Contextualising Engineering Identity: A Review of Cultural, Societal, and Employability Influences in Engineering Education

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ABSTRACT

Engineering identity is increasingly recognised as an important construct in engineering education because it shapes students' motivation, belonging, persistence, and transition into professional engineering roles. Existing engineering identity scholarship has provided valuable conceptual foundations, particularly through dimensions such as interest, performance and competence, and recognition. However, much of this literature has been developed in Western higher education contexts and may not fully explain how engineering identity is shaped within non-Western, collectivist, and industry-driven educational systems. This conceptual review examines how cultural, societal, institutional, and employability-related influences shape engineering identity development, with particular attention to Southeast Asian and Malaysian engineering education contexts. The review synthesises literature on engineering identity models, social recognition, family expectations, gendered experiences, institutional learning environments, professional accreditation, industry exposure, and employability. It argues that cultural and societal influences should be understood as active identity-forming forces rather than background factors. It also argues that industry readiness and employability should not be treated only as graduate outcomes, but as processes through which students test their competence, receive professional recognition, and develop confidence in becoming engineers. The paper contributes to engineering identity scholarship by proposing a broader contextual understanding of identity formation that integrates social, cultural, institutional, and professional conditions. Such a perspective can support more responsive engineering education practices, stronger university-industry alignment, and future research on contextualised engineering identity development in non-Western and Malaysian settings.

Keywords: Engineering identity; engineering education; cultural influence; employability; Malaysia

INTRODUCTION

Engineering identity has become an important construct in engineering education because it helps explain how students come to see themselves as engineers, develop a sense of belonging within engineering communities, and sustain commitment to engineering pathways. Beyond the acquisition of technical knowledge, becoming an engineer involves a gradual process of professional self-understanding, participation, recognition, and alignment with the values and practices of the discipline. Early sociocultural studies conceptualised engineering identity as a process of becoming, shaped by participation in engineering communities and by students' negotiation of what counts as legitimate engineering knowledge and practice (Tonso, 2006a; Stevens et al., 2008). This perspective suggests that engineering identity is not simply an individual attribute, but a socially mediated process through which students interpret their place within engineering education and the future profession.

Existing engineering identity scholarship has been strongly shaped by foundational work in STEM and science identity. Carlone and Johnson (2007) conceptualised science identity through the interrelated dimensions of competence, performance, and recognition, highlighting that students must not only develop disciplinary capability but also be recognised by themselves and others as legitimate participants in the field. Hazari et al. (2010) later extended identity research in physics education by foregrounding interest, performance and

competence, and recognition as important predictors of persistence and career orientation. Building from this tradition, Godwin (2016) adapted these identity dimensions into engineering education, conceptualising engineering identity through interest, performance and competence, and recognition. These dimensions provide an important foundation for understanding how students' motivation, perceived capability, and social validation shape their identification with engineering.

Subsequent research has reinforced the relevance of these core dimensions while also extending engineering identity scholarship into broader areas such as belonging, agency, emotional experience, gendered identity, and professional transition. Studies have shown that interest and recognition are particularly influential in predicting engineering identity and persistence, while performance and competence contribute to students' confidence in undertaking engineering-related tasks (Patrick et al., 2018; Verdín, 2021). More recent work also indicates that engineering identity remains developmental and may continue to evolve during students' progression through engineering programmes (Lockhart & Rambo-Hernandez, 2024; Lockhart et al., 2025). At the same time, studies on agency, emotion, belonging, gender, and affect show that engineering identity is increasingly understood as dynamic, relational, affective, and contextually situated rather than as a fixed psychological state (Godwin et al., 2016; Wang et al., 2022; Espino et al., 2024; Polmear et al., 2024; Treadway et al., 2025).

Despite these theoretical and empirical advances, important limitations remain in how engineering identity has been conceptualised across different educational contexts. Much of the existing literature has been developed and validated in Western higher education settings, often through quantitative instruments that emphasise individual-level dimensions and predictive relationships. While such work has strengthened the measurement and theoretical stability of engineering identity, it may not fully capture how identity is shaped within non-Western, collectivist, and policy-driven educational systems. In such contexts, students' decisions to enter engineering, remain in engineering, and imagine themselves as future engineers may be influenced not only by personal interest or perceived competence, but also by family expectations, societal perceptions of engineering, institutional pathways, professional accreditation structures, and labour market realities (Koul, 2018; Co & Chen, 2025).

