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What Sort of Engineer Am I? Understanding First-years' Identity and Belonging Within Engineering Major Selection

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Abstract

This study investigates how first-year engineering students navigate the process of selecting an engineering major, framing the decision as an emergent and identity-informed process. Drawing on social cognitive career theory, journey mapping was embedded within a large first-year engineering subject to capture students' reflections on influences shaping their disciplinary preferences. Analysis of 210 journey maps revealed that students most frequently articulated interests, goals and enacted experiences, while explicit self-efficacy statements were rare. Comparative analysis across civil, mechanical and electrical majors identified distinct patterns of alignment linked to practical exposure, aspirational goal setting and mathematics preparation. Findings suggest that major selection is influenced not only by competence beliefs but by perceptions of belonging and disciplinary culture.

***Keywords**:* Engineering education, professional identity, first year experience, engineering major selection

Introduction

Engineering programs increasingly recognise that students' early experiences play a critical role in shaping persistence, engagement and professional identity development (Hernandez et al., 2017; Huff et al., 2019; Nadelson et al., 2017). Among these early experiences is the selection of an engineering major, a decision that carries implications not only for education and career pathways but also for how students come to understand what it means to be an engineer. Within engineering programs, major selection is rarely a simple or singular choice made at entry. Instead, first-year students encounter a complex landscape of disciplinary cultures, classroom experiences and social influences that impact how preferences for engineering majors are formed, negotiated and revised.

As technology innovations and global challenges continue to redefine the role of engineers in society, universities are under increasing pressure to prepare graduates with the skills required in a rapidly evolving workforce (Briggs et al., 2023). However, the challenge of supporting and retaining students throughout their choice of major and engineering education remains persistent. Recognition of the motivations that guide students' selection of their engineering major enables the creation of frameworks to enhance engagement, alongside improved long-term retention and success.

Background

Transition Pedagogy in First-year Engineering

The first year of university represents a critical transition period in which students adjust to new academic expectations, social environments and disciplinary cultures. Transition pedagogy conceptualises first year not simply as an administrative entry point but as a distinct developmental phase requiring intentional curricular and pedagogical design to support student engagement, belonging and success (Kift, 2025; Kift et al., 2010). In engineering education, first year is often characterised by large cohorts, common foundational curricula and limited exposure to a range of discipline-specific content. While such structures are intended to provide flexibility and manage scale, they can also contribute to ambiguity around what different engineering disciplines entail and how students might fit within them (Crosthwaite, 2019; Reidsema, 2021). Transition pedagogy therefore provides an important framing for understanding major selection as a first-year phenomenon. Rather than assuming students enter engineering with clear intentions and well-formed preferences, this perspective recognises that first year is a period of exploration, negotiation and sensemaking.

Social Cognitive Career Theory

Social cognitive career theory (SCCT) offers a valuable lens for understanding how students develop interests, form goals and make choices about engineering majors. Rooted in Bandura's (1986) social cognitive framework, SSCT emphasises the interplay between self-efficacy and beliefs, outcome expectations, and personal goals in driving career-related behaviours (Lent et al., 1994). Within the context of engineering education, students' perceptions of their capability to succeed in particular disciplines, their beliefs about the kinds of careers those disciplines enable, and the personal values they hold all contribute to how major preferences emerge and evolve. These processes are further informed by learning experiences, social supports, cultural norms and structural opportunities, making SCCT particularly useful for examining the complex, non-linear nature of first-year major selection.

Engineering Major Selection

Individual variables such as academic self-efficacy; science, technology, engineering and mathematics (STEM) identity; and motivation have been consistently shown to influence engineering major choice (Alexan, 2022). According to Godwin et al. (2016), students' identification with mathematics and physics predicts their decision to pursue engineering careers. Similarly, Tan et al. (2021) found that high school maths achievement, grade point average (GPA) and maths identity strongly correlate with the likelihood of choosing an engineering pathway. These findings suggest that self-perceived competence in academic domains reinforces students' persistence and selection within engineering fields.

