented

in engineering and struggled to relate to my peers. As a researcher, I rarely saw people like myself represented in literature and struggled to find theories that 'fit.' Drawing from Chen's critique that there is a need to dilute our subscription with Western knowledge, I found Critical Race Theory (CRT) a useful framework to do so. CRT recognises the experiential knowledge of minoritised groups as "legitimate, appropriate, and critical to understanding, analysing and teaching," and asserts the need to draw on the experiences of minoritised groups through methods such as narratives (Yosso, 2005, p. 74). Narratives hold diverse meanings, which I will further discuss in Chapter 3: Methodology. To orient my research, I take on Kubota's (2020) suggestion to turn our critical lens away from dominant knowledge systems, and instead "look into ourselves." (p. 723) To clarify what I mean by "look into ourselves," I emphasise the multifaceted positionality of a researcher through the following quote:

> ... we never come innocent to a research task, or a situation of events; rather we situate these events not merely in the institutional meanings which our profession provides, but also constitute them as expressions of ourselves. (Clough, 2002, p. 17)

In other words, the narratives that I collect, interpret and present are by no means an objective account of my research participants. Rather, as Clandinin and Rosiek (2007) explain, "every representation ... involves selective emphasis of our experience" (p. 39). I will return to this in Chapter 3: Methodology, where I go into greater detail on the meaning of 'narrative' and the nature or characteristics of 'narrative inquiry.'

Before proceeding with an overview of how this thesis is structured, it is important to address the significance of the study. In this thesis, I adapt Clandinin's (2016) framing of personal, practical, and methodological justifications, which is further discussed in Chapter 3: Methodology. *Personal* justifications address why this research matters to me as an individual. *Practical* justifications address how this research might make a difference to practice. *Methodological* justifications address how this research contributes to theoretical understandings of narrative inquiry as a methodology. I will expand on this framework in Chapter 3: Methodology.

1.5 Thesis Structure

Figure 1.1 shows how this thesis is structured.

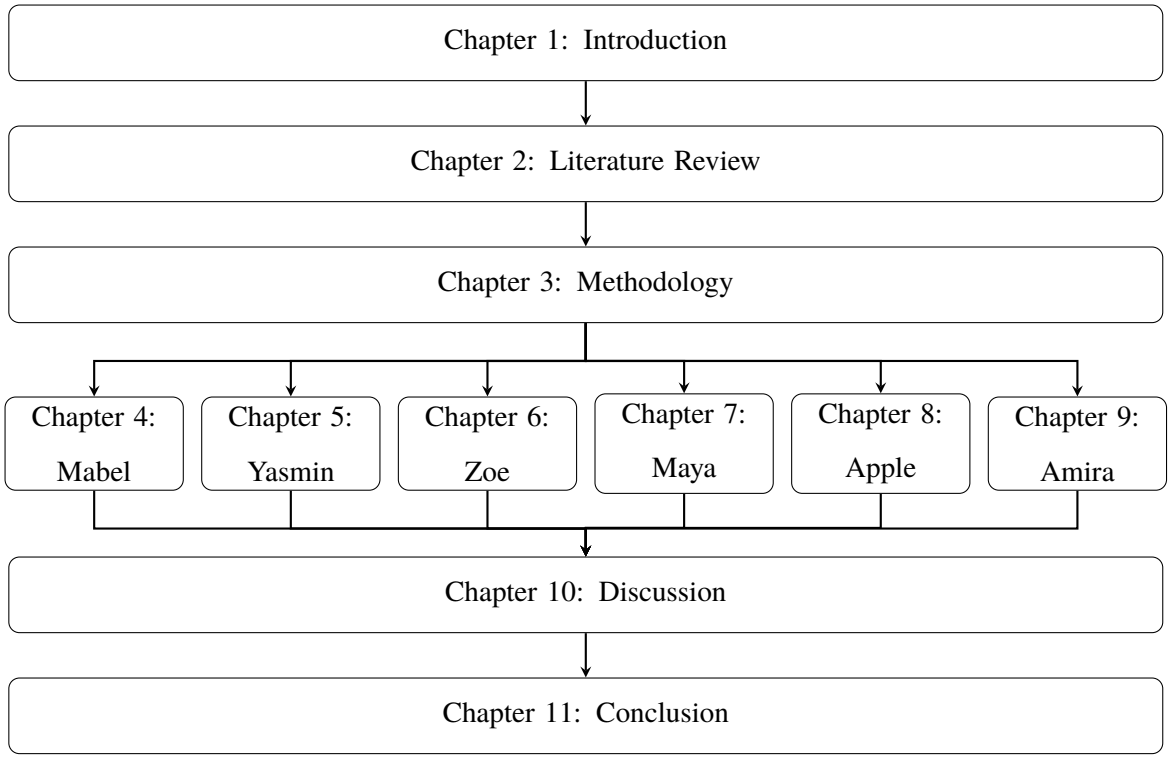

FIGURE 1.1: Thesis Structure

In Chapter 1: Introduction, I provided a glimpse of what the personal, practical, and methodological justifications are by introducing myself, my research, and how they inform my approach in this study.

In Chapter 2: Literature Review, I describe the study scope and approach to identifying relevant literature. I provide background context and discuss metaphors such as pipelines, pathways, and ecosystems to inform theoretical directions for this research.

In Chapter 3: Methodology, I provide an overview of narrative inquiry, and the research methodology adopted. I present my research design, outlining the processes undertaken to collect, interpret, present, and evaluate narratives.

In Chapters 4 to 9, I introduce each of my selected research participants – Mabel, Yasmin, Zoe, Maya, Apple, and Amira. Each chapter starts with a first-person narrative of the participant, followed by an analysis of the narrative. In the analyses, I attend to these narratives' personal, practical, and methodological justifications. I do so by 1) turning to my own experiences to understand the research participant and my selective emphasis on their experience, 2) drawing on the literature to situate the participant's experience and generate practical theory, 3) reflecting on the process of collecting, interpreting, and presenting these narratives to discuss how it contributes to theoretical understandings.

In Chapter 10: Discussion, I synthesise analytical threads from each participant's narrative. I share how this research has affected me personally, discuss how the participants' narratives were shaped by familial, cultural, and institutional narratives, and reflect on this study's analytic approach and quality.

In Chapter 11: Conclusion, I summarise my findings, discuss the contributions of this research, and outline recommendations for practitioners, policymakers and researchers.

1.6 Summary

In this chapter, I discussed my background and how I came to do this study. I highlighted the research aim and significance, and located my thesis theoretically and methodologically. I also outlined the thesis structure.

The next chapter discusses background context and theoretical directions of this study.

Chapter 2

Literature Review

In Chapter 1: Introduction, I located my thesis theoretically. Drawing parallels between my experience with storybooks and the literature, I discussed the effects of epistemological racism, where racial inequities influence knowledge production and consumption. I addressed *who* my research focuses on – women international students who are enrolled in an undergraduate engineering degree in an Australian institution, and *what* it focuses on – how they came to do engineering and their experiences in that area.

The *how* will be discussed in the following chapter. In this chapter, I describe the study scope and approach to identifying relevant literature. I provide background context, such as the internationalisation of higher education and the underrepresentation of women in engineering. I then discuss metaphors used to describe participation such as pipelines, pathways, and ecosystems, and situate the use of narrative methodology. Finally, I outline theoretical directions for this study based on my critique of existing approaches.

2.1 Approach

This section outlines the study scope and the search strategy used to guide the identification of relevant literature.

2.1.1 Scope

The scope of this study is primarily informed by the specificity of the population and the research aims.

2.1.1.1 Specificity of Population

The women international students enrolled in an undergraduate engineering degree in an Australian university are quite diverse in terms of their educational, dispositional, circumstantial, and cultural characteristics. These characteristics are listed below in Table 2.1.

TABLE 2.1: Diversity Dimensions (Thomas & May, 2010, p. 5)

Diversity dimensions	**Examples**
Educational	Level/type of entry qualifications; skills; ability; knowledge; educational experience; life and work experience; learning approaches.
Dispositional	Identity; self-esteem; confidence; motivation; aspirations; expectations; preferences; attitudes; assumptions; beliefs; emotional intelligence; maturity; learning styles; perspectives; interests; self-awareness; gender; sexuality.
Circumstantial	Age; disability; paid/voluntary employment; caring responsibilities; geographical location; access to IT and transport services; flexibility; time available; entitlements; financial background and means; marital status
Cultural	Language; values; cultural capital; religion and belief; country of origin/residence; ethnicity/race; social background.

Undergraduate students were chosen as a focus to scope the study more tightly and facilitate awareness of the variety of journeys that can be undertaken. The number of undergraduate students far outweighs the number of postgraduate students, whose educational and dispositional dimensions are significantly different. The decision to focus on this undergraduate population allows narratives

to be collected from students across different engineering disciplines, various years of study, home countries, and universities.

2.1.1.2 Aim of Study

As mentioned in Chapter 1: Introduction, my research aims to understand how this population came to do engineering and their experiences in engineering. This broad aim enables me to capture a holistic account of my research participants, which is aligned with the selected research methodology. I will further discuss in Chapter 3: Methodology how my research methodology influences the study aims.

2.1.2 Search Strategy

A critical decision in curating this chapter is to conduct a narrative literature review instead of a systematic literature review (the latter typically involves a much more comprehensive search process). The complexities of the population specifics and broad research aim inform this decision.

While the search process can be guided by the specificities of the population (e.g., international students, women, engineering, undergraduates, Australia), it will not return sufficient results as the literature on this specific population is sparse (Gan et al., 2021). One alternative is to broaden the search criteria by removing certain specificities. However, Crenshaw (1989) has argued that studies that focus on single-axis analysis do not account for the intersectional effects of these dimensions.

Working with a broad aim further complicates the search process, as my study is not limited to the experiences of participants in a distinct context (e.g., lab, work placement), nor is it focused on a particular aspect of their experience (e.g., working in teams, learning an engineering concept).

In the following section, I further clarify the scope of my thesis to guide critique on the limitations of my work. I outline my search strategy, including working definitions, search terms, and considerations on inclusion and exclusion criteria.

2.1.2.1 International Students

'International students' refer to students paying international student fees in their respective institutions. I acknowledge that this narrow definition does not account for variations in time spent in the host country, which affects all diversity dimensions discussed above. However, as this framing of 'international student' is adopted by higher education and government departments, and widely used both formally and informally for a range of different purposes, I believe it best represents the study population. Some alternate terms applied to the literature search strategy include 'overseas student' and 'foreign student.'

While there is a significant overlap in equity issues concerning international students and students of colour, the literature on students of colour primarily focuses on students raised in the country where the institution is based. Hence, they have a significantly different experience from international students who travel to the host country to pursue higher education. For the above reason, I have only included literature on students of colour where relevant to the argument.

In literature, this population is sometimes referred to as 'culturally and linguistically diverse students' and 'non-native English speakers.' These terms are not adopted in this thesis as they subscribe to the framing of 'the West and the Rest' (Hall & Morley, 1992), positioning international students as 'other.' However, I have included literature that used these terms where relevant to the population of this study.

2.1.2.2 Engineering

A wide range of literature across STEM applies to this population. However, women are significantly underrepresented in engineering compared to other STEM fields (Australian Academy of Science, 2019). Since gender is a focus of my study, I have only included literature on STEM where relevant to the argument.

Engineering can refer to participation in the educational system or workforce (Lee, 2019). In using 'engineering' as a search term, I commonly find articles on professional engineers. While this study seeks to inform recommendations that benefit students, I acknowledge that their experiences are not limited to their academic experience but extend to their professional experience (especially

if they undertake work placements). Hence, I have included literature on professional engineers as relevant.

2.1.2.3 Women

While 'women' is a term that appropriately describes the gender I am focusing on, several studies use the term 'female' for various reasons. I define 'women' as anyone who identifies as a woman, regardless of their biological sex assigned at birth. To account for studies exploring gender differences or the concept of gender more broadly, I have included 'gender' as a search term. While the focus here refers to women, I recognise that gender is not a binary concept.

This literature review also focuses on the literature published in English, indexed on an academic database, and accessible through the sponsoring research institution.

2.2 Background

Higher education was first recognised as a tradable commodity by the World Trade Organisation in 1995 (Tilak, 2011). Since then, international student numbers worldwide have increased more than threefold (United Nations Educational, Scientific and Cultural Organization Institute for Statistics, 2018). In Australia, international education gained momentum through the Colombo Plan in 1950 and has become one of Australia's top exports (Australian Bureau of Statistics, 2022). Alongside the United States and the United Kingdom, Australia has consistently remained one of the top host countries for international students (OECD, 2022).

International students pursue international education for personal and professional reasons. These reasons include gaining exposure to a foreign culture and increasing employment prospects (Dewey et al., 2013; Nilsson & Ripmeester, 2016). For host countries such as Australia, international students contribute to the higher education sector as well as the local economy, cultural capital, and skilled workforce (Deloitte Access Economics, 2016).

Engineers form a substantial proportion of the skilled workforce in Australia (Bell et al., 2022). A report by Engineers Australia (2022) shows that the supply of engineers comprises two streams: graduates from Australian universities, and skilled migrants. Figure 2.1 shows that pre-COVID,

international students form half the supply of professional engineers in Australia. The number of international students is three times larger than the number of skilled migrants, yet 40% of them depart after completing their studies. The report suggested that rather than "simply increasing intakes of undergraduate engineering students" (p. 17), it is more critical to make it easier for locally-trained graduates to transition to a permanent migration visa.

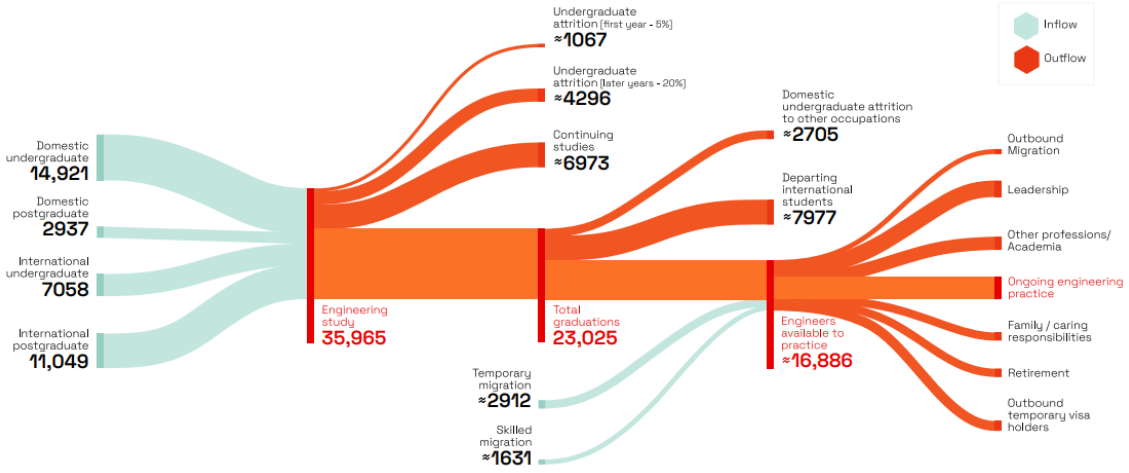

FIGURE 2.1: Inflows and outflows of Professional Engineers 2019 (Bell et al., 2022)

Another factor contributing to a shortage of engineers in Australia is the low proportion of women in engineering. Despite being the biggest employer across STEM professions, engineering has the lowest percentage of women, making up 16% of its students and 13% of qualified engineers (Romanis, 2022). This percentage is caused by barriers across the pipeline (further discussed in the next section), as shown in Figure 2.2.

Further information on statistics related to women in STEM across different stages can be found on the Australian Government's Department of Industry, Science and Resource's Snapshot of disparity in STEM webpage and the Women in STEM Decadal Plan published by Australian Academy of Science (2019). These numbers are specific to the Australian context but also vary greatly across countries. For instance, The Women in STEM Decadal Plan highlighted that across the Asia Pacific region, Australia had the lowest percentage of girls electing to take STEM subjects in school (27%), compared to China (76%) and India (69%).

The above statistics correspond to studies related to women in STEM across nations. In Else-Quest et al.'s (2010) meta-analysis of the outcomes of the Programme for International Student Assessment (which measures reading, mathematical and scientific literacy of 15-year-olds across

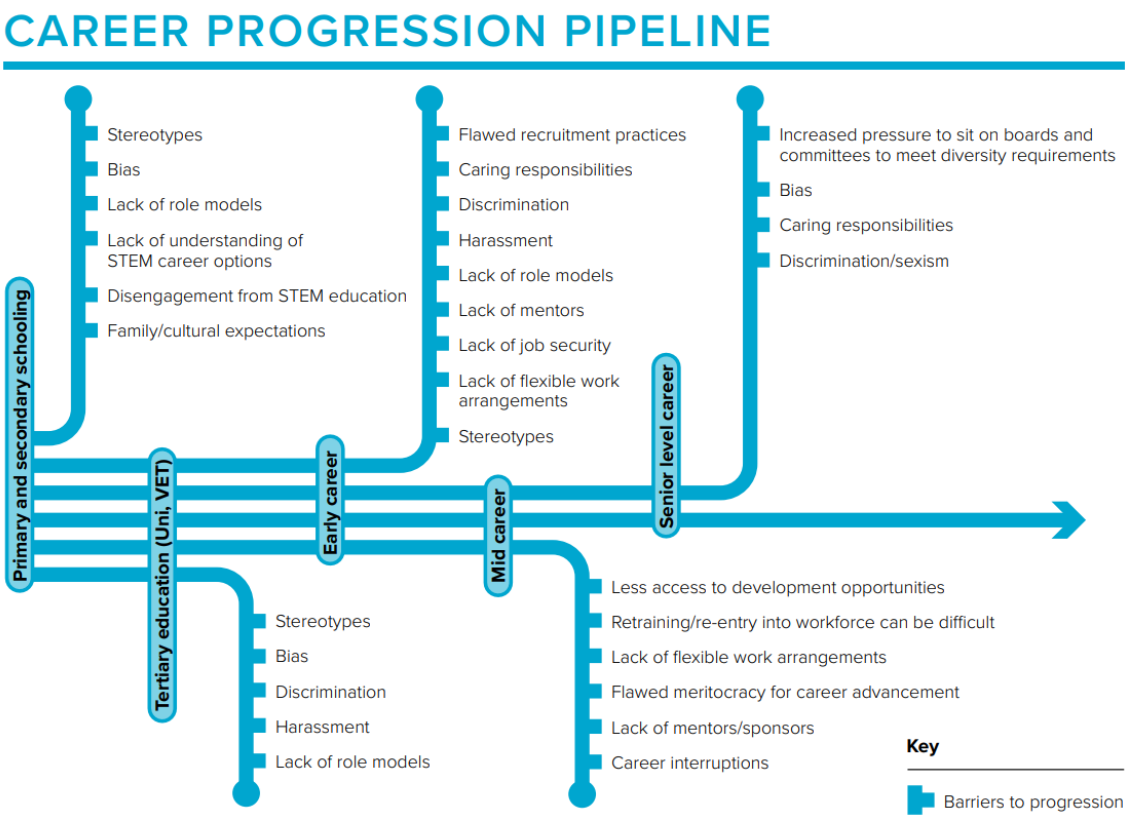

FIGURE 2.2: Barriers to career progression pipeline for women in STEM (Australian Academy of Science, 2019)

countries), they found that the gender gaps in mathematics are not present in all nations. At the tertiary level, the share of female tertiary graduates in engineering ranges from 2.7% (Saudi Arabia) to 54.6% (Benin) (United Nations Educational, Scientific and Cultural Organization, 2021). This range can be attributed to differences in education systems and cultural values, which are rarely discussed in the literature.

The above findings suggest the need for more studies on women international students in engineering, as the findings can potentially illuminate missed aspects critical to broadening participation and strengthening the engineering workforce. In Australia, the enrolment number of women international students in engineering exhibited the highest growth rate of 556% from 2001-2019 (compared to 478% for men international students, 194% for women domestic students, and 137% for men domestic students) (Australian Government Department of Education, Skills and Employment, 2022).

This section established the need to study women international students in engineering. Drawing

from the context presented, the following section will discuss the literature relevant to this population, and critique any existing relevant approaches for this study's research focus.

2.3 Metaphors for Participation

The previous section shows the inflow and outflow of professional engineers in Australia through a pathway diagram (Figure 2.1). The barriers women face in STEM are presented based on stages along a career progression pipeline (Figure 2.2). Both figures stem from metaphors that are widely used and increasingly critiqued: pipelines and pathways.

As summarised by Lee (2019), the pipeline metaphor focuses on who shows up (or drops out) at different educational and professional junctures, while the pathway metaphor focuses on where a population "originated and subsequently go" (p. 11). These metaphors allow researchers, practitioners, and policymakers to accurately measure participation rates, identify factors influencing these statistics, and implement initiatives to address the identified factors.

The impact of these metaphors is evident in Figures 2.1 and 2.2. In Figure 2.1: *Inflows and outflows of Professional Engineers 2019*, the numbers presented in the pathway diagram show the stark difference between the number of potential engineers (graduates from local universities and skilled migrants) and actual practising engineers. These figures demonstrate that the lack of professional engineers is not due to a lack of supply, which should prompt a rethink in policies and approaches across the government, education system and engineering industry. Meanwhile, Figure 2.2: *Barriers in career progression pipeline for women in STEM* sheds light on the wide range of challenges faced by women in STEM. Raising awareness of the challenges faced at each stage provides influencers with a direction for where to channel their efforts on broadening participation.

While the pipeline and pathway metaphors have proven successful in several contexts, their impact is limited. Like theories, any metaphor will focus on some aspects more than others (Lee, 2019). Lakoff and Johnson (1980) emphasised the importance of seeing metaphorical structuring as "partial, not total" (p. 13), while Lee (2019) cautioned against the urge to view any metaphor as a panacea. Instead, they argued that metaphors such as pipelines, pathways, and ecosystems (discussed later in this section) should be considered as different participation paradigms that can be thoughtfully leveraged, based on our goals.

The upcoming sections will outline the application and impact of different participation paradigms in the context of this study and position the use of a narrative methodology within these paradigms.

2.3.1 Pipeline

The pipeline metaphor can track participation rates across different junctures and identify junctures of concern (Lord et al., 2019). For example, Engineers Australia's Women in Engineering report (Romanis, 2022) highlighted that 3 in 4 women in non-engineering fields have never considered the field. Of the reasons stated, 50% of the respondents attributed their lack of awareness towards engineering, and the report concluded that familiarity from a young age is vital to broadening women's participation rates. This conclusion led to a list of recommendations at a school level, which includes fostering familiarity with engineering, supporting girls in developing STEM interest and aptitude, and promoting positive perceptions of engineering.

The argument logic is that familiarity increases the 'supply' of women in engineering. If more girls are exposed to engineering, they will consider it a valid choice. If that happens, the number of women participating will increase. This logic explains the appeal of school outreach programs designed to promote STEM among girls, which collectively have received federal funding of $100 million over the past decade (Hare, 2022). As most initiatives are one-off events organised through universities and industry partners, they are relatively easier to incorporate than redesigning the curriculum. While these initiatives help direct girls into the engineering pipeline, the extent to which it leads to more women in engineering is unclear. As shown in Figure 2.2: *Barriers in career progression pipeline for women in STEM*, attracting more girls to the pipeline does not shield them from challenges later in their studies or career. Those who eventually choose to leave are described as 'leaking through,' which shifts the blame to the next juncture of the pipeline.

More importantly, the pipeline metaphor only distinguishes between those who stay or leave. It does not offer a further explanation of what happened. While those who stay may be referred to as success cases, their experiences may not be positive. Similarly, those who leave may have done so for reasons unrelated to issues in engineering. As Cannady et al. (2014) point out, it is not a problem if someone chooses not to pursue STEM because they want to be a musician, but it is a problem if they choose not to pursue STEM because their teacher told them that girls could not do

science. In the pipeline metaphor, however, both cases are simply leaks caused by an inadequate system, with little acknowledgment of individual agency (Lee, 2019).

To interrogate the appropriateness of the pipeline metaphor in policymaking, Cannady et al. (2014) conducted a study based on longitudinal data to investigate the extent to which the pipeline metaphor applies to scientists' and engineers' STEM trajectories. They focused on two attributes consistently linked to STEM degree attainment or career entry: *interest in science* and *achievement in mathematics or science* (Tai et al., 2006; Tyson, 2011). In the engineering context, these attributes have been described as crucial drivers of the pursuit of engineering (Godwin et al., 2016; Romanis, 2022). In their study, however, Cannady et al. (2014) found that more than half of the scientists and engineers did not have both attributes, and 16% had neither attribute when they were at school.

Cannady et al. (2014) asserted that these findings do not mean that early interest and exposure are meaningless. Instead, it challenges the perception that one must consider engineering at a young age or take STEM subjects at school to be an engineer. When used as benchmarks for broadening participation, these attributes can perpetuate misconceptions about the characteristics that are required to be an engineer. As Cannady et al. (2014) argued, it is "precisely those women and underrepresented minority groups who are less likely to have [these] characteristics ..." (p. 454). Given that these attributes are not found in a sizeable number of scientists and engineers, prescribed interventions (especially those focusing primarily on supply) should be questioned. This argument complements Australia's Science Minister Ed Husic's call for an audit of federally-funded programs designed to get women into STEM, citing minimal outcomes from previous funding (Hare, 2022).

The relatively low number of scientists and engineers who follow the traditional STEM pipeline further reaffirms critiques that the pipeline metaphor is oversimplified. Researchers have problematised the depiction of the STEM trajectory as a linear process where people enter and exit engineering at the "same intake and outflow points" (Atman et al., 2018, p. 2) along a restricted path. This depiction overlooks authentic career patterns discussed in the literature (Cannady et al., 2014; Pawley & Hoegh, 2011). For instance, Xie and Shauman (2003) found that the pipeline overlooks the role of family and gender differences in familial role expectations, both of which significantly impact women's timing and sequencing of their careers.

The pipeline metaphor, when used effectively, allows us to raise awareness, structure arguments, and inform interventions. However, an exclusive focus on the supply side lessens the emphasis on retention, which is equally critical to workforce participation. As discussed earlier, benchmarks for participation need to be developed with caution, as they risk perpetuating the concept of a linear path that does not reflect the realities of career decisions. Those using the pipeline should be aware of how it reduces individual agency and identities and assumes retention is a success and attrition is a failure.

Instead of referring to leavers as those "leaking into the drain," Cannady et al. (2014) proposed framing them as "going off the beaten path." Compared to the former framing, the latter has a positive connotation that honours individual agency. The pathway metaphor better represents those who "went off the beaten path," as shown in Figure 2.1: *Inflows and outflows of Professional Engineers 2019*. As the pathway metaphor accounts for multiple journeys, it can be used in tandem with the pipeline metaphor to facilitate alternative routes into STEM (Cannady et al., 2014). The following section further unpacks the pathway metaphor and its relevance to this study.

2.3.2 Pathway

The pathway metaphor can be applied through two distinct approaches. The first approach extends the pipeline metaphor, with multiple entry and exit points to account for alternate paths taken (rather than simply considering leavers as leaks). The second approach is using narratives, where individual pathways are mapped to deepen understanding of what happens on the path.

Figure 2.1: *Inflows and outflows of Professional Engineers 2019* represents the first approach in the context of international education. In engineering education, the first approach facilitates understanding of transfer students and students who change majors (Lord et al., 2019). In the engineering workforce, it better represents diverse career patterns. However, these applications of the pathway metaphor do not address all the critiques associated with the pipeline metaphor. For instance, the above applications of pathway metaphor still do not describe what happens on the paths (Lord et al., 2019). While it represents more than one path in which an individual can navigate a system, our knowledge of alternate paths is still limited by demographic data collection processes where those systematically excluded tend to be least tracked (Lee, 2019).

The second approach of using narratives, which is further explained in Chapter 3: Methodology, addresses the above critiques. By collecting narratives from women international students on their pathways to engineering, I gained insight into aspects of their education trajectories prior to university, their decision-making processes, and their future aspirations. While the findings are based on a small number of participants, they can shed light on paths and factors that are not represented in the literature. For example, Cruz and Kellam's (2018) narrative methodology study on 21 students changing their majors to engineering resulted in a set of themes that influenced the students' retention in engineering. The findings of such studies can inform the development of more robust models (e.g., a catalogue of factors) which can then be assessed using larger datasets (e.g., through quantitative surveys). These models can be refined or reframed as analytic lenses to guide the interpretation of narratives and systematically advance our understanding of a particular issue.

These two approaches are highlighted to contrast how the pathway metaphor has been applied in the literature and how it is used in this study. They are not mutually exclusive approaches; they can be combined with the pipeline metaphor to yield different outcomes. As Lee (2019) argues, viewing these metaphors as participation paradigms allow us to intentionally select them as appropriate depending on the target population and research aim. For clarity, the first approach is referred to as 'pathways' and the second is referred to as 'narratives' for the rest of this chapter.

In this research context, the extent to which international students' entry and exit points can be mapped is limited due to difficulty in tracking the vast diversity of pathways. While a comprehensive representation of their pathways would be a novel theoretical contribution, it may not lead to actionable interventions due to the influencers' locus of control. For example, the education system of international students' respective home countries is not an aspect that the university in the host country is well placed to address. However, understanding why they chose to come and then leave the host country can help inform strategies to attract and retain them.

Characterising factors based on why participants choose to stay, or leave is commonly referred to as push and pull factors. These are drawn from the push/pull theory of migration (Lee, 1966). In this study, push factors refer to factors that 'push' students away from their home country, while pull factors refer to factors that 'pull' students to the host country. However, framing what are considered push or pull factors can be ambiguous and depends on the researcher's interpretation. For example, if a student decides to leave their home country due to its poor educational quality

and chooses the host country due to its better educational quality, should it be classified as a push factor, pull factor, or both?

Rather than labouring over whether a particular factor is a push or a pull factor, it is more critical to determine actions that can be taken within an institution's locus of control. In the above example, the push factor may drive universities to investigate future students' sentiments regarding the educational quality in their country. The findings can be used to inform recruitment strategies. Meanwhile, the pull factor may prompt host countries to launch marketing campaigns promoting the educational quality of their institutions. Like pipelines and pathways, push/pull is a "shorthand for discussion" (Bruzzone, 2020, p. 2) that prompts interventions. As argued earlier, they should not be the only framework used to guide discussion on attraction and retention. Instead, as Lee (2019) proposed, they should be viewed as participation paradigms with strengths and limitations.

As with the pipeline metaphor, the push/pull theory can lead to ineffective interventions if not applied critically. Researchers have critiqued the push/pull theory, arguing that causation is cumulative and societal, making it challenging to generalise trends across societies (Bruzzone, 2020). While generalising trends across societies may be meaningful from a positivist stance, it undermines the multiplicity of journeys and intersection of identities critiqued in the pipeline metaphor. As this study aims to highlight the voice of an underrepresented group, the factors identified based on the push/pull theory are used as a flexible analytic lens rather than a rigid analytical framework.

To guide the reading of narratives presented in this thesis, the following section presents findings from Nghia's (2019) study on motivations for studying abroad and the immigration intentions of international students. Table 2.2 summarises push and pull factors on international students' motivations to study abroad, while Table 2.3 summarises factors influencing intentions to return or stay. Based on the findings, a further discussion on these factors is presented in Chapter 10: Discussion.

TABLE 2.2: Push and pull factors on motivations to study abroad (Nghia, 2019, p. 766)

Push factors	**Pull factors**
Competitive entry into local universities	Experiencing foreign cultures
Unavailability of a desired program	Obtaining international experience
Avoidance of bad practices in local education	Establishing relationships with international friends
Being asked to study abroad by family	Improving foreign language competence
Pursuit of immigration opportunities	Improving chances of employment
Poor educational quality in the home country	Pursuing foreign educational values

TABLE 2.3: Factors influencing intentions to return or stay (Nghia, 2019, p. 770)

Intention to return	**Intention to stay**
Family ties and obligations	Obtaining international work experience
Developing the home country	High income in the host country
Work culture in the home country	Work conditions in the host country
Familiarity with the culture/lifestyle of home country	Opportunities for personal development in the host country
Social life in the home country	Quality of life in the host country
Work obligation in the home country	Culture of the host country
Better opportunities for personal and professional development at home	Intolerance of negative cultural and social practices in the home country
Better employment prospects in the home country	Social network in the host country
Inability to adapt to the culture in the host country	
Disadvantaged living conditions in the host country	

Among the findings, Nghia (2019) noted that female participants demonstrated a stronger intention to stay than males, consistent with the findings Güngör & Tansel (2014) reported. This is not the

only study where gender differences across international students were reported. For instance, Boey (2014) found that while international men students were primarily motivated to study overseas due to career prospects, international women students viewed international education as an opportunity for personal growth. Kenway and Bulleen (2003) assert that studies on international students tended to normalise men students and assigned women students as 'other'. This is in accordance with Xie and Shauman's (2003) critique of how the pipeline metaphor fails to capture gender differences.

The above findings and arguments highlight the limitations of the pipeline and pathway metaphors when it comes to representing gender differences. These metaphors have been developed based on our understanding of the dominant group (which refers to White men in the context of engineering) and the assumption of universal experience. However, any attempt at disaggregating the data solely based on gender (or any other dimension) risks reproducing patterns exhibited by the dominant group and creates a "vicious cycle of invisibility" for underrepresented groups (Ong et al., 2011, p. 197). This approach, which Crenshaw (1989) refers to as single-axis analysis, ultimately results in ineffective interventions. Ong et al. (2011) further asserted that "programs intended to serve women disproportionately benefit White women, and programs intended to serve minorities mainly benefit minority males" (p. 176).

Crenshaw's critique of studies employing single-axis analysis led to the development of intersectionality as a theory. As an overview, the concept of intersectionality emphasises that an individual's experience is not additive. For instance, the systems of oppression faced by an Asian woman are not a combination of those faced by an Asian man and a white woman. The application of intersectionality as a theory is most prominent in studies on women of colour, with gender and race as the primary dimensions of analysis. However, intersectionality can be extended to account for the dimensions listed in Figure 2.1: *Diversity Dimensions*.

In the context of this research, there is a significant overlap in systems of oppression faced by women of colour and women international students. In the pipeline and pathway metaphors, their social histories and networks are reduced to observable and measurable aspects, such as the race and/or ethnicity they identify with, which subjects they took at school, and where they eventually work. However, as it is much harder to collect this information from international students (Lord et al., 2019), they are often excluded from studies on women of colour. As a result, most studies

on women of colour tend to focus on women primarily based in Western contexts and omit topics specific to international students.

Regardless of whether a study focuses on women of colour or women international students, the pipeline and pathway metaphors are limited by the datasets available to researchers and do not capture the complexities of the systems in which these populations inhabit (Lord et al., 2019). The use of narrative methodology here addresses this critique by focusing on the path they took and how they navigated it. In other words, the use of a narrative methodology captures both the pathways and the 'ecosystem.' The following section discusses the ecosystem metaphor, and how it differs from the pipeline and pathway metaphors.

2.3.3 Ecosystem

The ecosystem metaphor rests on the premise that being permitted to enter the system is different from thriving within the system (Lord et al., 2019). Used interchangeably with environment and climate (Lord et al., 2019), the ecosystem metaphor acknowledges that whether one thrives within the system does not depend solely on individual factors such as self-efficacy or interest in STEM. Rather, it is influenced by multiple components within the system. The ecosystem metaphor counters the deficit-based approach often reflected in pipelines and pathways, where underrepresented groups are considered sites of reform (Beddoes & Borrego, 2011). One example was highlighted previously, where initiatives on broadening participation focused on supporting girls in developing STEM interest and aptitude, with limited recognition of the challenges faced by women as they progress through the pipeline. In other words, these initiatives focused on 'fixing girls/women' rather than 'fixing the system.'

As with the pathway metaphor, the ecosystem metaphor can be applied through quantitative and qualitative approaches. An example of a quantitative approach is Lord's (2019) study, where ecosystem metrics such as stickiness, migration yield, and graduation rate were used to investigate persistence in engineering. The authors took an intersectional approach by exploring how these metrics vary across a different combination of gender/race categories (e.g., Black female, Black male, Hispanic female, Hispanic male). However, they acknowledged that students have more than two intersecting identity categories, which are better represented through a qualitative approach.

Godfrey and Parker's (2010) study is one such example of a qualitative approach. The authors proposed six cultural dimensions in engineering education: An Engineering Way of Thinking, An Engineering Way of Doing, Being an Engineer, Acceptance of Difference, Relationships, and Relationship to the Environment. These dimensions guide researchers in identifying aspects of the engineering culture that influence participation in engineering and can be refined to characterise institutional and disciplinary cultures.

In the above examples, the ecosystem primarily refers to the engineering education ecosystem. However, students' experiences are not limited to their institution and discipline. In the context of this study, women international students' participation in engineering is influenced by the other ecosystems they inhabit, which involve their families and broader society. However, more than half of the studies on international students focus on the students' "study, living and social functions within the academic and social context of a host country" (Abdullah et al., 2014, p. 244).

Across studies on international student experience, prominent themes include cross-cultural adjustment, mental health problems, second-language acquisition and intercultural development (Abdullah et al., 2014; Jing et al., 2020; Khanal & Gaulee, 2019). In the context of work-integrated learning, which is a component in most Australian engineering curricula, Vu et al. (2022) identified a range of challenges faced by international students associated with securing placements and workplace adjustment.

Across studies on women of colour in engineering, Ong et al. (2020) identified themes associated with negative experiences, which include a sense of isolation from being the only one, being ignored or made invisible, being subjected to stereotype threats and spotlighting, as well as discrimination and harassment. These themes are briefly mentioned in this chapter to guide the analysis of narratives, with relevant themes further explored in the Findings chapters.

The above themes represent participants' complex relationships and interactions with components of the engineering education ecosystem. As Ong et al.'s (2020) synthesis showed, students' relationships within the ecosystem are not limited to peers and academics within their discipline. Their support network extends to their families, peers beyond their discipline, and other university staff who serve as a "surrogate familial support system" (p. 601). As I will further discuss in the next section, the participants of this study navigate the ecosystem in various ways, demonstrating what Yosso (2005) refers to as navigational and resistant capital.

Like the pipeline and pathway metaphors, the ecosystem metaphor focuses on and therefore emphasises some aspects more than others. The scope of prior research and the participants available also limits our understanding of the ecosystem. An overemphasis on experience within the institution and host country has resulted in unintentional blind spots in the participants' experiences. For instance, the process of obtaining information on their university and preparing visa documents are areas of support often overlooked by institutions (Khanal & Gaulee, 2019). After finishing their studies, international students intending to stay have to navigate immigration policies themselves, while those intending to return have to deal with reverse culture shock (Khanal & Gaulee, 2019). As Lee (2019) pointed out, highlighting the experiences of those currently within a system can render those outside of it invisible.