This contextual limitation is significant because identity formation is inherently social and cultural. Educational identity research suggests that students' sense of self develops through interaction, participation, recognition, and belonging within specific communities and institutional environments (Gee, 2000; Wenger, 1998). In engineering education, this means that students do not form engineering identity in isolation. They develop identity through classroom experiences, peer interaction, lecturer feedback, project work, industry exposure, family expectations, and broader societal narratives about engineering. Therefore, engineering identity should not be understood only through what students feel individually, but also through the conditions that enable or constrain their participation, recognition, and professional self-understanding.

The need for contextualisation is especially important in Southeast Asian and Malaysian engineering education. Available Southeast Asian studies suggest that engineering identity may be shaped by multiple social roles, family-related expectations, and career-oriented identity processes (Koul, 2018; Saputra et al., 2024; Saputra et al., 2025). In Malaysia, direct engineering identity research remains limited, although existing studies offer important contextual signals. DeBoer et al. (2019) show that Malaysian women engineers' identity experiences are shaped through professional practice, gendered expectations, and workplace legitimacy. Mastam et al. (2025) similarly suggest that female students' engineering career selection is connected to interest, recognition, self-concept, and broader social purpose. Other Malaysian engineering education studies point to the importance of early exposure, teamwork, student-centred learning, curriculum design, and professional skills development in shaping students' understanding of engineering roles (Sadikin et al., 2019; Syed Hassan et al., 2020; Tang, 2021). These studies indicate that engineering identity in Malaysia cannot be sufficiently explained through individual interest, performance and competence, and recognition alone.

A further contextual issue concerns industry readiness and employability. In engineering education, employability is often discussed as a graduate outcome, referring to whether students possess the knowledge, skills, and attributes required for employment. However, from an identity perspective, employability can also be understood as part of students' professional self-formation. Students' confidence to communicate, solve real

problems, work in teams, apply technical knowledge, engage with industry expectations, and imagine themselves as practising engineers may directly influence whether they internalise an engineering identity. Studies on authentic engineering practice, professional skills, industry exposure, and university-industry alignment suggest that workplace-related experiences can strengthen students' sense of engineering identity by connecting academic learning with professional legitimacy (Meyers et al., 2012; Choe et al., 2019; Bilgin et al., 2023; Souppez, 2025). Therefore, industry readiness should not be treated only as a final employment outcome, but also as an identity-forming process that shapes students' transition from engineering learners to future engineering professionals.

Unlike previous engineering identity reviews that have primarily focused on theoretical development, measurement approaches, persistence, or educational outcomes, this review specifically synthesises cultural, societal, institutional, and employability-related influences as interconnected contextual factors shaping engineering identity development. By bringing together literature from engineering identity, sociocultural theory, engineering education, and employability research, the review extends existing discussions beyond traditional individual-level dimensions and highlights the importance of context in shaping students' engineering identities. This perspective is particularly relevant for non-Western and Malaysian engineering education settings, where family expectations, societal influences, institutional conditions, and professional readiness may play a more prominent role in identity development.

This review aims to contextualise engineering identity scholarship by examining how cultural, societal, institutional, and employability-related influences shape engineering identity development, particularly in non-Western and Malaysian engineering education contexts. The review is guided by three questions: first, how have existing engineering identity models conceptualised the development of engineering identity in engineering education? Second, how do cultural, societal, institutional, and relational influences shape engineering identity development across different educational contexts? Third, how can industry readiness and employability be understood as identity-forming processes rather than only graduate outcomes?

By addressing these questions, this paper contributes to engineering identity scholarship in two ways. First, it synthesises existing models and highlights their contextual limits when applied across culturally and institutionally diverse settings. Second, it argues that cultural and societal influence, together with industry readiness and employability, should be treated as central contextual forces in engineering identity development. In doing so, the review supports a broader understanding of engineering identity as a socially situated, culturally mediated, and professionally oriented process.

Review Approach

This paper adopts a conceptual review approach to synthesise engineering identity scholarship with particular attention to cultural, societal, institutional, and employability-related influences. This approach is appropriate because the purpose of the paper is not to provide an exhaustive systematic review of all engineering identity studies, but to critically organise and interpret selected literature around a specific conceptual problem: the need to contextualise engineering identity beyond dominant individual-level dimensions. A conceptual review enables connections to be drawn across engineering identity, STEM identity, sociocultural identity theory, engineering education, and employability literature in order to examine how identity formation is shaped by broader educational, cultural, and professional conditions. A conceptual review was considered more appropriate than a systematic review because the objective of the paper is theory synthesis and conceptual integration rather than comprehensive evidence aggregation or effect comparison across studies.