Gender and race also intersect with these cognitive factors. Knight et al. (2012) and Lord et al. (2014) demonstrated persistent gender disparities across engineering disciplines, with women having higher representation in chemical and industrial engineering than in mechanical and electrical majors. These trends often mirror differences in self-efficacy beliefs and perceptions of belonging. Main et al. (2015) identified academic achievement in the first year of university, particularly GPA and expected grades in core STEM units, as predictors of engineering major persistence. Collectively, these studies indicate that personal competence beliefs and academic performance form the foundation for students' choice in engineering major.

Social networks, such as family, peers, teachers and mentors, play integral roles in engineering aspirations. Literature shows that family encouragement and teacher mentorship before and during high school critically influences students' decisions (Cruz & Kellam, 2018; Matusovich et al., 2010; Tan et al., 2021). Godwin et al. (2016) found that students with family members, particularly siblings, who are engineers are more likely to choose engineering themselves. Presence of role models appears to facilitate an early identification with the profession.

However, peer influence becomes increasingly evident during university. Main et al. (2022) observed that peers and university mentors, such as academic advisors, teaching assistants and engineering ambassadors, demonstrate a strong influence in early university when students are selecting majors. Similarly, Cruz and Kellam (2018) highlighted the guidance provided by advisors and peers in helping students navigate their initial uncertainty surrounding the field. These findings emphasise the dynamics of social influence, which shift from family-centred at the earlier stages to peer- and mentor-based during higher education.

Structural elements, such as educational resources, curriculum design and institutional structure, determine access to and perceptions of engineering pathways. Knight et al. (2020) showed that students from high schools with abundant STEM courses and higher university-going rates are more likely to enrol in engineering programs. Additionally, students from low socioeconomic backgrounds often have decreased exposure to advanced maths and science units, reducing their likelihood of pursuing engineering in later years (Main et al., 2020; McNeil & Ohland, 2015). Outreach initiatives, internships and first-year engineering programs also play a crucial role in fostering engagement (Ehlert et al., 2018; Main, 2020). This confirms the significance of institutional structure in supporting equitable access to engineering disciplines.

Engineering disciplines themselves have perceived cultures and reputations that also influence student choices. Ortega-Alvarez et al. (2016) found that students are drawn to specific majors based on perceived alignment with personal interests and professional goals. For example, a love of flying may drive a student towards aerospace, whereas an interest in working outdoors may attract students to civil engineering. Knight et al. (2020) noted that women are more likely to choose industrial or chemical engineering, perceiving these as people-oriented and collaborative, in comparison to the technical and competitive nature of mechanical or electrical engineering.

The current literature indicates that the choice of engineering major is a cumulative result based on individual competency, social influences, educational structures and perceived social culture (Cruz & Kellam, 2018; Ehlert et al., 2018; Main et al., 2022). However, these studies are not reflective of current student motivations and perceptions in a society where more recent investigations have been largely absent. While the previously mentioned quantitative studies have indicated significant relationships between these influential factors, few longitudinal qualitative studies have explored the evolving motivations influencing students' choice of engineering major.

Professional and Engineering Identity

Identity theory frames engineering major choice as a socially shaped, evolving process rather than a simple match of interests or abilities (Gee, 2000; Wenger, 1998). Engineering identity formed through competence, performance, recognition and interest develops through participation and experience, not at the point of entry. From this perspective, students choose majors by considering where they feel they belong and can imagine a future self. First year is especially important, as expectations meet real disciplinary practices and social cues; moments of alignment or tension can reinforce decisions or prompt reconsideration (Godwin et al., 2016). Understanding these shifts requires methods that trace how identity-related meanings change over time.

Journey Mapping as a Process-oriented Approach

Journey mapping is an approach that has been widely used in design, service research and increasingly in educational contexts to capture individuals' experiences over time. Rather than focusing on isolated events or outcomes, journey maps visually represent sequences of experiences, decisions and emotional responses, highlighting moments of continuity and disruption (Howard, 2014; Kalbach, 2016). As a research tool, journey mapping supports participants to reflect across time, making it well suited to investigating complex, non-linear processes.

Within engineering research, journey mapping has been used to explore student experiences of learning, transition and identity development, particularly where traditional methods struggle to surface temporal patterns and turning points (Young et al., 2024). By foregrounding participants' perspectives and sensemaking, journey maps can reveal how individuals interpret and respond to experiences as they move through their identity development.