The use of a narrative methodology builds on the strengths of the pathway and ecosystem metaphors. By exploring the "social, cultural, familial, linguistic, and institutional narratives within which individuals' experiences were, and are, constituted, shaped, expressed, and enacted" (Clandinin, 2016, p. 18), narratives capture the individual pathways of participants as well as their interactions with the ecosystem. As Lee (2019) argued, these metaphors (pipeline, pathway and ecosystem) are better viewed as a paradigm that can be thoughtfully leveraged based on our goals. A summary of the different paradigms is presented in Table 2.4.

TABLE 2.4: Participation paradigm positions on selected issues (Lee, 2019, p. 11)

Item	Pipeline paradigm	Pathway paradigm	Ecosystem paradigm
Inquiry aim	Education or work system	Individual persons	Learning or work environment
Unit of analysis	Impersonal, macro (The Pipeline)	Personal, micro (My Pathway)	Shared, meso (Our Ecosystem)
Mode of participation	Participants are passive	Participants are active	Participants are active
Issue highlighted	Access and barriers to participation via traditional routes	Signs for and deterrents from participation; nontraditional routes	Intergroup relations, interconnectedness, and engineering culture
Theoretical focus	Social reproduction; structural ability and motivation (e.g., policies, practices)	Agency; personal ability and motivation (e.g., aptitude, choices, identity)	Interpersonal interactions and contextual features; shared experiences (e.g., belonging, social capital)
Mode of progress	Longitudinal (time)	Longitudinal (time)	Localized (space)
Measure of progress	Retention; more volume and efficiency, single desired destination; linear	Persistence; smoother paths, various acceptable destinations; nonlinear	Experiences; better climate, irrespective of desired destination; nonlinear
Stakeholder accountability	Looking back; blame the previous part of the system	Looking forward; blame the subsequent part of the system	Looking around; blame the current part of the system
Policy implications	Supply side; recruitment, retention, outreach, school funding, and so forth	Demand side; placement, admission, enrollment management, transfer, and so forth	Internal; climate, culture, support, receptiveness, migration, and so forth

2.4 Theoretical Directions

This section will locate and outline the theoretical stance adopted here, and provide an overview of Community Cultural Wealth theory. As narrative studies are driven by topics salient to participants, theories are used as analytic lenses and not rigidly applied to structure the findings of this study. Hence, this section presents theories to guide discussion in the Findings chapters, with more relevant aspects unpacked in Chapter 10: Discussion.

As argued in Chapter 1: Introduction, the effects of epistemological racism limit scholars from minoritised groups to knowledge systems that exclude us (Kubota, 2020). I also discussed how existing metaphors used to model participation in engineering are developed based on our understanding of the dominant group, creating a vicious cycle of invisibility for those systematically excluded (Lee, 2019). While the use of narrative methodology addresses these issues, it is often critiqued as anecdotal rather than theoretical (Clandinin & Connelly, 2000), and referred to as art rather than research. However, as Anzaldúa (1990) argues,

> Theory, then, is a set of knowledges. Some of these knowledges have been kept from us — entry into some professions and academia denied us. Because we are not allowed to enter discourse, because we are often disqualified and excluded from it, because what passes for theory these days is forbidden territory for us, it is *vital* that we occupy theorizing space, that we not allow white men and women solely to occupy it. By bringing in our own approaches and methodologies, we transform that theorizing space. (Anzaldúa, 1990, p. xxv, emphasis in original)

One way of transforming that theorising space is through the lens of Critical Race Theory (CRT), which recognises the experiential knowledge of marginalised groups as "legitimate, appropriate, and critical to understanding, analysing and teaching" (Yosso, 2005, p. 74). However, students from underrepresented groups continue to be viewed through a deficit lens, which García & Guerra (2004) refer to as a form of 'contemporary racism'. Deficit thinking is most evident in studies that report differences between students from dominant and marginalised groups (e.g., men vs women, domestic vs international students). The subtext of these studies is that being different is deficient, with the onus placed on marginalised groups to 'close the gap' to thrive.

As discussed in the previous section, whether one thrives within the system does not depend solely on individual factors such as self-efficacy or interest. In such studies, however, there is a tendency to focus on individual traits and characteristics, which Gergen (1994) referred to as a cognitivist approach. This approach may appear to be value-neutral through an objective lens since all individuals are measured using the same 'ruler.' However, like metaphors, educational theories are drawn from our understanding of the dominant group and presumed to be universal. The dominant group historically consists of participants who are Western, educated, and from industrialised, rich, and democratic countries (collectively known as WEIRD people) (Henrich, 2020). The shortcomings of metaphors have been discussed in the pipeline metaphor, where the role of family and differences in gender expectations are not accounted for.

Another shortcoming of metaphors that are applicable to cognitivist approaches is their selected emphasis on some aspects of a concept, which implicitly reduces the focus on other aspects. In the cognitivist approach, the aspects that are most often reduced are the sociocultural contexts of individuals. As sociocultural contexts are much harder to measure and observe than individual traits, most quantitative studies collapse the sociocultural diversity of participants to simple binaries. While these studies can shed light on patterns and trends across different demographic groups, treating individuals as a homogeneous group may lead to less nuanced findings. Shifting away from the cognitivist approach is especially critical in studies of international students, as their education and sociocultural contexts vary greatly (Boey, 2014).

To counter deficit thinking and cognitivist approaches, I draw on Yosso's (2005) concept of Community Cultural Wealth (CCW), which will be discussed in the next section.

2.4.1 Community Cultural Wealth (CCW)

CCW challenges traditional interpretations of Bourdieu's cultural capital theory (1977). In these interpretations, students of colour do not succeed at the same rate as their White counterparts due to their lack of cultural capital, which is acquired through family and/or formal schooling. While this theory highlights the relationship between privilege and success, culturally wealthy and poor notions are judged based on "knowledge, skills and abilities that are *valued* by privileged groups in society" (Yosso, 2005, p. 76, emphasis in original).

CCW shifts the research lens towards knowledge, skills and abilities possessed by socially marginalised groups that often go unrecognised and unacknowledged. Based on Yosso's framing, *culture* refers to social histories and identities, which encompass "immigration status, gender, phenotype, sexuality and region, as well as race and ethnicity" (p. 76). In contrast, *wealth* refers to "the total extent of an individual's accumulated assets and resources" (p. 77). Yosso (2005) proposed at least six forms of capital, which are directly quoted in Table 2.5 to preserve the nuances of the definitions provided by the author.

TABLE 2.5: Types of capital identified in community cultural wealthy theory (Yosso, 2005, pp. 77-80)

Type of capital	**Definition**
Aspirational capital	Ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers
Linguistic capital	Intellectual and social skills attained through communication experiences in more than one language and/or style
Familial capital	Cultural knowledges nurtured among *familia* (kin) that carry a sense of community history, memory and cultural intuition
Social capital	Networks of people and community resources that provide both instrumental and emotional support to navigate through society's institution
Navigational capital	Skills of manoeuvring through social institutions not created with minoritized groups in mind
Resistant capital	Knowledges and skills fostered through oppositional behaviour that challenges inequality

An overview of how each capital is represented across STEM education is discussed by Denton et al. (2020). For instance, Dika et al. (2018) found that *aspirational capital* is most influential in the persistence of marginalised groups in engineering. *Linguistic capital* was least mentioned in studies using CCW and tends to be focused on spoken language (Denton et al., 2020). However, several researchers noted that it could extend to languages specific to institutions and professions as

well as code-switching behaviours (Martin & Newton, 2016; McPherson, 2012). *Familial capital* includes emotional, informational, and financial support, but is not limited to direct family (Denton et al., 2020). *Social capital* can stem from cohort programs and affinity groups, as well as "positive peer pressure" (McKnight, 2016, p. 78) and other empowerment agents. While *navigational capital* broadly refers to how individuals navigate through majors and institutions, Denton et al. (2020) noted an overwhelming focus on how resources were provided rather than how individuals exercised agency. *Resistant capital* can be classified as self-defeating, conformist, or transformative (Solorzano & Bernal, 2001). This broadly refers to individuals who decide to leave oppressive systems, change their behaviour to match norms within the structure, or actively act against such norms.

As each type of capital feeds into others (Yosso, 2005), there are multiple overlaps in capitals across studies (Denton et al., 2020). This overlap is encouraged, as categorising the above-mentioned capitals as mutually exclusive will limit the richness of data (Yosso, 2005). A further review of the capitals exhibited by the participants in this study is presented in Chapter 10: Discussion.

2.4.2 A note on identity

While identity is a core aspect of this research, in the literature it is often applied inconsistently and commonly adopts the cognitivist approach critiqued previously. In addressing the research problem outlined, I adopt a narrative understanding of identity, referred to as 'stories to live by' (Connelly & Clandinin, 1999). Through this understanding, narrative construction involves exploring and developing the meaning of a phenomenon through storytelling (Secules et al., 2018). As Rosenwald and Ochberg (1992) posit, narratives are not merely a means to make sense of past experiences but also to fashion identities. Hence, rather than *discovering* a self through narratives, one *imagines* and *constructs* a self through narratives. Through narrative identity, "people convey to themselves and to others who they are now, how they came to be, and where they think their lives may be going in the future" (McAdams & McLean, 2013, p. 233). I will expand on the notion of narrative and how it is applied in my research methodology in Chapter 3: Methodology.

2.5 Summary

In this chapter, I justified the scope of this study and outlined my approach to identifying relevant literature. I provided some background on international students in higher education and women in engineering. Drawing on metaphors commonly used to describe participation in engineering, I critiqued the use of pipelines, pathways, and ecosystems in the context of this study. I discussed the theoretical directions of this study, including an overview of the CCW theory.

The next chapter will elaborate on the theoretical underpinnings of the research methodology adopted, and describe the research design.

Chapter 3

Methodology

In Chapter 1: Introduction, I located my thesis methodologically. After some background on how I arrived at my research topic, I outlined my 'research puzzle,' a term that will be further discussed in this chapter. I then described my research journey and how I came to understand the impact of narratives and adopt narrative inquiry as a research methodology. As an overview, I pointed to some identifying features of narrative inquiry, such as the notion that the representation of narratives is by no means objective. I briefly shared the significance of my thesis, and the framework that guides my analytic process, namely the personal, practical, and methodological justifications.

Within my research puzzle, I briefly addressed *how* my research involves collecting, interpreting, and presenting narratives from women international students. In this chapter, I will expand on the *how* through two sections: an overview of narrative inquiry, and the research design of this study. In the first section, I will provide an overview of what I mean by 'narrative,' and why I chose to use narrative inquiry. In the second section, I will outline the process I undertook to collect, interpret, present, and evaluate narratives.

3.1 Overview of Narrative Inquiry

This section will provide an overview of what I mean by narrative, distinguishing features of narrative inquiry, and justifications for using narrative inquiry.

3.1.1 Defining narrative

Before going into detail on what I mean by narrative inquiry, there is first a need to clarify what I mean by 'narrative.' Polkinghorne (1995) distinguished two uses of narrative: narrative as *prosaic discourse*, and narrative as *story*.

In the former use, narrative can refer to "any text that consists of complete sentences linked into a coherent and integrated statement" (Polkinghorne, 1995, p. 6). In this usage, most forms of qualitative data such as questionnaire responses, interview transcripts and documents (used for document analysis) can be referred to as narratives. In the latter use, narrative refers to a story, where events and actions are configured into a plot. As Polkinghorne (1995) puts it, stories "preserve the complexity of human action with its interrelationship of temporal sequence, human motivation, chance happenings, and changing interpersonal and environmental contexts" (p. 7).

Within engineering education research, narrative may be used as prosaic discourse in questionnaires where participants are asked to identify factors that led them to engineering. Their responses may be analysed to develop a catalogue of factors decontextualised from the participants. In this study, however, I use narrative as story to understand the fullness of my research participants' journeys. I do so by considering multiple events and decisions along various biographical time points, and how they contribute to my research participants' decisions to do engineering (Polkinghorne, 1995).

3.1.2 Using narrative

While Polkinghorne's (1995) distinction is useful to clarify what 'narrative' refers to, there is also a need to consider how narrative is used. To understand how narrative is used in this study, I draw on Taniguchi's (2009) framing of narrative as an *object, product,* or *research method*.

When narrative is used as an *object*, it is used as a form of data (which could be a prosaic discourse or a story). This data can be used in other qualitative methodologies such as phenomenology or case studies (Clandinin, 2016). When narrative is used as a *product* of research, it is used as a form of representation. In literature studies, this product may be a poem or novel. Narrative can also be used to represent findings in various qualitative and quantitative methodologies (Clandinin, 2016).

When narrative is used as a *research method*, it is used as an analytic lens to interpret data. The data collected and the findings presented may or may not be in the form of narrative. To further explain what I mean by using narrative as a research method, I draw a parallel with research writing. In research, there is a notion that we either write to think (internally), or to communicate (externally). Writing to communicate to an audience is similar to using narrative as a product, while writing to think and make sense of your thoughts is similar to using narrative as a research method. In the next section, I will expand on what I mean by using narrative as a method when I define and justify narrative inquiry.

3.1.3 Distinguishing narrative inquiry

As discussed previously, narrative is defined and used in a broad range of ways. Thus, it is essential to make explicit what I see as the defining features of narrative inquiry in the context of my study. As my understanding of narrative inquiry is rooted in the works of Jean Clandinin and Michael Connelly, I use their definition of narrative inquiry as a starting point:

> Narrative inquiry is a way of understanding experience. It is collaboration between researcher and participants, over time, in a place or series of places, and in social interaction with milieus. An inquirer enters this matrix in the midst and progresses in the same spirit, concluding the inquiry still in the midst of living and telling, reliving and retelling, the stories of the experiences that made up people's lives, both individual and social. (Clandinin & Connelly, 2000, p. 20)

This definition guides my discussion on the defining features of narrative inquiry in the following sections: *thinking narratively, thinking relationally, thinking socially,* and *thinking temporally*. These sections are intended as an overview, with a further discussion on each feature embedded in the Findings and Discussion chapters.

3.1.3.1 Thinking narratively

By highlighting narrative inquiry as a way of understanding experience, narrative inquiry can be seen as both a theoretical and methodological orientation (Brockmeier & Carbaugh, 2001). In

the Introduction chapter of *Engaging in Narrative Inquiry* (2016), Clandinin shared how she and Connelly came to distinguish narrative inquiry from other research methodologies. During her doctoral study, she was concerned that she was dissecting the wholeness of her participants' lives through her analysis. She described how the idea of thinking narratively helped her make sense of narrative as a way of understanding experience through the mediation of storytelling (Taniguchi, 2009).

Clandinin's concept of thinking narratively is influenced by Bruner's (1985) designation of the two modes of thought (or cognition). These were classified as paradigmatic and narrative modes. Paradigmatic cognition refers to a logical-scientific mode of knowing, while narrative cognition refers to a storied way of knowing (Polkinghorne, 1995). For context, Bruner's argument stems from the notion of what counts as knowledge. In Western scientific tradition, rational discourse is valued over other discourse types (lumped under the term poetic discourse). Rational discourse has dominated academic writing (including how qualitative research is reported), relegating poetic discourse as expressive rather than knowledge-generating (Polkinghorne, 1995). Arguing that narrative knowledge is a "legitimate form of reasoned knowing" (Bruner, 1985, as cited in Polkinghorne, 1995, p. 9), Bruner proposed the distinction between paradigmatic cognition and narrative cognition.

As Bruner (1985) emphasised, both modes of thought offer "distinctive ways of ordering experience, of constructing reality ... and are irreducible to one another" (p. 11). According to Polkinghorne (1995), paradigmatic cognition attends to the "features or attributes that essentially define particular items as instances of a category" (p. 10), while narrative cognition attends to the "temporal context and complex interaction of the elements that make each situation remarkable" (p. 11). In this study, paradigmatic cognition focuses on identifying common themes or concepts from stories, while narrative cognition focuses on making sense of stories.

The distinction between paradigmatic and narrative cognition highlights the validity of a storied way of knowing. It is important to note that narrative is a valid form of knowledge, not just a representation form (i.e., a product of research). As Bruner (1986) notes, "it is not that we initially have a body of data, the facts, and we then must construct a story or theory to account for them ... Instead ... the narrative structures we construct are not secondary narratives about data but primary narratives that establish what is to count as data" (pp. 142-143).

3.1.3.2 Thinking relationally

There may be concerns about using narratives constructed by researchers as primary narratives. I will return to this point in later sections. In this section, however, I seek to address this concern by introducing the concept of thinking relationally. As Bruner (1990) pointed out, "people do not deal with the world event by event or with text sentence by sentence. They frame events and sentences in larger structures" (p. 64). This quote not only speaks to how narrative knowledge is maintained in stories (Polkinghorne, 1995), but also resists the notion of an "exclusively faithful representation of a reality independent of the knower" (Clandinin, 2016, p. 14).

As Clandinin and Rosiek (2007) note, "every representation ... involves selective emphasis of our experience" (p. 39). This concept reflects the relational nature of narrative inquiry, where narratives are co-constructed between researcher and participant. Using storytelling as a medium, participants construct a narrative identity (McAdams & McLean, 2013). In the context of this study, I adopt Connelly and Clandinin's (1999) framing of 'stories to live by' as a narrative term for identity. In constructing narratives, I attend to my participants' and my own 'stories to live by' and explore what is salient for us. In this view, a constructed narrative results from our relationship and my emerging understanding of my participants, both of which influence my understanding of their experiences.

3.1.3.3 Thinking socially

While narrative inquiry is commonly cited as the study of experience, it also focuses on the "social, cultural, familial, linguistic, and institutional narratives within which individuals' experiences were, and are, constituted, shaped, expressed, and enacted" (Clandinin, 2016, p. 18). This focus aligns with Gergen's (1994) call to move away from cognitivist approaches to studying narratives, which emphasise the individual. In engineering education research, this approach is reflected in studies framed by developmental or educational models (Cruz & Kellam, 2018), or use individual-level theories to explain gaps in specific demographics studying engineering (Pawley, 2019).

Gergen's (1994) advocacy to focus on the link between narrative and the broader culture is particularly applicable to the context of this study. As discussed in Chapter 1: Introduction, due to the dominance of literature based in Western contexts, mainstream theories often do not reflect

the shifting realities of those outside the Western context. Yosso (2005) asserts that the experiential knowledge of minoritised groups is "legitimate, appropriate, and critical to understanding, analysing and teaching" (p. 74). This builds upon Chen's (2010) argument for the need to multiply our frames of reference to dilute our dependence on Western epistemologies and progress critical work.

3.1.3.4 Thinking temporally

The concept of 'shifting realities' leads to the final defining feature of narrative inquiry, thinking temporally. As discussed previously, our memories of events are not linear or chronological. A narrative is bounded by a plot, which is "[delimited by] a temporal range which marks the beginning and end of a story" (Polkinghorne, 1995, p. 7). In this sense, the beginning of each participant's narrative is different, as their engineering journey starts at different points in their lives. The end of each participant's narrative is different too, as they are all at different points of their engineering journey.

Likewise, as a researcher, my narrative is by no means static. My understanding of myself and my participants draws upon previous understandings of myself and other participants, and how it varies from one another. While I initially transcribe my research interviews in a linear order, my subsequent engagement with transcripts and constructed narratives is by no means linear. My construction, interpretation, analysis, and presentation of narratives are intertwined with my ongoing personal and professional narratives.

As narrative inquiry is "people in relation studying people in relation" (Clandinin & Connelly, 2000, p. 189), narrative inquirers always enter research relationships in the midst. The narratives we construct are based on our current understanding of ourselves and are subject to change over time. The change is not limited to events that have not taken place, but also our perceptions of events that have taken place.

3.1.4 Justifying narrative inquiry

Before proceeding to the research design of this study, I return to my decision in Chapter 1: Introduction to outline my research puzzle rather than the research question. Given the defining features

of narrative inquiry discussed in the previous section – thinking narratively, relationally, socially, and temporally – the framing of this research puzzle reflects the shifting nature of narrative inquiry. Rather than a research question that leads towards an answer, a research puzzle carries a sense of "continual reformulation" (Clandinin & Connelly, 2000, p. 124) in how we *experience* experience. Other researchers have similarly posited that research questions in narrative inquiry should be framed "not as one that can be answered, but as one that calls for exploration" (Josselson & Lieblich, 2003, p. 265).

While the previous section distinguishes narrative inquiry from other methodologies, this section justifies the purpose of narrative inquiry. Clandinin (2016) acknowledged that without a deep understanding of narrative inquiry as a research methodology, it can be easily dismissed as "anecdotal or personal" (p. 35). As discussed in previous sections, narratives may also be seen as expressive rather than knowledge-generating (Polkinghorne, 1995).

To address these critiques, Clandinin (2016) outlined three justifications for narrative inquiry: personal, practical, and social. The following section discusses how these justifications are adapted into Personal, Practical, and Methodological dimensions to structure my analysis of participant narratives.

3.1.4.1 Personal

The personal dimension sheds light on why this narrative inquiry matters to us personally (Clandinin, 2016). In interpretive research, it often takes the form of a positionality statement, where the researcher describes their motivation or interest in the subject matter and lived experience they bring to their research. In Chapter 1: Introduction, I outlined my background, how I came to do my study and how it is personally significant. In narrative inquiry, this justification guides how researchers engage with participants and their narratives. As each interview creates new relations between individuals and their environments, the personal dimension is unpacked in each participant's narrative to guide readers in understanding the inquiry in more depth.

3.1.4.2 Practical

The practical dimension considers how this narrative inquiry might make a difference to practice (Clandinin, 2016). They are arguably of most interest to funding agencies, policymakers, and educators. Depending on the outlet where this study is disseminated, the practical dimensions can be framed differently.

For instance, I have argued for the business case of doing research on international students (although I personally believe that we should be researching 'with' this population, rather than 'on' or 'for,' as I further discuss in Chapter 10: Discussion). I have cited how international students are a significant source of revenue for higher education, and how they constitute an ample supply of skilled workforce in Australia. When guided by these purposes, the practical dimension will include discussions on ways to attract international students to Australia as a study destination, or to retain them post-study.

Within higher education, I argue for the social justice case of gaining a deeper understanding of this population, which is traditionally marginalised in engineering. For instance, I advocate for the need to increase the participation of women in engineering and address structural issues that lead to attrition. When guided by these purposes, the practical dimension will include discussions on gender-inclusive educational practices or interventions to retain women in engineering.

The topics associated with each case (business and social justice) serve as examples and do not reflect the entirety of the arguments presented in this study. As discussed earlier in this section, narrative inquirers do not seek to answer a precise research question (e.g., "how might we increase the number of women in engineering?"). Instead, it is a methodology that prompts a deeper understanding of the population and the phenomenon. As such, practical justifications are identified and discussed within each participant's narrative.

3.1.4.3 Methodological

This dimension is adapted from Clandinin's (2016) social dimension, which refers to how this narrative inquiry might make a difference to theoretical understandings or make situations more socially just (Clandinin, 2016). While Kim (2016) has suggested separating the social and the theoretical (or 'scholarly'), some practical justifications can also contribute to social justice. Since the

distinction between the practical and social dimensions is blurred, the social dimension is replaced with the 'methodological' dimension in this study for clarity.

While the practical dimension deepens our understanding of the population and the phenomenon, the methodological dimension deepens our understanding of theoretical and methodological considerations in this study. Within the methodological dimension of each participant's narrative, I identify issues that challenge how prior research is conducted, and explore issues associated with narrative inquiry as a research methodology. These discussions are intended to guide future research on this population in similar contexts and future studies using narrative inquiry as a research methodology.

3.1.5 A note on terminology

As discussed previously, narrative is defined and used in a wide range of ways. Hence, it is common to see studies that refer to narrative inquiry more loosely (without referring to specific scholars) or use the terms narrative inquiry, narrative analysis, and narrative research interchangeably. Rather than assigning a strict definition to each term that does not conclusively represent how they are used, I have sought to adopt the appropriate terminology based on the literature I reference.

In other mentions of these terms written in my own words, I use the term 'narrative inquiry' to distinguish the methodological features I discussed in the previous section. 'Narrative analysis' is used more heavily in the analysis section that adopts narrative cognition (Bruner, 1985; Polkinghorne, 1995). 'Narrative research' is used as an umbrella term for studies that use narrative (regardless of whether it refers to prosaic discourse or story, or is used as an object, product, or research method).

This section discussed how narrative is defined and used, the distinguishing features of narrative inquiry, and the analytical framework that guides the analysis of narratives. The following section will describe the research design of this study, which is guided by the concepts and frameworks discussed in this section.

3.2 Research Design

As presented in Chapter 1: Introduction, my research:

- Focuses on women international students who are enrolled in an undergraduate engineering degree in an Australian institution
- Starts with a broad aim to understand how women international students came to do engineering, as well as their experiences with engineering
- Involves collecting, interpreting, and presenting narratives from women international students

This section will outline the research design of this study, including how it is informed by its research aims, and the process undertaken to collect, interpret, present, and evaluate narratives.

It is important to note that most decisions outlined in this section are made iteratively (rather than linearly) and revised throughout the study as a result of new learnings and changing environments (i.e., navigating the effects of COVID-19). To guide understanding of my research design in a concise manner, I have used my discretion to identify critical aspects to discuss.

This section consists of four subsections: collecting narratives, storying narratives, presenting narratives, and evaluating narrative research.

3.2.1 Collecting narratives

This section covers the chosen data collection method, sampling strategy, participant recruitment process, and interview protocol development.

3.2.1.1 Data Collection Method

There are two ways to start a narrative inquiry: by listening to participants tell their stories, or by living alongside participants as they live and tell their stories (Clandinin, 2016). In data collection, the former is typically done through interviews, and the latter through a combination of interviews

and observations. As this study focuses on a specific demographic and is not centred around a particular institution, interviews were chosen as a starting point.

In choosing an appropriate interview approach, I was guided by the principles of narrative inquiry and my positionality as a research student. While narrative inquiry typically involves a series of unstructured, individual, longitudinal interviews (especially if researchers choose to start by living alongside participants), doing so requires a deep understanding of the field and research methodology on the researcher's part.

As is the risk with all open-ended research, I was wary of engaging my participants in 'unproductive' data collection, where I run the risk of wasting their time by lacking clarity on what I need from them. As I will further discuss in later sections, there was a high likelihood of participant dropout during the COVID-19 pandemic when this study took place, due to the impact of Australia's continuous lockdowns on participants' mental wellbeing (for context, the COVID-19 lockdown in Victoria, where some participants were based, was one of the longest continuous lockdowns worldwide). Hence, I decided to do a single rather than a longitudinal interview. The term 'single' is used as opposed to 'cross-sectional,' as the latter implies collecting data from multiple individuals at a single point in time, which is not the case in this study.

I next considered how I wanted to facilitate the interview. In narrative inquiry, there is a contested distinction between 'big story' and 'small story' research. Big story refers to biographical approaches where an individual articulates their life in large segments, while small story refers to stories that surface in everyday conversation (Bamberg, 2006). The need for both approaches and recommendations on integrating both approaches have been discussed elsewhere (see Freeman, 2011). I focus on how these approaches inform my interview protocol in this study.

While small stories can be accumulated in longitudinal studies to illuminate participants' lives, it also requires significant rapport between the researcher and the participant. As I am interviewing participants I have not met before, big story research enables me to grasp their engineering journey quickly to prevent participant fatigue. Choosing big story research led to my decision to conduct semi-structured interviews, which ensures that I capture sufficient context to construct a coherent narrative while allowing space for participants to share their stories with minimal directing. The interview protocol is further discussed later in this chapter.

In summary, I decided to conduct semi-structured, individual, single interviews for this study. This decision informs the sampling strategy, which will be discussed in the next section.

3.2.1.2 Sampling Strategy

In the initial phases of this research study, I was unaware of the distinction between paradigmatic and narrative cognition. Based on my understanding of how narratives can be analysed, I proposed an analytic approach that Polkinghorne (1995) refers to as 'analysis of narrative' (guided by paradigmatic cognition) rather than 'narrative analysis' (guided by narrative cognition). As discussed in Section 3.1.3.1: *Thinking narratively*, paradigmatic cognition focuses on identifying common themes and concepts from stories while narrative cognition focuses on making sense of stories (Polkinghorne, 1995). Bruner (1985) noted that both modes of cognition have their own "criteria of well-formedness" (p. 11). This section briefly discusses the criteria for paradigmatic cognition and how it informed my sampling strategy. A further discussion on the criteria for narrative cognition (which I later switched to) will be presented in Section 3.2.4: *Evaluating narrative research*.

When guided by paradigmatic cognition and considering my approach to doing single interviews, it is important to have a sample that represents different diversity dimensions. In Chapter 2: Literature Review, I justified my rationale for choosing women international students enrolled in an undergraduate engineering degree in an Australian university as target participants. Based on the remaining diversity dimensions relevant to this study – engineering discipline, year of study, home country, and university – I sought to recruit participants representing different dimensions. As university academics were identified as potential gatekeepers, the recruitment plan for this study was guided by the university where potential participants are enrolled.

The diversity of universities was determined based on state/territory, location (urban or regional), and university groups. Within Australia, there are four university groups of interest to this study: Group of Eight (Go8), Australian Technology Network (ATN), Regional Universities Network (RUN), and Innovative Research Universities (IRU). Other university groups such as sandstone universities, red brick universities and verdant universities are primarily grouped by the year of establishment and do not hold significant attributes relevant to this study.

Excluding universities with less than ten female undergraduate engineering students (to ensure participant anonymity can be retained), there were 31 universities from where participants could be recruited. Considering that there are eight states/territories and four university groups, a minimum sample size of 15 would ensure that approximately two participants represent every state/territory, and approximately four participants represent every university group. It would also increase the probability of having most engineering disciplines represented, and approximately three participants represented across each year of study.

Informed by my data collection method, and in discussion with my supervisors, I selected 25 as the maximum manageable sample size within the study's time frame. However, suppose no significant new information is gained after interviewing 15 participants (i.e., theoretical saturation is attained). In that case, the inclusion and exclusion criteria will be revised to achieve maximum representation across the following dimensions: engineering discipline, year of study, home country, and university.

I proposed a sample size of 15-25 participants for my study. The shift in the number of participants recruited and presented in this study is further discussed in future sections. However, understanding the sample size allowed me to develop a recruitment plan.

3.2.1.3 Participant Recruitment

Prior to recruitment, an ethics application (also known as institutional review) was lodged. Based on feedback from the Faculty Research Office, slight amendments were made to the research design of this study. Two aspects discussed in this section are my considerations on recruiting participants from overseas and my approach to accessing participants.

In this study, the target population is women international students who are enrolled in an undergraduate engineering degree in an Australian university. According to my institution's guidelines, they are classified as 'people in/from other countries.' This classification is intended to ensure research is conducted in a culturally appropriate manner that aligns with legal and regulatory frameworks in respective countries. Table 3.1 outlines how I addressed the ethical requirements concerning this population.

TABLE 3.1: Addressing ethical requirements for research involving people in/from other countries

Ethical requirement	**How it is addressed**
Use of culturally and language appropriate study materials	As my research participants would meet the English language requirement to study in Australia at a tertiary level, materials are not translated into their native language. Local ethnocultural requirements are considered and reflected in the interview protocol and risk management procedures.
Inclusion of a local contact person who meets the list of requirements	As my research participants can speak English at a conversational level, contact details for the UTS Human Research Ethics Committee are put forward in the participant information sheet.
Evidence of approval from relevant local (overseas) research or ethics committee	As I am not conducting targeted recruitment of participants based on country, this requirement is not applicable.
Inclusion of a local collaborator/investigator	As I am not conducting fieldwork overseas, this requirement is not applicable.

My initial recruitment plan involved disseminating a recruitment flyer through academic and student communities. The recruitment flyer, as shown below in Figure 3.1, outlines the inclusion criteria, an overview of the study, expectations from participants, and an Expression of Interest link for prospective participants to fill in their contact details and university name.

FIGURE 3.1: Recruitment Flyer

Figure 3.2 outlines how I planned to disseminate the recruitment flyer for my study. The top half of the figure shows a recruitment plan within an academic setting, where I reach out to engineering academics through personal contact or social media groups (e.g., Australasian Association for Engineering Education Facebook group). Through these academics, I will get in touch with an appropriate university contact to publish recruitment details (e.g., via internal newsletters or social media groups), or invite the academics to pass on recruitment details to their students (e.g., by including a slide in their lecture or posting on a subject-wide notice board). The bottom half of the figure shows a recruitment plan within a non-academic setting, where I reach out to relevant communities, societies, and organisations (e.g., UTS Pakistan Society, Council for International Students Australia) to get their approval to publish recruitment details through newsletters or social media.

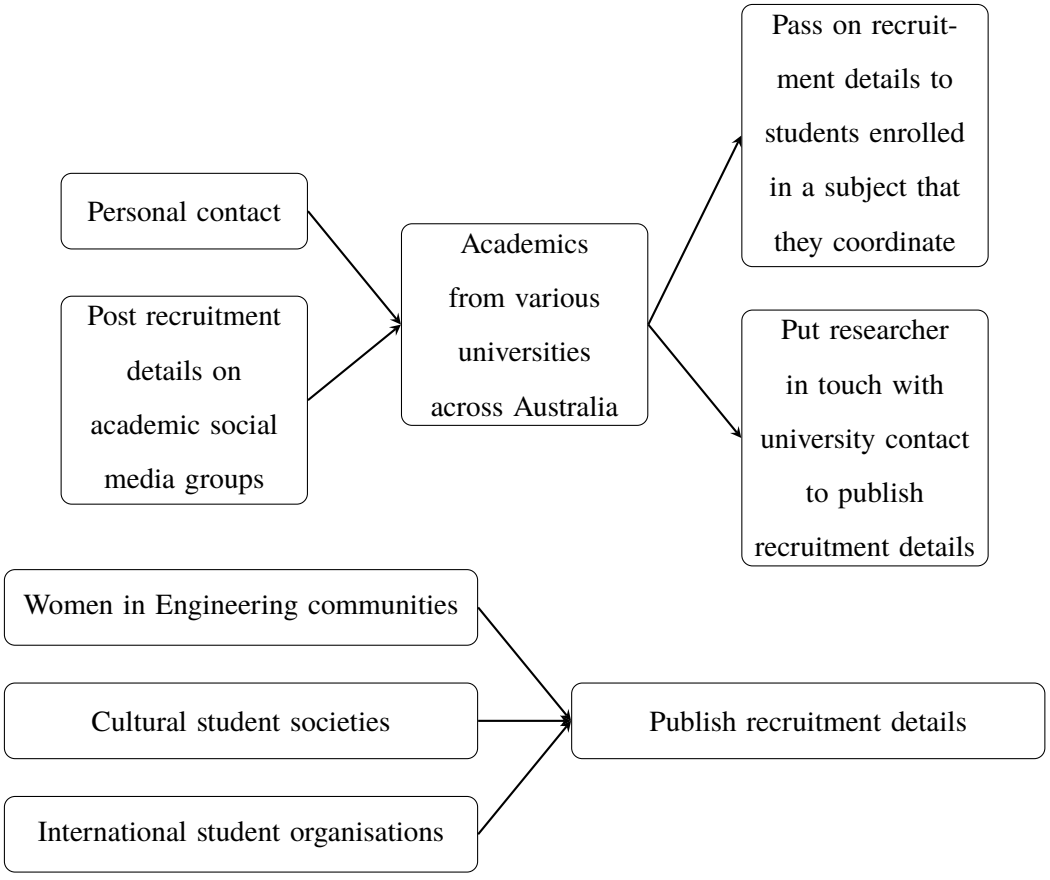

FIGURE 3.2: Initial Recruitment Plan

After consulting with the Faculty Research Office, these pathways were deemed inappropriate. As my target population is university students, the Dean of each university's engineering faculty

must approve my research before distributing recruitment details. Hence, all these options must be preceded by the Dean's approval. Figure 3.3 shows the revised recruitment plan.

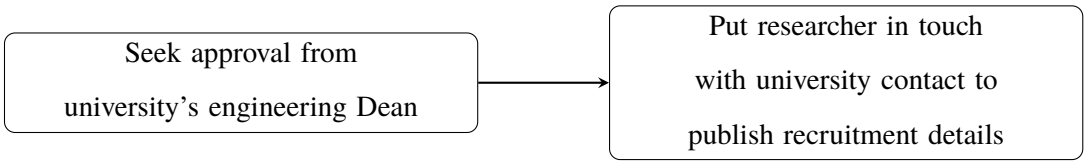

FIGURE 3.3: Revised Recruitment Plan

As the revised recruitment plan was less direct and required additional support from my supervisors, several universities were selected based on the diversity of universities discussed earlier - state/territory, location (urban or regional), and university groups. Due to low response rates, the invitation was subsequently sent to all universities with a maximum of two follow-up emails. The recruitment flyer was disseminated through internal student newsletters and relevant social media pages.

Once Expression of Interest forms from prospective participants were received, I followed up with an email with a Participant Information Sheet and Consent Form (attached in Appendix II), and asked about their engineering discipline, year of study, and home country. Eleven participants were interviewed, which was less than the minimum sample size of 15 proposed earlier. However, the reduced number of participants provided part of the motivation for the change in analytic approach, which will be discussed in Section 3.2.2: *Storying narratives*.

3.2.1.4 Interview Protocol

This section will cover the process of developing an interview protocol for this study. The first subsection will focus on the logistics of the interview, such as strategies adopted to ensure that the interview protocol honours participants' backgrounds and prioritises their well-being. The second subsection will focus on the principles of narrative interviewing, including the curation of prompts and activities to elicit narratives from participants.

Interview Logistics

For context, the interviews took place between 24th November 2021 and 14th December 2021, which was during a period of travel restrictions and lockdowns across Australia. As I am interviewing participants across different institutions in different locations, it was established that they would be online interviews, with audio and video recorded through video conferencing software. Given that most participants come from diverse cultural backgrounds, further considerations were undertaken to ensure the interviews were conducted in a culturally sensitive manner. This section outlines some key principles that informed the interview protocol for this study.

In online interviews, the following potential risks were identified:

- Participants may feel self-conscious about being interviewed and audio/video recorded online, which may result in uncertainty in answering questions.
- Participants may be concerned about their privacy/confidentiality, as the video conferencing software may capture and record details in the background that may result in accidental disclosure of their identity.
- Participants may not have access to a quiet and safe space where they can express their honest opinions without interruption or concern of repercussions.

To minimise the above risks, the following prompts and considerations were incorporated into the interview protocol:

- In addition to getting consent to audio and video record the interview, participants will be reassured that their data will be stored securely and de-identified to preserve their anonymity.
- Participants will be reminded that they can take a break, reschedule the interview, or withdraw from the study at any time without giving a reason.
- The researcher will recommend strategies to further protect the privacy/confidentiality of the participants, such as the participants' voluntary use of a virtual or blurred background during the online interview.