The review is guided by three questions. First, how have existing engineering identity models conceptualised the development of engineering identity in engineering education? Second, how do cultural, societal, institutional, and relational influences shape engineering identity development across different educational contexts? Third, how can industry readiness and employability be understood as identity-forming processes rather than only graduate outcomes? These questions provide the organising structure for the review and support the paper's broader aim of contextualising engineering identity within non-Western and Malaysian engineering education contexts.

The literature included in this review was selected based on its conceptual relevance to engineering identity development and its contextual influences. Foundational identity literature was included to establish identity as a socially constructed and relational process, particularly through the work of Gee (2000), Wenger (1998), Carlone and Johnson (2007), Hazari et al. (2010), and Godwin (2016). Engineering identity studies were then reviewed to examine how the core dimensions of interest, performance and competence, and recognition have been established, validated, and extended across different educational contexts. Studies on belonging, agency, emotional experience, gendered identity, and professional transition were also considered because they demonstrate the expanding conceptual scope of engineering identity scholarship (Godwin et al., 2016; Wang et al., 2022; Espino et al., 2024; Polmear et al., 2024; Treadway et al., 2025).

To address the contextual focus of the paper, the review also incorporates literature on social-relational influences, collectivist contexts, institutional learning environments, and industry exposure. Studies from Southeast Asian and Malaysian contexts were included where available, particularly those addressing work and family identities, engineering identity measurement, women engineers' professional identity, engineering career selection, introductory engineering courses, teamwork, student-centred learning, and employability-related preparation (Koul, 2018; DeBoer et al., 2019; Sadikin et al., 2019; Syed Hassan et al., 2020; Tang, 2021; Saputra et al., 2024; Mastam et al., 2025; Saputra et al., 2025). These studies provide regional and local evidence that engineering identity may be shaped by sociocultural expectations, institutional practices, and professional readiness concerns that are not always fully captured in dominant Western-derived models.

The synthesis was organised thematically rather than chronologically. The first part of the review examines existing engineering identity models and their contextual limits. The second part discusses cultural and societal influences, including family expectations, social recognition, gendered experiences, and societal perceptions of engineering. The third part considers institutional and pedagogical conditions, including curriculum design, active learning, professional exposure, and accreditation-related expectations. The fourth part examines industry readiness and employability as identity-forming processes, with attention to internships, capstone experiences, workplace expectations, professional skills, and university-industry alignment. The final part develops a contextualised research agenda for engineering identity scholarship, particularly for non-Western, Southeast Asian, and Malaysian engineering education contexts.

By adopting this conceptual review approach, the paper does not claim to provide a comprehensive inventory of all engineering identity literature. Instead, it offers a focused synthesis of literature that is theoretically and contextually relevant to the paper's central argument. The value of this approach lies in its ability to identify conceptual connections, expose contextual limitations in existing models, and propose directions for more culturally responsive and professionally grounded engineering identity research.

Existing Engineering Identity Models and Their Contextual Limits

Engineering identity scholarship has developed from broader identity research in science education, sociocultural learning theory, and career development literature. Across these traditions, identity is generally understood as more than an internal self-concept. Rather, it is shaped through participation, recognition, belonging, and interaction within particular disciplinary and social environments (Gee, 2000; Wenger, 1998). In engineering education, this perspective is particularly important because students do not become engineers solely through acquiring technical knowledge. They develop an engineering identity through experiences of learning, participation, performance, recognition, and engagement with engineering communities.

Foundational Models of Engineering Identity

A major foundation for engineering identity scholarship originates from Carlone and Johnson's (2007) science identity model. Their framework conceptualised identity through the interrelated dimensions of competence, performance, and recognition. Competence refers to disciplinary knowledge and understanding, performance refers to the ability to demonstrate that knowledge in socially meaningful ways, and recognition refers to being acknowledged by oneself and others as a legitimate participant in the field. This model was influential because it established identity as a multidimensional construct shaped by both personal capability and social validation.

Students may possess knowledge and skills, but without opportunities to demonstrate competence and receive recognition, those capabilities may not translate into a stable disciplinary identity.

Hazari et al. (2010) extended this identity tradition within physics education by emphasising interest, performance and competence, and recognition as important predictors of persistence and future participation in STEM pathways. Their work strengthened the connection between identity, motivation, and career intention by demonstrating that students' perceptions of themselves within a discipline influence their educational and professional aspirations. Importantly, the inclusion of interest highlighted that identity is not only about capability and recognition, but also about personal engagement and commitment to a disciplinary pathway.