This study therefore investigates how first-year engineering students navigate the process of major selection across their first year of study. Using journey mapping to elicit students' accounts of their experiences, the research examines how disciplinary preferences are formed, reinforced or reconsidered. The guiding research question for this study is: *What factors influence first-year engineering students in the process of choosing an engineering major?*

Methods

The study was conducted within a large first-year engineering subject at a large Australian metropolitan university, where journey mapping was embedded as a structured reflective task in Week 3 of the semester. While the journey map formed part of an assessed activity, this research focuses on the maps as qualitative artefacts that provide insight into students' experiences, interpretations and emerging disciplinary alignments during first year. More detailed information about the assessment and example journey maps can be found in Young and Cunningham (2025).

Context and Participants

The research context was a core first-year engineering subject introducing students to engineering design, professional practice and disciplinary breadth. The subject is typically undertaken in the first semester of study in both the faculty and college and enrols approximately 1,500 students annually. For many students, this subject coincides with a key program milestone: the need to select an engineering major following completion of first semester.

All enrolled students completed the journey mapping task as part of the subject curriculum. Ethical approval was obtained from the university's Human Research Ethics Committee (approval #9560) and students were invited to consent to their de-identified journey maps being used for research purposes. Only artefacts from students who provided informed consent were included in the study — this resulted in 258 students who agreed to participate out of a total of 1,436 enrolled students.

The task was intentionally designed as an open-ended reflective assessment that did not evaluate certainty, disciplinary commitment or alignment with curricular expectations. This reduced incentives for strategic or performative responses and enabled the capture of exploratory sensemaking characteristic of early-stage identity development. Although consent was obtained from a minority of the cohort (18%), this proportion is consistent with ethics-approved use of assessed reflective artefacts (Matusovich et al., 2010). Given the limited exposure to industry cases, alumni narratives and interdisciplinary experiences by Week 3, the timing of this task offers a methodologically appropriate and minimally confounded snapshot of students' emergent major selection processes prior to census-driven or curricular consolidation effects.

To protect privacy, all identifying information such as names and student numbers was removed prior to analysis. Demographic information of the participants is included in Table 1, as well as the comparison population percentages for the full subject cohort. At Week 5 of the semester, participating students reported major intentions distributed as follows: 6.8% Civil, 12.8% Mechanical, 9.6% Electrical, 5.2% Mechatronics, 1.6% Medical, 1.6% Chemical, 3.6% Computer and Software Systems, 5.2% Electrical and Aerospace, and 3.6% Electrical and Renewable Power, while 50% had not yet selected a major.

Table 1

Background Characteristics of Participants

Characteristic		Number of participants	Percentage of participants	Subject population percentage
Gender	Man	184	71.32%	77.16%
	Woman	71	28.52%	22.28%
	Other	3	1.16%	0.56%
International student status	Yes	29	11.24%	7.17%
	No	229	88.76%	92.83%
Age at course commencement	17 years or less	41	15.89%	19.57%
	18 years	150	58.14%	53.97%
	19–21 years	37	14.34%	15.39%
	22–29 years	23	8.91%	8.01%
	30+ years	7	2.71%	3.06%

Journey Mapping as Data Generation

Journey mapping was used to elicit students' accounts of their experiences entering engineering and their evolving thinking about disciplinary pathways (Huff et al., 2019; Young et al., 2024). Students were asked to construct a journey map that captured key pre-university and early-university experiences influencing their decision to study engineering; moments of challenge, uncertainty or affirmation during first year; emerging interests in specific engineering disciplines; and their anticipated future experiences and development goals.

To support reflection, students were provided with prompts encouraging them to consider academic, social and personal influences, as well as exposure to engineering disciplines through curriculum, peers and industry representations. This is discussed in more detail, including the process of scaffolding and implementing the task, in Young and Cunningham (2025). Importantly, the task was designed to allow flexibility in form and expression. Students were encouraged to adopt visual structures that made sense to them, including timelines, pathways, branching diagrams or annotated narratives. This openness was intentional, recognising that identity development and sensemaking are highly individual and non-linear processes.

Data Analysis

The collected journey maps were analysed using a deductive thematic approach (Braun & Clarke, 2006), informed by identity theory and process-oriented perspectives on decision-making. Analysis was supported by the domains of SCCT and focused on identifying patterns in how students described their pathways into engineering, the experiences that prompted reconsideration or reinforcement of disciplinary preferences and the meanings students attributed to these experiences.