Other potential risks related to participant well-being include the following:

- Participants may experience emotional discomfort as a result of the information they are being asked to recall, discuss or consider as part of the interview, for example, negative experiences faced as an international student or woman in engineering.
- Participants may feel uncomfortable sharing sensitive or personal information with the researcher.
- Participants may feel uncomfortable or guilty sharing views deemed as controversial in their culture, or opinions that are framed negatively.
- Participants may experience inconvenience, embarrassment or feel uncomfortable being interviewed in a language they are less fluent in.

In addition to what was previously mentioned, the following prompts and considerations were incorporated into the interview protocol:

- Participants will be provided details about appropriate counselling services to seek help following the interview if needed.
- Member checks will be conducted to ensure that published data is sufficiently de-identified, and participants are provided with an opportunity to remove information they deem sensitive or personal.
- Participants will be reassured of the researcher's respect for their situation and privacy and can contact the researcher at any time if they have any questions.
- The researcher will incorporate questions at the beginning of the protocol to gauge participants' language levels and ensure that the interview is conducted at an appropriate level of English language competency.

Narrative Interviewing

Narrative interviews are characterised by their ability to elicit stories from participants that may not be told otherwise (Kim, 2016). As such, researchers should refrain from viewing interviews

as a series of "stimuli and responses" (Mishler, 1986, p. viii) like questionnaires. Kim (2016) recommends two narrative interview phases: the *narration* phase and the *conversation* phase. In the narration phase, the interviewees are invited to narrate events in their life with minimum interventions from the interviewer. In the conversation phase, the interviewer may seek clarification from the narrative or probe into topics of theoretical interest.

The *narration* phase allows participants to speak in their own voices, decide the story's starting point and take control of the flow of topics (Narayan & George, 2012). In this study, the narrative phase encourages participants to self-determine the start of their 'engineering story' (prompted by 'how did you come to do [engineering discipline] in [current university]?'), and recount events that they see as relevant to their journey into engineering.

The *conversation* phase engages the researcher and participant in collaborative meaning-making, where the researcher is viewed as an "active co-constructor rather than a passive collector or recorder of data" (Gemignani, 2014, as cited in Kim, 2016, chap. 5, Narrative Interview Phases section, para. 4). During this phase, researchers should ask follow-up questions that elicit further stories, rather than simply moving on to the next question in the protocol. One strategy adopted by Morrissey (1987) is the two-sentence format technique, which consists of a statement and a question. As an example, "We've talked about some of the challenges you faced as a woman international student. How do you navigate these challenges?"

As narratives are fluid, an external structure is not necessary for an interview protocol (Kim, 2016). Instead, the interviewer should remain flexible to the narratives that emerge in the interviews, as what may initially be an unrelated response can become of analytical importance later (Riessman, 2012). Hence, it would be counter-productive to suppress personal stories to follow an interview protocol. Kim (2016) has also emphasised that in a narrative interview, the stance of the interviewer as a listener and the interviewee as a narrator is more important than the form and content of a question.

Considering the big story approach of my interview, the interview protocol is loosely structured in a past-present-future format, starting with the participants' pathways into engineering, followed by perceptions of engineering, experiences in engineering, and future in engineering. A pre-interview and post-interview protocol bookends the interview to incorporate the considerations discussed earlier in this section. An overview of the interview protocol is presented below..

Pre-Interview (before the interview starts):

- Greet participants, check name pronunciations and time zones
- Introduce personal context to establish rapport, and emphasise why I am interested in their stories
- Provide information on the study, and check if participants have any questions or concerns
- Obtain consent to start recording, and go through the verbal consent script

Interview:

- Pathways into Engineering
  - Prompt: How did you come to do [engineering discipline] in [current university]
- Perceptions of Engineering
  - An interactive activity where pictures are used to elicit narratives on the different perceptions of engineering (further explained below)
- Future in Engineering
  - Prompt: What are your plans after graduating?

Post-Interview:

- Invite participants to share anything else they may want to add
- Explain member-checking procedure
- Thank participants, assure them that they can contact me anytime

In interviews, images can be a useful anchor to ask about perceptions of specific topics, as they stimulate interviewees to think in different ways about things that they take for granted (Weber, 2008). Midway through the interview, participants were invited to take part in an activity on Jamboard, a brainstorming app. Participants were asked to match pictures against some descriptions,

with an example shown in Figure 3.4. This activity is used to elicit narratives. Hence the images themselves were not used as data.

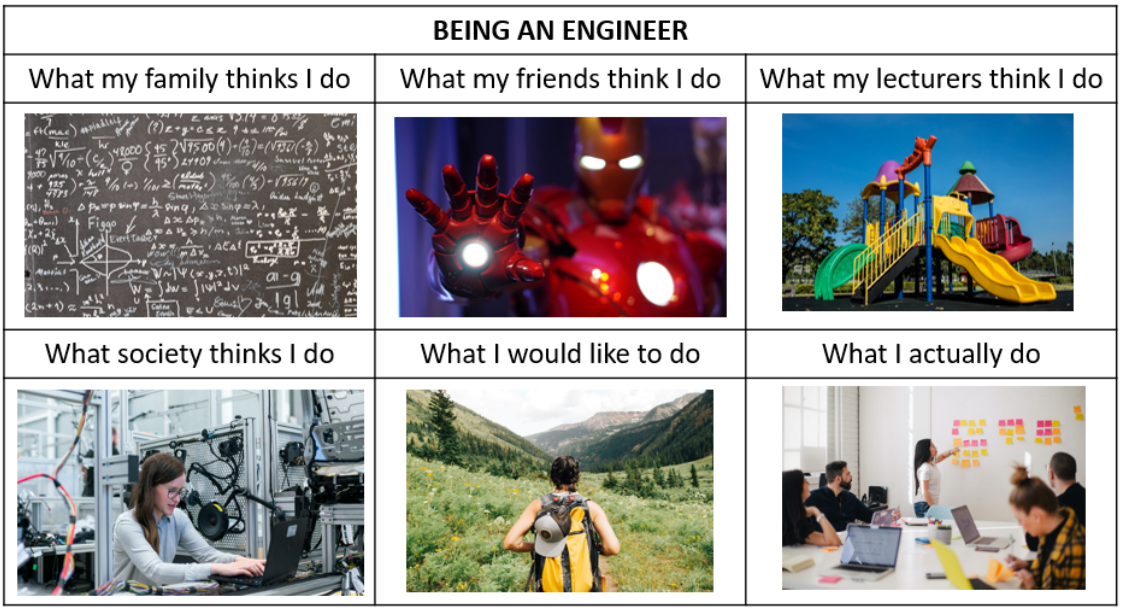

FIGURE 3.4: Example response to the interactive activity

(Photos by Bumba; Goodman; Lai; Mandarich; ThisisEngineering RAEng; Thomas on Unsplash)

To ensure data quality, a pilot study was conducted with three participants. As the interview protocol is relatively unstructured, most refinements focus on prompts, clarification of terminologies, and interviewer techniques. Following are the key changes from the pilot study which were implemented:

- *Pathways into Engineering*: Include a prompt on the education system in the participants' home countries, to account for the "social, cultural, and institutional narratives within which individuals' experiences are constituted, shaped, expressed, and enacted" (Clandinin, 2016, p. 12).
- *Perceptions of Engineering*: Let participants decide whether they are referring to an engineering student of professional engineer in the activity.
- *Negotiation of Identity*: The original protocol included a prompt on how participants' perception of engineering has changed over time. This prompt was removed as it does not result

in meaningful responses nor align with the principles of narrative interviewing discussed earlier.

3.2.2 Storying narratives

This section covers the process of interpreting and analysing the narratives. I will discuss the switch from paradigmatic to narrative cognition, locate the significance of stories in education, compare the role of author and writer, and describe the analytic approach undertaken in this study.

3.2.2.1 From paradigmatic to narrative cognition

While this study adopts the use of narrative as story, the participants' narratives (field text) are different from the stories curated in this study (research text). I use the term 'storying' to refer to the process where the researcher analyses and interprets the narrative presented by the participants and constructs a narrative that is accessible to the readers. As an example, the researcher could identify common themes across participant narratives and construct a research narrative around those themes.

As mentioned previously, my research design was initially guided by paradigmatic cognition, which focuses on identifying common themes and concepts from stories. As I started reading the transcript and taking notes, however, I started having the same concern that researchers like Clandinin (2016) and Kellam, Gerow and Walther (2015) have described. As I broke down my participant's pathways by listing reasons they chose engineering as a degree, a specific engineering specialisation, Australia as a study destination, a particular state, and their current university, I immediately felt that this summary did not represent my participants' full story.

I was missing something. While the way I have broken down their pathways helped to bring some order across different participants, it did not account for the importance they placed on each decision and how each decision was made. In my initial reading of the transcripts, I noted that many of their decisions were influenced by other happenings in their lives, cultural contexts and individual personalities. To me, these factors are irreducible to codes. Reflecting on my research, I realised that a plot is the best way to hold my data together. In this study, a plot refers to a "form that preserves the complexity of human action with its interrelationship of temporal sequence, human motivation,

chance happenings, and changing interpersonal and environmental contexts" (Polkinghorne, 1995, p. 7).

This decision signalled and motivated a change in my analytic approach, from paradigmatic cognition to narrative cognition. Instead of a list of 'data' that I categorised into codes, I now had to synthesise them in a plot. A plot is not merely organising the events in the narrative chronologically. The plot is needed to order the events into an "unfolding movement culminating in a conclusion" and "[make] explicit the meaning events have as contributors to the story" (Polkinghorne, 1995, p. 7). In the following section, I draw on the use of stories in formal education to illustrate this point and further discuss the purpose of stories.

3.2.2.2 From formal education to education research

Stories are often used to teach life lessons. For instance, the fable of the hare and the tortoise taught us that the slow and steady wins the race (Aesop, 1993). Stories across different languages and cultures teach us the importance of honesty, kindness, and other virtues. As part of language tests in my school, students were asked to read short stories and answer related questions to assess their comprehension skills. One common question is "what is the moral of this story?"

The 'moral of the story' is often explicit in these texts as they were specifically curated to educate readers. The hare and the tortoise were simply actors in an event described in the story (the race). Their backgrounds, motivations, and actions were not discussed. Using animals as characters reduced them to stereotypical traits (e.g., the 'slow' tortoise) and distanced the story from the complexity of human thought processes. This complexity is gradually introduced to older students as they transition to reading literature (e.g., Shakespeare). Much of the literature included in the curriculum reflects complex societal issues, where a 'moral of the story' is harder to pinpoint. Instead, students are asked to interpret the author's intentions, analyse metaphors, and identify themes.

Beyond formal education, many of us continue to engage with stories through books and films. However, the absence of test questions and acceptable answers leads to greater variations in the way we engage with stories. For instance, some readers and viewers may enjoy theorising the meanings behind the plot, while others may prefer interpreting the plot at face value. Compared to non-fiction (e.g., documentary films) which is widely accepted as a form of knowledge, fiction is

rarely acknowledged as a legitimate form of knowledge. However, genres such as reality television have blurred the distinction between fiction and non-fiction.

These observations raise parallel questions that have been discussed in educational research and narrative inquiry. Are stories considered as knowledge? If the extent of knowledge present in stories is measurable, does it change depending on the readers and viewers? Is the legitimacy of knowledge reliant on the form in which it is presented?

Kim (2016) discussed these debates at the American Educational Research Association (AERA) in the 1990s, where the legitimacy of narrative inquiry as a methodology was questioned because "it has a tendency to be art rather than research" (chap. 4, The Origin of Genre Blurring section, para. 1). Considering the positivist roots of sociology developed by Auguste Comte, there is a strong inclination towards empirical methods in developing social theory. While Geertz's (1980) concept of 'genre blurring' has played a role in dissolving the art-science dichotomy in social research, the way social research is presented is still strongly influenced by how scientific research is reported.

For instance, in scientific research, the findings of a study may be presented as a graph. Since the graph alone may not explain what the researcher has found, it is accompanied by a written explanation (a form of research narrative). This format is understandable because in the positivist paradigm, the meaning of the graph is relatively stable. A group of researchers can likely reach a consensus on how the graph should be interpreted. Hence, the written explanation outlines what the readers should look for in the graph to understand the study's findings.

In social research and more specifically narrative inquiry, the findings of a study may be presented as a narrative (or more colloquially, a story). However, the need for a written explanation is contested and varies by discipline. Those conducting arts-based research may argue that since the narrative itself conveys meaning that is accessible to readers and hence, no explanation is required. Furthermore, in the interpretivist paradigm, texts do not have stable meanings (Riessman, 1993). According to McCormack (2004), narratives are continuously reconstructed:

1. when a participant recalls an experience and describes it to the researcher,
2. when the researcher analyses and interprets the experience, and
3. when the reader reads and reacts to the experience.

The second point involves the process of curating a narrative, which will be described in Section 3.2.2.4: *Analytic Approach*. This section focuses on the justification of non-traditional formats of presenting social research, which guides my considerations on how narratives are presented and discussed in this study. In particular, I draw attention to Barone's (2001) distinction between writer and author.

> An *author* may suspect that the reader will not know how to "properly" read the text. Perhaps he fears that the reader will remain in a state of restrained consciousness, incapable of deciphering a message subtly embedded within a literary form. So the author may decide to declare (rather than express) that message, thereby shifting genres from novel to epic, and his status from writer to author. A *writer*, however, holding the reader in high regard, is pleased to think that she will dismantle what has been constructed and reconstructed. (Barone, 2001, p. 179, emphasis in original)

To clarify, the above excerpt is not an argument for researchers to present raw data without accompanying analysis. Rather, it is a prompt to reconsider alternate approaches to convey the findings of a research study and shift away from the researcher's position as authority.

3.2.2.3 From author to writer

What is the researcher's role, if not to explain the data and act as an authoritative voice? Kim (2005) compares the role of a narrative inquirer to that of a midwife, where researchers work with "what is in the womb" to deliver "healthy, trustworthy" stories (pp. 57-58). This position is markedly different from researchers whose role is to point out what participants "could not see, would not do, and could not have said" (Lather, 1997, p. 252). However, the role of the narrative inquirer is not limited to reporting on participants' experiences. Narrative inquirers, while becoming fully involved with the participants, have to simultaneously "step back and see their own stories in the inquiry, the stories of the participants, as well as the larger landscapes on which they all live" (Clandinin & Connelly, 2000, p. 81).

In other words, a narrative inquirer *mediates* stories. Barone's (2001) excerpt above suggests that declaring a message embedded in literary form shifts the genre from novel to epic. Kim (2016)

has similarly cautioned against the temptation of an "epic closure" (chap. 7, Avoiding an Epic Closure section), where researchers present an authoritative, complete view of their participants' experience, leaving no room for ambiguity. This approach is far from what is expected in narrative inquiry, where "final research texts do not have final answers, because narrative inquirers do not come with questions" (Clandinin, 2016, p. 51).

Although narrative inquirers do not come with questions, addressing the 'so what' question is still necessary. For researchers who are accustomed to the position of researcher as author (rather than writer), it may be difficult to understand the significance of the findings in this study, which aim to prompt readers to reconsider "the ways in which they practice...and relate to others" (Clandinin, 2016, p. 51). This concern is addressed in Section 3.2.4: *Evaluating narrative research*, where the impact of narrative research is discussed.

Building on the role of the narrative inquirer discussed in this section, the next section will describe the analytical approach undertaken to reconstruct field text to research text.

3.2.2.4 Analytic Approach

While the process of constructing narratives is by no means linear, I outline the steps to guide understanding of how I went from field text (the narrative term for 'data') to research text (the narrative term for 'analysis') (Clandinin, 2016). In this study, field text refers to interview transcripts and researcher notes. Interim research text refers to the initial narrative sent to each participant. The final research text refers to the revised narrative and corresponding analysis. A further discussion on the presentation of research findings is discussed in the following section.

From field text to interim research text

1. After each interview, I write a reflection that includes notes on each participant's personality, emerging themes from the participant's narrative, and methodological notes specific to each interview (e.g., rapport with participants, unexpected insights, personal reflections).

2. A transcript is generated. For this study, the interviews were transcribed in few different ways. Some of the interviews were transcribed manually, some through an online transcription software and some through a professional transcription service. In each case, the file name

was de-identified, and the audio file was deleted from the system after the transcript was generated.

3. I listen to the audio file to proofread the transcript, ensure consistency in transcription style and guide further reflection. Notes from further reflection (which are added as comments throughout the transcript) include recurring themes, aspects requiring clarification, and observations on the participant's linguistic expressions.

4. I do repeated readings of the transcript, noting excerpts that reflect their pathway into engineering, perceptions of engineering, experiences in engineering and future in engineering.

5. I start constructing their narrative by ordering their pathway into engineering chronologically.

6. I paste excerpts in the above chronological order into a new document and explore different ordering of excerpts to ensure it flows meaningfully.

7. After settling on a plot structure, I perform "narrative smoothing" (Spence, 1986) to ensure the excerpts read as a coherent and compelling story, adding narration where necessary.

8. I send the narratives the participants to ensure their stories are adequately represented.

From interim research text to final research text

1. I develop a participant map (structure shown in Table 3.2) to facilitate an overall understanding of the participants in this study.

2. As I identify emerging themes for each participant to guide analysis, I use them as criteria to select excerpts to keep or omit from the narrative.

3. I revise the narratives by reflecting on whether the constructed narratives reflect what I see as important and unique for each participant and their narrative.

4. I perform another iteration of "narrative smoothing" (Spence, 1986) to increase readability while maintaining the linguistic expressions of each participant.

5. I then write an analysis of each narrative based on the framework described in Section 3.1.4: *Justifying narrative inquiry* – Personal, Practical and Methodological.

TABLE 3.2: Participant Map Structure

Topic	**Information included for each participant**
About	Demographic information Degree and year of study Personality (participant-identified and researcher-identified)
Motivation	To study engineering (general and specific discipline) To study in Australia (city or university where applicable)
Perceptions	Individual Family Society Friends
Experience	As an international student As a woman Specific to online learning
Future	Desired role Desired work environment
Core Narratives	What makes this participant unique from other participants that are theoretically meaningful
Personal Practical Methodological	Potential themes that can be explored

As I started constructing the narrative for one participant, I realised I would not be able to present all 11 participants due to the thesis word limit, and my time frame. While it is common for studies in narrative inquiry to focus on 1-4 participants (Hunsburger, 2008), they are typically longitudinal studies, which was not achievable in my time frame. In seeking a middle ground that allowed me to conduct an inquiry with sufficient depth while making a substantial contribution, I decided to focus on six narratives. These narratives were chosen to reflect a diversity of pathways into engineering, perceptions of engineering, and experiences in engineering.

While there may be concerns on the lack of theoretical saturation, Malterud et al. (2016) has argued

for the need to consider 'information power' instead of saturation. Information power indicates that "the more information the sample holds, relevant for the actual study, the lower amount of participants is needed" (p. 1753). According to Malterud et al. (2016), studies with dense sample specificity and strong dialogue quality that applies within case analysis has higher information power, thus requiring less participants. These features are applicable to this study, which justifies the reduced sample size.

The following section covers the process of presenting narratives.

3.2.3 Presenting narratives

Narrative inquiry scholars have emphasised that there is no set way to present narrative inquiry studies (Bold, 2012). The way the findings are presented may vary depending on the scope of the research puzzle, the number and diversity of research participants, the structure of the interview and whether the researcher chooses to conduct an analysis of narratives or narrative analysis (as discussed in Section 3.1.3.1: *Thinking narratively*). To orient readers to the structure of upcoming chapters, this section will summarise and justify the decisions made in relation to the presentation of findings.

As mentioned in Chapter 1: Introduction, six chapters are dedicated to Findings in this thesis. Each chapter focuses on one participant of the study, as in other similar research (e.g., Clandinin et al. (2013) and Clough (2002)). This decision also reflects the choice to adopt narrative analysis, where knowledge moves from "case to case" rather than from "case to general", the latter being a key feature of thematic analysis (Polkinghorne, 1995). However, it is important to note that the mentioned authors constructed their narratives based on two or more interviews with their participants. Compared to a single interview conducted in this study, multiple interviews allow researchers and participants to build rapport, which greatly enhances the richness and trustworthiness of their narratives.

As this study was conducted during a period of lockdown due to the COVID-19 pandemic, data collection was delayed (as discussed earlier in this chapter). Hence, a subsequent interview could not be completed within the study's timeline. Furthermore, most of the participants in this study were disproportionately affected due to domestic and international border closures, which led to

low numbers of Expressions of Interest. A follow-up interview would further decrease the number of available participants. Instead, I drew on my lived experience as a fellow woman international student in engineering to relate to my participants and weaved in my personal narrative to enrich the findings of this study.

Each chapter consists of two sections. The first half presents the participant's narrative, while the second half presents my analysis of the participant's narrative. The separation between participant narrative and researcher analysis, as well as the style adopted for the narrative, are informed by the narrative genre of this study.

3.2.3.1 Participant Narrative

As mentioned earlier, there is no set way to present narrative inquiry studies. However, a narrative genre guides the researcher in putting together a story that best represents the research data (Kim, 2016) and provides the reader with an expectation of the content. As shown in Table 3.3, Kim (2016) divides narrative inquiry genres into three areas: autobiographical, biographical, and arts-based (chap. 4, Narrative Research Genres section, Figure 4.1).

TABLE 3.3: Narrative Inquiry Genres (Kim, 2016)

Narrative Inquiry Genre	**Examples**
Autobiographical	Autobiography, autoethnography
Biographical	Bildungsroman, oral history, life story, life history
Arts-based	*Literary-based:* Creative nonfiction, short story, fiction, novel, poetry, drama *Visual-based:* Photovoice, photographic narrative, archival photographs, digital storytelling

While this study contains elements from the autobiographical and biographical genres, the presentation of findings is best characterised as a form of biographical narrative inquiry, more specifically a life story (used interchangeably with life history). Also known as the narrative study of lives, life story is defined as:

> the story a person chooses to tell about the life he or she has lived, told as completely and honestly as possible, what is remembered of it, and what the teller wants others to know of it, usually as a result of a guided interview by another. (Atkinson, 1998, p. 8)

In this study, the scope is narrowed to the participants' 'engineering stories,' but the above definition is still applicable. The following guidelines for writing a life history, taken verbatim from Kim (2016, chap. 4, Table 4.3) were used to curate narratives in the first section. These guidelines complement this study's analytic approach described earlier.

1. Include descriptions of the cultural context in which the storied case study takes place, while attending to the contextual features that give specific meanings to events.
2. Attend to the bodily dimension of the protagonist, including the protagonists' personalities and propensities that affect personal goals and life concerns.
3. Attend to the importance of relationships between the main character and other people in affecting the actions and goals of the protagonist.
4. Concentrate on the choices and actions of the protagonist, which indicate the inner struggles, emotional states, plans, motivations, purposes, and interests.
5. Consider the historical continuity of the characters. In considering the protagonist as a biographical being, attention needs to be given to social events that the protagonist and his or her historical cohorts have experienced.
6. Mark the beginning point of the story and the point of denouement in the context of time and space.
7. Make the story plot plausible and understandable because the story is a reconstruction of a series of events and actions that produced a particular outcome.
8. Answer the question, "How is it that this outcome came about; what events and actions contributed to this solution?"

It is important to note that the above guidelines are mainly suggestions on the content of the narrative rather than the structure. While many narrative inquirers typically weave their analyses into

the narratives, the analyses include other forms of data (e.g., through observation or artefacts) or provide additional context on the participant. This format is not applicable to this study as data is collected based on a single interview. Furthermore, the need to maintain the anonymity of the participants in my research limited the amount of context I was able to provide. Hence, participant narratives were separated from researcher analysis.

The decision to present participant narratives in the first person to retain linguistic expressions unique to their spoken words is further elaborated in Section 3.2.4: *Evaluating narrative research*. While the participants' universities and home countries are mostly redacted for anonymity, there were participants whose narratives were heavily centred around their cultural context. These participants' home countries are represented with a wider geographical region.

Presenting narratives in the first person leads to a common difficulty in narrative research: word length. As the nature of narrative research "requires sufficient word length in a written report to allow for sufficient use of data in the form necessary to demonstrate quality analysis" (Bold, 2012, p. 163), some researchers may consider putting the narratives in the appendix. However, doing so would simultaneously silence the voice of the participants and the space for readers to interpret the stories, which is against the purpose of using narrative methods. Instead, these narratives are analysed in the second half of the chapter.

3.2.3.2 Researcher Analysis

As discussed in Section 3.1.3.1: *Thinking narratively*, presenting findings by participants rather than themes is informed by the distinction between narrative and paradigmatic cognition, with the former being the focus of this study. While paradigmatic cognition typically involves prescriptive procedures, methods of narrative analysis are highly varied.

Kim (2016) describes three categories of narrative analysis: *references and temporal order*, *textual coherence and structure*, and *narrative functions* (chap. 6, Methods of Narrative Data Analysis section, Figure 6.2). Reference and temporal order refer to the format in which the story is told, textual coherence and structure refer to the sociolinguistic aspects of the narrative, and narrative function is typically tied to the chosen theoretical framework. Like narrative inquiry genres, it is not

a requirement to subscribe to one of the above methods. The analytic approach should be catered towards participants' narratives, the researcher's background, and readers' expectations.

Multiple frameworks and approaches were considered in structuring the analysis section of the chapter. In line with the life story approach, biographical time points were considered (e.g., childhood, primary school, secondary school, university) as it provides a consistent structure across participants. However, not all biographical time points were represented in each narrative as participants' 'engineering stories' start at varied points in their lives. Barone's (2001) approach of using "prominent shifts in life plots" (p. 168) as themes better reflects each participant's journey. However, these themes have already been adopted in each participant's narratives and do not effectively address the 'so what' question.

To balance between providing a consistent structure and addressing the 'so what' question, the personal, practical and methodological dimensions discussed in Section 3.1.4: *Justifying narrative inquiry*, was chosen as a framework to guide the analysis of participant narratives. While analyses guided by this framework are focused on an individual participant, the Findings chapters are structured such that knowledge moves from case to case (Polkinghorne, 1995). Hence, narratives and analyses from previous chapters were drawn upon to enhance arguments where relevant. A comparison between narratives is discussed in Chapter 10: Discussion. Based on analytical threads identified from the literature, the findings of this study across all participants are discussed.

3.2.4 Evaluating narrative research

Many quality considerations that dominate the academic discourse are based on positivist assumptions that do not apply to narrative research (Riessman, 1993). When Connelly and Clandinin established narrative inquiry as a research methodology, they argued for the need to move beyond concepts such as reliability, validity and generalisability (Connelly & Clandinin, 1990). They also warned researchers against "squeez[ing] the language of narrative criteria into a language created for other forms of research" (p. 7).

Within narrative research, there has been an increasing consensus on the relevance of various criteria depending on the research circumstances (Andrews, 2021; Connelly & Clandinin, 1990; Riessman, 1993). There is also a growing acceptance of interpretive research in engineering education

research, arguably driven by Walther et al.'s (2013) typology of quality strategies. In their works, these scholars have emphasised that quality criteria should not be simplified to a set of standards (Bold, 2012; Riessman, 1993; Walther et al., 2013). Rather, researchers should identify and justify the criteria relevant to their work (Connelly & Clandinin, 1990; Walther et al., 2013).

In identifying and justifying quality criteria relevant to this study, I referred to the literature relevant to my study, including those mentioned above. As each scholar uses a distinct set of terminologies to frame quality criteria, there are inevitable overlaps in definition and purpose. For instance, Riessman (1993) discussed 'persuasiveness' as a criterion. In the first half of the discussion, she referred to 'persuasiveness' as a "reasonable and convincing" interpretation (p. 65), which can be achieved through claims that are supported by data, and the consideration of alternative interpretations. In the second half of the discussion, she argued that 'persuasiveness' could also be achieved through "the analyst's capacity to invite, compel, stimulate or delight the audience" (Gergen, 1985, p. 272, as quoted in Riessman, 1993), since texts do not have stable meanings.

The first sense of persuasiveness, represented as being 'reasonable and convincing,' has been referred to as 'trustworthiness' by Andrews (2021), while the second sense has been referred to as 'invitational quality' by Connelly & Clandinin (1990). While it may be compelling to separate persuasiveness into two criteria, trustworthiness and invitational quality, doing so would result in a loss of meaning. Conversely, retaining persuasiveness as a sole, double-barrelled criterion may lead to inconsistent use of the criterion. This example demonstrates the complexity of identifying quality indicators in narrative research and why a list of quality indicators is not presented in the following section.

It is beyond the scope of this study to present a meta-analysis on the range of quality criteria, how they relate to one another, and how different scholars frame them. Furthermore, this study is situated in engineering education research, an emerging field where research quality remains contested due to its positivist research traditions. Hence, rather than presenting a list of quality criteria, this discussion is focused on reconceptualising existing criteria that dominate academic research, specifically reliability, validity and generalisability. This broad structure allows for a richer discussion that views quality criteria as guiding principles for evaluation rather than a checkbox activity with corresponding strategies.

The following discussion will be split into two sections, the first addressing the concept of reliability and validity, and the second addressing the concept of generalisability. In each section, alternate quality indicators appropriate to this study will be discussed, followed by strategies implemented to ensure data quality and analytical rigour.

3.2.4.1 Reconceptualising validity and reliability

This section problematises the concept of validity and reliability in narrative research, and discusses alternative quality indicators such as trustworthiness, correspondence, fidelity and verisimilitude.

In the scientific context, validity refers to the "agreement of the results of a measurement with the true value of the measured quantity" (Sirohi & Radha Krishna, 1983, p. 39, as cited in Walther et al., 2013). Acknowledging the definition's lack of applicability to qualitative research, Walther et al. (2013) redefined validity as "the extent to which the research findings appropriately reflect properties of the social setting investigated" (p. 636). Based on this definition, a question that should be asked in this study is whether the presented narrative appropriately reflects the properties of the social setting investigated, which raises some concerns.

Firstly, who decides if the properties of the social setting have been appropriately reflected in the narrative? The researcher, the participant, or the reader? While Walther et al.'s (2013) definition accounts for multiple realities, it still suggests researcher as authority. The definition also does not account for the dialectic nature of narrative research (Heikkinen et al., 2007), where meanings are co-constructed between researcher and participant (Andrews, 2021). Rather than appropriately reflecting the properties of a social setting, a narrative inquirer should appropriately represent different voices and interpretations (Heikkinen et al., 2007).

Secondly, what is considered as a social setting? If the study involves a thematic analysis of the experiences of women international students, then the themes presented (research findings) should represent the experiences of women international students (the social setting investigated). In narrative research, however, personal stories (personal truths) do not always translate to social stories (sociological truths) (Kim, 2016). Thus, the purpose of narratives should be to represent participants authentically rather than to reflect the properties of the social setting investigated.

These concerns demonstrate the limitations of using 'validity' as a quality indicator for narrative research. Despite Walther et al.'s (2013) redefinition, the concept of validity has underlying positivistic connotations (Heikkinen et al., 2007), which reifies Connelly and Clandinin's (1990) concerns about 'squeezing' narrative criteria into quality indicators created for other forms of research. The term also lacks semantic rigour compared to indicators adopted by other researchers such as authenticity and fidelity (Andrews, 2021; Heikkinen et al., 2007; Kim, 2016).

Similar concerns apply to the concept of reliability. For example, an indicator of reliability is when the same instrument given to the same people, under the same circumstance, at a different time generates the same response. This criterion would be applicable in the context of a quantitative study where responses are collected through a questionnaire. In a narrative study, however, it is impossible to create the 'same circumstance' at a 'different time.' For example, if a research participant was asked a similar set of questions in their interview's first and second rounds, it is unlikely that they would provide the same response in both rounds. The variation in response is not necessarily due to a lack of reliability. The participant may have developed rapport and feel more comfortable sharing with the researcher, or perhaps what is salient for them has changed over time. Hence, it is more appropriate for a narrative inquirer to demonstrate critical reflexivity, which refers to the researcher's acknowledgment of the "situatedness of knowledge" (Andrews, 2021, p. 364).

The alternative indicators presented above may appear vague and messy, which Andrews (2021) argues is entirely appropriate. As she puts it, "human beings trying to understand other human beings are not a clear-cut business, and the tools which we use to carve our work should not have a sharp edge" (p. 363). As mentioned earlier, the purpose of this section is not to present a clear list of quality indicators, but to prompt a reconsideration of existing indicators. However, acknowledging the need to demonstrate the quality and rigour of this study, the following paragraphs outline some guiding principles and quality strategies.

It is important to emphasise that narrative inquirers focus on *trustworthiness* rather than truth (Connelly & Clandinin, 1990). Truth tends to be associated with something that can sustain "factual scrutiny" (Andrews, 2021, p. 363), which is difficult to claim in narrative research. However, researchers should still seek to convince and persuade the readers that the findings can be trusted. Trustworthiness offers a "kind of objectivity suited to the narrative enterprise" (Riessman, 2015, p. 229, as cited in Andrews, 2021) while honouring the subjective nature of narrative research.

To achieve trustworthiness, Riessman (1993) highlighted *correspondence* as one of the quality criteria. Correspondence involves taking findings back to those studied to ensure they adequately represent participants. This process is commonly known as member-checking, which strengthens trustworthiness. However, Riessman (1993) has questioned the validity of using member checks to validate interpretations, as narrative research is not limited to reporting what the participant is conscious of.

Kim's (2016) concept of *fidelity* addresses Riessman's point. According to Kim (2016), a narrative inquirer should maintain fidelity "both toward the person's story and toward what that person is unable to articulate about the story and its meanings" (chap. 3, Fidelity to Told Stories section, para. 1). Articulating what that person is unable to convey refers to the researcher's interpretation of the participant's story, rather than a 'larger' truth that the participant is unaware of. According to Kim, fidelity "distinguishes a story as research from a story that is read for leisure" (para. 1).

To maintain fidelity, Kim (2016) suggests using the contextualised and vernacular language of the research participants rather than the analytical language used by researchers. While one may argue that literary practices are not a key quality concern in narrative research, Riessman (1993) has asserted that legitimacy and persuasiveness stem from reader response rather than a set of attributes. Producing an accessible text contributes to *verisimilitude*, which is a "conceivable experience" (Bruner, 1985, p. 52) that allows readers to "experience vicariously or virtually" the story presented (Kim, 2016, chap. 3, Creation of Virtual Reality/Verisimilitude section, para. 1). Verisimilitude allows the text to take on its own life and furthers the impact of narratives beyond generalisability, which will be discussed in the next section.

3.2.4.2 Reconceptualising generalisability

This section problematises the concept of generalisability in narrative research. It discusses alternative quality indicators such as pragmatic use, political and ethical use, workability, and evocativeness.

Like validity and reliability, the concept of generalisability relies on realist assumptions which makes it irrelevant to narrative research (Riessman, 1993). While all three criteria (validity, reliability, and generalisability) concern the quality of research, generalisability is more oriented towards the impact and utility of the research.

In quantitative studies, the generalisability of findings can be achieved through statistical power. For example, a high confidence value suggests that the hypothesis applies in most cases. The value can be used to argue that the research findings from the sample reflect the population. In qualitative studies, working with large sample sizes is less viable. However, qualitative researchers are still expected to report findings that speak to empirical conditions, especially for journals that are traditionally dominated by the positivist stance (Small, 2009). Most qualitative researchers respond by incorporating elements of quantitative methods, with saturation being one of the most widely adopted concepts.

Saturation is used to prove that a theory stands and that the findings are representative. This is because saturation was developed from grounded theory (Malterud et al., 2016), which aims to generate a theory based on the collected data. While saturation is not necessarily attained through a large sample size, there is still an underlying assumption that the researcher's goal is to represent an objective social setting to the best of their knowledge. However, as O'Reilly & Parker (2013) argue, not reaching saturation "simply means that the phenomenon has not yet been fully explored rather than that findings are invalid" (p. 194).

The above quote leads back to the concept of validity which was problematised in the previous section – is it the aim of narrative inquiry to appropriately reflect properties of the social setting investigated? Regarding the validity of data from a small sample size, Riessman (1993) discussed how enduring theories have been developed based on in-depth studies with a few individuals. As narrative inquiry is a methodology that seeks to illuminate aspects that do not fit the dominant discourse, data that is enough for us to act on should be considered valid (Riessman, 1993).

To summarise, it is counter-productive for qualitative researchers to adopt strategies designed for quantitative research. Instead of imitating the form, Small (2009) called for researchers to adopt strategies that align with the purpose and approach of their research.

In this study, several alternative quality indicators were considered. For instance, Guba and Lincoln (1989) argued that 'generalisability' should be replaced with 'transferability.' Transferability refers to the extent to which the findings can be transferred to other contexts or settings. While it departs from the concept of generalisability, representativeness and saturation, transferability alone does not sufficiently demonstrate the impact of narrative research.

Riessman (1993) proposed two dimensions in which the impact of narrative research can be evaluated – *pragmatic use*, as well as *political and ethical use*. Pragmatic use is the extent to which a particular study becomes the basis for others' work, while political and ethical use is the extent to which the inquiry contributes to social change. Riessman's framing of pragmatic use can refer to both the practical and theoretical implications of a narrative. However, political and ethical use extends to social implications, which Kim (2016) describes as "planting the seed of social justice" (chap. 7).

The two dimensions proposed by Riessman can be represented by Heikkinen's (2007) notion of *workability*, which refers to the extent to which the research gives rise to change in how researchers understand and investigate a phenomenon. To clarify, workability is not limited to the researcher's analysis, but also the participants' narratives.

As to what makes a good narrative, I return to the concept of verisimilitude mentioned in the previous section. Verisimilitude, which is defined as "the appearance of being true or real" according to Oxford Languages, is tied to many other indicators discussed. For instance, a narrative that appears to be true or real increases the trustworthiness of the research. To appear true or real, readers should be able to connect with the narrative "by recognizing particulars, by imagining the scenes in which the particulars could occur, and by reconstructing them from remembered associations within similar particulars" (Tannen, 1988, as cited in Connelly & Clandinin, 1990, p. 8).

The last part of this quote leads to the final quality indicator discussed in this section, *evocativeness*. According to Connelly & Clandinin (1990), the particular (not the general) is what triggers emotions. Evocativeness is the ability of the research to awake and provoke new thinking. This thinking is not limited to rational thinking (which is covered in workability), but also the ability to touch readers emotionally (Heikkinen et al., 2007). This indicator reflects the artistic dimension of narrative research, where aesthetic value is an important criterion. A good narrative should convey

to readers what the writer intends to tell them and exhibit invitational quality (Connelly & Clandinin, 1990). Ultimately, it is the readers' response that contributes to the persuasiveness of the narrative, and persuasiveness "rests on the rhetoric of writing" (Riessman, 1993, p. 66).