Building upon these foundations, Godwin (2016) adapted the core dimensions of interest, performance and competence, and recognition into engineering education and developed one of the most widely used models of engineering identity. In this model, interest represents students' motivation and engagement with engineering, performance and competence reflect perceived ability to undertake engineering-related tasks, and recognition captures whether students see themselves, and are seen by others, as engineering people. Godwin's model has become particularly influential because it provides a discipline-specific framework that has been widely applied to examine engineering students' persistence, belonging, confidence, and professional aspirations.

Subsequent studies have consistently reinforced the importance of these dimensions. Patrick et al. (2018) found that engineering identity is associated with persistence in engineering programmes, while Verdín (2021) demonstrated the importance of identity-related factors in supporting persistence beliefs among minoritised women in engineering. More recent studies suggest that engineering identity remains developmental and may evolve throughout students' educational journeys (Lockhart & Rambo-Hernandez, 2024; Lockhart et al., 2025). Collectively, these studies confirm that interest, performance and competence, and recognition remain central mechanisms through which students develop an engineering identity.

Expanded Perspectives on Identity Development

Although the tripartite dimensions provide a strong foundation, other theoretical perspectives have broadened understanding of how engineering identity develops. Sociocultural approaches emphasise participation, community membership, and the social nature of learning. Communities of Practice theory conceptualises identity as developing through participation in shared practices and movement toward fuller membership within a community (Wenger, 1998). From this perspective, students become engineers not only by learning engineering knowledge, but by participating in engineering-related activities and gradually developing a sense of belonging within engineering communities.

Similarly, Stevens et al. (2008) conceptualised engineering learning as a process of becoming an engineer through engagement with accountable disciplinary knowledge and engineering practices. Their work highlights that identity development involves understanding what counts as legitimate engineering knowledge, how engineers solve problems, and how individuals position themselves within engineering communities. These perspectives shift attention away from identity as a purely individual construct and toward identity as a socially negotiated process of participation and becoming.

Career and motivational theories have also contributed to engineering identity scholarship. Social Cognitive Career Theory explains how self-efficacy, outcome expectations, and goals influence educational and career decisions (Lent et al., 1994). Relatedly, possible selves and identity-based motivation perspectives suggest that students' future-oriented self-concepts shape present engagement and persistence (Markus & Nurius, 1986; Oyserman, 2015). These perspectives are useful because they explain why students may remain committed to engineering when they perceive engineering as attainable, desirable, and aligned with their future aspirations. However, they primarily focus on individual motivation and decision-making processes rather than broader social and contextual influences.

Recent Extensions Beyond Traditional Identity Dimensions

More recent scholarship has expanded engineering identity beyond the traditional dimensions of interest, performance and competence, and recognition. One important extension is the concept of Critical Engineering Agency, which incorporates students' perceived capacity to contribute positively to society through engineering (Godwin et al., 2016). This perspective suggests that engineering identity is not only about belonging to a profession, but also about understanding how engineering can be used to address social and societal challenges.

Other studies have highlighted the importance of belonging, emotion, gender, and psychological well-being. Wang et al. (2022) demonstrated that engineering identity interacts with gender identity and psychological well-being, indicating that identity formation is also emotional and relational. Similarly, Espino et al. (2024), Polmear et al. (2024), and Treadway et al. (2025) show that belonging, affective experiences, and social positioning influence how students understand their place within engineering education. These developments suggest that engineering identity is increasingly viewed as dynamic, multifaceted, and shaped by students' lived experiences rather than solely by academic achievement or disciplinary competence.

Although these models differ in theoretical orientation, they share several common assumptions. First, engineering identity is understood as a developmental process rather than a fixed trait. Second, identity emerges through the interaction between individual perceptions and social experiences. Third, recognition remains a central mechanism through which students come to see themselves as legitimate participants within engineering. Collectively, these models have significantly advanced understanding of engineering identity formation. However, they also reveal an important pattern: most were developed within Western educational settings and primarily focus on individual, educational, and disciplinary influences. As a result, broader contextual factors such as family expectations, cultural values, societal perceptions of engineering, institutional structures, and employability-related experiences remain less explicitly theorised within dominant engineering identity frameworks.