Of the 258 journey maps collected, 210 included some justification or discussion of their major selection. These excerpts were manually identified from within the maps and extracted. They were then coded against SCCT using Microsoft CoPilot. CoPilot was used as an analytic support tool to enhance scalability and consistency, rather than to replace researcher judgment, which remained central to interpretation and validation.

To validate the use of Microsoft CoPilot for SCCT coding, an initial subset of excerpts was independently coded manually by the research team and then analysed using CoPilot. The results from the manual and automated coding were compared to assess alignment and identify discrepancies in theme attribution. This process supported the trustworthiness of the analysis by establishing inter-coder reliability between human and artificial intelligence (AI)-assisted coding approaches and reducing the risk of systematic bias. Once satisfactory consistency was established between manual and CoPilot-assisted coding, the automated approach was applied to the full dataset. Student excerpts were coded according to how phrases and statements aligned with interests (e.g., "I enjoy maths and problem-solving"), choice goals (e.g., "I want to work in renewable energy"), choice actions (e.g., "I selected electrical engineering because …"), performance attainments (e.g., "I achieved strong results in Specialist Mathematics"), outcome expectations (e.g., "This degree will lead to …") or self-efficacy (e.g., "I feel confident I can succeed in …").

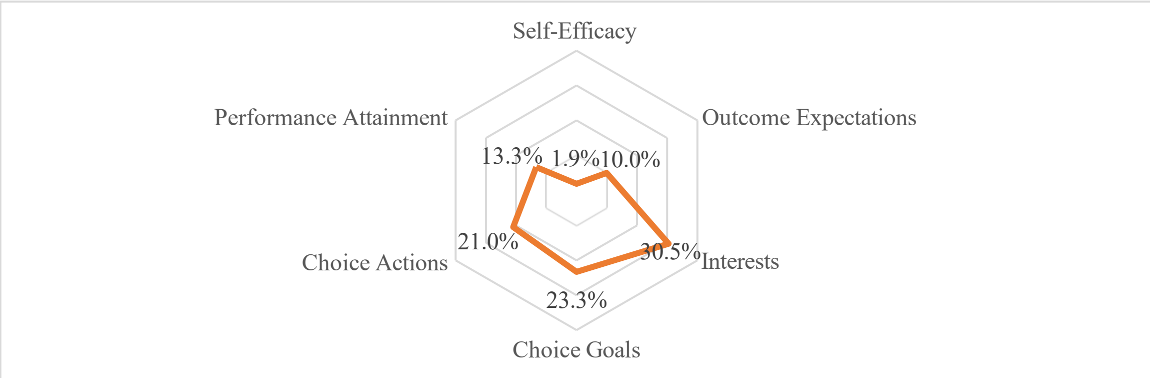
Chi-squared tests were also performed using IBM SPSS software to analyse potential correlations between students' discussion of high school subjects and activities, and students' selected majors (Figure 3). The three engineering majors (civil, electrical and mechanical) with the highest levels of enrolment were selected for analysis.

Results and Discussion

Coding the journey maps against SCCT revealed uneven distributions across the domains. Students most frequently articulated Interests (n = 64, 30.48%), followed by Choice Goals (n = 49, 23.33%) and Choice Actions (n = 44, 20.95%). References to Performance Attainments were less common (n = 28, 13.33%), as were mentions of Outcome Expectations (n = 21, 10.00%). Explicit references to Self-Efficacy were comparatively infrequent (n = 4, 1.90%).