The above sections focused on reconceptualising dominant criteria such as validity, reliability and generalisability. The quality indicators presented are not an exhaustive list of what has been discussed in the literature. However, they serve to set expectations for evaluating the research findings presented in the following chapters. As each narrative is discussed, further quality indicators will be unpacked as relevant, and further elaborated in Chapter 10: Discussion. These include the need for narrative researchers to pay attention to the untold, contextualise their research, and be transparent about the research process. I will return to these indicators in Chapter 10: Discussion to further the discussion on the challenges and limitations of this study.

3.3 Summary

This chapter provided an overview of narrative and discussed the distinguishing features of narrative inquiry. I outlined my research design including my data collection method, sampling strategy and recruitment plan. Drawing on Bruner's (1985) distinction between paradigmatic and narrative cognition, I described how the interview protocol and analytic approach were developed. The final section discussed how narrative inquiry is markedly different from other methodologies in how it is presented and evaluated.

The next chapter is the first of the six Findings chapters in this thesis. Each chapter will focus on one participant in this study, and present their narratives as well as my analysis of their narratives.

The Findings Chapters: An Introduction

The upcoming chapters signal a shift in my role from author to writer, from leading readers through a chain of reasoning to leaving readers to interpret in their own terms (Barone, 2001). Each of the six chapters is dedicated to a participant of this study and consists of two sections: the first section presents the participant's narrative, and the second section presents the researcher's analysis. The participant's narrative is titled 'Story' to make explicit the process of curation undergone to reconstruct a plot from the interview transcript. The researcher's analysis is titled 'Reading' (from Clough, 2002) to reflect the nature of narrative research that departs from presenting authoritative findings.

The 'Story' sections are mainly constructed verbatim to reflect each participant's linguistic expressions, with "narrative smoothing" - focus, addition, omission, appropriation, transposition (Gracia, 2012) - applied to increase readability while maintaining fidelity. As such, quoted sentences are not exactly in the order or structure in which it is said, but the phrases are taken directly from the participant transcripts. Different subsection headings are used for each participant to demonstrate stages of their engineering stories and highlight their sentiment towards a particular topic. In reading these narratives, it is essential to remember the difference between paradigmatic and narrative cognitions discussed in Section 3.1.3.1: *Thinking narratively*. In this study, narrative cognition is emphasised to make sense of the story rather than to draw on commonalities across stories. Hence, some aspects of the narratives are necessarily ambiguous and incomplete to retain the particulars of each participant and the complexities of their journeys.

The 'Reading' sections are structured based on the personal, practical, and methodological dimensions discussed in Section 3.1.4: *Justifying narrative inquiry*. These sections focus on practical theory generation, with literature referred to as appropriate (Bold, 2012). The topics covered in each dimension are what I identified as core to each participant's narrative, which is contingent upon who I am at the time I interpreted these narratives. As texts do not have stable meanings (Riessman, 1993), different people at different times may ascribe different meanings.

Chapter 4

Mabel

4.1 Mabel's Story

Mabel is a final-year Mechanical Engineering student. In her narrative, she described how she got into engineering out of confusion, shared perceptions associated with engineering, and described her quarter-life crisis.

4.1.1 From confusion to uncertainty

Throughout her childhood, Mabel lived and studied in both her home country and Australia.

> So my childhood was a bit odd. I was born in [home country], but when I was in primary school, my mother received a scholarship to study in Australia. And that was kind of my first time that I travelled and left a long time. So I was in Australia until about Year 9, I think, when my mother finished her study. And then she took me back to [home country].

When she returned to her home country for secondary school, Mabel started considering what she wanted to do in university.

> I went to an international school. So once you're in Year 10 and then going into Year 11 and 12, you basically just look at the university that you want to go to, you look through the programs and what kind of subjects they need for you to get into that university, and that's the subjects that you choose to take in high school.
>
> To be completely honest, I think at some point, when I was in secondary school, I was pretty lost in what I wanted to do, and it was just a coincidence that both of my parents did engineering. And because I guess I was really confused, I just thought that maybe I should just follow a pathway that was in a way familiar to what my parents did. And that's why I decided to go into engineering.

Mabel negotiated how engineering fits with her other interests.

> Weirdly enough, I was considering going into the arts. So not liberal arts, but actual arts, like music, and also traditional art, and drawings and things like that. But my father explicitly didn't support me going down that path, so I guess that's why I was a bit scared as well trying to pursue it.
>
> And I thought engineering as well, I guess it's- if you squint closely, it is kind of a form of art in a way. You do get to make things, although there are more technical aspects of it rather than more artistry, kind of area. So I thought that doing something where I could channel the artistry would maybe benefit me a bit more. So that's why I guess I just decided, oh, let's go there.

Once she settled on her decision to do engineering, Mabel started looking into potential universities.

> Um, I originally wanted to study in Japan. So there was an international program for a lot of universities in Japan. I was kind of eyeing it because it has always been my dream to live there. But then I realised that my scores weren't pretty- well it weren't up to the standard I was comparing. I was comparing all their intakes and things, and I was like, ooh, that's really high, I don't think I can make it.

> So because of that, I decided to come to Australia. My father also pushed me to go to Australia, because I actually have an older sister here as well. Yes, so I guess my father just wanted me to study somewhere familiar since in a way I grew up here so that that's why I'm here, I guess?

She outlined her considerations for selecting an engineering specialisation.

> Um, I had about three options in mind. So the first one was Aerospace Engineering. Because I had a tutor who did Aerospace, he just seemed like a really cool guy, so I thought people who were in Aerospace were that cool. The second one was Environmental Engineering. Because when I was looking through the university programs in Japan, they had a lot of Environmental Engineering, I think that was the first time I was introduced to electric cars as well, when I did my research on which program I wanted to go into. And then the third one was Mechanical Engineering.
>
> And I was unsure about the three, but I ended up going to Mechanical Engineering, just based off what my parents said. They said that if you're in Mechanical Engineering, you tend to be able to do everything, because it's so broad, and you're not restricted from the get-go. So I guess as someone who was very confused as well about what I wanted to specialise in, I thought Mechanical Engineering was the best option.

Despite considering Mechanical Engineering as the best option, Mabel had other reservations.

> So [pre-university program] has this kind of consultation program that you can go to and things like that, and I remember very specifically me going there, because I was very scared of my score as well. I wasn't sure if it's high enough to go into- I mean, they already said that you do need certain digits to get into it. I did pass that certain digits, but I wasn't sure the amount of margin would be appropriate, like you know how sometimes they're like, oh, you have to have a WAM (Weighted Average Mark) of 60 to go into this. But technically, well not technically, but a lot of people who actually go into that program are actually in the 70s and the 80s, it was something like that.

> And also it was just really daunting being surrounded by so many males. I've had so many experiences where I'm the only female in a classroom of students- my tutorial where my tutor was a male, and then I was surrounded by 15 other you know, big men. I'm a very small person as well, I'm not even- I don't even pass the like 160 mark in terms of height so being very small and then you're just surrounded by all this kind of like- well, I wouldn't say macho but just tall males it was just... if you already experienced that in college, I just couldn't imagine experiencing that over and over again in university.
>
> But I had those- the people in the consulting group going like, no usually university there's, you know, a lot more females representatives. And it was just nice knowing that there are people that I could probably relate to later on as well. And now, being in that degree, and actually seeing a lot more people like me, it did become a bit more encouraging as well to pursue it. Although there are daunting bits, it's not as scary as I thought it would have been in the beginning.

Mabel described what she found daunting.

> Considering my personality, I am a bit of a coward. I'm not gonna lie about that. And being surrounded by a lot of males as well, it made it really hard for me in a way to kind of project my ideas, and I guess creativity as well. And I'm not sure if this is true or not, but because I believe that my technical skills are a bit underwhelming compared to others, it just makes it a bit more difficult to just go, hey, let's try and, you know, go through this idea when it's not supported as much.
>
> I mean, I did pitch in a lot of things, but 80% of them were rejected on the get-go, like during teamwork. But I guess it's understandable because during brainstorming stage, there are things that you take, and there are things that you don't, but yeah, it was just a bit dejecting, I guess. But what can you do? It's teamwork.

Now in her final year and two years into online learning, Mabel spoke about how things have shifted.

> Um, I guess because everything has been online, it hasn't been as prominent. But I guess it's a double edged sword if that makes sense. Because usually when you're in a classroom, and then you're the only female, there are chances when you try- I don't know if you did this, but I try to find out the females in the classroom as well. And then I kind of try and sit with them. And it just makes me feel a bit more, you know, not as surrounded.
>
> But in an online setting, one you're kind of alone in your own place, looking at a camera, so you don't feel as- I don't feel a pair of- well a lot of male gazes on you in a way. But also on the same note is when you get put into breakout rooms and things like that, and then you just happen to be the only female. That's when you're a bit like, you hear all these male voices around you. And then sometimes you just want to go, excuse me, you want to ask something, but then your voice is the only one that's different, you're very high-pitched and things like that. And it gets washed away by, you know, your classmate going like, [low-pitched] oh, yeah, this is blah, blah, blah.
>
> So it's a double-edged sword. You don't feel as intimidated, but also at the same time, you do feel a bit like- in person, I can't even voice my concerns out. In an online setting, my voice is still so small, how am I supposed to project what I want to say.

4.1.2 *"Engineering is not just about cars"*

Mabel shared how engineers are perceived in her community.

> I have a few friends who's pursuing things that they really like, I have a friend who's just kind of going along with the flow. And whenever we catch up and I tell them, oh I'm doing this project, they just go like, oh, what an overachiever, blah blah blah. So I guess that image just kind of like resonates with the whole, you're part of the people who make society works, you do a good job, you just put your head down and just do it kind of thing, if that makes sense.

However, several stereotypes of engineering are prominent in Mabel's wider circles.

> I don't know if you ever get that reaction, but when I tell a family member that I'm not close with or even just a stranger as well, and they ask you, oh, what are you doing? I'm studying. Oh, what are you studying? And then you go, oh, Mechanical Engineering. And then you know the reaction card? Oh, wow, isn't that a man's job? Isn't that really tough? Ooh cars? That's always what I get, cars. And I'm always, it's not just about cars. But that's always the impression that they get, cars, I guess. So yeah. It's a bit frustrating, not gonna lie, but what can you do, I guess.
>
> It's a lot of stereotypes that you don't particularly feel very good about hearing, especially in your face. If you're just reading it online, I guess that's kind of, hahaha, it's a stranger thing, but just hearing it to your face, when you're speaking to someone you get a bit taken aback a bit like, ooh, okay.

I asked Mabel how she would describe Mechanical Engineering instead.

> That's the thing - the more you try to categorise Mechanical Engineering, the harder it gets? Because we just- well I mean, not me, I'm not a mechanical engineer yet. But the people who's in Mechanical Engineering, if I had to narrow it down, deal with basically anything that moves, from very small things to very large things.

> It's so broad, it's hard, I guess. With Aerospace it's just things that you blast off into the atmosphere. But with Mechanical Engineering, this mouse needs a mechanical engineer, a train needs a mechanical engineer, but they're completely different things.

In trying to explain what Mechanical Engineering is, Mabel reaffirmed its appeal for her.

> Something that I do really relate the most to is the fact that you never really run out of work to do. I'm the type of person that can never sit still, I need to move all the time. And I guess something that really interested me in Mechanical Engineering as a whole is there's just so many things you can do with it. There are so many projects that's so different from one another. And I guess that whole flexibility and always something new to do is what makes it really exciting as a degree or as an area of study as well.

4.1.3 A Quarter-Life Crisis

As Mabel is in her final year, post-study options were naturally brought up in our conversation.

> Um, well, I guess I'm in the middle of a, I wouldn't say a midlife crisis, maybe a quarter-life crisis, where it's one of those, I've been doing this for four years, but I still don't know what I like in terms of engineering. So what should I do later on in the future? What kind of job should I do? Should I go into research? Should I study more? But I don't want to study more because of all the things that I've done and it was so painful. But yeah, I don't know yet.
>
> I don't regret the things that I learned, but I guess I regretted the fact that I didn't research into it more and gave a good thought on, I guess my future when I was younger.

Later in the interview, she revealed an area of study that has caught her interest during her studies.

> Well, I guess if I had to rewind what I wanted to choose, in terms of my specialisation, I think I would have gone into materials, so nothing of the three (aerospace, environmental, or mechanical).
>
> So [rocket club name] was the club that introduced me to composites. It also introduced me to the very hardworking nature of, you know, making it in the first place. I thought it was such an interesting thing to study, but it wasn't particularly suitable for me in terms of my study load. Because as an international student, you can't underload. You can't just take, you know, only three subjects or two subjects even. And it really weighed me down. So I exited the club because it's very demanding.

After quitting the club, Mabel worked on a Final Year Project (FYP) related to composites.

> My FYP deals with the prototyping of composite, and they are comparing it with the traditional methods. So wet layups with the 3D printer ones. It's more lifecycle analysis than anything kind of testing and seeing the, you know, characteristics of that material, what it can do, etc. But yeah. An aspect of that project is something that

> I'm interested in (composite materials), but unfortunately, it wasn't the main focus of it. So I kind of misread the thing, so I was like, oh man, I guess I'm already doing it. Might as well just finish it too.

She expressed a gap between what she would ideally like to do post-study and what she could practically do.

> I don't think I've spent enough time in my degree to be able to just jump into anything composite-related, even if I want to. Because when I started getting interested in it, that was about two years ago. And now everything's just- to be able to close that gap within a semester might be really hard. So in most cases, I'd probably just take any job that I can. At this point.
>
> I mean I don't particularly have any other options as dejecting as that sounds, but I don't particularly want to waste the four years that I've had with it as well. So it would be nice to be able to make something of the four years that I've studied.

Mabel described the type of engineer she wants to be.

> I want to be someone who's reliable I guess? The kind of, the very image of the person who people can just come to and ask for advice, and be able to give that advice that a lot of other people seek, I guess. So, well I mean, if you want to be someone reliable, I guess you have to be knowledgeable as well, so knowledgeable and reliable as well. That's probably the type of engineer that I want to be, someone who works in the background and not stand out but makes sure that everything runs smoothly.
>
> Having done a lot of leadership roles, I've just had enough of it. I prefer just, you know, doing my own thing, where not everyone can scrutinise me and things like that. I guess I don't particularly have very high confi- because you know, how some people are sometimes put in a pedestal when they have like very large projects that booms, Elon Musk, all those kinds of people. But I prefer not to be in a spotlight. It's gratifying enough for me knowing that a project that I've taken part in has launched successfully.

So I guess that's the kind of work that I want to aim for, not in the spotlight, but maybe having things that society needs and making sure that it helps people when they, you know, when they really need it.

4.2 A Reading of Mabel

Mabel was the only participant I did a follow-up chat with. As the conversation was not recorded, I took notes and got permission from Mabel to share the content of our conversation. To ensure the accuracy of my memory, an earlier version of this analysis which included a summary of our conversation was sent to Mabel for verification. I exercised my judgement on accounts that were appropriate to include, while maintaining interpretive awareness of how they were co-constructed between Mabel and me.

In this section, I discuss my relationship with test scores, themes of social pain in Mabel's narrative, and how my follow-up chat with her led to a reflection on the temporal nature of narrative inquiry.

4.2.1 Personal - Test Scores and Self-Doubt

While constructing Mabel's narrative, I picked up on multiple occurrences where Mabel had something she wanted in mind but backed away. For instance, she considered going into the arts, but was scared to pursue it without her father's support. She looked at universities in Japan but didn't think she could attain the required test scores. Despite meeting the enrolment requirements, she worried that her test scores weren't high enough to pursue her chosen degree. While she was interested in composites, she felt uncertain that she had sufficient experience to pursue a career in them.

Mabel's narrative was consistently peppered with themes of self-doubt. While I related to her thoughts, I simultaneously questioned the validity of her perceptions. Were her test scores as low as she described? Is it true that her peers who are enrolled in the same program performed better academically? Reminding myself that narrative inquiry is about "people in relation to studying people in relation" (Clandinin & Connelly, 2000, p. 189), I reflected on my own experiences with test scores and self-doubt to make sense of why Mabel feels this way.

During my follow-up chat with Mabel, she expressed interest in my own engineering journey. One of the questions she asked me was, "have you ever felt inferior about math and physics?"

Mabel's question helped me understand the core of her self-doubt. It also prompted a reflection on my educational trajectory, and how my relationship with math and physics evolved over time. Whenever someone asks how I came to do engineering, I mention something about being good

with math and physics as a conventional answer. However, responding to Mabel's question made me realise it wasn't always the case. To unpack my relationship with math and physics (or science in my earlier years of education), I break down my story into four phases of my education pathway: primary school, secondary school, pre-university, and university.

Primary School - 'B' for Blemish

Throughout primary school, I generally excelled academically. This meant that getting a 'B' felt like a blemish on my report card. During these years, the main culprit for this blemish was science. I don't remember being particularly fussed that I was 'bad' at science specifically, perhaps because it was just one out of the seven subjects that were the focus of national standardised tests, which included math, which I typically scored well in. However, I do remember feeling slightly upset when I was not chosen to participate in math and science competitions, and I always admired my peers who did.

Secondary School – Finding comfort in numbers and equations

One of the key changes in moving from primary school was the change in the medium of instruction. For context, my home country, Malaysia, adopts vernacular education. This means that parents can choose to send their children to schools that teach in Malay, English, Mandarin, or Tamil. In my case, I attended a primary school that taught primarily in Mandarin and a secondary school that taught primarily in Malay. During this transition, math and science emerged as the two subjects that were relatively easier to grasp (or translate). I started finding comfort in numbers and equations that transcended language barriers, and put more effort into these subjects, which resulted in better grades. As science was branched out into physics, biology and chemistry in later years, I somehow built an identity as a student who was good at math and physics.

Pre-University – My First 'F'

After secondary school and before coming to Australia, I did a pre-university program where you choose a combination of subjects based on your desired degree at university. One of these subjects was Specialist Mathematics, which was a prerequisite for an engineering degree. Probably one of

the hardest subjects I have ever done, I got my first ever 'F' on the first quiz. I remembered learning about my grade during a parent-teacher meeting while my mum was speaking to my Specialist Mathematics teacher, and was close to tears. However, I was determined to prove that I did not make the wrong choice (my mum had pushed me to take biology instead, a prerequisite for studying medicine). I did endless practice questions, and by the end of the year, I achieved one of the highest scores in class for the final assessment.

University – Peer Helplessness

Feeling confident in my ability to work my way up from an F to an A, I started the first year of my university on a high note, breezing through general math and physics units as part of my university's Flexible First Year program. In my second year, I chose to major in Mechanical Engineering. I found a group of fellow Malaysian classmates, and we attended lectures and worked on assessments together. However, as most of them were scholarship students who appeared to grasp concepts faster than me, my confidence dropped rapidly. Due to the intense nature of engineering degrees, where students juggle multiple assessments over 12-week semesters, I relied on them to complete assessments instead of understanding the concepts on my own, resulting in poorer test scores. This trend continued till the end of my degree.

Looking back at my relationship with math and physics/science, I realised that it started as a source of blemish, became a source of comfort, advanced to a source of rebellion, and ended as a source of helplessness. Apart from the B in primary school and an F in the pre-university program, I hardly remember my test scores. What I do remember is how I felt about math and science when my educational environment changed in secondary school, how I was motivated to do well in Specialist Mathematics to prove myself to my mum during the pre-university program, and how my confidence dropped due to peer pressure in university.

Going back to Mabel's narratives, I realised that while test scores may have contributed to Mabel's self-doubt and inferiority with math and physics, there is more to it. For example, both Mabel's parents are engineers, so amid Mabel's confusion, engineering was a familiar path that they supported. While they appear to be supporting factors for Mabel's pathway to pursue engineering, it also meant that she needed a justifiable reason (and courage) to pursue a different path. Her description of some of her friends, who are pursuing things "that they really like" and are just "going

along with the flow" suggests that what she is pursuing (engineering) is not necessarily what she really liked, but what she perceived as a better path.

Mabel constantly negotiated her engineering identity throughout her degree. On the one hand, she reasoned that engineering can be seen as a form of art in a way, and that Mechanical Engineering suits someone like her who "can never sit still". On the other hand, she perceived her technical skills as "underwhelming" and felt like she was in a quarter-life crisis because she still didn't know what she liked in terms of engineering. However, Mabel's engineering identity is not just influenced by personal factors. In the next section, I further discuss how informal social dynamics and interactions affect Mabel's experience.

4.2.2 Practical - Social Pain

In Mabel's narrative, there was constant reference to "being surrounded by males" which made it hard for her to engage in group projects, made her feel daunted in physical classrooms, and a combination of both in an online setting.

Outside of her studies, Mabel grapples with how engineering is perceived in the wider society, and how Diversity, Equity and Inclusion (DEI) initiatives are perceived by her peers. Recounting incidents where she told someone she is doing engineering, she described common "reaction cards" such as "isn't it hard?" or "isn't it a man's job?". She expressed frustration and helplessness at these reactions, which she found particularly confronting when it was said to her face compared to reading it online.

In our follow-up chat, she shared an instance where some of her classmates insisted that graduate programs (structured early career development programs offered by companies) that targeted women were unfair. Mabel was frustrated by their lack of understanding of inherent biases in current processes, and how they didn't seem to question initiatives that are designed to attract more men into professions such as nursing or teaching. As someone who identified as being reserved, Mabel described how it was hard to confront them. A participant in Sosnowski's (2002) study similarly shared how "there is really no one you can talk to that's going to relate with things that you have to deal with on a day-to-day basis as a woman in engineering" (p. 137). When I shared how meritocracy seemed to be used as an excuse to overlook injustice, Mabel responded with this statement: "that merit that they speak of, to some it's served on a silver platter, but for some of us it's obtained through blood!"

Mabel's experience is what Ong et al. (2020) describe as social pain. Drawing from the work of psychologists Eisenberger and Lieberman, Ong et al. (2020) refer to social pain as experiences of "rejection, feeling left out, or feeling like one does not belong ... [which] triggers a neural reaction that may be analogous to a reaction to physical pain" (p. 595). Mabel's narrative demonstrates these experiences come from informal social dynamics and interactions. Ong et al. (2020) argue that social pain "[diverts] ... cognitive resources away from the study and practice of engineering and towards the managing of their social environment" (p. 595).

In her studies, Mabel demonstrated navigational capital (Yosso, 2005) through her management of social environment. One prominent example is how she compared her experience studying in person and online. When studying in person, Mabel often looked for other women and sat with them to feel less surrounded. This strategy did not translate to an online setting, where she struggled to get her voice out among men. For Mabel, studying online introduced a new dimension of challenge, from visual/physical to auditory. As someone who already found it difficult to project her ideas in a group setting, being online made it even more difficult for her to establish her presence.

For Mabel, her experience with social pain is correlated with her sense of self-doubt which was discussed in the previous section. During our follow-up chat, she shared her experience in a math tutoring group, where the tutor would often single her out or make eye contact with her when he asked, "does everyone understand?" Mabel couldn't tell if it was because of her grades or gender, but she didn't feel good when the tutor checked in on her more frequently. This experience may have led to her concerns about her test scores when she attended a consultation session before university.

Mabel's narrative highlights several important considerations for practice. Building on Ong et al.'s (2020) framing of social pain, the experiences of minoritised groups in engineering are not limited to what they have to manage in an academic setting, but also what they have to manage in a social setting. The challenges faced by Mabel during the shift to online learning further demonstrates the risks of subscribing to narrow benchmarks in inclusion efforts (as discussed in Chapter 2: Literature Review), which may not apply in different contexts. Instead, educators should use these benchmarks as guidelines, and regularly review their practice to attend to students' evolving needs. I will return to these considerations in Chapter 10: Discussion.

In the next section, I discuss how Mabel's narrative prompted a reflection on my methodology.

4.2.3 Methodological - The Purpose of Narratives

Entering in the Midst

I previously mentioned that I had a follow-up chat with Mabel. Something that I have not revealed is that Mabel had left engineering by then.

For context, this chat took place nine months after our interview, when I emailed Mabel her story and invited her to catch up if she was interested. Unlike the initial interview, which was recorded, this chat was intended to create space for participants to reflect on their story and share thoughts that may be difficult to convey via email. For instance, whether anything about the narrative surprised them, or if they had concerns about accuracy or confidentiality.

Before our chat, I went through my notes on Mabel and noted several points I could raise with her to clarify or further elaborate. Mabel was in her final year when we had our initial interview, so I expected her to have completed her degree and was expecting to chat about what's next while being sensitive about the uncertainty that often plagues recent graduates. When she joined the online meeting, Mabel started by saying "I've actually quit school. I'm not sure if that will affect your research."

I came to learn that Mabel had decided to discontinue her engineering degree and had chosen to take up culinary arts at another institution. She had always loved cooking and was inspired to pursue culinary arts while working at a Japanese restaurant. In describing how she came to this decision, Mabel simply said engineering just didn't feel right for her.

I was taken aback because Mabel was so close to finishing her degree when we last spoke. It hadn't occurred to me that she would consider quitting. I tried recalling our last conversation to see if there was anything that hinted at Mabel's departure from engineering. Although she didn't seem particularly excited about being an engineer at that point, I was under the impression that it felt like the only pathway for her, as indicated by her use of expressions such as "might as well just finish it" and "as dejecting as it sounds." I had assumed that her helplessness was, in a way, a sign of persistence. In retrospect, her helplessness was a sign of her impending departure from engineering.

Given that Mabel had left engineering, I didn't feel the need to follow up on our previous conversation. This conversation was a timely reminder that narrative inquiry is about entering one's life "in the midst" (Clandinin & Connelly, 2000, p. 20). However, it does not mean that what Mabel said in her previous interview was no longer valid or relevant. Rather, her current situation provided me with an additional lens to interpret her transcript. For example, aspects that I had overlooked before, such as statements on her uncertainty with engineering, became more salient after our follow-up chat.

Participant-Researcher Relationship

This follow-up chat also allowed for the relationship to develop between the researcher and the participant. Since our initial conversation, Mabel was notably more relaxed as the story I sent her gave her affirmation that her thoughts were relevant and valid for my research. As I had asked about her life trajectory in the previous conversation, it was easier to launch into deeper discussions. Just like how the previous conversation was about how Mabel entered engineering, this conversation could now be framed as how Mabel left engineering. With these considerations in mind, I inquired more about her current course.

Mabel spoke about how she liked the structure of culinary arts, where she was assessed throughout rather than at the end of the term like engineering. It was less demanding than engineering in terms of contact hours, and there was usually a theoretical component followed directly by a practical component. For Mabel, it was nice to be able to see the concepts being applied directly. This was something she missed about being in student groups while doing her engineering degree – the opportunity to see the application directly. She also said she didn't regret doing her engineering degree, as she acquired many professional skills that she found transferable, such as planning.

She then turned the conversation to me, expressing interest in how I got to do engineering. Realising I've never shared my story with Mabel, I saw this as a reciprocal action for the time that she has given me. I began sharing how I was interested in learning how things work, how I liked and did well in math and physics, and how I eliminated options through understanding which socially acceptable options I didn't want to do (e.g., medicine, commerce/accounting). I also spoke about how I had a similar thought process to Mabel when choosing Mechanical Engineering, where I chose what seemed to be the most flexible option that led to a wider range of pathways.

When I shared my response to Mabel's question on whether I have ever felt inferior about math and physics, which I discussed in Personal, Mabel expressed deep empathy. She shared that hearing about my experience gave her closure, and that she wasn't alone in feeling inferior with her capabilities. In sharing her other experiences discussed in Practical, Mabel viewed this interview as an outlet that made her feel less alien. This speaks to the impact of such research on the participants themselves (Secules et al., 2018), not just the population as a whole. As a minoritised population, it is often hard to find a community where you can freely share your honest thoughts. This interview and relationship gave Mabel a space to share and provided some closure.

In the context of engineering, Mabel's story may be about attrition. However, when I see Mabel as an individual, I realise that her decision to leave engineering is a turning point for her. Although she was initially pulled into engineering for various reasons, she persevered till the end and decided it wasn't what she wanted. Mabel's decision to choose culinary arts demonstrated agency that is not represented in the 'leaky pipeline' metaphor.

Chapter 5

Yasmin

5.1 Yasmin's Story

Yasmin is a third-year Civil Engineering and Architecture student. In her narrative, she shared how she was led to engineering by her faith, instances where she questioned whether she belonged, and being in between futures.

5.1.1 *"Everything happens for the best"*

Yasmin grew up in a multicultural environment.

> In my high school, we had 80 nationalities within students and 30 nationalities within teachers. That's why even I don't have a specific accent, I just talk in English because I've just been around so many different cultures.

Engineering wasn't the first profession that Yasmin considered.

> Actually, it's a very funny story. I wasn't even going to do engineering. I wanted to do architecture because my city has a lot of unique buildings. I grew up learning about different architects, I grew up seeing all of these revolutionary buildings being built from the beginning. I've seen [home city] as a construction site as a kid, so it's always

> been really interesting to see. I've always wanted to go back and work there in [home country].

Australia wasn't the first country Yasmin considered either.

> I actually wanted to go to the UK, but I didn't get into my first choice of uni in the UK and then all the other choices were mediocre, so then I applied for [uni option #1] in Australia. However, I did the IB Program, and they gave me a conditional offer saying you had to get 31 points to get the admission. My grades came back, and I got 30 points, so [uni option #1] said, you need to have 31 because it's in high demand.
>
> I sent my grades back for remarking, so that's about a couple of weeks to wait for the results to come back. While I was waiting, I was looking at my other options and that is when I saw [current uni]. [Current uni] is famous for its double degree. You can do a double degree in nearly everything. I saw that they had the option of doing a double degree of Architecture and Civil Engineering. I was a bit interested in that because I always liked math and physics.
>
> My grades came back, and my grades had gone up, so they became 32. Then [uni option #1] gave me the offer back and even [current uni] gave me an offer. Then, I felt like it was by fate that I got a lower mark, so then that's why I picked [current uni]. I'm happy that I picked [current uni] because in three years' time when I finish my degrees, I will have two Bachelor's degrees, so then I'm more flexible in what I want to do. If I got 31 points, I wouldn't even have looked at [current uni]. I'm happy that my grades came back lower. I'm a very religious person so I always do think that everything happens for the best.

Yasmin recalled another factor that led her into engineering.

> Another thing that pushed me towards engineering as well was my maths teacher, who unfortunately passed away in 2019 on my birthday. My class was the last class he taught. I think doing calculus with him especially, it made me want to go into engineering as well. He really pushed me to work hard. I guess every time I'm stuck on a

> math problem, I always start asking him for help. I start praying for him and it does work.
>
> We all looked up to him like a father. He genuinely cared for us. He was a bit strict. If you weren't putting in the effort, he would call you out in your class and you don't want that to happen so then you'd want to put in more effort. He really pushed your boundaries; made you want to work harder to prove him wrong. He was truly kind. He was a very kind person and he wanted us to do better. He genuinely wanted everybody to work harder.

Yasmin shared her thoughts on her double degree.

> I feel like most people don't realise how important architecture is. If you want a building to stand, you just need an engineer. If you want a building with a purpose, you need an architect.
>
> I think people need to understand that how a building is built makes a really big difference in the way you function and do things every day. It changes your mood and everything. I feel like Architecture does play a very important role in our day to day lives, but unless you study architecture, you don't really appreciate it.
>
> Actually, it's (the double degree) a very good balance because in architecture, you're very creative and you have to think a lot out of the box. There's no right or wrong answer. In engineering, it gives you a bit of stability because if you're doing math for example, you know there's an answer in the end. It's a really good balance of being creative, but also having a boundary. It's very interesting to study both degrees. They go well together.

5.1.2 *"Should I actually be here?"*

Yasmin shared an interesting experience she had while working in groups.

> Actually, this might be an interesting story for you. Semester 2 2020, I had a Civil Engineering unit and we were assigned to groups randomly. So it was me, another girl and two other guys. Three of us were people of colour; so I'm a person of colour, the other girl was also a person of colour, one of the guys was a person of colour and the last guy was Caucasian. He was from Australia, and he has never left Australia. He was always basically living under a rock. Even the way he spoke, you could tell that he's not really ventured out much to learn about other people's cultures and stuff.
>
> One day we had to do an assignment as a group. There was one question in that assignment, which the three of us agreed on the answer but he did not agree on the answer. If three people in a group agree on the answer and one person doesn't, it's very likely that the three people are correct. He just couldn't accept it, so we went to a Zoom help desk where we could ask our questions. I challenged him. We just had a big fight and I just said, if you don't want to agree, let's go to the help desk.
>
> The thing is, on the help desk, the demonstrator on the help desk was also a female and also person of colour. He just wouldn't listen to her either, even though she's telling- she laughed at his answer and he's like, no, I know I'm correct.
>
> It was just very offensive the way he would speak to me and the other girl. He said that, if you guys have any problems or if you don't understand anything, you can always ask me and the other guy to help you out. We were just like, why? He talked to us as if we didn't know what we were doing.
>
> We had this argument that, we're doing the same degree as you so you're not any smarter than any of us. But basically, he just couldn't think that females could do engineering. That was basically what I got from the time I had, and I was in a group with him.
>
> That was an interesting experience. That caused a bit of emotional turmoil as well because I was questioning, most of the people in my class, 90 per cent of them are men, should I actually be here? I'm still here, I'm fine. Most men who study engineering are

> okay, but it's just a few of them that just- I feel like it's still in their head that girls can't do engineering. Obviously, we prove them wrong as you know. That's an interesting experience I had being in a group.

She further elaborated on her experience as a woman in engineering.

> As a female, you do stand out. Even in my class, I had an in-person class in semester one this year, and in a class of around 20 people, it was only me and two other girls. We do stand out in the class. Then sometimes you do realise that the demonstrator would check up on you more than anyone else, so then you can see that and you're like, why are you checking up on me? I'm okay. I wish there were more females in engineering then I feel like it would be completely different how we're treated.
>
> It's difficult being a female studying engineering I feel. It is significantly more difficult just for the fact that people always question like, can you do it? Can you complete this task? We can. We have the same abilities as any guy. That gets a bit challenging to hear sometimes, but I guess that makes us tougher and makes us want to work harder. I really wish more females were in engineering. It's not a man's job. I feel like anyone can do it.

5.1.3 LEGO, Dolls, and Crayons

Yasmin discussed her thoughts around gender stereotypes in engineering.

> I guess because it's mostly a male dominated industry. I feel like a lot of females maybe might be intimidated or just aren't interested or just don't want to get their hands dirty. I guess you never know until you try it.
>
> If you see children's toys, for example my nephew, he enjoys building stuff. He has a lot of construction toy sets. He'll have LEGOs, he has a toy drill, a toy screwdriver and stuff. Whereas in girls, if you go to a toy section in a store, you won't find construction tools in the girls' toy section, but you'll find a kitchen or you'll find something artistic.
>
> I think it starts from a very young age. I feel like toys in general, when you're a child, you play with toys and that's where your learning starts. If you're told that this toy drill is a boys' toy, that sticks with you. I guess that plays a very important role.

In Yasmin's case, however, toys did not play a huge role.

> As a kid, I was very interested in artistic stuff. I used to paint a lot and everything. I actually did not have many toys. I was never interested in Barbies and stuff. I never had dolls. I was very creative. I liked making stuff. That's one big hint - I loved making stuff.
>
> Although we're not- we don't celebrate Christmas, I always get a present because all my friends get presents. On Christmas my parents would ask me, what do you want? I'd always be like, I want some art supplies, I want paint, or I want crayons or something. I was more of a creative person. I liked building, creating stuff so I guess that stuck with me. I was never told like, you can't play with this toy because it's a boy's toy. We literally never cared. My parents never cared.

She explained her parents' view on education.

> My parents, they gave me all the freedom to choose what I want to do in uni, but the only thing is they said that you need to get a degree. That's the main thing. I wanted to

> actually do baking. I wanted to go into confectionery. Then my parents said, look, you can do whatever you want, once you have a degree. So, I think from there it developed into just doing architecture because I could be creative, and it can make me money.
>
> If I finish my Bachelor's degree in Civil Engineering and Architecture and then say I still want to go into culinary, they will let me because now at least I have a Bachelor's degree in something that is able to get me a job. If something doesn't work out, I have something to fall back on. That was the main reason they wanted me to go to university and get a degree. However now, because I just feel so involved in engineering and in architecture, I just don't picture myself working in confectionery. I picture myself on a construction site.

She also shared how the interplay between her parents' backgrounds and her culture influenced gender perceptions.

> My dad's a doctor and my mum is in banking and finance so it's very, very different careers all of us. My parents grew up in India and it's a stereotype in India that people want a son, but not in my culture. My culture has always been females and males are completely equal. There's no males are more dominant than females. Whereas in the rest of the cultures in India, unfortunately that's the case. Then when it comes to uni, they'd always give them three options maybe, but mostly it's two options and that is going to become a doctor or an engineer.
>
> Whereas in my culture, we were always encouraged to do whatever we wanted as long as you're getting a degree. For my parents, that was important, to get a degree. People would be happy that a female's doing engineering. They'd encourage us to do engineering. I feel like it's a cultural thing as well. I feel like more cultures need to accept that women can study or go into STEM. I feel like people just think that they don't want their daughters to get their hands dirty.

I asked Yasmin what she meant by 'get their hands dirty'.

> Like building, because we associate building and construction with being a man I guess, or working a bulldozer for example. You never picture females sitting and operating heavy machinery. I guess that's another thing that's so ingrained in us, is that we always picture men being engineers or men being construction workers or people in construction.
>
> Because of that starting from such a young age, I feel like girls just think that that's a guy's job, I don't want to do that. That looks really intense. That looks really difficult in the sense that it's really heavy machinery, I don't want to operate that. I don't want to dig stuff. I guess from a young age, if you say that to your child, then that's what's going to happen.
>
> I guess the stereotypes need to end. You need to encourage girls to build or do science experiments, whatever, just join STEM. I feel like girls because it starts from such a young age, that they just assume guys are more interested in building stuff and getting their hands dirty that girls wouldn't be interested in it.

5.1.4 In-Between Futures

In considering her future, Yasmin had a few key questions to juggle.

> It gets confusing sometimes. You're swapping between two different degrees, sometimes I question like, where am I going to be in 10 years? Am I going to do a Master's degree? It gets confusing after a while. You start questioning things.
>
> The thing is, I want to do a Master's degree but then I'm confused of where I want to do it and whether I want to do one or two Master's degrees. That's one thing. Another thing is, will I live in Australia forever? Will I settle here or will go back to the [home country]? It's a lot of things to consider, especially being an international student.
>
> I'm definitely doing an Architecture Master's because in order to get your licence for becoming an architect, you need to do a Master's degree followed by the architecture licensing exam. That's why I want to do an Architecture Master's. But then I feel like over the coming years, I might enjoy doing engineering more, so then I might want to do an Engineering Master's as well. Then it would be four degrees. Then I feel like I would just be spending a lot of time getting all these degrees but then not getting to work. Then I would get older, I'd get in my 30s by the time I finish and then I've just wasted a lot of time.
>
> If I do get the chance to do my Architecture Master's degree at University College London, which is the number one for architecture in the world, I would like to, but then I've also come to Australia to get permanent residency and there's a lot of steps that go to that. I don't want to waste time on that just so that I can get a Master's degree done. I'll become older and it'll take a long time. I definitely want to do an Architecture Master's, but now I'm considering, should I do an Engineering Master's?