To illustrate how engineering identity scholarship has evolved and where contextual limitations remain, Table 1 summarises the major theoretical models that have informed engineering identity research together with their primary contributions and contextual limitations.

Table 1. **Existing Engineering Identity Models and Contextual Limitations**

Model / Theory	**Core Focus**	**Contribution to Engineering Identity Scholarship**	**Contextual Limitation**
Science Identity Model (Carlone & Johnson, 2007)	Competence, performance, and recognition	Established identity as a multidimensional construct shaped by disciplinary knowledge, demonstrated practice, and recognition by self and others.	Developed within science education rather than engineering; limited direct attention to engineering-specific professional formation and non-Western contexts.
Physics Identity Model (Hazari et al., 2010)	Interest, performance/competence, and recognition	Extended identity research by linking interest and recognition to persistence and career orientation in STEM-related pathways.	Developed in physics education; stronger predictive orientation may underrepresent cultural, institutional, and professional meaning-making.
Engineering Identity Model (Godwin, 2016)	Interest, performance/competence, and recognition	Provided a discipline-specific model for examining how students identify with engineering through motivation, perceived	Primarily validated in Western higher education contexts; limited integration of family expectations, societal influence,

		capability, and social validation.	accreditation structures, and employability concerns.
Communities of Practice (Wenger, 1998)	Participation, belonging, mutual engagement, and community membership	Explains identity as developing through participation in shared practices and movement toward fuller membership in a community.	Conceptually rich but less operational as a measurement model; requires adaptation to engineering education and local institutional contexts.
Accountable Disciplinary Knowledge Framework (Stevens et al., 2008)	Participation, disciplinary knowledge, accountability, and becoming an engineer	Positions engineering identity as a process of becoming through participation in engineering knowledge practices and communities.	Based on Western qualitative evidence; less structured as a transferable dimensional model for different cultural and educational settings.
Social Cognitive Career Theory (Lent et al., 1994)	Self-efficacy, outcome expectations, and goals	Explains how confidence, perceived outcomes, and goals influence academic and career persistence in engineering-related pathways.	More individualistic in orientation; gives less attention to social recognition, family influence, cultural expectations, and institutional systems.
Identity-Based Motivation / Possible Selves (Markus & Nurius, 1986; Oyserman, 2015)	Future self-concept, identity congruence, and motivation	Helps explain how students' imagined future selves influence present engagement, persistence, and career direction.	Less engineering-specific; requires stronger connection to engineering practice, cultural context, and professional readiness.
Critical Engineering Agency (Godwin et al., 2016)	Agency, sociopolitical awareness, interest, and recognition	Extends engineering identity by linking identity to students' perceived capacity to contribute to society through engineering.	Developed mainly within Western contexts; requires further examination in collectivist and non-Western educational systems.
Gender and Emotional Identity Perspectives (Wang et al., 2022; Espino et al., 2024; Treadway et al., 2025)	Gender identity, emotional experience, belonging, affect, and social positioning	Broadens engineering identity by showing that identity formation is also affective, gendered, relational, and shaped by students' lived experiences.	Evidence remains context-specific and uneven across regions; limited integration into broader engineering identity models for Southeast Asian and Malaysian contexts.

Contextual Limits of Existing Engineering Identity Models

Collectively, the models presented in Table 1 demonstrate substantial theoretical convergence around participation, competence, recognition, and future professional orientation. However, they differ considerably in the extent to which contextual influences are explicitly incorporated. While sociocultural perspectives acknowledge the importance of community participation and social interaction, most engineering identity models continue to prioritise individual educational experiences over broader cultural, societal, and professional influences. This pattern suggests that contextual factors remain more frequently acknowledged than systematically theorised within engineering identity scholarship.

Despite their significant contributions, existing engineering identity models provide only a partial explanation of how engineering identity develops across diverse cultural and educational contexts. Most dominant frameworks were developed within Western higher education environments and were designed primarily to explain individual motivation, competence, participation, recognition, and persistence. Consequently, factors operating beyond the immediate educational environment, such as family expectations, societal narratives,

cultural norms, professional accreditation structures, and employability concerns, have received comparatively less theoretical attention.

This limitation is particularly relevant in non-Western and collectivist contexts, where educational and career decisions may be shaped by broader social influences. In such environments, engineering identity may be influenced not only by personal interest or perceived competence, but also by family expectations, social prestige, community values, national development priorities, and perceptions of future employability. These influences may affect how students enter engineering, how they interpret recognition, and how they imagine themselves as future professionals.