Figure 1

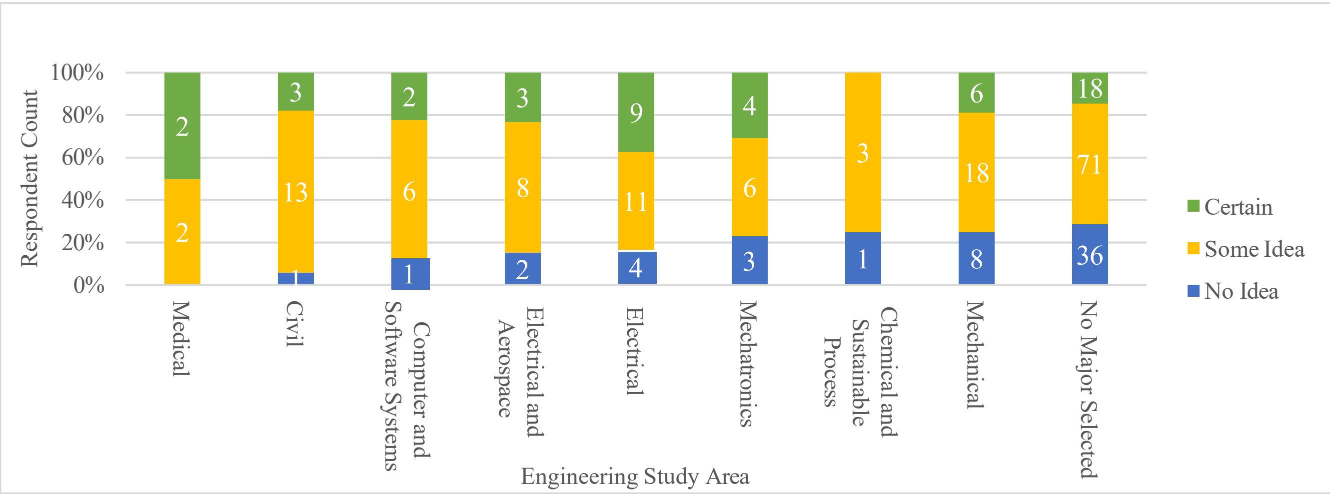
Representation of SCCT Domains in Participant Journey Maps



While Figure 1 shows the overall distribution of SCCT domains, it does not capture differences in disciplinary commitment. Figure 2 addresses this by comparing students' selected majors with the certainty expressed in their explanations, categorised as Certain, Some Idea or No Idea. Clear patterns emerged: students in Medical and Electrical Engineering showed higher proportions of Certain responses, indicating stronger early commitment, whereas Civil, Mechanical and Mechatronics students more often expressed Some Idea, suggesting tentative alignment. Those without a selected major were concentrated in the Some Idea and No Idea groups, reinforcing that undeclared status reflects ongoing exploration. Overall, the data illustrate that while many students' expressed aspirations, their confidence in specific disciplinary choices varied widely.