I asked if she was inclined towards a particular choice at the moment.

> That's another confusing thing. I'm not entirely sure whether I want to focus on engineering or architecture in the future, but I think it has always been my goal to become an architect and it was just by good luck I got into engineering as well. I guess my

final goal would be to become an architect and possibly to open my own practice one day.

5.2 A Reading of Yasmin

In this section, I discuss how Yasmin's narrative led me to reflect on my notion of 'culture', how cultures clash for international students, and the intention of participants and researchers in a narrative inquiry.

5.2.1 Personal – My Culture

An overarching thread in Yasmin's narrative is being in between cultures and generations. For instance, Yasmin spoke about not having a distinct accent because of the multicultural environment she grew up in, and getting Christmas presents despite not celebrating Christmas. She also shared how her parents were raised in a different culture and differentiated it with her culture where females and males are equal and women are encouraged to do engineering.

Yasmin's concept of 'culture' seemed different from the rest of my research participants. When sharing their narratives, most of my research participants use 'culture' as a marker to describe what they consider characteristic in their home country or race that may be (un)familiar to me. Below are a few examples from Zoe (Chapter 6) who referenced her home country, and Amira (Chapter 9) and Mabel (Chapter 4), who referenced their race and/or ethnicity.

> Zoe: I think in my culture, it's (engineering) such a mainstream. In [home country], it's such a mainstream job to do.
>
> Amira: Engineering is definitely similar to Asian culture.
>
> Mabel: I know that in Asian cultures, there's a lot of emphasis on seniority.

Sharing that her parents grew up in a different country, Yasmin described her culture as one that is different from her parents', emphasised by her use of 'my culture' rather than 'our culture'. However, it does not mean that her parents are not part of her culture. Rather, the culture they raised Yasmin in is different from the culture they were raised in. What does Yasmin mean by 'my culture' then? Her upbringing? Her multicultural educational environment? Something characteristic of her home country? Something about her background and identity?

To better understand what Yasmin is referring to, I turn to my own notion of 'my culture.' Using myself as a reference point, I consider 1) how Yasmin's statements on culture apply to my context, and 2) what 'my culture' means to me.

Yasmin's statements in my context – Patriarchy across generations

Reading Yasmin's excerpt, I noted that her parents were raised in a patriarchal culture, as reflected through their culture's preference for sons and the dominance of men. She contrasts it with her culture, where men and women are equal, and women are encouraged to do engineering.

As a child, I remember feeling overwhelmed by the number of grandaunts and granduncles I had to greet at family events (my maternal grandfather had 18 siblings). As I grew up and started familiarising myself with the order in which they were born, I learned that I was missing a granduncle (who passed away at a young age) and three grandaunts. These grandaunts were given up for adoption when they were young, which was a common practice to relieve financial strain within a large family. It was always daughters who were given away, as sons needed to stay and 'continue the name of the family.'

In the next generation, my maternal grandparents gave birth to two sons and four daughters, including my mum. While no one was given up for adoption, my mum, while offering me a chicken drumstick at the dinner table, would remind me that they used to be reserved for her brothers. From time to time, she emphasised her commitment to ensure that my brother and I received equal education, as only her brothers received tertiary education due to limited finances.

When it came to tertiary education, getting a degree was non-negotiable – it was the minimum you needed in life, something my brother and I never questioned. However, I was explicitly discouraged from doing engineering. These reasons are further unpacked in Chapter 10: Discussion.

What 'my culture' means to me – Complexity of 'culture'

While I was in Malaysia, I don't remember thinking about 'my culture.' When friends asked what I did for Chinese New Year, I shared what my family did, acknowledging that each household has different practices. When I came to Australia, however, it got very confusing. For example, the

popular Malaysian dish nasi lemak comes from the Malay culture, yet I get confused looks when I tell non-Malaysians I don't cook it in my Chinese household.

This confusion is not limited to racial differences. When a non-Malaysian friend asked me if Uncle Roger was an accurate representation of Malaysian Chinese, I did a double-take. Uncle Roger is an online persona of Malaysian stand-up comedian Nigel Ng, based on a middle-aged Asian uncle character who speaks English with a Cantonese accent. None of the middle-aged men around me spoke or acted that way, but trying to explain why would require explaining my family's socioeconomic status, the place I grew up in, and the type of school I attended, all of which contributes to the accent I have, the food I eat, and the values I hold.

Over the years, I learned to practise discretion with what the listener expects when they ask about my culture. Sometimes I share some light-hearted remarks about Malaysians' signature tardiness (which is not a feature of my household). Other times I feel the need to be a walking Wikipedia , to educate myself about the different variations of my culture to avoid misleading others. I occasionally turn to my parents for explanations on cultural practices, many of which they do not have answers for.

Going back to Yasmin's narrative, our parents were similarly raised in a patriarchal culture, but have adopted a more progressive mindset, which is reflected in Yasmin's and my access to tertiary education. We float across many different cultures, so much that 'my culture' becomes a very specific intersection of our upbringing, education, and generation. As Yosso (2005) puts it, culture can mean race and ethnicity, or "forms of social histories and identities" (p. 75). However, studies that categorise participants by nationality or race do not reflect the above concept of culture.

In the next section, I unpack Yasmin's academic experience and discuss how the reduction of sociocultural context limits how engineering culture is studied.

5.2.2 Practical – Clash of Cultures

In Yasmin's narrative, she shared incidents that contributed to social pain, which was previously explained and discussed in Chapter 4: Mabel. While Yasmin is more confident in her abilities compared to Mabel, it still caused an emotional turmoil for her.

Yasmin shared an instance when she was randomly assigned to a group with a "Caucasian guy who was basically living under a rock." Aside from being strong-minded, he spoke to Yasmin and another woman member of the group in an offensive manner.

In her narrative, Yasmin demonstrated navigational and resistant capital (Yosso, 2005) by challenging him and seeking an external opinion. However, she started questioning her placement in her program. Yasmin's response is a common thread found in Ong et al.'s (2020) systematic thematic analysis on women of colour in undergraduate engineering education, which is typically the result of "being the only one of their gender and/or race/ethnicity in engineering classrooms that were populated mostly by White men" (p. 596). Yasmin's framing of race/ethnicity in her narrative, where she specified who was a person of colour and who was not, further suggests that she is cognizant of the overrepresentation of White people in engineering, not just men.

While Yasmin considers such people a minority, she observed that the demonstrator seemed to check on her more than anyone else. Previous literature reviewed by Ong et al. (2020) has highlighted the effects of invisibility and being ignored by academic staff and peers. However, Yasmin's observation (along with Mabel's experience of being singled out by her math tutor) showed the converse effects of hypervisibility and being spotlighted. Their experiences speak to the complexity of being part of marginalised groups, and how faculty members unintentionally exacerbate feelings of 'unbelonging.'

In the Personal section above, I also discussed how Yasmin described her culture where men and women are equal. This mindset was reflected in how she coped with the incidents described above, through statements such as "we have the same abilities as any guy" and "it's not a man's job. I feel like anyone can do it."

Despite coming from a culture where women are encouraged to do engineering, Yasmin started questioning herself during her studies. Drawing on my point in Chapter 2: Literature Review that underrepresentation of women in engineering is not a universal phenomenon, Yasmin's experience

further suggests that it is not 'engineering culture' that is problematic (as often discussed in the literature), but rather engineering culture in Western contexts.

The above proposition is best explained through the gender-equality paradox, where gender differences in occupational choice are larger in more gender equal countries (Stoet & Geary, 2020). As an example, the World Economic Forum's (2022) Global Gender Gap Report showed that Finland and Norway are the most gender equal countries while Algeria and Oman are the least gender equal countries. However, Finland and Norway have a much lower share of female tertiary graduates in engineering (<25%) compared to Algeria and Oman (>40%) as reported by UNESCO (2021). One reason cited is that women in developing contexts pursue engineering in order to climb the social ladder (Breda et al., 2020). This explanation highlights Chen's (2010) argument discussed in Chapter 1: Introduction on how the literature overlooks the shifting realities of those outside the Western context because they are primarily conducted by researchers in the Western context.

Yasmin's narrative highlights several important considerations for practice. Considering the complexity of invisibility and hypervisibility, faculty members must look beyond simple fixes and sensitively address issues related to marginalised groups. The difference in gender dynamics across cultures in Yasmin's narrative challenges the notion that engineering is an acultural profession. It also highlights the Western-centric views in the literature on women in engineering, and emphasises Chen's (2010) call to decentre from such views. I will return to these considerations in the Chapter 10: Discussion.

In the next section, I revisit Yasmin's excerpt on her experience of working in a group to unpack a statement she made.

5.2.3 Methodological - The Intention of Narratives

Before Yasmin shared the incident with the White male group member discussed in the previous section, she started by saying, "Actually, this might be an interesting story for you." This statement prompted me to deliberate whether the incident should be included in her narrative.

My concern stemmed from the distinction between stories told as entertainment versus stories told as explanation (McLean, 2005). McLean (2005) posited that in stories told to entertain a listener, "meaning does not appear as relevant as when one is trying to explain oneself to another" (as cited in McAdams & McLean, 2013, p. 236). However, the participant's meaning-making process is core to narrative analysis.

In considering whether to include this incident, I questioned Yasmin's intention when she shared this incident. Was she trying to help me get what I needed out of our conversation, which was framed as a research interview on the experiences of women international students? Or is this incident one of Yasmin's 'stories to live by' (Connelly & Clandinin, 1999), something that shaped her identity significantly? In my reading of her narrative, both questions answered yes.

However, if the first question was true, what does it say about how I have framed my research, and the research participants who take part in my research? Beyond the list of eligibility criteria described in Chapter 3: Methodology, who does this research include/exclude, and whose voices does it amplify/silence? Do participants show up because they have a story to share? Or is it one of the navigation strategies described in Ong et al. (2020), where they choose to give back to the community by supporting a researcher studying issues that affect them? In either case, how does it affect the quality of this research, and the authenticity of their stories?

Personally, I was conscious that my decision to present this narrative was what Goodson and Gill (2011) referred to as "researchers effectively telling their own stories" (p. 37) by selecting stories that appeal to them or stories that they sympathise with. A few months after I interviewed Yasmin, I chatted with my career mentor, who wanted to learn more about my experience as a woman in engineering. I remembered telling him how I felt patronised by academics during my undergraduate degree, but could not describe a specific incident. I later realised I may have vicariously experienced what Yasmin described and mistook her experience for my own. Upon further reflection, I started

wondering if I did experience something similar, but the feelings of condescension became more concrete considering Yasmin's narrative.

Yasmin's narrative prompted methodological reflections on the participants' and researcher's intentions. On the participant's end, who takes part in this study and why? On the researcher's end, which stories get included and why? These issues are further considered in Chapter 10: Discussion alongside other study participants.

Chapter 6

Zoe

6.1 Zoe's Story

Zoe is a final-year Environmental Engineering student. In her narrative, she shared how she came to do engineering and what she liked about her degree.

6.1.1 Family and Education

Zoe spoke about the education system in her home country.

> So basically, to be honest, I think people choose their degree based on what they studied in high school, sometimes. Like when they finish and they don't know what to do, and then they say, oh, I already know how to do calculations, I know a bit about physics and stuff, so I will go into engineering. They don't really explore much options. And I think the sad thing is in [home country], we don't get exposed that much to other subjects compared to here (Australia), I would say, like art or even coding.
>
> And then, we've got some kind of culture where during high school after class, we go to private tuitions, which is very tiring. If you have tuitions every day to be honest, you don't enjoy and relax. But yeah, that's the education in [home country]. Just personally, I don't find it that great to get more exposure and develop oneself. It's just about studying studying studying.

Her family influenced her decision to do engineering.

> Because my eldest brother didn't know what to study, so he decided on engineering. And then I think my second brother was quite interested in engineering already, because he's a very hands-on person, so he studied Mechanical Engineering. And then my turn because I actually was considering education, but then I decided to do engineering.
>
> Because my parents, they let us do what we wanted to do, but also something that's also going to help us get the PR (Permanent Residence) here in Australia - so like education, engineering, or even doctors but we don't have enough good grades to be doctors. For instance, if I did arts, my parents would be a bit concerned about employment, if I could get any job in that sector.
>
> So in the family, now, there's four engineers (including a cousin). But before that, there were no engineers. So on my mom's side, it's more medical-related, some are doctors or nurses. And on my dad's side, it's more the business side, so they sell stuff and do some- yeah.

Despite being part of her family's first generation of engineers, engineering wasn't an unfamiliar profession for Zoe.

> I think in my culture, it's (engineering) such a mainstream job to do. Lots of people study engineering, or accounting, or business/economics after they finish high school. So I think it's highly regarded, but here (Australia) the pay is better than [home country], I would say, for an engineer. So [home country] it's either business, doctors, or engineers, just the three main ones.
>
> Like you won't really- there's not much space or enough push towards, for instance, arts, or even teachers. I've noticed that here (Australia) you need to do a degree in educational teaching to become a teacher. But in [home country], I don't think we have the appropriate skills or foundation to teach teachers well, I think. They only know how to explain and teach the subjects. But other than that, I don't really think they know how to do other stuff to be honest.

Zoe elaborated on how she shifted her decision from education to engineering.

> I was thinking being a teacher would be nice, teaching kids or like high school students would be a rewarding job. Because you get to interact with them, but also you understand because you've been through the same thing. And I wouldn't mind summer holidays like during summer break. And the pay isn't too bad, I think. Of course there's still some work behind the scenes like preparation for class or like marking the test and whatnot.
>
> But I do think that being a teacher makes a difference for a kid to choose the career pathway. Because if a teacher has a good impact on how to engage, talk and help the students figure out what they want, then that teacher is really amazing, I think. If you have a teacher like this, that's what I thought, becoming a teacher would have been good.
>
> Helping, yeah. I think one thing I really like is helping people in general. So sometimes I did wonder as an engineer, becoming an engineer would be helping people, but not directly. So not one on one, but rather, as a society. So I thought, oh, but still helping people. So yeah.

6.1.2 Australia and Engineering

Zoe explained how she came to study abroad in her current university.

> So I actually have family here. And I have quite a few cousins here in Australia. So my parents decided to ask us (Zoe and her brothers) if we wanted to study in Australia, and also the climate is quite similar to [home country]. So we thought why not? So we came to Australia.
>
> My siblings are in [current state] as well. Because I think my parents wanted to keep us together in a single place so that when they come visit us, they don't have to go every single state, easier for them. And also easier for us, because if we need help, we can ask each other.
>
> So my eldest brother, he went to pre-university program in [current uni] first. And then I guess the easiest way for him was like, going to [current uni]. And then my second brother also, we chose [current uni] because we could get a sibling discount. That's why. And we're all within the same university, it's easier that way.
>
> My brothers live together in the studio apartment together. So they go to uni kind of together also, I guess. Being nearby also helps, imagine one is in the suburb, one is in the city, one is in regional. It's so, so hard to meet.

She shared how she found her engineering degree so far.

> If I think about all the courses here in [current uni]. I always tell my friends, the top three in that I think are the most difficult and requires a lot of work, and also very stressful are engineering, medicine, and I think law. But I still think engineering might be the hardest. I'm not saying commerce and the others are not difficult, but in terms of workload, meetings, group work, creative thinking, and other skills it is way more demanding, I think, compared to others.

Zoe explained how she chose to do Environmental Engineering.

> So first year here, at [current uni], we need to do a compulsory first year of all the engineering specialisations, so you don't get to choose. But at the end of first year, you put down your preferences for your specialisation that you want to do.
>
> So I picked environmental because I didn't want to do mechanical. It's a lot of movement, and I just don't want to do that. Civil was also- I had a taste of civil from one of my first year engineering units, and I was like, ah, I don't want to do that. And then I was like, oh, why not the environment.
>
> And I look at the course progression map. And for the environment, I actually do a lot of chemical, civil, and some business, and arts. I can also do enviro and renewable engineering units. So what I like is, it's such a broad variety of different streams. So I thought, oh, I think I'm going to do environmental, that was really good to touch on so many different specialisations.
>
> I think also now I realised, like I actually got to know a lot of different people from different specialisations, which was good. So I actually increased my network in that way, as well.
>
> And also one thing I've realised in enviro, compared to other engineering specialisations, is we actually have almost 50-50% of boys and girls, or even more girls than boys, which is quite interesting because in civil and mechanical or any other specialisations, it's many boys. I quite liked it, because it's easier, I think, to talk to people that way, like to integrate and make friends. I mean, I'm not saying I can't talk to boys, but it's just, it's good to see more girls, I guess, in environmental.

Given the higher proportion of women in Environmental Engineering, Zoe touched on some of the perceptions of Environmental Engineering.

> It's kind of an inside joke with my friends because one studies mechanical, one studies electrical, and I do enviro. So he says oh, with electrical you can just come in and repair the cords, the electrical cords, and then the other one is doing mechanical and then he says oh you will repair our cars then. And then as an inside joke they're like

> Zoe, you're doing enviro, you will mow the lawn because you're doing enviro. And then anyway it's quite funny as an inside joke.
>
> I actually don't know what they think I do, but when they think of environmental, they think of this kind of picture (green landscape). I think they don't really think more in-depth in terms of like contamination or like the solar energy kind of stuff. They don't think about the building occupancy, like how much energy is being consumed.
>
> They don't really also think about the Environmental Impact Assessment we do. So yeah, when they think of environmental the first thing that comes to mind is like the surrounding environment like the greeneries around us, I think. I guess it's just a cliché kind of stuff. But yeah.

She expanded on how those perceptions extended to a group project on which she was working.

> This semester, I took the unit where I told you I worked with the four civil engineers, and we actually worked on a real project. So it was about creating a cultural community centre, and it required so many different aspects of knowledge for civil and environmental. So that's when I felt like wow, there's so much to do within 12 weeks. Like someone had to do geotechnical stuff, someone had to do structural, someone had to do transport, someone had to do water stuff, and I did the environmental aspect.
>
> But I think one thing that was a bit annoying is like, all these civil students had only one thing to focus on whereas for enviro, I had to focus on risk assessment, solar energy, waste management. All the environmental stuff are all for me, a single person, so my environmental friends and I were quite frustrated about it.

Despite having to manage more tasks in a group project, Zoe appreciated the skills she acquired in her degree.

> What I find interesting is people think we don't deal with finance, business stuff, but we actually do with project management, like NPV (Net Present Value), or even depreciation stuff. We need to know actually some basic knowledge of finance and accounting for instance. Because I've used it for not one year, but at least three years now. I think people don't know that we actually know quite some stuff about it.

> I also did some arts unit and business unit. So I think that's the beauty of Environmental Engineering for me. I got to do so much stuff within one degree. I touched on so many different aspects.

Zoe's appreciation for her degree informed her desired career.

> Personally, I want to do something that's going to help. Well, ideally, after I graduate, I want to do work that's going to help in climate change, if possible.
>
> Initially, I wanted to work in consulting. I'm not someone who likes to go there and visit the site that much, to be honest. If possible, I'd rather stay in the office, or go on the site once in a while if required. So more like research-based and testing out some technologies and everything. So I guess I would say, consulting, primarily, maybe doing some auditing, or something involved in climate change.
>
> I think engineering is definitely needed in the society, because where we are is because of what engineers have built. Like, even doctors would not be there without engineers, like how do they work in a hospital if there's no hospital being built, you know?
>
> It's definitely a respectable job to me, I think. Like I'd say hard work and it requires a lot of effort. And working with people is definitely a good skill to have but sometimes can be tiring, of course. But this is how society works, you know, working with people.

6.2 A Reading of Zoe

In this section, I discuss the influence of family and prior education on degree choices, the perceptions of engineering and the process of storying narratives.

6.2.1 Personal – Exposure and Influence

In Zoe's narrative, two aspects not present in other participants' narratives resonated with me. These include her view that the education system in her home country does not allow one to get exposure and develop oneself, and how she followed in her brothers' footsteps to pursue engineering.

Exposure and Self-Development - Studying Studying Studying

As mentioned in Chapter 1: Introduction, I attended weekly private English lessons despite having English classes at school. Throughout primary school, I also attended private tuition for other subjects. I was not the only one doing so among my peers. One reason may be the perceived low education quality in public schools, and my parents' mindset on the need to do well academically to lead a successful life. I vaguely remember having Malay lessons at 8am and having Mandarin lessons till 10pm. My routine probably explains why I couldn't relate to American coming-of-age novels.

When my brother was studying in the Netherlands and helped to pick up a classmate's child from school, he jokingly shared, "Why are these children so happy? They are hopping around with empty bags. Meanwhile, going to school felt like an obstacle course for me, where I had to hop over drains and climb flights of stairs while carrying a 10kg backpack and a huge dictionary." My brother's experience is not unfounded as this article discusses the "heavy bag phenomenon" in Malaysia (Yusof, 2017). A quick search of school children in Malaysia will return image results of school children carrying bags larger than their bodies, or using trolley bags. The fact that it is normal for school children in Malaysia to have so many textbooks, workbooks, and exercise books reflects the importance of formal education in my culture.

As Zoe described, the education system I was brought up in was primarily centred on studying rather than obtaining exposure and developing oneself. Arts was considered as extracurricular activity rather than a viable career path, and there was not much free time for hobbies (apart from reading, which is part of my parents' agenda to develop my fluency in English). Zoe's narrative emphasised the three main acceptable careers – business, doctors, or engineers. In my culture (refer to Chapter 5: Yasmin for a discussion on 'culture'), we speak of the 'Asian Five' - doctor, lawyer, accountant, engineer, architect. My mum was an accountant, and my brother is a lawyer. While business is not included in the 'Asian Five' as it is not considered a specialist profession, my father and most of my extended family run businesses.

The effect of having such a limited catalogue of acceptable careers is that there is not much time or point in discovering our interests. In my reading of Zoe's narrative, she didn't demonstrate a strong interest in any career path; it was primarily driven by practicality. I believe one core reason she chose Environmental Engineering was because it offered a broad variety of streams. The curriculum gave her space to be exposed to business and arts, something she didn't acquire through her formal education in her home country. I could see myself making Zoe's decision if I had discovered Environmental Engineering earlier if it had been an option in my university.

In the next section, I share another aspect of Zoe's narrative that resonated with me and helped me uncover a different reason that pushed me to engineering apart from what I have shared in previous chapters.

Familial Influence - Finding My Edge

Zoe often quoted her brothers when articulating how she got into engineering. While the literature has discussed the idea that having parents who are engineers provides motivating factors for women to pursue engineering (which is also reflected in Mabel, Apple, and Amira's narratives), there has been limited reference to how siblings influence one's choice to do engineering.

Personally, I don't think I would have pursued engineering if my brother had studied engineering. My brother is five years older than me and has always been interested in history and politics, so I naturally assumed that those were the subjects I needed to be interested in and knowledgeable in if I were to pursue law. Being the youngest in my family, I always felt that I had the least knowledge

in everything. I often wondered if choosing engineering was a way of establishing my unique area of expertise within my family to shield myself from unsolicited advice on what to do with my life.

These narratives of myself only emerged when I studied overseas. Being away from family helped me gain perspective on my choices. Taking a step back, I realised how my study and career choices were entangled with my family's aspirations and how I positioned myself within my family. Studying overseas was also a time where I could freely discover my interests without being tied down by judgements or practicality.

In this section, I primarily focused on Zoe's narrative prior to university. In the next section, I will discuss Zoe's narrative while in university.

6.2.2 Practical – Planes, Cars, and Bridges

As Zoe was in her final year when we had our interview, it is evident from her narrative that she had a holistic understanding of engineering, based on her articulation of what Environmental Engineering is about (e.g., building occupancy, energy consumption, contamination etc.). However, something she shared raised considerations of the perception of different engineering specialisations. One consideration that will be discussed in this section is how engineering is communicated within the curriculum.

In Zoe's institution, all students are required to complete a compulsory first year of all engineering specialisations before selecting their preferred specialisation in their second year. Although my institution does not have this structure, I did a Flexible First Year program which included a subject where we learned about each engineering specialisation. I will draw on both my experience with the program as well as Zoe's narrative to discuss the practical implications.

In the subject I did, enrolled students were split into three groups and underwent three four-week rotations in different sequences. I did my rotation in this order:

- 1st rotation - Aeronautical, Mechanical, Mechatronic, and Electrical
- 2nd rotation – Civil
- 3rd rotation – Chemical

As part of the subject, students attended a lecture and a tutorial each week. For my first rotation, I had an introductory lecture on one of the engineering specialisations each week followed by a tutorial where we did an activity related to that specialisation. For example, we built a paper aeroplane while learning about Aeronautical engineering, and programmed a robotic car while learning about Mechatronic engineering. We were given a quiz at the end of each tutorial before moving on to something completely different next week.

Civil and Chemical were given larger blocks of time and projects due to practical reasons that are irrelevant to this discussion. However, at the end of first year, I remember wondering how I was expected to choose my engineering specialisation (Mechanical) based on one week of lectures

and tutorials in one subject. In the end, I selected a specialisation that seemed to offer the most pathways, as I mentioned in Chapter 4: Mabel.

Although I do not have complete details on how Zoe's curriculum was structured, her reasoning implies that she did not get to engage with each specialisation in detail. In her narrative, Environmental Engineering was largely a choice by omission, determined by which other specialisations she didn't want to do. Her choice was largely informed by her research on the course progression map. It was a situation where she selected Environmental Engineering because it offered a broad variety of different streams.

One immediate concern is whether such curriculum structures benefit students in making a more informed decision, or whether it perpetuates a narrow definition of different engineering specialisations. When I was in third and fourth year, I would occasionally spot Flexible First Year students carrying bridges made of popsicle sticks as part of their Civil Engineering rotation. I often wondered if anyone was deterred from Civil Engineering because they weren't interested in building bridges, just like I was.

When Zoe shared her experience of doing a group project with four other students from Civil Engineering, she indicated that they weren't aware of how much she had to do as the only member in Environmental Engineering. Another instance she shared where her friends from Mechanical and Electrical jokingly said Zoe would be in charge of mowing the lawn suggests that their perception of Environmental Engineering is limited to aspects such as greenery. While she did not specify if this group of friends was from her institution, it highlights that engineering students don't often get a holistic view of the profession. If engineering students themselves don't see the application of different streams of engineering, we are arguably missing out on many prospective engineers who are daunted by the idea of mathematics and physics. Zoe also mentioned that she did not realise that the gender ratio in Environmental Engineering was much more equal compared to other streams, which she liked.

Zoe's narrative highlights several important considerations for practice. Due to the diversity in engineering specialisations, there is a need to consider how engineering specialisations are represented publicly. Institutions should consider how the curriculum is communicated to guide students in making informed decisions on their engineering specialisation.

In the next section, I discuss how Zoe's narrative demonstrated her increase in agency.

6.2.3 Methodological - The Storying of Narratives

One feature of narrative inquiry is the ability to understand a participant's trajectory more deeply, including how their identity developed over time. In this section, I discuss how I made sense of different elements of Zoe's narrative to better understand her decisions as an individual.

Compared to other research participants, Zoe's pre-university narrative was less centred on herself and primarily guided by a combination of family and practicality. For instance, when she described how she decided to do engineering, she started by sharing that both her elder brothers did engineering. While she did not explicitly discuss her brothers' influence on her decision, the way she briefly shared her interest in Education before summing up with "but then I decided to do engineering" suggests that it was a decision that did not require further thought. Amidst considerations of migration and career prospects by her parents, Zoe negotiated and further justified her decision to do engineering. As someone who initially considered Education because she likes helping people, Zoe described engineering as helping people on a societal level, "but still helping people."

Considerations of family and practicality extended to Zoe's choice to study in Australia. Mirroring the narrative that led Zoe to engineering, she started with how her eldest brother went to her current university, followed by her second brother and herself. On the surface, this narrative speaks to the appeal of staying close to family and sibling discounts (where universities offer younger siblings of current students a discounted rate for tuition fees). These are common considerations for international students. However, a closer look at the narrative suggests that from Zoe's perspective, neither she nor her brothers were particularly deliberate with their decisions. This interpretation is informed by how Zoe said "so we thought, why not"' in response to their parents' suggestion to study in Australia, and how her eldest brother seemingly chose to study at their current university because it was the most direct pathway from his pre-university program.

However, in later parts of the narrative after Zoe started her degree, she demonstrated increasing ownership of her engineering journey. Articulating how she chose Environmental Engineering, she spoke about how she liked the exposure she gets to various disciplines, including business and arts. Zoe's mention of business and arts stood out to me because she previously mentioned that business is a common profession in her country compared to arts, which tends to be less valued. While Zoe's preference for variety may have stemmed from other aspects of her personality or background, in

the context of her engineering journey, I saw it as a process of engineering identity negotiation. For Zoe, doing Environmental Engineering allowed her to pursue a socially well-regarded profession while integrating knowledge common in her family and society (business) and disciplines less valued in her family and society (arts). Zoe's mention of the gender ratio in Environmental Engineering further served as a justification that it is a major that suits her personally.

As with all narratives presented in this thesis, the learnings from Zoe's narrative are not intended to be generalisable across the wider cohort of international students doing engineering. However, by understanding how one student negotiated her engineering identity, we unpack a range of cumulative and societal causations (e.g., pre-university exposure, sibling discounts, accessible pathways, multidisciplinary curriculums) that are less represented in existing frameworks on engineering participation. As demonstrated by the narrative here, neither of these are sole deciding factors as they depend heavily on participant context. Hence, these findings should not be directly translated into interventions. Rather, they can inform future research, as I further discuss in Chapter 10: Discussion.

Chapter 7

Maya

7.1 Maya's Story

Maya is a first-year Civil Engineering and Biomedical Science student. In her narrative, she shared how she was guided by her dreams, her views on challenges, and the importance of taking the initiative.

7.1.1 Dreams

Maya shared how she was led by her dreams since she was young.

> I had these dreams at the beginning of my high school, that was basically when I was at the age of ten. When I was growing up, I was looking forward to studying medicine, because of the passion I have for- in fact, I like a lot of things, but basically I had the dream of making a difference in the world.
>
> So as time goes up, like as I grew up, I realised engineering also provides me with that pathway of sustainability, another way of making this difference in the world. So I was like, I want to provide sustainability in the world, improve technology and innovations. And on the other hand, I really want to advance these dreams of mine (medicine).

> Yeah, so that really made me have a dream about versatility. All the days of my high school class, I try to find this balance between subjects that will improve me in engineering and also in the health science as well. It mainly made me stand out from my peers, because it was really kind of difficult seeing somebody, they'll have a balance with subject that has to do with calculation as well as all the health science courses. So I'm very, very grateful to this dream of mine.

She explained how she stood out from her peers throughout high school.

> Basically, that's the mentality of those in [home country] have. Most people think that engineering is only for males. Even when I was in high school, most engineering subjects have been taken by mostly male students. We had this course we called Further Mathematics, it's mostly for engineering students. I think we are basically like three girls taking that course. So, like I said, I am basically standing out and I really had to prove to my peers that engineering is not only for males who can as well be successful in that.
>
> So I graduated from high school, I was the best student in Further Mathematics and Mathematics in my high school. And I was the second-best student in Chemistry as well. So I was really happy because I was achieving the balance between engineering and health sciences straight from high school.

As time passed, Maya developed a more concrete idea on how to advance her dream in university.

> Yes, so basically, engineering is like, improve the world to make the world a better place. I already had in mind, having to change a lot of things that are really impacting negatively in the world. And I believe engineering gives me that opportunity to have my say, and then have lots of people who also have the same perspective with that, and also it's working together with them to make the world a better place.
>
> And then coming down to study, taking Biomedical Sciences. I really have the intention of like having a positive impact in the health sector of the world. Especially like, some of the outbreak in disease like COVID-19. I've not really have a cure, but

> I'm really hoping to join the research, having assist them and really impacting when it comes to finding cure for these diseases, which has really been life threatening to the world and the society at large. So that really prompted me and improved my mindset. And made me have these dreams and goals about studying Biomedical Sciences.

With these dreams in mind, she searched for a suitable university.

> Yeah, so basically, my family has really expected a lot from me. And so I told my parents I'm basically for studying engineering, and any health science courses also. My parents are basically cool with that because they knew my capability and they knew I basically could do and achieve very well in the field of engineering. So they really got my back and supported me.
>
> So that's when I had to look for one of the best universities in Australia. I'm basically studying in [current uni] because I think it has double degrees for Engineering and Biomedical Science. And also, [current uni] is very reputable. Because I had these dreams I really wanted to study in a university that is reputable and learn a lot of things. Not that I'd say that other universities won't provide me with that, but basically, [current uni] have all these double degrees.
>
> So my mom was like, yeah, and also reputable university then I should go for it. So I ended up- and also [current uni] gave me a- I received my admission first from [current uni] so I just had to go.

7.1.2 Challenges

Maya found online studies challenging from the start.

> I really really suffered a lot from the time zone. I basically had all my classes late at night. And then during the day, I find it difficult because normally nobody sleeps during afternoon time. So I basically sleep only three hours in a day, which was very, very challenging.
>
> And then next to talk about was the bad internet connection in my country, it was really so bad. It's really caused a slowdown in my academic learning. Because maybe sometimes I had to, like set out a list of things I have to do. So I need internet connection, like have access to those materials, or I would like to read. But sometimes I wake up at night, and I don't really achieve the goals of waking up at night to attend the classes because of the network.
>
> As an engineering student I dealt with challenges to face. We need to build up a lot of initiatives, which was quite challenging, but also made my studies interesting. Because I believe challenges are what really what makes life interesting, and then overcoming them makes it meaningful. So there are lots of them. And I really have to cope with a routine because I'm taking a double degree of Engineering and Biomedical Science. So finding a balance between both Engineering and Biomedical Science was a tough one. But I still continued as part of my challenges, so I had to deal with it.

She reflected on how she dealt with the challenges she faced.

> After the end of the semester, I had a self-evaluation of my academic performance this semester. I'll write down all the challenges I faced during the semester, and then I'll think of, did I basically overcome this challenge, or it got the better of me. And then what could I have done better if I experienced such challenges again.
>
> On my own end I thought I didn't quite have a balance for studies and my social life. So I was this girl, like, studying a lot. And it didn't really help me because I think I was off balance. Halfway through the semester, I was very tired and overwhelmed. So

the speed I use at the start of the semester slowed down a little bit during the middle of the semester, and then all of a sudden really slowing down. I have tried to increase my pace again, so I had this slopey encounter during the semester. So it's just a lot for me.

And I didn't really quite manage my time well, because of the very massive time difference in my country. So most times after studying, I just sleep late at night, and I'm not able to wake up for the next classes. And some of these classes have been videoed, so I just tell myself, I'm gonna watch the video later on. And then the next day I don't get on top with it and that really made me lagged behind in some of my courses. I always say it's a kind of procrastination. And I think it's because I didn't quite organise myself well, and it really got the better of me.

As I put down the things I did wrong, and some of the things I didn't do well, I think about how to improve my performance for next semester. So I hope from next semester it will all be great. I'm basically looking forward to facing the challenges and implementing more strategies. From next semester, we should be having face-to-face classes and I believe learning should be way more better then.

And yeah I believe my academic performance will increase very well because basically this semester I don't think I really met the standard I set myself at the beginning of the semester. Yeah, hopefully from next semester I should basically return back to maintaining my high standards.

7.1.3 Initiatives

Maya described a project that significantly changed her mindset on engineering.

> They had this technical sort of project that we did during the semester. So I can remember, one of the main aim of the project was making a dirty wastewater to become clean. But I knew from my own end, for my team members, after the project, the wastewater was basically clean. But we didn't get the full mark, we got a four over five. And then a team also, it seemed they didn't really- they did the project, the end product of the water was not clean, but they still got a full mark. So yeah, that really made me think why they get the full mark when the end was not really good.
>
> So during the last lecture, our lecturer made us understand that being an engineer is not all about taking the first step and the first step turns out to be very accurate. It's basically the step and the thinking and the initiatives behind that. And that was when I realised that team that basically got the full mark, when you look at the initiative behind them to carry out the project, it was really a cool one. They had implement a lot of processes. There was, yeah, they really introduced a lot of things like reverse osmosis, things that really didn't come to my mind, while carrying out the practical myself.

Maya reflected on her approach to the project.

> I was so quickly doing mine with the aim of getting the positive outcome, I didn't really look at how all the things I did affect what we call sustainability, how they affect the future society. But I realised, the particular group, they really considered all this. They involved a lot of thoughts, although the outcome of the project wasn't really that successful, but their input, the initiative they took was a very interesting one. And that really changed my mindset about what engineering is.
>
> So basically, you need to understand that as an engineering student, you don't really have to be successful at the first go. You can take your first step, and then the second go you improve some of the things that didn't work out in the first one. So provide more efficient results. And then, if the second one still doesn't work, the third step you

can make it more efficient. So as we go on, that's basically what engineering is all about, being able to like improve on what you've done before. That really changed a great part of me about what engineering is.

7.2 A Reading of Maya

In this section, I discuss what dreams mean to me, the challenges faced by Maya and how an event during the interview influenced my construction of Maya's narrative.

7.2.1 Personal - Dreams

Across my participants, Maya's motivation for doing engineering appeared to be the most intrinsic and intentional, and clearly underpinned by her dream.

By intrinsic, I am referring to how she articulated her dream to make a difference in the world, and the challenges she wanted to solve through engineering. Her motivation is at odds with the relatively extrinsic motivations exhibited by some of my participants, who considered engineering an acceptable pathway deemed prestigious or as mainstream by their family or the wider society. The only exception I noted is participants choosing engineering due to their interest in math and physics.

By intentional, I am referring to how she proactively took up subjects in high school to attain a balance between engineering and health sciences, and how she chose her current course for the same reason. This is contrasted with the less intentional pathways that many of my participants chose. For instance, Mabel cited her confusion as a reason for doing engineering, while Yasmin stumbled upon engineering while she was waiting for an offer for architecture. As discussed in the next chapter, Apple referred to engineering as "just something you do."

Maya's use of the word 'dream' felt unfamiliar to me. 'Dream' has appeared in other participants' narratives, as when Apple quoted 'every kid follows their dreams after doing engineering', and when Mabel said it was her dream to live in Japan. However, it was not strongly linked to their engineering narrative. Personally, I don't recall having a dream. I recall writing many essays throughout my school years on my ambition, which were typically career-related (e.g., "I want to be a doctor to save people"). Dreams seemed unattainable, used by the media to compel the audience. I often scoff at phrases such as "dream big" and "dreams come true."