A second limitation concerns methodology. Much of the engineering identity literature has relied on quantitative instruments and survey-based approaches. While these methods have contributed significantly to the development and validation of identity constructs, they may not fully capture the meaning-making processes through which students negotiate identity within specific cultural and institutional settings. Identity is not only a measurable construct but also a lived experience shaped by interaction, interpretation, and context. Greater use of qualitative, interpretive, and longitudinal approaches may therefore provide deeper insights into how engineering identity develops over time and across diverse educational environments.

A third limitation is the relatively limited integration of professional readiness and employability into engineering identity theory. Engineering education is closely linked to professional practice, yet employability is often treated as a graduate outcome rather than a component of identity formation. Experiences such as internships, industry engagement, workplace mentoring, capstone projects, and exposure to professional expectations can influence whether students perceive themselves as capable future engineers. These experiences provide opportunities to demonstrate competence, receive professional recognition, and connect academic learning with engineering practice. However, their role in engineering identity development remains underexplored within many dominant frameworks.

Taken together, these limitations do not diminish the value of existing engineering identity models. Rather, they highlight opportunities for further theoretical development. Established models continue to provide important foundations for understanding interest, performance and competence, and recognition. However, a more contextualised understanding of engineering identity requires greater attention to cultural, societal, institutional, and employability-related influences. Such an extension can strengthen existing models by situating identity development within the broader social and professional environments in which students learn, participate, and prepare to become engineers.

Cultural And Societal Influences on Engineering Identity

Engineering identity does not develop in a social vacuum. Rather, it develops within social and cultural environments that shape how engineering is understood, valued, and experienced. While dominant engineering identity models emphasise dimensions such as interest, performance and competence, and recognition, these dimensions do not operate independently of context. Students' decisions to enter engineering, remain engaged in engineering education, and imagine themselves as future engineers are influenced by cultural expectations, family relationships, social recognition, gendered experiences, and broader societal perceptions of the engineering profession. Consequently, engineering identity should be understood not only as an individual developmental process but also as a socially situated and culturally mediated phenomenon.

This perspective is consistent with sociocultural understandings of identity, which view identity as emerging through participation, recognition, and interaction within particular communities and social environments (Gee, 2000; Wenger, 1998). From this viewpoint, students do not simply acquire an engineering identity through learning technical knowledge. Rather, identity develops through ongoing engagement with the people, institutions, and cultural narratives that define what engineering means and who belongs within the profession. The social and cultural environment therefore provides an important context through which established dimensions such as interest, performance and competence, and recognition are interpreted and experienced.

Family Influence and Cultural Expectations

Family influence represents one of the most significant pathways through which cultural and societal factors shape engineering identity. Educational and career decisions are often embedded within family relationships, expectations, and aspirations, particularly in collectivist societies where educational success is frequently viewed as a shared family achievement rather than solely an individual accomplishment. Family members may encourage engineering because it is perceived as a prestigious profession, a pathway to economic security, or a means of upward social mobility.

Research suggests that family support and encouragement can influence students' entry into engineering and STEM-related pathways. Ortiz et al. (2019) describe this influence through familial capital, where values, aspirations, and support are transmitted through family relationships and contribute to students' educational trajectories. Similarly, Malaysian studies have shown that parental encouragement and family support influence students' STEM interests and career intentions (Tan & Tay, 2019; Tey et al., 2020). These findings indicate that family influence often functions as an important entry mechanism into engineering.

However, family influence alone does not guarantee the development of a strong engineering identity. Students may initially choose engineering because of parental encouragement or societal expectations without necessarily internalising engineering as a meaningful aspect of self. Identity development requires more than entry into the discipline; it involves participation, competence development, recognition, and the gradual alignment of personal aspirations with professional pathways. Family influence may therefore initiate engagement with engineering, but deeper identity formation depends on how students subsequently experience engineering education and engineering practice. This distinction highlights the need to differentiate entry into engineering from the subsequent development of a stable engineering identity.

Recognition Beyond the Classroom

Recognition has long been considered a central component of engineering identity development (Carlone & Johnson, 2007; Godwin, 2016). Existing models typically focus on recognition from peers, educators, and disciplinary communities. However, recognition can extend beyond formal educational settings and may originate from multiple social sources, including family members, community networks, employers, and wider society.

When students receive affirmation that they possess engineering capability or potential, they are more likely to view themselves as legitimate participants within engineering. Patrick et al. (2018) demonstrated that recognition from family, friends, and peers contributes significantly to engineering identity development. This suggests that recognition should not be viewed solely as an academic process. Social validation from multiple sources can strengthen students' confidence, reinforce their sense of belonging, and encourage continued participation in engineering pathways.