Figure 2

Selected Engineering Major Versus Respondent Count

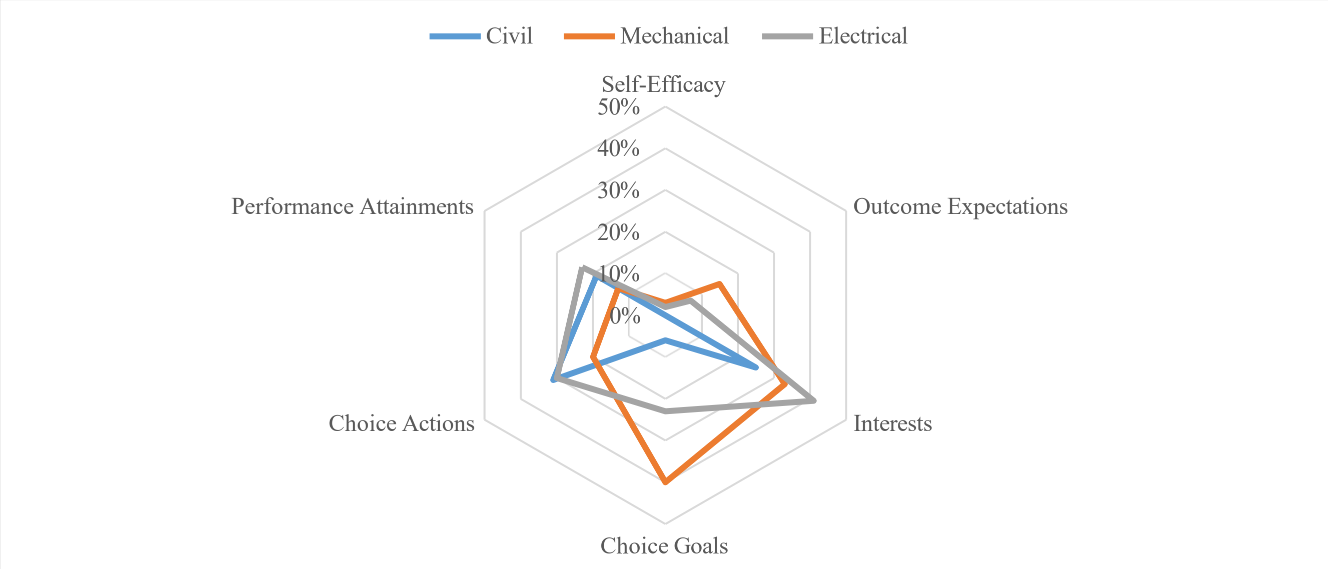


Taken together, these findings reinforce the framing of engineering major selection as an emergent, identity-informed process rather than a single rational decision point. The predominance of Interests, Choice Goals and Choice Actions within students' journey maps suggests that first-year students are actively constructing possible futures, articulating what they enjoy and imagining where particular pathways might lead. In contrast, the relative absence of explicit Self-Efficacy statements is notable. While prior quantitative literature positions self-efficacy as central to major choice (Lent et al., 1994; Godwin et al., 2016), these qualitative data indicate that students do not necessarily narrate their decisions in terms of confidence beliefs. Instead, they speak in terms of curiosity, alignment and aspiration. This may suggest that efficacy beliefs operate implicitly within students' accounts, or that first-year students are still forming stable judgments about their capability within specific disciplines.

While the aggregate analysis illuminates cohort-level patterns, it necessarily obscures disciplinary nuance. The next section therefore examines the data by major, exploring how different engineering pathways are associated with distinct constellations of interests, perceived competencies and sources of influence. For analytical coherence, the range of engineering majors was consolidated into three categories, Civil, Mechanical and Electrical, based on their closest disciplinary alignment, seen here in Figure 3.

Figure 3

Representation of SCCT Domains Across Engineering Majors



Civil Engineering

Students with a civil engineering enrolled major demonstrated a distinct SCCT profile, characterised by comparatively higher references to Choice Actions (31%) and Performance Attainments (19%), but no explicit references to Self-Efficacy or Outcome Expectations. Interests (25%) were present, though were less dominant than in other majors. This pattern suggests that Civil students' narratives were grounded less in abstract aspiration and more in tangible experiences. Many described prior exposure to construction, infrastructure or community-oriented projects, often referencing work experience, family connections or visible built environments. Within SCCT, such accounts align with learning experiences that inform outcome beliefs and reinforce domain-relevant skills (Lent et al., 1994), yet students rarely articulated these as confidence statements. Instead, they described "liking practical work" or "wanting to build things that last", positioning their decision as action-oriented and externally anchored.

Compared to Mechanical and Electrical cohorts, Civil students expressed lower levels of certainty (Figure 2) and fewer explicit future-oriented Choice Goals (6%). This aligns with research suggesting that civil engineering is often perceived as broad and context-dependent, with professional identity developing through applied engagement rather than early specialisation (Crosthwaite, 2019). Civil students' narratives suggest alignment through participation and proximity rather than through strong internalised identity claims. Their identity work appears situated in experiences of "doing" rather than in projecting an idealised future self. This contrasts with Mechanical and Electrical students, whose accounts were more aspirational and goal-driven.

Electrical Engineering

Electrical engineering students exhibited the strongest concentration of Interests (41%) and comparatively high Choice Actions (30%) and Performance Attainments (23%). Although Outcome Expectations (7%) were lower than Mechanical, this cohort demonstrated higher levels of certainty in major selection. A key structural distinction emerged in the chi-squared analysis — students who mentioned Maths C or Specialist Mathematics were 2.5 times more likely to be electrical engineering majors than non-electrical majors. This finding is consistent with literature linking advanced mathematics identity to certain engineering pathways (Tan et al., 2021). Electrical engineering is widely perceived as mathematically intensive and abstract, and alignment with Specialist Mathematics may serve as both preparation and an identity marker. In SCCT terms, prior performance attainments in advanced mathematics likely reinforce both self-efficacy and outcome expectations, even if not explicitly articulated.