However, her dream gave Maya a direction and a reason to persist. It gave her aspirational capital (Yosso, 2005), the ability to "maintain hopes and dreams for the future, even in the face of real and

perceived barriers" (p. 77). From my interaction with Maya, I understood her as a goal-oriented high-achiever. These traits were reflected in how she highlighted her academic achievements in high school, and her approach to choosing universities. Despite her challenges during her studies, she exhibited navigational capital by actively reflecting on what she could do better to ensure she was "back to maintaining her high standards."

Another aspect that stood out was Maya's perception of engineering. Maya's portrayal of engineering was relatively holistic, something that I only found with participants close to finishing their degree. She described engineering as being able to face challenges, take a step, and create initiatives. Admittedly, although this is what I usually say to the first-year students I tutor, I have never internalised this mindset during my studies. In her narrative, Maya described how she initially thought a project's goal was to produce a desired end-product (i.e., clean water), and how she was trying to achieve that goal quickly. However, she learned that the process was more important by understanding why another group got a higher score.

When I shared Maya's narrative with her through email, she replied that she realised what she had said about this experience gave her strength to keep pushing through the semester. She pointed to the following statement:

> Engineering is not all about being successful at the first result, it is all about taking initiative. If the first trial is not successful, keep trying and take initiative from your failure so as to improve in the second attempt and if the second is still not the best, reflect and still keep taking initiative on how to fight your weaknesses so as to achieve your desirable goal.

From this reflection, I realised that her mindset was largely influenced by her dream. Her dream was translated into her willingness to learn and take on challenges, which allowed her to grow quickly, even in the face of barriers, which I will discuss in the next section.

7.2.2 Practical – Impacts of Online Learning

I interviewed Maya in December 2021, when she had just completed her first year of studies offshore. Maya's interview was particularly memorable for me. We met on Zoom at 8am Sydney time, where I learned that it was late at night for her due to the time difference. When I asked Maya how she was doing, she immediately shared how challenging it was dealing with large time differences and slow internet connections (I had to quickly ask for her consent to start recording).

As shown in Maya's narrative, the time difference affected her greatly, resulting in reduced sleep hours and quality. She also shared how the internet connection slowed down and disrupted her learning process. Maya's narrative revealed that these were not standalone issues, as there were times when she couldn't achieve her study goals because of the internet connection despite waking up at night, and how her irregular sleeping schedule made it difficult to be on top of her course.

It is important for educators to understand the flow-on consequences of online learning, as it disproportionately affects offshore students and students who do not have reliable internet access. The dominant narrative with online learning (and by extension, hybrid working) has been the flexibility it provides to students who live far from campus, with chronic illnesses, or with carer responsibilities. However, Maya's narrative represents a population whose considerations were neglected, a population that adapted to unreasonable waking hours and unideal learning conditions.

Maya's narrative highlights several important considerations for practice. There is a need to critically assess how changes in teaching and learning (which happened in this case due to the pandemic) affect students from diverse backgrounds, as checkbox solutions often miss the needs of underrepresented populations. As shown in Maya's narrative, narrative methodologies facilitate a deeper understanding of flow-on consequences, which are critical to ensuring interventions address systemic challenges instead of being temporary 'band-aids.'

In the next section, I discuss how an event that happened during my interview with Maya influenced my analytic process.

7.2.3 Methodological - The Context of Narratives

As discussed in the previous section, Maya had unreliable internet access, which affected her studies. Halfway through the interview, I witnessed and experienced what Maya regularly faced throughout her studies. Maya dropped out of the Zoom meeting multiple times, and after the first two times I mentally prepared myself for an email from Maya saying that she won't be able to continue this interview. However, Maya would reconnect without fail each time, and upon reconnecting she would immediately pick up on where she left off without missing a beat.

My instant impression was the stark contrast with the responses I am familiar with when someone reconnects after dropping off – apologising for the disruption, explaining what went wrong, and asking at which point they got cut off. Maya's seemingly nonchalant response suggests it was common for her, though it was concerning to realise how rocky it was for her to follow along with lectures and engage in tutorials. Although Maya eventually switched to a stable network after 20 minutes of dropping in and out, a significant part of her interview was not captured. This made it tricky to revisit due to the semi-structured, narrative interviewing format.

The reason I am sharing this incident is to highlight how interviews are viewed as narrative events in narrative research. This perspective on interviews does not solely focus on the content of the interview (i.e., participant's responses to questions), but also the context of the interview. Understanding the context of the interview requires acknowledging that the participants' responses and researchers' analyses are largely influenced by aspects that do not appear on the transcript. These influences may range from the participant's understanding of the purpose of the interview, to the setting in which the interview took place, to incidents unrelated to the research that occurred during and outside the interview. In Maya's case, the event described enhanced my understanding of her online learning experience. A further reflection on the event also prompted me to revisit how I interpreted her narrative, and more specifically the term 'challenge.'

In Maya's narrative, it was evident that she faced many 'challenges,' a term that I used interchangeably with 'barriers', 'issues' and 'problems.' This definition made sense when she was describing time differences, network connections, and her self-evaluation activity. However, there were bits of the transcript where 'challenge' was used differently, when Maya mentioned "I still continued as

part of my challenges," and "I'm basically looking forward to facing the challenges." With the volume of each transcript, I initially paid less attention to what 'challenge' meant to Maya. However, while reflecting on how persistent Maya was when she reconnected after dropping off each time, it dawned on me that Maya's definition of 'challenge' was participating in a stimulating task or a competitive situation. In the context of the event that occurred during the interview, Maya didn't see the network connection as a 'challenge' that prevented her from achieving her goal, but rather something she wanted to overcome.

I revisited the transcript, and realised there was a comment that Maya repeated multiple times that I had previously missed – "challenges are what makes life interesting, and overcoming them makes life meaningful." A further look at the instances where she mentioned 'challenge' led me to her articulation of what engineering is – "engineering is all about being able to face challenges." These quotes indicate that Maya felt empowered rather than powerless in facing challenges, reflecting her agency. Perhaps some readers read 'challenge' as Maya intended, or readers do not think there is a difference between my concept and Maya's concept of 'challenge.' However, for me, it significantly changed the tone of Maya's narrative from a vulnerable student to a gritty individual.

As someone involved in Humanitarian Engineering, I noted that the term 'challenge' is often used in literature, reports, and media to portray undesirable situations that prevent an individual or community from achieving their desired goal (e.g., financial constraints, environmental pollution). I remember discussing how the term 'problem' implies that the issue lies with the people themselves, and how 'challenge' shifts the focus to the situation rather than the people to facilitate productive conversations on structural reforms. In education literature, 'challenges' associated with international students include language barriers, lack of support, and cultural differences (Vu et al., 2022). These topics suggest that 'challenge' is used to imply barrier, issue, or problem, though it is unclear whether the authors use it intentionally for reasons similar to those of Humanitarian engineering academics and practitioners. Vu et al. (2022) noted that "little is known about how international students exercise their agency in navigating challenges" (p. 2021), and Maya's narrative is a fitting example that fills that identified gap.

Chapter 8

Apple

8.1 Apple's Story

Apple is a first-year Aerospace Engineering student. In her narrative, she shared how engineering is just something you do, her perceptions of engineering, and her vision for better education.

8.1.1 *"Engineering is just something you do"*

Apple spoke about how she perceived engineering as she was growing up.

> When I was very small I just thought everybody in my country did engineering. I was like yeah, that's just something that you do. In my country, there's also a meme that's very popular. It says that every kid follows their dream after doing engineering. So you would finish engineering and then you follow your passion.
>
> I've seen many people study engineering not because they want to. It's just that's something they do and then they go- whatever they want to do, they do MBA afterwards or they just go into films or something like that. It's just a backup degree. There's a lot of actors also who have completed engineering. So it's like okay, I've got engineering, tick, now I'll go and explore and if it doesn't work out, come back.

> But I think Gen Zs are changing the perspective now. All the Gen Zs- like my age people- are doing it because they want to, not because they need to. I think it will change a lot after all the generations.

As a Gen Z person, Apple explained why she chose to pursue engineering overseas.

> So first of all my father is an engineer, and my grandfather was an engineer, so I think it's a major influence in my life that all my family is engineers. But also I love mathematics, so that's why I think engineering was a thing and Aerospace particularly because I think I don't like physics that much but- let's say I wanted to try it once and see what happens. Because people around me love physics and I just wanted to know why.
>
> In South Asia education is a bit rigorous, it's very exam-based education where you give a lot of exams and your marks define what you are. Like what grade you get is what place everybody holds you on. So I don't like education in my country that much. It's very booky- it's a bookish education. There's no practical knowledge, around here we don't work in labs and nothing like that. Just very bookish. So that's why I decided to go to study abroad.
>
> Even in the top colleges in my country, we still study by way old methods where there's a board, there's chalk and there's a marker and people write on it. And I just- it's not as advanced as it should be I feel, very behind. And Australia, I think we have a lot of- in my university we have a lot of things on computer like we have a lot of new methods. We have labs, we have clubs, we have research programs going on. We have a lot of opportunities I feel here. There's a lot more possibilities.

She further explained how she came to study at her current university.

> First of all I wanted to go in [city name], it was my preference in Australia. So I read about all the different universities, but I found that [current uni] is close to what I was looking for. There's a lot of students there, there's a lot of community there and people are also focused on research there. So that's why I happened to go with [current uni].

> Also, my uncles and aunt live in [city name] so that is also a reason with my parents because I'm just 18 - I'm 19 I think now.

Apple's university offered a general first year curriculum to engineering students before choosing a major in the second year.

> I knew I wanted to do aerospace when I was in Year 12. But I just wanted to make sure. Like I don't want to have any regrets like if I did this I could do better or if I did that I could do better- I don't like it or whatever. I just want to keep an open mind for all the engineering branches. So yeah, I made a bridge, I made a wastewater treatment plant and we did all sorts of things, we made electrical circuits and stuff. But still my mind was not favouring on any of those.
>
> It was not as rigorous mathematics as I'd like it to be. There were a lot of things that you had to do in theory as well but physics in aerospace, what I felt is it would be more of understanding and knowledge and- I really want to try physics.

Having finished her first year, Apple reflected on how it matched her expectations.

> In engineering I felt a lot more relieved when I joined a university here because we had a lot more projects I would say, and the course work was also very defined. There's like 40 percent for examinations and 60 percent for all your other works and projects. So it was not just all problem solving. That's why that was like really great change for me personally because I love that kind of stuff. We build projects, we do stuff together, we have classes and we work on things together.
>
> Here in my country we don't have as many projects or as many practical knowledge coursework. That was one of the main reasons that I wanted to go abroad, because here you have students study like one day before the exams and they wake up all night just to study.
>
> In Australia we also study the day before exams but we don't do as rigorous works because it's all in here- it's all there in your mind. It's because you're doing it every day. Working on a project I think enhances your understanding of the theory. That's

> what I think, if you work on a project it will stay in your mind a lot longer than if you just study for exams and finish exams and just finished with it.

As her first year was completely online, Apple spoke about how she connected with her peers.

> Online in general I think it was good, but it can no way compare to on campus experience. People don't make as much friends. We had a lot of group projects but still I feel we did not - our whole class did not connect as well as I feel it would have if it was on campus.
>
> So if you join a club or get involved in any of the activities that people are currently doing online you'll make friends. But in engineering most of the students- like in many of the classes I was the only girl and boys like to play a lot of games so if you want to be friends with your classmates you just play games with them.
>
> Oh, I am not a fan of games honestly. I don't play games as much as my fellow classmates do. I think they play every day. Engineering, I think- like I don't know if it's a stereotype problem but I know most of my classmates are boys and they don't like to socialise. They like only two things, music and games, and other than that they talk about projects is all.

8.1.2 *"You can do anything else after engineering"*

Apple shared how engineers are perceived in her home country.

> I think where I live, engineers are not considered that innovative or creative. In my country people do engineering because they have nothing else to do. That's actually true. They feel like a doctor or a lawyer or something that has to do a lot of with books is more capable- is more smart in any way.
>
> In South Asia, the government allots seats for students, like this much students can take up engineering and there are a lot of seats compared to the population. So you will get an admission somewhere or some place in the country. So it's not considered as what smart kids do. It's just you get this mark, like if you get into a good college you are doing a good engineering but still jobs are very less for engineering students in South Asia.
>
> If you are an engineer in South Asia you are not paid- if you just did a Bachelor's degree, definitely not paid that well. You have to do Masters or you have to do something else just to take good job. If you want to work in a good MNC (multinational corporation) or if you want to go to NASA (National Aeronautics and Space Administration) or wherever you want to go just Bachelors wouldn't do.
>
> Most of the engineers in South Asia are not first doing anything related to their field. Like they take up on entrepreneurship, they are running businesses, a start-up or whatever. Yeah, you can do anything after engineering.
>
> Engineering is a course that demands a lot of practical knowledge so many people feel if you passed engineering you are a lot more practical. You have skills which are required for entrepreneurship. I grew up in here so I would particularly say about my country - people going through engineering always end up doing something else most of the time.

She also shared her thoughts on women in engineering.

> I feel there are a lot less women in engineering than there should be. Women generally would prefer taking up medical or business.

Many of my friends, I ask them why did you not take engineering and they were like I'm not good with mathematics. I think that's a stereotype. They don't like mathematics and many of them plan to get married or whatever so they feel like doctor or whatever is more safe- like it's more refined as a profession.

It's not a job that takes you up on so many things. Like if you are a dermatologist you can do things on your own time and way. If you get married or if you have family, I think women tend to think of that and don't take up engineering because there's a lot of field work, and they think they won't be able to take time out of their family. It's just what I think.

Most of my friends that are doing engineering are males but there are a few girls. They are just like me - head-on, you know? Most of the females that are doing engineering with me have a personality trait that is head-on. Like they are independent, they want to become independent. There's a lot of difference in thinking. They know what they are doing, they are not pressured by family or anything.

Their families are very open minded, not orthodox, and they are a lot good at mathematics also I feel. They are very practical. They have very nice leadership skills I feel, many females doing engineering with me. And many of them have also taken up engineering I feel because it's just a degree that you have and afterwards you can do anything else. So that also might be a reason.

8.1.3 Vision for Education

Apple spoke about what she wanted to do after completing her engineering degree.

> After I graduate I actually don't know if I would do Masters. I still am waiting because I don't want to plan it all out and ruin the possibilities or opportunities for me. But I'm studying physics because I feel that it's a hard subject for me and I feel that the way it is taught, not just in Australia or anywhere else, worldwide, the way education is taught I think we can do a lot better honestly.
>
> I want to build my own school. That's why I applied for the academic board because to see how universities work. But what my goal is currently- that's why I'm studying physics, I think that's the hardest subject. So I just want to see if I learn the subject, I think I will figure out a better way to teach the same subject. So that's what my main goal is currently. I don't know what I'll study next but that's the goal.

Apple's had a vision of education where practicality is at its core.

> I don't like the idea of you having books and you studying. I just like a practical field where you go and you study different concepts.
>
> The teaching system in my country was very different 2000 years ago and it was like a whole practical class. They did not have books. They did not have anything. They just had a lot of practical knowledge. And I also feel the knowledge that you can access on internet, you should not be forced to remember that same thing that you can access easily. The times are changing and we should too in terms of education I feel.
>
> In our school once we asked how would you describe gravity. We all know the apple fell and it's like okay, that's gravity and we just study about it like g is 9.8. So when our class was asked what project would you have in mind regarding gravity which explains gravity, they were just like yeah, we can describe gravity but we don't know how to make something out of it, and that just bugged me. We've been studying gravity for so long and we could not think of a single project.

> I mean, just look around, like rollercoasters. But we could not come up with a unique idea. It's just sad. And I immediately caught it's the way that we have been taught - that we were not able to think outside of a problem.
>
> We just think one way and I don't want that for other generations that are to come. I follow Elon Musk a lot because of that. He also believes in the same thing, that you know, don't learn from schools. That's why I'm learning from a school to know what they're doing wrong.

Another aspect of Apple's vision for education was one where students are not defined by grades.

> In South Asia we have like a final exam thing where it's very competitive. So there's like a lot of students competing, 400,000 or something just giving this one exam. It's just tough I would say. If you can crack that exam that's not an issue. But the pressure the people put on you to pass that one exam is hurtful. It's very difficult and then you get an admission in a good college or good university and then you pass and the degree holds nothing internationally if you want to get a job somewhere else. Your degree would not be valid as if you get somewhere from an accredited university.
>
> I feel there shouldn't be grades. I really want students not being judged by a number. I want them to feel that you are doing it on your own pace. You are not brighter or dumb than any student in your field or whatever. I really want a school experience which builds students not to learn a particular subject. I want them to know how to learn. I have seen a lot of students who are struggling and not just because they are not bright, it's just- I blame the system that's teaching them.
>
> I have researched on Finland. Finland have the best schools around the world and they don't have grade system I think. I just find it very cool that the students know their own strengths and know their own weaknesses and it cannot be defined as in- you cannot define a whole bunch of people together on just a mark, on just a number, on just a GPA. I think there is so much more. It just hinders their education. Sometimes many students get demotivated because of that- you know, when you put a number on that.
>
> I don't think that should be the case where you are judged on a number. I think you should be judged on your creativity. And I think students would be a lot more- we

would have a lot more projects and inventions if things went around this way. There are many college dropouts as well that are- people who do so well in life and stuff like that. I have research on that. I really want a school that is not partial or whatever.

8.2 A Reading of Apple

In this section, I discuss how Apple was led to engineering out of curiosity, the complex perception of engineering in her culture, and how her narrative led me to rethink the issue of engineering attrition.

8.2.1 Personal - Curiosity and Agency

In Apple's narrative, she spoke about how she came to do engineering. Interestingly, she didn't like physics that much, but "wanted to try it once and see what happens" because people around her love it. She eventually chose Aerospace Engineering because it involved more rigorous mathematics and physics.

Contrary to Apple, I was interested in physics, as shared in Chapter 4: Mabel. However, one factor that pulled me into engineering was because I wanted to know what was possible for me in engineering. As someone who identified as being good at math and physics, I wanted to know how hard it could get, how far I could go. Doing a degree in Mathematics or Physics felt less practical, so I landed on engineering. Although Apple didn't mention why she did not consider a degree in Mathematics or Physics, the prevalence of doing engineering in her context likely contributed to her decision to do engineering.

In making a decision to study overseas, Apple demonstrated more agency than myself and most of my participants. For instance, most participants (apart from Yasmin) cited family as one of the main reasons they came to Australia and did not elaborate further. With Apple, however, she spoke at length about what she didn't like about her home country's education system, which is one of the push factors for studying abroad found in Nghia's (2019) study. Referring to her home country's education as "bookish", she was firmly against the current education system in her country that places more emphasis on theoretical rather than practical knowledge. She also shared her frustration with an education system where numbers define students and described current teaching practices in her country as "very behind". From Apple's perspective, there were "a lot of opportunities and a lot more possibilities" in Australia.

Like most of the participants, coming to Australia was primarily my parents' decision. While I was in school, I wasn't aware that I would be going overseas for tertiary education (possibly because my parents were still saving funds at that time). When my brother went to the UK, I had a vague understanding that it was because Law degrees from the UK were more aligned with Malaysia's accreditation system for lawyers. I had assumed that I would go to the UK as well, but since my brother is five years older than me, he would have graduated by then, leaving me with no family members in the UK.

It was only much later in my degree that my mum shared her decision to send me to Australia. She felt Australia was safer for a girl, and the closer proximity made them feel more assured. It turned out that she had also considered the possibility of me migrating and felt Australia had better migration prospects. Personally, I had no idea that I would study overseas, let alone consider migrating. Up till the end of my undergraduate degree, I was under the impression that I will work in Australia for a few years for exposure and head back to Malaysia. In hindsight, my parents had thought so many steps ahead of me, including the wider range of opportunities and possibilities available to me. My participants' and their parents' intentions in choosing Australia are further discussed in Chapter 10: Discussion.

While I did not question my parents' decision to send me to Australia, I refused to go to the university of their choice. The University of Melbourne was their preferred choice because it was ranked first in Australia, but the curriculum didn't allow me to specialise in engineering until I had completed a Master's degree. For me, doing a Bachelor of Commerce with a minor in engineering felt like I was circling around engineering instead of getting down to the nitty-gritty of what engineering is all about. I was not convinced that I would have a good enough understanding of what engineering is to decide whether I liked it or not, and it felt like it would be too late to find out during my Master's degree that engineering is not for me.

Although Apple and I were attracted to engineering for different reasons, it is personally meaningful to hear that someone else had done engineering out of curiosity. Her narrative validated my rationale for doing engineering, which has always sat uncomfortably with me. It also helped me understand how Mabel felt heard when I shared my story about feeling insecure with math and physics in Chapter 4. In a field saturated with narratives of the dominant population, these narratives help both me and my participants find our voice and reaffirm our thoughts, which I further

discuss in Chapter 10: Discussion.

Apple's rationale to study overseas, considered to a lesser extent in my own and other participants' narratives, prompted a reflection on how I got to where I am. As discussed earlier, studying overseas is not always an individual decision, and parents' considerations are not always made explicit. This finding may explain why other participants did not elaborate much on their decision to study in Australia.

In the next section, I discuss Apple's perspective on the education system in her home country, and how she navigated her current studies.

8.2.2 Practical - Micro and Macro Worlds

From the start of Apple's narrative, it is immediately evident that pursuing engineering in her context is extremely common. In particular, the way Apple repeatedly framed engineering as "just something you do" signals a significant departure from discussions in the literature on attraction in engineering. These studies tend to focus on identifying factors that motivate or demotivate one from pursuing engineering. However, saying that "I chose engineering because it's just something you do" rather than engineering was chosen because of X, Y and Z factors indicates a stark difference in intention. While investigating the latter framing may translate more efficiently to tangible interventions, the former framing deserves attention if we as researchers are seeking to unlearn our thinking on engineering pathways.

The statement "it's just something you do" itself does not conclusively explain whether engineering is associated with positive or negative sentiments in Apple's context. In Apple's narrative, she described varying perceptions of engineering that are somewhat contradictory. For instance, engineering is a relatively accessible degree, with a proportionally higher number of seats offered compared to other disciplines, possibly due to governmental decisions on national priorities and resource allocation. However, it is difficult for engineering graduates to land a lucrative role as an engineer. While the prestige of engineering does not match those in the medical (doctors) and legal (lawyers) fields, a degree in engineering serves as a recognition that graduates can pursue anything else, such as entrepreneurship which Apple raised as an example.

These perceptions do not provide straightforward answers on what it means to do engineering in Apple's cultural context. Further research is needed as to whether the number of seats offered to engineering degrees in Apple's home country is driven by national demands for more engineers, or an oversupply of people intending to study engineering. There is also a need for further research into what aspects of an engineering degree are recognised or valued. However, learning from narratives primarily involves "[relating] the 'micro' world of the individual to the 'macro' world of institutional meanings which they both inhabit and re-create" (Clough, 2002, p. 12). In the context of Apple's narrative, I build on these perceptions (macro) as well as what is emotionally salient for her (micro) to make sense of her journey and decisions.

Apple observed that most women who do engineering share a common personality trait: 'head-on', a term she used to describe someone who wants to become independent, knows what they are doing, and are not pressured by family. Prior research has found that among international students, women placed more emphasis on establishing their independence than men, who placed more emphasis on career-oriented goals (Boey, 2014). For some women, studying overseas is a way of breaking away from a "normative life script" (Martin, 2022, p. 227).

These self-identifications are crucial as it is reinforced throughout Apple's narratives. For instance, when Apple spoke about how Gen Zs are doing engineering because they want to and not because they need to, it becomes apparent that Apple's agency is influenced by her intersectional identity as a head-on woman and a Gen Z who is leading a change in mindset. These identities gave Apple navigational capital (Yosso, 2005) during her studies, including playing games (despite not being a fan) in order to socialise with other engineering students, and joining academic boards to better understand how universities work.

Apple's narrative highlights several considerations for practice. As discussed in Chapter 2: Literature Review and demonstrated in Apple's narrative, "causation is cumulative and societal" (Bruzzone, 2020, p. 2) and cannot be reduced to push and pull factors. The limitation of push and pull factors further emphasises the need to study the interplay between individual identities and their cultural context instead of focusing on just the individual or context alone.

In the next section, I discuss how Apple's articulation of her goals shifted my understanding of her engineering narrative.

8.2.3 Methodological – The Implications of Narratives

When Apple chose Aerospace Engineering, she claimed that she wanted to know why people around her love physics. When this excerpt is isolated from the rest of her narrative, it paints a picture of Apple as an inquisitive individual who is up for a challenge. Later in her narrative, however, the link between Apple and physics became more profound when she shared her goal after completing her engineering degree. As someone who found physics difficult, she pinpointed the lack of practical application in education as the root cause. She further shared how she studied physics so that she knows how it can be better taught, and how she applied for the Academic Board to see how universities work. When Apple's narrative is viewed as a whole, her reason for studying physics becomes tied to her vision for better education, rather than pure curiosity. This is one example of how narrative analysis (viewing narratives as a whole) can inscribe different meanings and enrich an existing narrative.

Throughout the narrative, from articulating her pre-engineering journey to post-engineering considerations, Apple has never once mentioned a career in engineering. While the meme "every kid follows their dreams after doing engineering" might sufficiently explain why, it prompts further thinking on attraction and retention in engineering. If Apple's narrative remained unshared, she would be part of the number of engineering graduates discussed in quantitative studies who 'leave' engineering, and researchers would continue asking the same questions, "how can we increase retention in engineering?" With Apple's narrative unpacked, however, doing engineering served a completely different purpose from the start. For Apple, she has never 'entered' or 'left' engineering for reasons related to the engineering profession itself, and thus should not be seen as someone who 'leaked through the pipeline.' Apple's narrative reaffirms what researchers have problematised with the concept of the pipeline - that it assumes a restricted, linear pathway (Cannady et al., 2014; Pawley & Hoegh, 2011). Instead, researchers should challenge what attraction and retention means in engineering, accounting for sociocultural factors that lead individuals to pursue an engineering degree.

Chapter 9

Amira

9.1 Amira's Story

Amira is a third-year Software Engineering student. In her narrative, she shared how she entered engineering and stayed afloat during her studies.

9.1.1 Entering Engineering

Amira's narrative started at Year 11 in high school, where she had to choose between subjects such as biology, psychology, economics and computer science.

> Bio (biology), I was not that inclined for because I felt that there was a lot of memory application so I could not do that. Next we had psychology, same as bio. Then there was economics which I felt was pretty interesting but at the same time, I wasn't that gravitated towards it. Then I had computer science, which I chose because I just knew it was a good option.
>
> So I was exposed to data structures, algorithms, and C++. Then as my final year project, I had to make this railway management system using path handling and all. It was very basic but still it was interesting for me because I got to see how computer science has a really practical application. So yeah, this way I decided to join Software Engineering.

> I'm going to be honest, from my high school I was more inclined towards engineering, like something which was a combination of- which also had some angle of this one, bio. So I was looking into computational biology or something like that.
>
> Also I was considering biomed (Biomedical Engineering) as well, but then I just thought that I will focus on one field, which is Software. I think it's a good decision. Because the thing is that with all software, I can join many sectors such as physics, energy, bio. Because the thing is that all software is used in each and every sector.

She shared her family's response to her degree choice.

> They were happy. The other thing is that as an Asian, I think you can also relate to it. You can be doctor, engineer, that's it. So yeah. So they were definitely happy that I chose Software Engineering because for them, it's a much reputable degree.
>
> So my family thinks that I can just fix their laptop, printer. I have showed them certain websites I have built. I mean they're just wowed by it. So then I'm like, okay, that's great. I'm so happy that they think it is good because it does matter to me all what they feel, what they think.

Societal perceptions of engineering influenced Amira's decision to study in Australia.

> Engineering is definitely similar to Asian culture. Engineering is viewed as ultimate career path. But then at the same time, I feel that engineering is very saturated also because so many people are going for engineering so that you have to be your best. This is why I chose Australia between India because of less competition and I didn't choose [home city] because I wanted to get out of my comfort zone.
>
> Why I choose [current uni] was because I wanted to explore another city. Other states were out of question for me because I have family in [current city]. Next I was also considering [uni option #1], [uni option #2] but the thing is that I feel that was really a city– living inside a city would not be as safe as living in a suburb. So based on this logic, I chose [current uni].

Then there was one more reason, so the thing is that [home city] it has this reputable Computer Science college which is called Carnegie Mellon University so a US branch is here. So initially I did want to get into that but the thing is that I did not do well in my SAT so I could not get into it.

9.1.2 Staying Afloat

Currently in her third year, Amira recalled her first day of university.

> I was so nervous. I had no idea about things. I was just running around. So once my class got over, I was lost. What I decided to do was, I just wait inside a mosque. I saw some people there. I was like, hey, so I just came from [home city]. I don't know anyone here and this is my first day at [current uni]. Just do something. Just help me. They were like, aw you're a baby. Yes, I'm lost. So then yeah, we had lunch together. So this way I made my first friends at [current uni].
>
> I'm going to be honest, before coming to [current city] I could not speak confidently. I had this issue of stammering since high school. So the thing is that when you're out of your comfort zone, it's like– okay, here's a good analogy for you. So coming from [home city] to [current city] was like coming out of this ship. So I have to– so I can either sink or float. So I just want to float or support this, I had to make the best of university life, improve my speaking, and just put myself out there. So yeah, does it make sense?
>
> Because the thing is that I have seen people around me unfortunately – I mean international students who are my extremely close friends - so they got depressed during lockdown and all. So this depression has impacted them negatively. I was like, okay, I do not want to be in their place at all.

Amira spoke about her experience during lockdown.

> So last year I was in [current city]. So definitely lockdown was hard because my movement was sort of restricted and then also I was in this one single room only. I mean there were times when I could feel pretty lonely. Then also because of lockdown, I have gained a lot of weight. So this also impacted my self-esteem. But then luckily I had my friends and they were a huge part of my support system. So my friends played a huge role.

> Then also one good thing was that my accommodation is inside [current uni]. So this way I could still access the lake and football field as I'm not completely restricted in my movement.
>
> I just spoke to my family a lot via phone. Other than that, I just did myself to be like productive. So I set this goal for myself that I have to secure summer internships. So I was applying, resume checks, covering letter checks. Then upskilling in my IT skills so this way I also kept my mind busy.

Amira also detailed her search for summer internships.

> So last year I had applied for [company name]. So I got into the first round and went for second round. The thing is because of COVID there was just seven companies, normally there are like around 20-30. So obviously there were a lot of people but there were less companies. So because of that, I could not get into [company name]. So I was going about this but then I just took it in my stride.
>
> First I decided to ramp up my CV because the thing is that, my first CV it was just like lines but then that's it. Just written, written, written. There was no format. There was no structure. So I first rewrite that. Then I decided to upskill. So for that I was just doing projects related to Python, website development. Then I just made my profile a bit nicer. Then I got an internship at the Australian Synchrotron.
>
> When I told my family about my internship they were extremely proud. That was just like a different level of happiness. Yeah, so that was the most impactful thing for me.

However, she eventually had to make a tough decision.

> But then the thing is that after being one year away from my family, I knew that I had to come back. Despite border shut down, I knew I had to come back because then it would be hard for me. So I made this decision, despite being extremely reluctant. I do not regret it because actually this year's lockdowns were horrible. So yeah, this way I made a good decision and I'm happy.

> I've been here (home city) since March. I'm so happy I am with my family but the main issue is the time difference. Because during semester, like my sleeping pattern was so messed up. I would sleep for 13 hours. When I woke up I was in this trance so I could not concentrate. I don't know how to explain it. So yeah, that was massive. That wasn't good for me. But then coming to [home city] was also needed because family is also important for me.
>
> Then also this whole experience made me pretty versatile because this shows that it can take you to different places, different paths. So you need to be versatile, I mean you have to accept change when it comes.

Amira reflected on her decision to study overseas in her current university.

> Up till now, it has been a really rewarding decision. To be honest, I feel that this is the best decision I have made because I got out of my comfort zone, adjusted to a new city life. So definitely I feel that I have become more confident and resilient as well.
>
> [Current uni] is good. I really like [current uni]. I feel like because with [current uni] I have discovered a lot of interesting opportunities, through which I have developed as a person.
>
> Other than that, I have also secured opportunities which has helped me become a better software engineer. I have learned so much about the IT industry. So yeah, definitely my journey so far with [current uni] has been pretty rewarding. I hope that it continues this way.
>
> During my high school, I didn't know much about Software Engineering definitely as much as I know now because- I mean the thing is in my school, there weren't a lot of career days and then networking with companies and all that. So I don't much about the IT industry as much as I know now.

Amira spoke about where she would like to work after graduating.

> Most likely Australia because the thing is that I feel like Australia it has a better work/life balance. This is a major plus point for me because I get flexible working hours. Then I also get benefits. Just from my internship experience, I have noticed.

> Then also, I feel that so much effort has been put so I would want to be here if things work out, like if the policies work in my favour, so let's see.

She described what sort of engineer she wanted to be.

> Definitely I want to stand out from other engineers because, for me, that requires a lot. At the same time, I also want to be a part of really supportive thing where I learn a lot and also develop myself as a person.
>
> Then other than that, I just want to have an amazing time. Then also, I would like to be a part of a job where I can travel a lot hopefully. So yeah, let's see.

9.2 A Reading of Amira

In this section, I discuss how Amira's analogy of staying afloat resonated with me, alternate paths and plots in her engineering journey, and issues to do with rapport.

9.2.1 Personal – Staying Afloat and Returning Onboard

Staying Afloat

> So coming from [home city] to [current city] was like coming out of this ship. So I can either sink or float. So I just want to float or support this.

When Amira first shared this analogy, I was surprised by how well it resonated with my own experience as an international student. This simple analogy puts into words what it is like to be detached from your support system (the ship) and plunge into a world of uncertainty (the sea). There is not much choice – you can either do nothing and sink, or do whatever you can to stay afloat.

Like Amira, I went abroad right after secondary school at 18 years of age. While my peers at home were exploring coming-of-age freedoms like driving or drinking (not together), I felt like I was fast-tracked to the less glamorous side of adulthood: managing multiple accounts created within days (i.e., bank, phone), figuring out what bills I had to pay, and finding my way around a new city that I had never set foot on.

One aspect that has not been discussed extensively in this thesis is the privilege held by women who study overseas. Being able to afford international student tuition fees and Australia's living cost indicates a certain degree of economic privilege, unless they are receiving a scholarship. In certain contexts, being allowed to study overseas as a woman may imply that there is no preferential treatment between them and their brothers in terms of education. It also means that they were allowed to live away from home, which does not align with certain cultural values (Dutta, 2017). These privileges were particularly applicable to me, and continue to be an enduring theme throughout my years overseas. For example, my parents financially supported me throughout my undergraduate degree, which allowed me to focus on my studies and live comfortably.

However, being away from home also made visible my privileges at home, including access to stable housing, personal transport, and community support. For instance, while in Australia, I was living in a rental property, and I would never know when I might get evicted, lose access to my house, or can't live there due to maintenance or safety issues. These are not daily concerns when I live in a house owned by my parents, and have a wide network of family and friends to turn to if I needed shelter. In my years overseas, I have had to look for new accommodation on short notice, familiarise myself with tenancy laws due to the range of matters that I had to deal with, and prepare countless backup plans for a variety of situations (including sleeping over at the university if I lose my keys and can't find a locksmith late at night). I was my own Plan B, C, D, and E, so I had to do whatever I could to stay afloat. As Amira pointed out, I had to be versatile and accept change when it came.

In Amira's case, staying afloat meant making the best of university life, overcoming stammering, and putting herself out there. She demonstrated navigational capital by describing how she coped with university from her recollection of her first day, when she felt lost and asked for help in a mosque. While she shared some of the low points during her lockdown, such as being in a single room and how her self-esteem was negatively impacted due to weight gain, she maintained her mindset that she did not want to be depressed like some of her friends (which in Amira's analogy, would be considered sinking). She shared how she kept in touch with family and stayed productive, which are all coping strategies for staying afloat.

Returning Onboard

The turning point in Amira's narrative occurred after being away from her family for a year. In her words,

> I knew that I had to come back. Despite border shutdown, I knew I had to come back because then it would be hard for me.

Despite coming to Australia to get out of her comfort zone, Amira had a good grasp of when it was time to get familial support, which led her to return home despite the consequences of the time difference. In other words, Amira knew when it was time to return onboard before the sea

conditions worsened. Family was clearly important to Amira, as they prompted her to make the unconventional decision to return home. This decision reflects Amira's agency and independence in making decisions that work for her. In her narrative, there was also repeated use of how it's the best decision, and how she doesn't regret it, which shows Amira's ownership of her decisions.

In Amira's narrative, it is clear that she cares about her family, which is reflected in how she shared that her family's pride in her attainment of an internship was the most impactful thing for her, and how what they feel and think matters to her when she showed them the websites she had built.

In my case, when I situated my experience within the frame of Amira's analogy, I realised that the ship, while safe and comfortable, was not always headed in the direction I wanted. While I had the option to return home during the lockdown, where I had a stronger support system, I chose not to. Perhaps it was because I was pursuing a path that my parents didn't support at the start, so unlike Amira, returning home came with challenges that were personally harder to manage than living alone overseas. Instead of returning onboard, I decided to stay in the sea and swim in rough water. While tougher, this decision gave me more freedom to pursue what I wanted and swim towards my desired destination.

In the next section, I discuss how Amira entered engineering and coped with her degree.

9.2.2 Practical – Alternate Paths and Plots

In Amira's story, I constructed her narrative chronologically to describe how she came to do Software Engineering. According to that order:

1. She chose Computer Science in high school because she "just knew it was a good option."
2. After being exposed to the practical applications of Computer Science, she decided to do Software Engineering.
3. She considered Biomedical engineering, but eventually decided on Software Engineering because of its broader range of applications.

When Amira's narrative is viewed in this sequence, it is similar to the narratives of students who decide to do engineering because they like math and physics, though Amira's exposure is much more specific. However, in constructing Amira's narrative, I looked deeper into the options she did not choose – Computational Biology and Biomedical Engineering. These options were only briefly mentioned and seemed tangential to her narrative of pursuing Software Engineering. However, when I read the transcript as a whole, I constructed a different plot that further explained how she chose Software Engineering. The below excerpt was used as a starting point:

> I'm going to be honest, from my high school I was more inclined towards engineering, like something which was a combination of- which also had some angle of this one, Bio. So I was looking into Computational Biology or something like that.

I was slightly confused because she mentioned that she was not inclined to do Biology because of the need to memorise the subject matter. Furthermore, I personally didn't consider Computational Biology as a stream of engineering, which is a reputable degree in Amira's context. However, the exchange below helped me understand her choice:

> Wenqian: How did they (family) respond when you decided to do Software Engineering?