The importance of recognition may be particularly pronounced in collectivist cultures, where social approval and communal perceptions often influence educational and career decisions. In such contexts, being recognised as an engineer may carry meanings that extend beyond individual achievement and become associated with family pride, social status, and community contribution.

Gender, Belonging, and Identity Negotiation

Cultural and societal influences are also evident in students' experiences of gender, belonging, and inclusion within engineering. Historically, engineering has often been associated with masculine norms, technical stereotypes, and narrow assumptions about who naturally belongs within the profession. Such assumptions can influence students' experiences of participation, confidence, and recognition.

Recent studies demonstrate that engineering identity interacts with gender identity, emotional experience, and psychological well-being (Wang et al., 2022). Similarly, Espino et al. (2024), Polmear et al. (2024), and Treadway et al. (2025) show that belonging and social positioning influence how students interpret their place

within engineering education. These findings suggest that engineering identity is not only cognitive or motivational but also emotional, relational, and socially negotiated.

Malaysian evidence further illustrates these dynamics. DeBoer et al. (2019) found that Malaysian women engineers' professional identities were shaped by workplace legitimacy, gendered expectations, and professional recognition. Mastam et al. (2025) similarly showed that female students' engineering career selection is connected to interest, recognition, self-concept, and broader social purpose. Collectively, these studies indicate that students may experience engineering identity differently depending on how social norms, expectations, and opportunities influence their participation and recognition within engineering environments.

Societal Perceptions of Engineering

Beyond family and interpersonal relationships, engineering identity is influenced by how engineering is perceived within society. Public narratives surrounding engineering contribute to students' understanding of what engineers do, why engineering matters, and whether engineering represents a desirable future identity. Engineering is frequently associated with technical expertise, social prestige, economic stability, and national development. These societal meanings can strengthen students' commitment to engineering when they align with personal interests and aspirations.

At the same time, societal prestige may produce identity tensions. Students may be encouraged to pursue engineering because it is viewed as a respected profession, even when their personal interests or understanding of engineering remain limited. In such cases, engineering may initially function as a socially endorsed career choice rather than a deeply internalised professional identity. This distinction is important because identity formation requires more than external approval. Students must also develop meaningful connections with engineering practices, values, and professional roles.

Studies from Southeast Asia provide additional evidence that societal expectations influence engineering identity development. Koul (2018), for example, demonstrated that engineering identity may develop alongside anticipated work and family identities, suggesting that students often understand engineering within broader life-planning and social responsibility frameworks. Similarly, Indonesian studies indicate that engineering identity and engineering-oriented career identity are closely connected to future aspirations and educational intentions (Saputra et al., 2024; Saputra et al., 2025). These findings suggest that societal expectations and future life goals may influence how students interpret the meaning and value of engineering participation.

Toward a Contextual Understanding of Cultural and Societal Influence

Taken together, the literature suggests that cultural and societal influences should not be treated as background conditions within engineering identity development. Rather, they function as active identity-forming forces that shape how students enter engineering, interpret recognition, experience belonging, and imagine their future professional selves. Family expectations may encourage entry into engineering, social recognition may validate participation, gendered experiences may influence confidence and belonging, and societal perceptions may shape how engineering is valued and understood.

Importantly, these influences do not replace established dimensions such as interest, performance and competence, and recognition. Instead, they provide the broader context within which those dimensions are formed, interpreted, and sustained. A contextualised understanding of engineering identity therefore requires attention not only to what students believe about themselves, but also to the cultural and societal environments that influence what it means to become an engineer.

Institutional And Pedagogical Conditions Shaping Identity

Engineering identity is not formed solely through personal motivation or social influence. It is also shaped by the institutional and pedagogical environments within which students learn engineering. Universities provide the formal structures through which students acquire disciplinary knowledge, engage in engineering practices, interact with peers and educators, and develop an understanding of what it means to become an engineer.

Consequently, curriculum design, teaching approaches, assessment practices, project experiences, and professional preparation initiatives play an important role in shaping engineering identity development.

This institutional perspective is important because participation in an engineering programme does not automatically lead to identification with engineering. Students may successfully complete engineering courses and achieve strong academic performance while remaining uncertain about their place within the profession. Identity development requires opportunities for students to connect learning with practice, demonstrate competence, receive recognition, and understand how engineering knowledge relates to real-world challenges. Therefore, engineering education environments function not only as sites of knowledge transmission but also as contexts in which professional identities are formed and negotiated.