Compared to Civil and Mechanical students, Electrical students' narratives suggest a closer link between academic preparation and disciplinary choice. Their references to interest often centred on electronics, coding, renewable energy or complex systems — domains frequently associated with technical depth and innovation. The relatively high proportion of Performance Attainments (23%) suggests that prior academic success plays a visible role in legitimising students' choice. From an identity theory perspective, Electrical students appeared to draw on recognition within mathematically demanding spaces to position themselves as "fitting" the discipline. This aligns with findings that some engineering subcultures are perceived as more technically rigorous (Knight et al., 2020), potentially strengthening early certainty for students who perceive alignment while deterring others.

Mechanical Engineering

Mechanical engineering students demonstrated the highest proportion of Choice Goals (40%) and substantial references to Interests (33%). Outcome Expectations (15%) were more visible than in Civil or Electrical, suggesting that Mechanical students more frequently articulated imagined futures linked to innovation, industry or design impact. These students commonly described longstanding interests in machines, vehicles, robotics or problem-solving, often tracing these interests back to childhood hobbies. Such narratives reflect SCCT's interest-development pathway, in which early positive experiences reinforce outcome expectations and goal formation (Lent et al., 1994). Compared to Civil students, Mechanical students were more likely to frame their decision in terms of forward-looking aspiration — "I want to design …", "I hope to work in …" — indicating a clearer projection of possible selves.

Interestingly, chi-squared analysis indicated that students who mentioned grades were 2.5 times more likely to be Mechanical majors than non-mechanical majors. This suggests that academic performance, as a proxy for competence recognition, may play a stronger role in mechanical identity alignment. Despite this, explicit self-efficacy statements remained low (3%), reinforcing the broader cohort trend that students narrate decisions in terms of goals and interests rather than confidence beliefs. It may be that efficacy operates implicitly, embedded within references to achievement and aspiration rather than being directly named. Relative to Civil students, Mechanical students appeared to occupy a more aspirational identity space, projecting themselves into future engineering roles. However, compared to Electrical, their interests were less tightly coupled to specific academic pathways (e.g., advanced mathematics), suggesting a broader interpretive framing of what "mechanical" entails.

Cross Major Comparison

Comparatively, the three majors revealed distinct patterns of influence. Civil students tended to be action-oriented and experience-driven, with identity emerging through practical exposure and participation and with lower levels of articulated goals and certainty suggesting exploratory alignment. Mechanical students were more aspirational and goal-focused, projecting clear future selves and drawing on academic performance as a source of recognition. Electrical students demonstrated interest-intensive and academically anchored narratives, with advanced mathematics functioning as a key structural and identity marker, contributing to stronger certainty in their choice.

Across all majors, explicit self-efficacy statements were rare, challenging dominant SCCT framings that position efficacy as central to decision-making (Lent et al., 1994; Godwin et al., 2016). Instead, students emphasised curiosity, alignment and aspiration, suggesting that early major selection may be less about stable confidence beliefs and more about negotiating belonging within perceived disciplinary cultures. Each discipline thus presents distinct cultural narratives and structural signals that shape how students interpret fit, reinforcing the need for discipline-sensitive approaches that broaden representations of competence and belonging.

Concluding Remarks

This study shows that engineering major selection is not a single rational choice, but an evolving, identity-focused process influenced by students' interests, aspirations, experiences and perceptions of disciplinary cultures. Rather than expressing explicit self-efficacy, students described their decisions through curiosity, alignment and imagined futures, with civil, mechanical and electrical students drawing on distinct cultural narratives that affected their sense of fit.

For educators, these findings highlight the need for first-year curricula that reveal the varied practices, values and career pathways within each discipline, using authentic experiences such as industry cases, alumni stories and interdisciplinary projects. First-year programs should also normalise uncertainty, treating undeclared status as exploration rather than deficit and supporting students through reflective activities like journey mapping. In addition, educators should challenge narrow disciplinary stereotypes by broadening representations of competence to include collaboration, creativity and social impact.

Structural cues also impact student decisions and the links between advanced mathematics and electrical engineering, or between grades and mechanical engineering, can signal who belongs. Institutions therefore need transparent, supported pathways into all majors, especially for students without traditional backgrounds. Overall, fostering equitable and confident major selection requires intentional, discipline-sensitive design that centres identity development within first-year engineering education.

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