> Amira: They were happy. The other thing is that as an Asian, I think you can also relate to it. You can be doctor, engineer. That's it. So yeah. So they were definitely happy that I chose Software Engineering because, for them, it's a much reputable degree.
>
> Wenqian: Do you think they would have responded the same if you, for example, did Computational Biology?
>
> Amira: Yeah, they would be definitely supportive of me because definitely it is like bio along with engineering so I think they would have been supportive definitely. So yeah.

In prompting how her parents would have responded if she had done Computational Biology, I came to understand that the reason they were happy was not just because it was engineering. As Amira pointed out, being a doctor or engineer is the only option in her culture. Hence, in Amira's case, doing a degree that combines aspects of being a doctor and engineer would have been ideal. This reasoning, along with how Amira has demonstrated how much her family means to her in other parts of her narrative, explains why she considered Computational Biology and Biomedical Engineering.

In the chronologically ordered narrative, we started by understanding Amira's personal inclination towards her high school subjects, followed by her considerations in choosing a degree, and ended with her family's response to her degree choice. With each biographical timestamp, we uncovered her thought processes at a subject level (Biology, Computer Science), degree level (Computational Biology, Software Engineering) and profession level (doctor, engineer).

However, unpacking her family's response led to further interpretation. Rather than her inclination towards Computer Science leading her to eventually do Software Engineering, it is the perception of what is a reputable job that actually led her to do Computer Science in high school (and why she "just knew Computer Science was a good option"). In making sense of her decisions narratively, I discovered the cyclic process of decision-making, and how personal interest and societal norms interact with each other. This section also demonstrates how narrative inquiry does not aim to produce an objective account of narratives (Clandinin, 2016), and how the same data elements can produce more than one plot (Stake, 1988).

Amira's narrative highlights several important considerations for practice. In studying engineering participation, there is a need to think beyond individual interest and motivation, and consider how societal perceptions shape them. A deeper look into paths not pursued can also enhance understanding of engineering participation.

In the next section, I will discuss other aspects of Amira's transcript that weren't included in her constructed narrative for various reasons, and how it is associated with my rapport with Amira.

9.2.3 Methodological - The Issues with Narratives

In qualitative research, establishing rapport with participants typically results in richer and more authentic data. In the context of information power, a concept I discussed in Chapter 3: Methodology, a strong dialogue, defined as a dialogue between a researcher and a participant with a strong rapport, is used as a justification for using a small sample size (Malterud et al., 2016). The rationale is simple – a participant is more likely to share honest thoughts when they trust the researcher, and the researcher will get more out of the participants with whom they have a strong relationship.

However, my interview with Amira challenged my understanding of rapport. With most participants, I tend to struggle with having too much data, and I often have to make difficult decisions on what to focus on, or omit content from their transcripts to construct a smooth narrative.

Amira was my fourth participant (I interviewed eleven in total). When I interviewed her, I was still navigating how to establish rapport with my participants. Earlier in the interview, I noted how Amira related to me through the statement "The other thing is that as an Asian, I think you can also relate to it. You can be doctor, engineer, that's it." When I learned that she volunteered for an organisation that I also volunteered for, I mentioned it and we went on a tangent discussing some shared experience. As the interview progressed, Amira became more relaxed. However, when I was constructing her narrative, I found that there weren't many excerpts from the later part of the interview that were relevant enough to my research to fit into her constructed narrative. I will share an example and discuss the implications of rapport with Amira.

In Section 3.2.1.4: *Interview Protocol*, I described my interview protocol, including an interactive activity. As part of the activity, which was inspired by a meme, participants were invited to use pictures to describe their perceptions of engineering from different perspectives such as their family, friends, lecturers, and society. The pictures they choose are not the main source of data. Rather, they are used to elicit stories about engineering perceptions.

Amira was relatively excited about this activity. As a Software Engineering student, she shared a picture of someone dismantling a laptop and spoke about how her family thinks she can fix their laptop. While looking for other pictures, she made comments such as "The greatest meme that we've got" and "Now look at the next picture. You're going to love it." Among her comments, I will highlight three of them briefly to discuss what it means for our rapport and my research.

"It's a really cute image so that's why I added it."

Amira said this when she added a picture of a cat using a computer to describe her friends' perceptions of what she does in engineering.

> Oh, so with this it's just like- so me and my friends, we have this thing when we say we are busy working. We just send this emoji GIF (cat using a computer) to each other. I don't know. It's a really cute image so that's why I added it. That's it.

We then launched into a short exchange on cats and cat accounts on Instagram before I prompted her to explain the next picture. Although her statement helped me understand her relationship with her friends and her carefree personality, I wasn't sure how to make sense of it because it seemed to lack rationale. I didn't know how to interpret the picture and her explanation of it in the context of culture and identity.

"You got it? I hope you got this one."

Amira said this when she added a picture of a screenshot from Stack Overflow, a question-and-answer website for programmers. This picture describes what she actually does in Software Engineering. Having done an internship as a software engineer, I immediately understood what she was referring to – that in reality, software engineers spend a large amount of time on Stack Overflow finding solutions to their problems. It was the website I accessed most often throughout my internship.

However, looking back at the transcript, I did not prompt her to explain further. On the one hand, the rapport we had from shared experience enabled me to understand what Amira was trying to convey even when she did not say it explicitly. On the other hand, I may have missed an opportunity to uncover an important narrative due to my complacency as a researcher. As I was complacent with the rapport between us, I assumed meanings without seeking to elicit further clarification.

3 Idiots

In describing her lecturers' perceptions of what she does, she shared a scene from the movie 3 Idiots, a Bollywood comedy film about three students at an Indian engineering college.

> Amira: By the way this is – this scene is from an actually Bollywood movie so yep. It's actually very funny, yeah.
>
> Wenqian: [Laughs] You will need to give me a bit of explanation when you're done (adding pictures) with this because I haven't watched it yet.

She later explained:

> In this scene, so he's asked by the professor to explain any two concepts related to Mechanical Engineering. So he chooses these two which are 'Farhanitrate' and then 'Prerajulisation'. But then when you first look at it, you may think these are actual terms related to Mechanical Engineering, but then these are names of his best friends which he just converted into Mechanical Engineering terms.

Amira's detailed explanation of the scene sheds some light on how her lecturers might perceive students as the characters in the movie. However, there wasn't much scope for interpretation that would add value to the constructed narrative (like the picture of a cat using a computer), and I didn't prompt for sufficient details to add value to my research (like the screenshot of Stack Overflow).

Perhaps a follow-up interview with Amira would have given me a better picture of how these pictures relate to other aspects of her narrative. However, this is an instance that prompted me to think about how rapport can sometimes lead to less meaningful responses and interactions, which I further discuss in Chapter 10: Discussion.

Chapter 10

Discussion

In Chapter 1: Introduction, I presented my research puzzle to highlight the *who* (research participants), *what* (research aim), and *how* (research methodology).

- Focuses on women international students who are enrolled in an undergraduate engineering degree in an Australian institution
- Starts with a broad aim to understand how women international students came to do engineering, as well as their experiences with engineering
- Involves collecting, interpreting, and presenting narratives from women international students

To guide the interpretation and analysis of participant narratives in the Reading of each participant, I discussed the findings of this research based on three dimensions – Personal, Practical, and Methodological.

- in Personal, I address why these narratives matter to me personally to guide readers in understanding the inquiry in more depth;
- in Practical, I outline aspects of the narratives that illuminate considerations for practice;
- in Methodological, I explore issues associated with narrative inquiry as a research methodology.

In research utilising narrative inquiry as a methodology, the purpose of a Discussion chapter is to create a link between "the past world of the story to the present world of the storytelling" (Patterson, 2013, p. 32). Describing narrative inquiry as both descriptive and interventionist, Kim (2016) emphasises the importance of bringing the readers back to the research puzzle and discussing what happens next with these stories. What happens next may take the form of personal, practical and methodological implications. However, as discussed earlier in this thesis, narrative inquirers do not aim to present a 'correct' version of the reality or provide answers to the research problem. Hence, the discussion chapter should invite ongoing stories rather than providing a final story. As Kim (2016) puts it,

> Through an accumulation of our ongoing stories, we are participating in the process of transforming the world into a better place, little by little, although the change may take place with the speed of water dripping upon a stone, whose definite erosion is not noted until many years later. (chap. 7, Becoming a Scheherazade section, para. 8)

Building on the Readings from previous chapters, this chapter continues the threads from the Personal, Practical and Methodological dimensions. In Personal, I discuss my story in relation to the participants' narratives. In Practical, I pull together analytical threads across participants and highlight how they collectively prompt a deeper understanding of the population and the phenomenon. In Methodological, I discuss the considerations and limitations of the adopted research methodology.

10.1 Personal - The Missing Story

In this section, I reflect on my own pre-university journey in relation to the stories shared by the participants. I share the two paths I did not take – medicine and commerce, and the path I eventually took – engineering.

I often get asked when I share my research topic: "how similar or different were your participants' experiences compared to yours?" I usually avoid answering them because narrative inquiries do not seek to answer questions (Clandinin, 2016), but saying that out loud seemed obnoxious. However,

I acknowledge the validity of this question in a discipline where narrative research is sparse and seek to address it in this section.

When I started interviewing participants on their journeys into engineering, I expected stories with heroic arcs (i.e., participants being told they cannot do engineering and overcoming negative stereotypes to excel in engineering) (Campbell, 2004). While most participants described the challenges they overcame during their studies, their entrance to engineering did not involve as much resistance as I expected. Apple and Amira were raised in a family of engineers and came from a culture where doing engineering is extremely common to the point of being saturated. Mabel decided to do engineering amidst confusion because her parents are engineers. Zoe's parents are not engineers, but engineering is a well-regarded profession in her culture and is positively associated with employment and migration prospects. Yasmin and Maya's parents aren't engineers, but they fully trusted their abilities and supported their decision to do engineering.

The contrast between me and the participants' narratives is mentioned to emphasise that narrative inquiry is not just 'navel-gazing,' or a methodology in which researchers tell their own stories through the 'voices' of their participants (Goodson & Gill, 2011). Rather, incorporating the researcher's story acknowledges that knowledge is relational (Munro, 1998). In Munro's work, she weaved her own story into her participants' stories to create a "tapestry" of their lives, which she considered an epistemological act (p. 11).

Reflecting on my journey, I identified a *missing* story - the lack of familial resistance in the participants' stories. As to why familial resistance is not present despite being a common topic in the literature (Dutta, 2017), the most obvious inference is that the participants are not representative of the population I am researching. However, as discussed in Chapter 3: Methodology, representativeness is not an appropriate quality criterion for narrative research, where enduring theories can be developed based on in-depth studies with a few individuals (Riessman, 1993).

Through the participants' stories, I arrived at a renewed understanding of my own story, which contributes to enduring theories on the role of the family in study and career choice. In this section, I share how my pathway into engineering was entangled with my family's aspirations and expectations.

In previous chapters, and more prevalently in Mabel, Zoe, and Apple's Readings, I discussed how my decision to do engineering was broadly informed by my interest in exploring the depths of math and physics, my understanding of what I didn't want to do (medicine and commerce), and a hint of ulterior motive in finding my edge as the youngest and 'least knowledgeable' member in my family. One aspect that was not detailed was why my family discouraged me from doing engineering.

To be honest, I do not have a definite answer (this is unrelated to the notion that narrative inquirers do not seek answers). What I can offer instead is my meaning-making process, where I infer semantic conclusions based on episodic information (McAdams & McLean, 2013). I do so in the following three sections:

1. The path not taken 1: Doctor
2. The path not taken 2: Commerce
3. The path taken: Engineering

10.1.1 The Path Not Taken 1: Doctor

In Chapter 5, Yasmin spoke about how toys shape gender stereotypes in careers.

> I think it starts from a very young age. I feel like toys, in general, when you're a child, you play with toys and that's where your learning starts. If you're told that this toy drill is a boys' toy, that sticks with you. I guess that plays a very important role.

Yasmin discussed how the toy sections in stores are categorised by gender. For example, you will find construction sets and LEGO in the boys' section; and kitchen sets and artistic supplies in the girls' section. When I think of the toys I grew up playing with, my brother was bought LEGO while I was bought doctor sets. I remember having a set of toy medical equipment, such as a body thermometer, and giving my paternal grandmother a 'medical check-up.' After she passed away when I was six, I stopped playing with these toys.

However, my mother constantly instilled in me that it would be good for me to be a doctor. When I was younger, she pointed to my astigmatism, skin allergy and frequent stomach aches as reasons

I should study medicine. For her, it would be reassuring to understand the cause of my conditions and how to cure them. As I got older, she shared the appeal of opening my own practice, such as the flexibility to determine my own working hours and to take a break whenever I wanted. This flexibility was something my parents did not have in their jobs. These considerations expand on Apple's narrative, where she spoke about how some women prefer to be doctors, which is deemed a safer and more refined profession.

As to why becoming a doctor did not appeal to me, I often felt burdened by the thought of being responsible for someone's life. This perception was based on my limited understanding of the medical specialisations that were commonly featured on TV shows that I grew up watching. In retrospect, when I was giving my grandmother medical check-ups, I was more interested in the technicality of the medical equipment rather than the idea of healing someone, which probably explains why I was drawn to engineering.

Apart from the influence of toys, Yasmin also spoke about a math teacher who made her want to do engineering. As discussed in Mabel's Reading, my interest in math and physics started growing in secondary school. During a parent-teacher meeting, I remember looking forward to my mother meeting my physics teacher because I scored well in physics that semester. However, when my mother asked him "what profession do you think she should pursue?" my physics teacher replied, "she is so smart, she should be a doctor." For years, his response felt like a betrayal, until I heard Apple's narrative on how doctors are perceived as smarter than engineers in her culture.

As I shared in the Readings of Mabel and Apple, my mother did not give up on pushing me towards medicine. When I volunteered with Engineers Without Borders during my undergraduate degree, she questioned why I did not become a doctor instead if I wanted to contribute to aid in a development context. When I was in the final stages of my PhD, she was diagnosed with a heart defect, and I learned about how valves worked. As my parents described what they heard from the cardiologist, my mother told me, "the heart is so mechanical, you should have become a doctor if you liked mechanical stuff." They even jokingly asked if there was an express pathway to study Medicine if I had a PhD, since I would be a 'doctor' as well.

These incidents show how I have been pushed towards medicine throughout my life. As a child, I was bought medical toys to cultivate my interest in medicine. As a teenager, my medical conditions and grades were used to reinforce why I should study medicine. As an adult, my actions and

interests were constantly raised to question why I did not become a doctor. In the next section, I discuss another path that was not taken other than medicine.

10.1.2 The Path Not Taken 2: Commerce

As I discussed in Mabel and Apple's Readings, I became firmer (or from my parent's perspective, more rebellious) in my choice to do engineering when I was taking a pre-university course. I had to pick between Biology and Specialist Mathematics; if this was Round 1, I won Round 1 and managed to do Specialist Mathematics. With this win, becoming a doctor was out of the question. Next came Round 2, when I had to pick a university. I had narrowly made the mark for Bachelor of Commerce, which required a higher ATAR score due to the demand, and my mother felt that I was not "making the most out of my scores" by doing engineering.

Why Commerce was encouraged might be linked to Zoe's narrative on business being a mainstream profession. My mother was an accountant, so for her, becoming an accountant was the second-best option for me after becoming a doctor, according to the 'Asian Five' (doctor, lawyer, accountant, engineer, architect). I grew up listening to the pathway I could take to become an accountant, which included getting chartered and 'suffering' for a few years in the Big Four (Deloitte, EY, KPMG, PwC).

When I was 16 or 17, my mother brought me to do an aptitude test upon a colleague's recommendation. The test included questions on numerical literacy, memory application, and orientation. At the end of the test, a 'career counsellor' (I do not remember the exact role) presented my score for each section and suggested career options based on that. I assumed that if you demonstrated significant aptitude in a certain area (e.g., numerical literacy), there would be an accompanying catalogue of suitable career options (e.g., actuarial science).

I did surprisingly well on the test. When my mother asked her what the scores meant regarding career prospects, she replied I should go into investment banking. I had no idea what that was, but according to my mother, it was a lucrative job that required high intelligence. The career counsellor asked if I was interested in anything, and I carefully said 'engineering,' to which she expressed distaste and said that I was too smart for that and will be "working with stupid men" if I did engineering.

My mother was elated for days after the aptitude test. From her perspective, it meant that I could pursue an intellectually challenging and financially rewarding career, which is her definition of success and happiness. On the other hand, I was confused for days. What did the career counsellor mean by "stupid men?" Was it based on her understanding of engineering as a job that involved more manual labour than intelligence? Did she use the term "stupid men" to deter me from doing engineering, or was it a derogatory remark about blue-collar workers? What did she know about engineering?

It was only when I was midway through my engineering undergraduate degree that I realised what the career counsellor meant. On a family call, I heard from my parents that one of my cousin brothers, who is five years younger than me, was considering engineering. To my understanding, his father (my uncle) works as a welder, so his family was strongly against him doing engineering. For them, doing engineering meant he would be 'stuck' doing what his father did – working in a factory. They wanted him to do a degree where he could work in the office, so he eventually studied Business. This incident helped me understand how engineering is perceived in my culture, and how social class and gender influenced our parents' aspirations for my generation.

10.1.3 The Path Taken: Engineering

I was on a flight to Singapore with my mother and brother for a short trip at the beginning of 2015 when unconditional offers started pouring in from universities via email. I had received an offer to do a Bachelor of Commerce at the University of Melbourne, my mother's first choice and my personal last. Thinking that she wanted me to accept the offer from the University of Melbourne because it was the highest-ranked university in Australia, I told her I would rather go to the Australian National University (ANU). ANU was ranked similarly to the University of Melbourne, and I received an offer to do a Bachelor of Engineering. She refused, saying there was no direct flight to Canberra, so the next options were the University of Queensland and the University of Sydney. At the University of Queensland, I had a friend who did not speak highly of the university, so I said I would go to the University of Sydney instead. She asked me if I was sure, and I said I was. The decision was made during that one-hour flight to Singapore, and I accepted my offer from the University of Sydney upon landing.

In the coming months, my mother connected me with the two engineers she knew for a chat – her cousin and her colleague – both of whom I have only met a couple of times. Her cousin did a PhD in Aeronautical Engineering, and her colleague did a Bachelor of Industrial Engineering. I was not sure what the purpose of the chat was – maybe to dissuade me from engineering before it was too late? To give me advice on navigating the engineering degree? I do not remember the details of the chat – both of them asked me some general questions and did not say anything notable. However, I later learned from my mother that they had convinced her that engineering is a viable career path. Her colleague, who took a Master of Business Administration (MBA) after his engineering degree, told her I could still pursue a career path in Commerce after doing engineering, as engineering is recognised as a difficult degree (my mother was concerned that I would enter the workforce at a lower salary grade as an engineer). Her cousin (my uncle) openly encouraged me to do engineering and told her it was a career path that would open many doors (and he was right).

I found it odd that the people who supported me most were those who barely knew me. It was also interesting that instead of dissuading me or giving me advice, they decided that my doing engineering wasn't an issue and directed their efforts towards convincing my mother. In the end, these unlikely allies helped influence my mother's perception of engineering.

In sharing my narrative, I realised that there were a lot of missing stories that could have been further unpacked from the participants to better understand their pathways to engineering and how their familial and cultural narratives shaped it. These are further unpacked in later sections of this chapter. In the next section, I discuss how the interweaving of my and the participants' narratives impacted me personally.

10.1.4 Shifting Personal Justifications

While constructing the narratives for each of the participants, I had two threads of thought: awe and resonance. Awe as in "wow, their attitude and outlook are really inspiring, I wish I was more like them;" resonance as in "oh, so that explains why I felt that way when I was in a similar situation." While these are implicitly discussed throughout most of the Readings, I draw on some personally significant shifts in this section. By applying Clandinin et al.'s (2013) framing of 'shifting justifications,' I discuss how I have been shaped by the experience of participating in this inquiry with Mabel, Yasmin, Zoe, Maya, Apple, and Amira.

There is a shared understanding that the final months of a PhD can be very challenging. During these months, I often kept myself going by reminding myself that one day I would look back and be proud of what I had achieved. One day, it occurred to me that I had internalised Maya's outlook, which was repeatedly emphasised in her narrative, "challenges are what makes life interesting, and overcoming them makes life meaningful." I had never come across this framing of challenge before meeting Maya, but I have subconsciously adopted it, which helped me become more resilient. Whenever I came across a challenge, my first response became, "this is interesting, let's see what I can do to overcome it."

Maya's narrative is just one of many examples. There are many more participants whose narratives were not shared in this thesis due to the scope and timeline of my PhD, but every time I revisit them, I find aspects of their narratives that impacted my own attitude and outlook. A recurring theme is agency, which I view as one's sense of control over their decisions and journey.

Similar to familial resistance, I believe the way the participants' exercise their agency stood out to me because I felt it was missing from my personal story. Compared to how Apple articulated her decision to study overseas and how Maya shared her dream, I was sometimes ashamed of how little I thought about what or where I wanted to study when I was their age. However, as I weaved my stories into each narrative, I realised that there were moments where I exhibited agency (e.g., when I insisted on doing engineering and did what I could to manage life as an international student). Engaging with the participants became a liberating act for me, as it created space for me to reconsider the stories I tell myself, the stories I live by. Although this research was initially intended as a platform to amplify the voice of the participants, their narratives ultimately gave me a voice.

Personally, I associate voice with visibility and representation. While I have reservations about the quote "you can't be what you can't see" because it undermines how underrepresented groups are capable of forging their own paths, representation is essential. However, representation is not just seeing someone who looks like you; it is also seeing someone who does not look like the dominant group. Representation is not just about gender and race; it is also about other aspects of one's identity that contributes to their belonging in a community.

For instance, I mentioned in Chapter 1: Introduction that I first came across the field of engineering education research through my undergraduate thesis, and had the opportunity to present my work at a conference. As engineering education is an emerging field of research, participants of the

conference mainly comprised engineering academics who did a technical engineering PhD and were interested in education. Among those who did a PhD in engineering education, they were primarily experienced engineers, educators, or academics. I often wondered, "who was I to pursue a PhD in engineering education? What knowledge or qualifications did I bring?"

As discussed in Chapter 1: Introduction, my self-doubt may be attributed to the saturation of literature in the Western context that led me to compartmentalise my worldview and lived experience. When I interviewed the participants, I realised many were grappling with similar questions on visibility and representation. Like me, they often wondered whether they belonged in engineering, and whether their stories were valid.

One benefit of the life story interview is that it can "help people see their lives more clearly or differently and perhaps be an inspiration to help them change something in their life" (Kim, 2016, chap. 5, Life Story Interview/Biographical Interview section, Table 5.1). For me, my engagement with the participants' stories translated into a change in mindset while I was involved with Engineers Without Borders Australia. When I was tapped for promotional videos, blogs, and livestreams, I was initially reluctant to share my story or appear in videos that would be widely circulated. At some point, however, I began wondering, "what are the consequences if I do not make myself and my story visible?" While insignificant to myself, I learned that my story might be the representation someone else needed. Through the participants, I realised the need for marginalised groups to see people who do not look like the dominant group (not just people who look like themselves), and to hear stories with which they can resonate. Through sharing stories, we create community and realise we have more in common than we thought (Kim, 2016).

The impact of narrative inquiry on voice and visibility is further discussed later in this chapter. In the next section, I discuss how this research contributes to our understanding of women international students in engineering, which a lack of representation has hampered.

10.2 Practical - The Shared and Untold Stories

In Chapter 2: Literature Review, I discussed how the pipeline metaphor is at odds with the reality of multiple journeys and intersecting identities, and how the pathway metaphor fails to represent complex decision-making processes where personal, familial, and cultural narratives are entangled. Arguing that cognitivist approaches overemphasise individual traits while playing down the importance of sociocultural contexts, I turned to narrative inquiry as a methodology, which Clandinin (2016) defined as "an exploration of the social, cultural, familial, linguistic, and institutional narratives within which individuals' experiences were, and are, constituted, shaped, expressed, and enacted" (p. 18).

In this section, I pull together analytical threads across participants' narratives to orient readers towards implications. In these discussions, I attend to the *shared* stories – the different narratives that shaped their motivations to study abroad, pathways into engineering and perceptions of engineering. I also discuss challenges in online learning and policy impacts on international students.

As the narratives presented in the Findings chapters were curated to highlight the uniqueness of each participant, aspects that were less significant to individual participants were omitted as part of the process of narrative smoothing. However, some of these excerpts (the *untold* stories) are included in this section where relevant to the discussion.

10.2.1 Motivation to Study Abroad

This section focuses on the participants' decisions to study in Australia and their universities.

As discussed in Chapter 3: Methodology, I initially analysed the participants' narratives using paradigmatic cognition, which focuses on identifying common themes or concepts from stories. I extracted excerpts related to their decision to study in Australia, their choice of state/city, and their university. Most participants mentioned considerations that Nghia (2019) summarised from their research on motivations to study abroad (refer to Table 2.2 in Chapter 2: Literature Review). However, there was limited mention of considerations that were specific to Australia.

For instance, Maya and Amira wanted to study abroad to experience foreign cultures. Maya shared that it was an opportunity to meet people with different perspectives about life, while Amira wanted

to get out of her comfort zone. Apple disliked the 'bookish' approach of local universities, which she described as the emphasis on theory rather than practice, and the lack of technology usage. Mabel, Yasmin, and Amira each shared how they considered Australia after they did not get into other universities in other countries for various reasons.

Zoe was the only participant who shared in detail how she came to study in Australia. She shared that she had some cousins in Australia, which led her parents to propose Australia as a study destination. As both her elder brothers commenced their studies in Australia, she eventually followed suit for practical reasons (e.g., family support and sibling discount). In her narrative, she also shared that her parents had considered immigration opportunities, which influenced her choice of study.

Noting that the individual participants' decisions to study in Australia could not be simplified into a discrete list of factors, I switched from paradigmatic cognition to narrative cognition, which focuses on holistically making sense of their stories. One feature of narrative cognition is that knowledge moves from case to case rather than case to general (Polkinghorne, 1995). When I constructed Zoe's narrative and understood how her family influenced her decision to study in Australia, I realised most of the participants mentioned their family in response to my question "how did you come to study [engineering discipline] in [current university]?"

The mention of family is most obvious in Mabel's narrative, where she shared that her father pushed her to go to Australia because she has an older sister in Australia and has lived in Australia as a child. For other participants, the role of family emerged as a major factor when they explained why they chose to study in a particular state, city, or university. Like Mabel, Maya mentioned that she has an older sister in Australia. Meanwhile, Apple and Amira pointed out that they chose to study in a particular city as they had family there.

> Amira: Other states were out of question for me because I have family in [current city].
>
> Apple: My uncles and aunt live in [current city] so that is also a reason with my parents because I'm just 18 - I'm 19 I think now.

When I positioned family as a key factor, the ambiguity in the participants' narratives made sense. Apart from Yasmin, all participants had siblings or relatives in Australia. Familial support, among other reasons, prompted their parents to consider Australia (and in most cases, a specific state or

city) as a study destination for them. Participants then considered potential universities within these states or cities and chose one that matched their preference. Hence, when asked why they chose to study in Australia, their reasons were likely informed by what they understood from their parents. In other words, their experiences were constituted, shaped, expressed, and enacted within their familial narratives (Clandinin, 2016).

I was able to uncover the role of the family due to a feature of narrative interviews – the use of 'how' questions rather than 'what' or 'why' questions. If I had asked "why did you choose to study in Australia?" the response would have likely been more succinct. Due to demand characteristics (discussed later in this chapter), participants are likely to offer what they think researchers want to hear (Orne & Whitehouse, 2000). In this case, citing family as a reason may not appear to be useful. The use of 'how' questions created space for loose threads and relieved participants from the need to provide airtight reasoning or 'well-packaged' answers. Through narrative interviewing, what initially appeared as a minor factor became analytically important (Riessman, 2012). By taking a holistic view of each participant's journeys (as opposed to looking for 'answers' where I asked the 'questions') I came to infer the role of their families in their decisions to study abroad.

The narratives in this study suggest that the need for support in a foreign environment drives the decision to pursue studies in a location where they have family connections/members. These findings are in accordance with a common critique in migration research, where the social network is often undervalued in studies of migrant decision-making (Bruzzone, 2020). The arguments in this section further emphasise the limitations of a cognitivist approach that overemphasises individual decisions. For international students, the role of the family is likely more prominent because they are financially funded by their families, resulting in unintended power dynamics where participants cannot challenge their parents' decisions. Future studies on international students should focus on the interplay between individual, familial and cultural narratives to develop a robust understanding of the motivations of this population.

10.2.2 Pathway into Engineering

The interplay between individual, familial and cultural narratives extends to the research participants' pathways into engineering.

For instance, Mabel considered arts, a path not supported by her father. In choosing engineering, she negotiated on the idea that "if you squint closely, it is kind of a form of art in a way." Yasmin was interested in architecture but did not get an immediate offer to study architecture at her preferred university. Although she eventually received an offer, she believed that "everything happens for the best" and decided to pursue a double degree in Engineering and Architecture. Zoe was considering education and eventually studied engineering for various reasons related to her family. However, she reasoned that like education, engineering was "still helping people," but on a societal level.

Maya grew up dreaming of making a difference in the world through medicine. When she realised how she could make a difference through engineering, it made her "have a dream about versatility," which she realised by pursuing Biomedical Science and Engineering. Apple's familial and cultural narratives were strongly centred around engineering, which led her to pursue engineering with the mindset that she could do anything after completing her studies. Amira was looking for a degree that combined being a doctor and engineer, and initially considered Computational Biology. She eventually pursued Software Engineering because of the prospects of working in multiple sectors.

In Chapter 2: Literature Review, I argued that the pipeline and pathway metaphors do not reflect the multiplicity in journeys. However, these narratives further emphasise that the pathway into engineering is by no means linear either. As Cisneros (2002) puts it, "plotlines convolute and spiral, lives intertwine, coincidences collide, seemingly random happenings are laced with knots, figure eights, and double loops" (p. 429). While these research participants eventually entered engineering, the diversity in pre-engineering pathways demonstrates a gap in the literature and highlights that increasing participation in engineering is not as simple as increasing the supply at the start of the pipeline through outreach initiatives. By opening the door to this complexity, narrative methodology contributes to a deeper understanding of how participants negotiated their pathways into engineering.

10.2.3 Perceptions of Engineering

For the participants, their pathway into engineering is influenced by individual, institutional, and cultural perceptions of engineering.

In A Reading of Zoe, she described how her engineering program is structured such that all students do a general subject in their first year. This subject aims to introduce students to different streams of engineering before they choose an engineering specialisation in their second year. Zoe's approach to choosing Environmental Engineering was primarily a choice by omission.

> So I picked environmental because I didn't want to do mechanical. It's a lot of movement, and I just don't want to do that. Civil was also- I had a taste of civil from one of my first year engineering units, and I was like, ah, I don't want to do that. And then I was like, oh, why not the environment?

While Zoe later elaborated that she appreciated the variety of subjects offered in Environmental Engineering, her seemingly simple reasoning led me back to other participants' narratives, and how they chose their engineering specialisations. For instance, Apple was interested in trying Physics and thought Aerospace Engineering would offer the academic rigour she desired. Amira initially considered Biomedical Engineering, but chose Software Engineering because of the potential to work in different sectors. Mabel considered Aerospace Engineering and Environmental Engineering, but chose Mechanical Engineering because the breadth of applications meant she was not restricted.

In the reasons articulated above, there was limited mention of the application of these engineering specialisations. For instance, Apple did not mention anything about aircraft. This finding suggests that the practical applications of different engineering specialisations were not salient to participants when they made their choice. Zoe's narrative further suggests that the general subject did not play an important role in informing students about their choice of engineering specialisations. It is only later in their degrees that they start exhibiting a deeper understanding of their specialisation.

However, stereotypes of different engineering specialisations pervade their social settings. Mabel expressed her frustration on how Mechanical Engineering is almost exclusively associated with cars, and Zoe shared how her friends associate Environmental Engineering with greenery (by jokingly assigning her to mow the lawn). Amira mentioned how her family thinks she can fix laptops and printers, while her friends think she can hack websites.

The lack of familiarity with engineering can contribute to social pain, which is the experience of "rejection, feeling left out, or feeling like one does not belong," which "triggers a neural reaction

that may be analogous to a reaction to physical pain" (Ong et al., 2020, p. 595). As discussed earlier in this chapter, narrow stereotypes of engineering (i.e., working in factories) resulted in pushback from my family which required additional resistance from my end to overcome. Since students from underrepresented backgrounds are less likely to know someone who is an engineer, they are also less likely to be supported to pursue engineering.

These findings speak to the need for better representation of the engineering profession. They raise questions on how engineering is represented publicly, and how the engineering curriculum communicates different specialisations. As one of the reasons women are underrepresented in engineering is due to their lack of familiarity with engineering (Romanis, 2022), a further investigation into the perceptions and representations of engineering will inform interventions that can promote engineering more broadly to attract students from diverse backgrounds.

10.2.4 Challenges in Online Learning

Apart from attracting students from diverse backgrounds, it is important to ensure they are supported throughout their studies.

In previous chapters, I discussed some challenges faced by the participants while engaging in online learning. For context, Mabel, Yasmin, and Zoe were in Australia during the lockdown, while Apple and Maya were offshore. Amira was onshore for a year before returning home and studying offshore. This context is given to guide understanding of the range of challenges they faced.

Mabel, who studied onshore, shared challenges that were most closely associated with gender. In particular, she described online learning as a double-edged sword. On the one hand, she did not feel as surrounded by tall males or experience as many male gazes as when she was in a physical space. On the other hand, being in an online breakout room was more isolating, as the difference in vocal pitch caused her to stand out more.

In Amira's case, the effects of the lockdown were prominent in her narrative, prompting her to return home. However, she had to weigh her decisions and eventually compromised on sleep quality for family support. Similarly, Apple selectively joined social activities, which often came at a cost – waking up at 5:00am. Maya's narrative further demonstrated the disruptive nature of time zone differences in her study, especially when combined with internet connectivity issues. Apple and

Yasmin shared similar reflections on how studying alone can be demotivating and emphasised that being around people would help them focus more and procrastinate less.

> Apple: If you are on campus and see so many people around you studying, it's just like I also should complete this. I can do this. But you don't have that here. So we just okay, I have time, chill. It's all relaxed. It'll happen. It's that mode. If you are on campus I would wake up at 6:00am and otherwise now, like normally people if they have 9:00am classes, they just wake up at 8:50 and just comb their hair, or not, and sit on the Zoom call.
>
> Yasmin: There used to be moments last year when I just turned on the Zoom call and take a nap literally.

While most universities are gradually transitioning away from online learning, these narratives highlight how online learning disproportionately affects students from marginalised backgrounds. Although these impacts are unintended, they reiterate the need for educators to look beyond check-box solutions that do not account for unexpected circumstances such as the pandemic. It is important for educators to be in touch with students' evolving needs and adapt their practice accordingly rather than sticking with the default.

10.2.5 Policy Impacts on International Students

Students' experiences are not limited to their academic setting. For international students, policies can affect them in a wide range of ways, in perhaps unintended aspects of their lives. This section discusses some examples.

Across the participants, Zoe and Mabel, who were in their final year of studies, expressed stronger frustration towards policy issues compared to participants in their first year such as Maya and Apple. In Mabel's narrative, she shared how she had to quit a student club with a high workload because she could not underload as an international student. Zoe found this policy unfair, as it was difficult to juggle full-time studying and extracurricular activities.

> Yeah, I do think balancing everything is hard. Like it's doable, but it takes a toll on your physical and sometimes even mental health. So I do think it does have an impact,

> because you're not being as efficient or immersed in what you're doing, and that lowers the quality of the work you put into.

Besides the toll on physical and mental health, Zoe also shared other barriers international students face due to the limitations on work hours. For context, international students in Australia are only allowed to work 40 hours per fortnight. In her narrative, Zoe highlighted that it is harder for international students to get recruited as their work hours are limited.

As Zoe pointed out, these policies put international students at an unfair disadvantage, as they are hindered from meaningfully participating in activities that contribute to career development. The literature has discussed visa-related challenges faced by international students in relation to working eligibility, local employers' reluctance to engage with them and additional learning load compared to domestic students (for context, international students are required to undertake full-time study due to visa requirements while domestic students are allowed to undertake part-time study) (Vu et al., 2022). However, there has been limited policy change that addresses these issues. Yasmin shared her frustration with how international students are often viewed as commodities.

> I feel like the past two years have really showed international students how much the government doesn't care for us. Our feelings are not considered whatsoever. It shows that we're just money makers for the Australian government.

Yasmin further noted that international student fees were increased while domestic student fees remained the same. She pointed out the unfairness of being considered a resident for tax purposes while being treated as a non-resident for welfare purposes. She also shared the flippant comments she received.

> It's very hurtful to hear comments from people saying that, why don't you just study in your country? They don't realise that everyone's trying to just have a better life.

Despite unfavourable policies, most participants expressed their intention to stay in Australia after completing their studies. However, complex immigration policies complicate post-study considerations. For instance, Yasmin wants to do a Master's in Architecture in the UK but was concerned

that it conflicts with her plan to gain a Permanent Residency visa in Australia, which requires many steps. While Amira had a more carefree outlook, she spoke about wanting to use the experience and connections she has established in Australia.

> I feel that so much effort has been put in so I would want to be here if things work out. Like if the policies work in my favour, so let's see.

As discussed in Chapter 2: Literature Review, international students form half the supply of professional engineers in Australia. Supporting them in transitioning to a permanent visa is critical to strengthening Australia's skilled workforce. Given that women international students demonstrate stronger motivation to stay in Australia due to their intolerance of cultural practices in their home country (Boey, 2014; Nghia, 2019), further research on this population will contribute to their retention in Australia's engineering workforce.

The participants' intention to stay in Australia is associated chiefly with employee benefits (salary, annual leaves) and workplace culture (work-life balance, relaxed environment). Mabel and Zoe noted that there is less social hierarchy in Western cultures.

> I guess the whole non-rigid hierarchy between co-workers is something that I do appreciate. In a lot of Asian cultures, there's a lot of emphasis on seniority. It's just nicer to not have someone always looming over you.

The findings presented in this section reassert the need to view the experiences of international students more holistically. A closer look at how they are impacted by government and workplace policies is an area for future work that can contribute important insights to policymakers at all levels.

10.2.6 Shifting Practical Justifications

In Chapter 2: Literature Review, I critiqued the prevalence of deficit thinking in studies on students from underrepresented groups. I introduced Community Cultural Wealth (CCW), and the six forms of capital proposed by Yosso (2005): aspirational, linguistic, familial, social, navigational, and

resistant. This section outlines relevant forms of capitals (aspirational, familial, and navigational) exhibited by this study's participants and discusses implications for future research.

In STEM education, *aspirational capital* is most often associated with the persistence of marginalised groups. Across the participants, this form of capital is most evident in Maya's narrative, where she articulated her dream and demonstrated how she overcame challenges. The varied ways other participants exhibited aspirational capital contributed to the development of this concept. For example, Apple described her goal to build a school after completing her studies. Throughout her studies, the thought that "you can do anything after engineering" contributed to her persistence to complete her degree. In Apple's case, if she leaves engineering as planned, it should not be associated with a lack of aspirational capital. Her narrative also challenges assumptions on engineering attrition.

Mabel and Zoe may appear to lack aspirational capital, as their families considerably influenced their decisions. However, they each demonstrated increasing ownership of their journeys as their narratives progressed. A holistic look at their narratives suggests that aspirational capital should not be seen as something possessed at a certain point in time. Instead, it can be gradually acquired as they progress through their lives.

As presented in previous chapters, most participants possessed *familial capital*. Earlier in this chapter, I discussed how most of the participants' study destinations were driven by the presence of familial support. In pursuing engineering, Maya and Amira spoke about how their families had high expectations for them, which Denton et al. (2020) found in multiple studies. Yasmin and Apple shared that they were supported to pursue engineering as their families were open-minded and unorthodox. However, Mabel's narrative suggests that familial capital may cause tension with individual interests. For instance, she was supported in pursuing engineering, but not Arts which she initially considered. Given that she eventually decided to leave engineering, her familial capital may not have contributed to her personal goals.

Denton et al. (2020) noted that mentions of *navigational capital* in the literature lacked focus on how individuals exercised agency. This gap was addressed through the use of narrative methodology in this research, which demonstrated how participants exercised agency in varied ways. For example, Amira, who was determined to stay afloat, went to a mosque on her first day of university to seek help. During the lockdown, she actively developed her employability skills. When she sensed it was hard for her, she returned to her home country to be with her family. Despite not being a fan

of games, Apple demonstrated navigational capital by playing games as it was one way she could connect with her classmates. Mabel, surrounded by men in her classroom, looked for other women to sit next to. When a classmate displayed discriminatory behaviour, Yasmin sought help from an academic.

By understanding each narrative holistically, what initially seemed like unintentional (or at times, illogical) actions and decisions made more sense in their intertwining individual, cultural, familial, and institutional narratives. Clandinin et al. (2013) refer to this as 'narrative coherence.'

> Seen at any one point in time or from within any one narrative vantage point, perhaps their stories to live by appeared incoherent and without purpose ... Seen over time, and from within the stories [they] were telling, we noted the narrative coherence in their stories to live by that they were continually composing. (p. 257)

In the next section, I explore issues associated with narrative inquiry as a methodology.

10.3 Methodological - The Hidden and Ongoing Stories

In this section, I discuss methodological considerations of the research design (the *hidden* stories) and reflect on the quality of the research design. To structure the discussion, I draw on Heikkinen's (2007) quality criteria for action research: the *principle of historical continuity, principle of reflexivity, principle of dialectics, principle of workability* and *principle of evocativeness*. While these criteria are developed for action research, they are applicable to narrative inquiry as both methodologies are rooted in pragmatism.

As emphasised throughout this thesis, narrative research does not have final answers (Clandinin, 2016). In Section 3.2.4: *Evaluating narrative research*, I argued that quality criteria cannot be simplified to a set of standards (Bold, 2012; Riessman, 1993; Walther et al., 2013). Hence, it should not be surprising that the issues discussed in this section do not lead to clear, straightforward answers to "what should I do next time?" (Kim, 2016). Rather, they invite *ongoing* stories from those engaged in this research.

10.3.1 Principle of Historical Continuity

The *principle of historical continuity* is based on the understanding that "development of action does not begin in a vacuum" (Heikkinen et al., 2007, p. 9). Heikkinen et al. (2007) further posited that narratives should demonstrate causalities as well as the goals of the protagonists. This argument is in accordance with Clandinin's (2013) concept of narrative coherence discussed in the previous section. The importance of narrative coherence is most apparent in Apple's narrative. While her decision to study engineering appeared unintentional at first, an understanding of her goal to improve educational approaches provided coherence to her narrative.

However, Crites (1986) has cautioned against "the illusion of causality" (p. 168), where researchers examine events temporally (backward and forward) and curate narratives such that these events appear deterministically related. As narrative inquiry is driven by a sense of the whole (Connelly & Clandinin, 1990), the plot should not solely be a string of cause and effect (i.e., event #1 led inevitably to event #2, which led inevitably to event #3). Rather, researchers should carefully select the *beginning* and *end* of the plot such that it unfolds into a holistic explanation (Polkinghorne, 1995) while attending to the different layers of narratives (familial, cultural, institutional).

In doing so, researchers face the dilemma of balancing the whole and the detail (Connelly & Clandinin, 1990). In other words, researchers must decide which details are necessary to include for readers to understand the whole story. Yasmin's narrative is one example where I faced this dilemma. To recap, in describing how Yasmin came to do engineering, I started the story with how she initially wanted to do architecture. After a series of events (being rejected from universities, sending her test scores for a re-mark), she came to do a double degree in Engineering and Architecture. Later in the story, it was revealed that before considering architecture, she considered confectionery, which was driven by her interest in art. As her parents insisted that she choose a degree, she reasoned that architecture was a field where she could be creative and make money.

If Yasmin's story were ordered solely based on causality, I would describe in chronological order her interest in art, her intention to do confectionery, her transition to architecture, and her entry into engineering. One immediate consequence is that readers would take too long to get to the start of her engineering journey. Furthermore, her narrative suggests that the above events did not happen linearly. For instance, she spoke about how she wanted to do architecture because she grew up seeing revolutionary buildings being built, which serves as a solid standalone reason for doing architecture. Even just within Yasmin's narrative, there were multiple intersecting plotlines.

The process of curating Yasmin's narrative highlighted how I navigated multiple plotlines to determine the 'beginning' of the plot. This dilemma extends to how I determine the 'end' of the plot. Considering the temporal nature of narrative inquiry (discussed in Mabel's narrative), an epic ending with full closure is not a feature of narrative research, which is characterised by the "aesthetics of incompleteness, the ragged beauty of the continuity of life" (Heikkinen et al., 2007, p. 10).

In philosophy, atomism views individuals as self-interested, equal, and rational components of society (van Melsen, 1998). Through the principle of historical continuity, this section discussed the importance of causality at a holistic level while cautioning against causality at an atomistic level. The holistic stance aligns with social psychologists' critiques of cognitivist approaches (see Gergen (1994), further discussed in Chapter 2: Literature Review).

10.3.2 Principle of Reflexivity

Another quality criterion proposed by Heikkinen et al. (2007) is the *principle of reflexivity*. Andrews (2021) refers to reflexivity as the "acknowledgement of situatedness of knowledge" (p. 364). Through this definition, reflexive researchers make explicit their "process of knowing" (Winter, 2002, p. 151) to actively remind readers that researchers create the stories.

However, Kim (2016) pointed out the paradox of reflexivity. On the one hand, researchers (especially students) may be urged to be more reflexive to enhance the credibility of their research. On the other hand, too much reflexivity may be viewed as self-indulgence, where researchers focus on themselves rather than their participants. Given these considerations, how do we know whether we are too reflexive or not reflexive enough?

This paradox is particularly applicable to this study. When I first started analysing the narratives, I struggled to write about Maya. In my first draft, I described how an unexpected event during the interview (Maya dropping out frequently due to a poor internet connection) made me realise the differences between our idea of 'challenge.' At that time, I was accustomed to qualitative research reports where positionality and reflexivity were discussed in a separate section. I thought I was over-interpreting a trivial matter and felt uncomfortable discussing a story that seemed to centre on me rather than Maya. With some affirmation from my supervisors, I gradually incorporated more of my voice and adopted the Personal-Practical-Methodological framework to structure the analysis.

Over time, I came to understand the two reasons I incorporate my voice in this thesis – to provide transparency on the research process, and to provide readers with an additional lens to understand the experiences of women international students in engineering. Munro (1998) distinguishes between using the self as a *source of conceptualisation* (i.e., acknowledgement of situatedness of knowledge) and as an *object of study* (i.e., autobiographical research). The former use of self is incorporated throughout this thesis, while the latter use of self is more prominent in the Personal sections of each narrative. As with many distinctions highlighted in this thesis, both uses are not mutually exclusive as they both highlight my role in the research process.

To address the question of too little or too much reflexivity, I turn to Jenkins' (1992) definition of reflexivity – a reflection on the reflection. Heikkinen et al. (2007) highlighted that "reflection serves

as the momentum that triggers the next cycle of reflection" (p. 12). Through multiple cycles of reflection, researchers develop new practices of *action* and *research* (hence action research). In this study, new practices of action are discussed in the Practical sections, while new research practices are discussed in the Methodological sections. This distinction guided me in walking a fine line between too little and too much reflexivity.

The process of reflecting on a reflection is reflected in Yasmin's narrative. In her narrative, her comment, "Actually, this might be an interesting story for you" prompted a reflection on who took part in this study and why. This reflection prompted another reflection on how participants' understanding of the research shaped our relationships and what they shared during the interview.

To address these questions, I returned to the original transcripts in search of relevant excerpts. Towards the end of the interview, Apple said she was glad I was doing this research. Zoe and Amira also shared why they took part in the research.

> Zoe: I think the engineering faculty sent us an email about that, so I was like, sure, why not? Because we're women in engineering, we need to help out each other.
>
> Amira: I really hope that your research is like Australia-wide because I think this way, more can be done to improve the experience for female international students. So I feel that this research does have a lot of scope too.

As outlined in Chapter 3: Methodology, the recruitment flyer and Participant Information Sheet (PIS) did not indicate that participants would be financially reimbursed. These responses suggest that participants were motivated to give back to the community, which explains why they frequently checked if their responses were helpful to me. These behaviours are referred to as 'demand characteristics,' a response bias where participants interpret what the researcher is trying to investigate and adapt their responses accordingly (Orne & Whitehouse, 2000).

While demand characteristics can be a threat to the validity of the results (if participants only tell researchers what they think researchers want to hear), Corneille and Lush (2023) have argued that it can also give rise to genuine experiences. This argument is applicable to Mabel, who shared that she previously did not have an outlet to share her honest views. As she gauged the aim of my research (and my stance on gender issues), she gradually opened up about her experiences. In

Yasmin's narrative, while her story of being discriminated against by a peer may be an outcome of demand characteristics, it does not mean that the story was untrue or unauthentic.

Another aspect that influences the authenticity of stories is the rapport between the researcher and participants. Cornwell (1984) found that interviewees tended to offer what they thought the interviewer wanted in the first interview and shared more meaningful accounts in subsequent interviews. This finding highlights a limitation of the research design in only conducting single interviews. However, as discussed in Chapter 9: Amira, there is also a risk of over-rapport (Goudy & Potter, 1975). Like demand characteristics, rapport is not inherently good or bad for research. However, researchers should be reflexive of their relationships with their participants and ensure that rapport is used to generate meaningful data (Kim, 2016). In the context of the study, my understanding of demand characteristics and rapport prompted a reflection on what I told participants before the interview, such as my background as a woman international student in engineering and my motivation to conduct this study. However, I did not conduct further analysis as this introduction was not recorded.

Another form of bias that may be pertinent across the participants is selection bias. One indicator is the participants' English language fluency. Despite the language barrier being a key challenge discussed in international student literature (see review by Abdullah et al. (2014)), all the participants spoke proficient English, which suggests they are not representative of the population. While representativeness is not a quality criterion of narrative research, the presence of selection bias emphasises that the findings of this study should not be generalised (which I further discussed in Chapter 3: Methodology). As selection bias is mitigated through large sample sizes, future work may include the development of quantitative surveys based on the findings of this study. It is also important to consider who is eligible for this study but did not participate, as their experiences may illuminate critical gaps in research on this population.

10.3.3 Principle of Dialectics

The *principle of dialectics* is underpinned by the notion that knowledge is constructed in interaction. As Angen (2000) posited, "all interpretations are ... always open to reinterpretation and that the truth of an interpretation must continually be negotiated through continuous conversations and

dialogue" (p. 385). Instead of truth, which often refers to something permanent and unchangeable, narrative inquirers focus on trustworthiness (Connelly & Clandinin, 1990). To establish trustworthiness, narratives should be authentic such that participants "recognize their own thinking in them" (Heikkinen et al., 2007, p. 13). Heikkinen et al. (2007) further argued that the authenticity of thoughts is strongly associated with voice.

One way to ensure that participants' voices are heard is to bring the research text back to them, a process referred to as member-checking. For each participant, I sent them their narratives. These narratives are slightly longer than those presented in the Findings chapters, which have been refined based on the focus of the Readings. Below is an example of my email:

> Hi [Participant Name],
>
> I hope you have been well. Thank you again for giving up your time to be part of my research last November. Your input has given me a lot to work with, and I appreciate your openness in sharing your experience.
>
> I have attached your story which I put together based on our interview. This is just an initial summary, so please feel free to let me know if there is anything I misinterpreted, or if there is something you would like to add. If you are happy with the summary, please let me know and I will proceed with further analysis for my research.
>
> If you would like to have a chat about it, I would be more than happy to do so and catch up with how things are going on your end.
>
> Regards,
> Wenqian

Following are some of the responses I received from the participants:

> Mabel: You captured what I was trying to convey perfectly, really grateful for that!
>
> Yasmin: Your notes are spot on, and everything is very accurate.
>
> Zoe: I'm happy with the content and accuracy.
>
> Amira: Amazing job in capturing my story.

> Maya: The summary looks okay and I am pretty much comfortable with it. Just giving a heads up, I am in [current city] now and having face-to-face classes which is really great. I went through the summary and I realised that some of the things I said during that interview has given me the strength to keep pushing through this semester.

As I shared in Maya's chapter, reviewing the transcript helped her reflect on how engineering is about continuous improvement rather than succeeding on the first try. In Mabel's chapter, I shared that I had a follow-up conversation with her and learned that she had left engineering. As participants were asked to review a narrative rather than the original transcript, their responses indicated the narratives' authenticity. However, I also wondered if asking them to correct any misinterpretations was reasonable, given how the narratives were primarily constructed based on their words. For instance, they may agree with what they said, but not what I said about their narrative.

However, as discussed in Chapter 3: Methodology, narrative research is not limited to reporting what the participant is conscious of. Researchers should interpret narratives with a combination of faith and suspicion (Kim, 2016). Interpretation of faith refers to believing the participants' stories at face value, while interpretation of suspicion refers to the search for "surface appearances that mask depth realities; a told story [that] conceals an untold one" (Josselson, 2004, p. 13).

Compared to other studies on narrative inquiry, the research text in this study has not been developed with as much dialogue with the participants. Hence, the interpretation of suspicion should be approached with an equal level of suspicion. In this case, suspicion is related to what Winter (2002) refers to as cognitive modesty, to which "no knowledge can ever be final or conclusively competent, but tentative and propositional" (as cited in Heikkinen et al., 2007, p. 17). Therefore, readers are invited to interpret this thesis with faith and suspicion, noting that the claims are suggestive contributions intended as material for future dialogues, or what Kim (2016) refers to as ongoing stories.

10.3.4 Principle of Workability

The purpose of narrative research as discussed in the previous section leads to the *principle of workability*. In conceptualising the five principles, Heikkinen et al. (2007) referred to them as principles for 'validation.' Validation is contrasted with validity, which I problematised in Chapter

3: Methodology due to its underlying positivist connotations. According to Heikkinen et al. (2007), a fertile process of validation involves "raising new possibilities, opening up horizons, generating new interpretations and stimulating dialogue between the researchers and the participants, between the academy and the rest of the world" (p. 18).

Riessman (1993) emphasised that in narrative research, data that prompts action is valid data. In other words, data quality is evaluated based on its workability. However, workability is not limited to pragmatic use, but also ethical use (Heikkinen et al., 2007; Kim, 2016; Riessman, 1993). The difference between both uses became more apparent when I conducted a workshop related to this study at the Australasian Association for Engineering Education Annual Conference.

The workshop, titled *'What can we learn from narratives? Translating stories to practice'* was developed when I was unsure whether the narratives presented in the Findings chapters contributed to practice and research. In the workshop, I provided workshop participants with short excerpts (around 200 words) from the narratives, and gave them the following prompts to discuss:

> Think of a subject, initiative, or program that you have been involved in, or more generally the engineering curriculum at your institution.
>
> - What aspects of it may engage or disengage this student?
> - What can you (or your institution) do to positively engage this student?
>
> Think of your current understanding of issues related to this narrative (from experience and/or literature).
>
> - How does this narrative enhance or contradict your existing understanding of this issue and/or student population?
> - What are the theoretical and social implications of this narrative?

To be transparent, I initially expected responses that would guide me in discussing the pragmatic use of this study (e.g., educators should do XYZ, and future research should consider XYZ). To my surprise, as workshop participants read the narratives, they started pointing out aspects of it that relate to their own experience (e.g., how Mabel's experience of feeling surrounded by men reminded them of their workplace, and how Zoe's pathway into engineering reflects a stereotypical narrative

in Asian culture, "you can be a doctor, engineer, or failure"). Despite having a pool of workshop participants with starkly different demographic characteristics from the research participants, they quickly empathised with the research participants' narratives. While their response may be a result of self-selection bias in the fact that they chose to attend the workshop in the first place, these responses suggest that the impact of this study is not limited to women international students in engineering, but also men and domestic students.

When I led the discussion back to pragmatic use, participants discussed how these narratives (200-word excerpts) highlighted the multiplicity of individuals and bridged the gap between *awareness* of an issue and its *impact* on those affected, which Kim (2016) refers to as "personalizing social problems or socializing personal problems" (chap. 6, Analysis in Biographical Narrative Inquiry section, para. 8). They resisted coming up with ideas on interventions, arguing that there can never be a silver bullet to inclusion. It later occurred to me that while pragmatic use informs what practitioners and researchers should do, ethical use refers to the empowerment and emancipation of practitioners and researchers alike (Heikkinen et al., 2007). This empowerment leads to ongoing reflections on practice and research which gradually transform the landscape of engineering education.

The ethical use of research also applies to research participants. In Mabel's chapter, I discussed how she viewed the interview as an outlet that made her feel less alien. Mabel's experience represents some of the benefits of the life story interviews presented by (Kim, 2016, chap. 5, Table 5.1):

1. A clearer perspective on personal experiences and feelings is gained, which brings greater meaning to one's life.
2. Greater self-knowledge, a stronger self-image, and self-esteem are gained.
3. Cherished experiences and insights are shared with others.
4. Joy, satisfaction, and inner peace are gained in sharing one's story with others.
5. Sharing one's story is a way of purging, or releasing, certain burdens and validating personal experience.
6. Sharing one's story helps create community and may show that we have more in common with others than we thought.

7. Life stories can help other people see their lives more clearly or differently and perhaps be an inspiration to help them change something in their life.

8. Others will get to know and understand us better, in a way that they had not before.

9. A better sense of how we want our story to end, or how we could give it the "good" ending we want, might be gained.

As narrative researchers, it is important to ensure that the research process is a productive experience for participants. The benefits presented above can be used as a guide to evaluating how the research process impacts participants. Since the impact may not be immediately apparent, there is a need for ongoing engagement with participants. This engagement is an ethical commitment as a researcher, which is often overlooked in ethical clearance processes (Andrews, 2021). This stance also highlights how narrative inquiries view participants as collaborators rather than data.

10.3.5 Principle of Evocativeness

The final quality criterion is the *principle of evocativeness*, which Heikkinen et al. (2007) refers to as the extent to which the narrative evokes mental images, memories, and emotions. This principle relates to Connelly and Clandinin's (1990) argument that the particular (not the general) triggers emotion. Therefore, a good narrative compels readers "by recognizing particulars, by imagining the scenes in which the particulars could occur, and by reconstructing them from remembered associations within similar particulars" (Tannen, 1988, as cited in Connelly & Clandinin, 1990, p. 8).

However, Heikkinen et al. (2007) emphasised that narratives should not just allow readers to relive the story, but also unlock an entirely new way of understanding the world. Understanding a world different from your own requires contextual details. In this study, the sociocultural context of participants contributes heavily to understanding their narratives. However, it is important to ensure that the details do not compromise the confidentiality of the participants.

While ethical guidelines offered by institutions suggest a blanket solution of anonymising details unique to the participants (mentions of names, places, and institutions), the de-identification process is much more complex. It requires further negotiation with participants and careful curation

of narratives. This process not only retains the confidentiality of participants, but also ensures they feel comfortable with the details I share about them. Through the member-checking process described earlier in this chapter, participants can provide feedback on which aspects get redacted and how their story is presented.

10.3.6 Shifting Methodological Justifications

In this thesis, I address different audiences (e.g., research participants, imagined readers such as practitioners, researchers, policymakers, and myself) through the separation between participant narratives and researcher analysis, and the adoption of the Personal-Practical-Methodological framework. While the framework allowed me to interpret and present the participants' stories through different lenses, I often felt I had to make an additional effort to articulate and justify the research approach out of the concern that other researchers would perceive it as lacking theoretical foundations.

However, as discussed in Chapter 2: Literature Review, all theories "highlight some aspects of a concept while inherently preventing us from focusing on another" (Lee, 2019, p. 9). In this sense, the use of narrative methodology is theoretical in that it focuses on individualities while sidelining commonalities. Hence, the critique that narrative inquiry is not theoretical enough (Clandinin & Connelly, 2000) is perhaps a reflection of how much of academia is preoccupied with the tradition of finding commonalities that can be generalised across a monolithic population. Under the guise of theory, this tradition diminishes the lives of those systematically excluded, ignores shifting realities due to increasing mobility, and reproduces inequality at all levels – individual, institutional, and epistemological. The use of narrative methodology calls for a rethink of what theory *is* and *does*, and how we can transform the notion of theory to drive necessary social change.

10.4 Summary

In this chapter, I pulled together threads from the Findings chapters. In Personal, I reflected on the process of engaging with the participants and how they impacted the stories I live by. In Practical, I highlighted how the narratives collectively prompt changes in practice. In Methodological, I

discussed issues in narrative methodology and how they illuminate broader issues in qualitative research.

The next chapter will outline the contributions of this research and recommendations for practitioners, researchers, and policymakers.

Chapter 11

Conclusion

In Chapter 1: Introduction, I discussed my educational, familial and cultural background, and how I came to do this study. I highlighted the research aim, and located this thesis theoretically and methodologically.

Chapter 2: Literature Review outlined the scope of this study, and provided background context on international students in higher education and women in engineering. Metaphors such as pipelines, pathways and ecosystems were discussed to situate the use of narrative methodology. I described how my critique on cognitivist and deficit based approaches informed the theoretical directions of this research.

Chapter 3: Methodology highlighted the features of narrative inquiry and elaborated on the analytical framework, namely the Personal, Practical, and Methodological dimensions. I outlined this study's research design, including the data collection method, sampling strategy and recruitment plan. Drawing on Bruner's (1985) distinction between paradigmatic and narrative cognition, I described how the interview protocol and analytic approach were developed. The final section discussed considerations on presenting and evaluating narrative research.

Chapters 4 to 9 presented curated narratives for selected research participants – Mabel, Yasmin, Zoe, Maya, Apple, and Amira – and analysed these narratives based on the Personal-Practical-Methodological framework. These narratives were further discussed in Chapter 10: Discussion. In Personal, I shared a missing story in relation to the participants' narratives, and reflected on how the process of engaging with them impacted me personally. In Practical, I highlighted the

shared and untold stories across participants, and outlined how they collectively prompt changes in practice. In Methodological, I discussed the hidden and ongoing stories of using narrative inquiry as a methodology, and how they illuminate broader issues in qualitative research.

This concluding chapter signals a shift back from writer to author (Barone, 2001), where I outline the key contributions of this research and discuss recommendations for practitioners, policymakers, and researchers.

11.1 Contributions

> To see things or people small, one chooses to see from a detached point of view, to watch behaviors from the perspective of a system, to be concerned with trends and tendencies rather than the intentionality and concreteness of everyday life.
>
> To see things or people big, one must resist viewing other human beings as mere objects or chess pieces and view them in their integrity and particularity instead. One must see from the point of view of the participant in the midst of what is happening if one is to be privy to the plans people make, the initiatives they take, the uncertainties they face.
>
> The vision that sees things big brings us in close contact with details and with particularities that cannot be reduced to statistics or even to the measurable. (Greene, 1995, p. 10)

The above quote captures the main contribution of this research, which aims to understand how women international students came to do engineering and their experiences during their studies.

This study's research methodology, narrative inquiry, adopts the notion of 'seeing people big.' Through narratives, readers are provided with a portal to better understand each participant's engineering journey holistically. These narratives illuminate how individual narratives intertwine with social, cultural, familial, and institutional narratives, which are not represented in cognitivist approaches that collapse the complexity of sociocultural contexts. They also reassert the shortcomings of the pipeline and pathway metaphors, which do not account for multiple journeys and individual agency. The use of Community Cultural Wealth (CCW) theory in this research emphasised

participants' aspirational, familial, and navigational capitals, which challenge existing approaches that frame this population in a deficit manner. These findings highlight the Western centricity of existing theories, and call for a need to transform that theorising space through the experiential knowledge of marginalised groups.

Narrative methodology enhances experiential knowledge through two features. The first feature is the stance of the interviewee as the narrator and the interviewer as the listener. Unlike interviews with question-answer formats, this feature allows space for participants to make sense of their own stories. It also takes the pressure off them to provide 'well-packaged' responses, which often lack explanatory power to transform the theorising space. The second feature is viewing participants as a collaborator rather than an object. In this view, narratives are co-constructed by the researcher and participant, highlighting that truth is transient rather than permanent. This view also highlights that the research is conducted 'with' this population rather than 'for' or 'on' this population.

Instead of benefiting specific populations, this research is conducted 'for' a just society. Given the need to strengthen the engineering workforce, it is critical to ensure that regardless of background and identity, everyone feels empowered to study and pursue a career in engineering. Ultimately, an engineering profession that is demographically representative of the broader population will benefit everyone. Narrative methodology contributes to this vision by making the stories of marginalised groups accessible to influencers who can drive change, as I discuss in the following section.

11.2 Recommendations

This section highlights recommendations for practitioners, policymakers, and researchers. Here, practitioners refer to staff members who directly support and engage with students (e.g., tutors, counsellors etc.). Policymakers refer to staff members across the faculty and university who make decisions that impact students (including learning designers and academic developers). These definitions are guided by this thesis's intended audience, which is situated in engineering education research.

As discussed in previous chapters, narrative research does not lead to a list of recommendations that can be directly implemented to produce immediate outcomes. As such, the recommendations in this section are intended as guiding principles to prompt further reflection on practice and research.

11.2.1 Practitioners

The findings of this research emphasise that there is no one-size-fits-all approach to addressing challenges faced by students. As practitioners act as main touchpoints, their actions greatly influence students' experiences. As discussed in previous chapters, a lack of awareness of students' needs may lead to unintended harm. Hence, practitioners should use guidelines on inclusion (e.g., 'best practice') with caution and adapt them based on the context of their institution, program, and subject. Instead of subscribing to static checkbox solutions, practitioners should ensure that students' evolving needs are met.

While one way to meet students' needs is through constant feedback, practitioners should be mindful of whom they are getting feedback from (whether it comes from a diverse pool) and how the feedback is elicited (considerations of power dynamics). It is also important to ensure that the feedback process does not put students from marginalised groups at risk of representation burnout (i.e., being consulted regularly as a member of a particular demographic group), as it would subject them to added cognitive load beyond their studies (Tesema, 2019).

11.2.2 Policymakers

To mitigate representation burnout among students, policymakers should offer practitioners opportunities for capability-building and connecting with each other to share resources and learnings. While professional development opportunities and Communities of Practice exist in many institutions, practitioners are often occupied with the logistics of delivering a program or subject within a tight timeline. The lack of practitioner interaction is economically ineffective, as many staff members invest valuable time reinventing the wheel for their program or subject.

While the approach to addressing this issue will differ significantly depending on the institution's governance structure, strategic priorities and workplace culture, the following recommendations are put forward for consideration:

- Allocating time within existing initiatives for conversations on teaching and learning (e.g., a fixed agenda item at the start of meetings to share reflections and learnings, or inviting ad hoc agenda items to discuss ideas and challenges)

- Leveraging the expertise of learning designers and academic developers to develop resources and training that builds empathy as a skill among practitioners
- Creating space for staff members to contribute and interact asynchronously (e.g., a physical board or online forum)

Policymakers' locus of control is not limited to their work institution. The findings of this research highlighted that students' experiences are not limited to the academic setting. As policymakers wield influence across engineering industries and government agencies, they can shape decisions that prioritise the well-being of students and ensure equity measures are in place for students from different backgrounds to thrive.

11.2.3 Researchers

The findings of this research propose several areas for future work, most of which are highlighted in Chapter 10: Discussion. The following areas, in particular, warrant further attention:

- Considering the tension between the 'micro' world of the individual and the 'macro' world, such as the influence of family and the role of gender on international students' decisions to study abroad (Clough, 2002)
- Investigating perceptions of engineering across different cultures and how it relates to the proportion of women in engineering across different nations
- Understanding the impact of government and workplace policies on students and the role of universities in influencing change that benefits students

This thesis has demonstrated how narrative methodology could unpack complexities and reveal insights into a marginalised population. However, the lack of narrative studies in engineering education research poses a barrier for engineering academics interested in adopting this methodology. As engineering education is an emerging field of research, there is a critical need to diversify research methodologies and shift away from an exclusive focus on positivist research. This study addresses this need by introducing a research methodology from other disciplines to allow the exploration of diverse research questions that cater to different research paradigms.

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Appendix

Appendix I: Ethics Approval

Your ethics application has been approved as low risk - ETH20-5424

research.ethics@uts.edu.au <research.ethics@uts.edu.au>
Fri 18/12/2020 11:24 AM
To: Anne Gardner <Anne.Gardner@uts.edu.au>;Wenqian Gan <WenQian.Gan@student.uts.edu.au>

Dear Applicant,

Re: ETH20-5424 - "Engineering identity of international women engineering undergraduates in Australian universities"

Your local research office has reviewed your application and agreed that it now meets the requirements of the National Statement on Ethical Conduct in Human Research (2007) and has been approved on that basis. You are therefore authorised to commence activities as outlined in your application, subject to any conditions detailed in this document.
You are reminded that this letter constitutes ethics approval only. This research project must also be undertaken in accordance with all UTS policies and guidelines including the Research Management Policy.
Your approval number is UTS HREC REF NO. ETH20-5424
Approval will be for a period of five (5) years from the date of this correspondence subject to the submission of annual progress reports.

The following standard conditions apply to your approval:

- Your approval number must be included in all participant material and advertisements.
- Any advertisements on Staff Connect without an approval number will be removed.
- The Principal Investigator will immediately report anything that might warrant review of ethical approval of the project to the Ethics Secretariat (Research.Ethics@uts.edu.au).
- The Principal Investigator will notify the UTS HREC of any event that requires a modification to the protocol or other project documents, and submit any required amendments prior to implementation. Instructions on how to submit an amendment application can be found here.
- The Principal Investigator will promptly report adverse events to the Ethics Secretariat. An adverse event is any event (anticipated or otherwise) that has a negative impact on participants, researchers or the reputation of the University. Adverse events can also include privacy breaches, loss of data and damage to property.
- The Principal Investigator will report to the UTS HREC annually and notify the HREC when the project is completed at all sites.
- The Principal Investigator will notify the UTS HREC of any plan to extend the duration of the project past the approval period listed above through the progress report.
- The Principal Investigator will obtain any additional approvals or authorisations as required (e.g. from other ethics committees, collaborating institutions, supporting organisations).
- The Principal Investigator will notify the UTS HREC of his or her inability to continue as Principal Investigator including the name of and contact information for a replacement.

This research must be undertaken in compliance with the Australian Code for the Responsible Conduct of Research and National Statement on Ethical Conduct in Human Research.

You should consider this your official letter of approval.

If you have any queries about this approval, or require any amendments to your approval in future, please do not hesitate to contact your local research office or the Ethics Secretariat.

Appendix II: Participant Information Sheet and Consent Form

UTS UNIVERSITY OF TECHNOLOGY SYDNEY

PARTICIPANT INFORMATION SHEET

ENGINEERING IDENTITY OF INTERNATIONAL WOMEN ENGINEERING UNDERGRADUATES IN AUSTRALIAN UNIVERSITIES (UTS HREC REF NO. ETH20-5424)

WHO IS DOING THE RESEARCH?

My name is Wenqian Gan and I am a student at UTS. My supervisor is A/Prof Anne Gardner (Anne.Gardner@uts.edu.au).

WHAT IS THIS RESEARCH ABOUT?

This research is to investigate the engineering identities of international women engineering undergraduates in Australian universities. Engineering identity refers to how one describes engineering and identifies as an engineer. It will focus on the intersectional relationship between social and engineering identities, and the negotiation of these identities among international women engineering undergraduates in Australian universities.

WHY HAVE I BEEN ASKED?

You have been invited to participate in this study because you are an international student, identify as a woman, and are enrolled in an engineering undergraduate degree in an Australian university.

IF I SAY YES, WHAT WILL IT INVOLVE?

If you decide to participate, I will invite you to:

- participate in an online 1-hour semi-structured interview that will be audio/video recorded and transcribed
- verify if the interview summary presented post-interview accurately reflects your views, feelings or experience

ARE THERE ANY RISKS/INCONVENIENCE?

Yes, there are some risks/inconvenience. They are:

- You may feel uncomfortable being interviewed and audio/video recorded
- You may feel uncomfortable recalling or disclosing certain information
- You may be concerned about your privacy and confidentiality
- You may be concerned about or feel uncomfortable sharing sensitive information and honest opinions
- You may be concerned about damaging your social network by participating in this study
- You may be inconvenienced or feel uncomfortable conversing in English
- You may be inconvenienced by technical difficulties

If any of the above risks/inconvenience apply to you, please be reassured that:

- You can stop the interview at any time for a break or reschedule the interview
- You are not obliged to answer any questions if you do not feel comfortable to do so
- There will be no collection or disclosure of information on your visa and legal events
- Your identity will remain confidential through the use of pseudonyms and de-identification of data
- Your situation and privacy will be treated with utmost respect

DO I HAVE TO SAY YES?

Participation in this study is voluntary. It is completely up to you whether or not you decide to take part.

WHAT WILL HAPPEN IF I SAY NO?

If you decide not to participate, it will not affect your relationship with the researchers or the University of Technology Sydney. If you wish to withdraw from the study once it has started, you can do so at any time without having to give a reason, by contacting the researcher Wenqian Gan by email at Wenqian.Gan@student.uts.edu.au.

If you withdraw from the study, any recordings, transcripts or handwritten notes will be destroyed. However, it may not be possible to withdraw your data from the study results if these have already had your identifying details removed.

If you decide to leave the research project, we will not collect additional personal information from you, although personal information already collected will be retained to ensure that the results of the research project can be measured properly and to comply with law. You should be aware that data collected up to the time you withdraw will form part of the research project results. If you do not want them to do this, you must tell them before you join the research project.

CONFIDENTIALITY

By signing the consent form you consent to the research team collecting and using personal information about you for the research project. All this information will be treated confidentially. Research data will be collected and saved using pseudonyms, and de-identified for each participant. Personal details will be saved as a separate, password-protected file in the university cloud storage system. Only my academic supervisors and I will have access to the data. Your information will only be used for the purpose of this research project and it will only be disclosed with your permission, except as required by law.

We plan to publish the results in the form of analysed, de-identified data as part of my doctoral thesis, in academic conference papers and journal articles for the purpose of research. In any publication, information will be provided in such a way that you cannot be identified.

WHAT IF I HAVE CONCERNS OR A COMPLAINT?

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact me at Wenqian.Gan@student.uts.edu.au or my supervisor at Anne.Gardner@uts.edu.au.

You will be given a copy of this form to keep.

NOTE:
This study has been approved in line with the University of Technology Sydney Human Research Ethics Committee [UTS HREC] guidelines. If you have any concerns or complaints about any aspect of the conduct of this research, please contact the Ethics Secretariat on ph.: +61 2 9514 2478 or email: Research.Ethics@uts.edu.au], and quote the UTS HREC reference number. Any matter raised will be treated confidentially, investigated and you will be informed of the outcome.

UTS UNIVERSITY OF TECHNOLOGY SYDNEY

CONSENT FORM

ENGINEERING IDENTITY OF INTERNATIONAL WOMEN ENGINEERING UNDERGRADUATES IN AUSTRALIAN UNIVERSITIES (UTS HREC REF NO. ETH20-5424)

I _____ agree to participate in the research project Engineering Identity of International Women Engineering Undergraduates in Australian Universities (UTS HREC REF NO.) being conducted by the researcher Wenqian Gan (Wenqian.Gan@student.uts.edu.au) of the University of Technology Sydney.

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research as described in the Participant Information Sheet.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time without affecting my relationship with the researchers or the University of Technology Sydney.

I understand that I will be given a signed copy of this document to keep.

I agree to be:
☐ Audio recorded
☐ Video recorded

I agree that the research data gathered from this project may be published in a form that:
☐ Does not identify me in any way

I am aware that I can contact Wenqian Gan if I have any concerns about the research.

_____ ____/____/____
Name and Signature [participant] Date

_____ ____/____/____
Name and Signature [researcher or delegate] Date

Appendix III: Interview Protocol

Pre-Interview

- Introduce each other: *Ask participant about their day/plans afterwards*
- Check familiarity with video conferencing software: *Adjust volume, check internet connection*
- Introduce personal context, share eligibility criteria: *I'm interested in their story, opinions, and experiences (no right and wrong answer)*
- Talk about project information, ask if participants have questions: *Interview duration, emphasise right to withdraw/take a break*
- Get consent to start recording, emphasise anonymity: *Start recording*
- Go through verbal consent script

Pathways to Engineering

Objective: alleviate anxiety, build rapport, gauge conversation style/literacy level

Questions:

- Tell me how you came to do engineering/specific engineering discipline (ask about other options if any)
- Tell me how you came to attend university in Australia/specific university (ask about other options if any)

Prompts:

- Where did you grow up?
- How long have you been in Australia?
- Have you always wanted to be an engineer?

Perceptions of Engineering

Objective: Unpack how social identities intersect to shape engineering identities

- Share Jamboard link and share screen

Prompts:

- What does an engineer look like when you were growing up?
- How is engineering/engineers viewed in your culture?

Future in Engineering

Objective: Reconnect the dots on how social identities intersect to shape engineering identities

Questions:

- Can you tell me about your plans after completing your degree?
- How did you arrive at this option(s)?

Post-Interview

- Ask if participants want to share anything else
- Member-checking procedure
- Reassure participants they can contact me anytime
- Get participant pseudonym
- Ask participants to refer me to anyone relevant
- Thank participant