Curriculum as an Identity Development Environment

Curriculum design provides one of the earliest institutional influences on engineering identity. The curriculum determines how students encounter engineering concepts, how they experience engineering work, and how they understand the relationship between academic learning and professional practice. When engineering education is presented primarily through technical theory and examination-oriented assessment, students may perceive engineering as a collection of subjects rather than a professional community of practice. In contrast, curricula that integrate design activities, problem-solving experiences, teamwork, communication, and authentic engineering challenges can help students connect technical learning with professional identity formation.

This perspective aligns with Stevens et al. (2008), who argued that becoming an engineer involves participation in accountable disciplinary practices rather than merely acquiring technical knowledge. Engineering identity therefore develops when students begin to understand not only what engineers know, but also how engineers think, communicate, collaborate, and solve problems. Curriculum can support this process by creating opportunities for students to engage with engineering as a professional activity rather than simply an academic discipline.

Early curricular exposure appears particularly important. Students often enter engineering programmes with limited understanding of engineering roles and responsibilities. Introductory engineering experiences can therefore play a critical role in helping students develop realistic understandings of the profession. In the Malaysian context, Sadikin et al. (2019) found that introductory engineering courses supported students' awareness of engineering roles and responsibilities. Similarly, Zakaria et al. (2020) highlighted the value of integrated first-year engineering experiences that combine technical learning with professional exposure. These findings suggest that early curricular interventions can support students' initial transition from engineering learners to emerging engineering professionals. Overall, curriculum design may influence not only what students learn about engineering, but also who they believe they can become within the profession.

Student-Centred Learning and Active Participation

Engineering identity develops through participation rather than passive observation. Students are more likely to internalise an engineering identity when they actively engage in engineering-related tasks, contribute ideas, solve problems, and collaborate with others. Consequently, pedagogical approaches that promote active learning may contribute significantly to identity development.

Student-centred learning encourages students to take ownership of learning, participate in decision-making, and engage collaboratively with engineering challenges. Such approaches provide opportunities for students to demonstrate competence, receive feedback, and experience recognition from peers and educators. These experiences directly support the development of identity because they allow students to see themselves as active contributors within engineering learning environments.

Within Malaysian engineering education, Syed Hassan et al. (2020) emphasised the importance of cooperative and student-centred learning approaches in supporting engineering education outcomes. From an identity perspective, these approaches are valuable because they create opportunities for participation, interaction, and recognition. Students who actively contribute to discussions, projects, and collaborative activities may be more

likely to develop confidence in their engineering capabilities and a stronger sense of belonging within the discipline.

This argument is consistent with Wenger's (1998) Communities of Practice perspective, which views identity development as emerging through participation in shared practices. Engineering identity therefore develops not only through learning engineering content but also through engagement in engineering-related social and collaborative activities.

Project-Based and Experiential Learning

Project-based, problem-based, and design-oriented learning experiences provide particularly important opportunities for identity development because they expose students to activities that resemble professional engineering practice. These approaches move learning beyond theoretical understanding and allow students to apply knowledge in realistic and often complex situations.

Through projects and design activities, students must define problems, generate solutions, communicate ideas, negotiate constraints, and justify decisions. Such experiences enable students to perform engineering rather than simply study engineering. Consequently, project-based learning creates opportunities for students to test their competence, receive recognition, and develop confidence in their ability to function as engineers.

Research supports the identity-forming value of these experiences. Rohde et al. (2019) found that design experiences contribute to engineering identity and belongingness among engineering students. Similarly, Chen et al. (2022) highlighted the continuing relevance of project-based and problem-based learning in engineering education. These findings suggest that authentic engineering tasks help students connect academic knowledge with professional practice, thereby strengthening identity development.

Importantly, project experiences also create opportunities for peer recognition. Students receive feedback not only from educators but also from teammates and collaborators. This social dimension reinforces identity because competence becomes visible and recognised within a community of practice.

Assessment, Feedback, and Recognition

Assessment is often viewed primarily as a mechanism for evaluating student performance. However, from an identity perspective, assessment also communicates what is valued within engineering education and influences how students perceive their own capability and legitimacy.

When assessment focuses exclusively on examinations and technical correctness, students may associate engineering success primarily with academic achievement. In contrast, assessment approaches that include design work, communication, teamwork, reflection, and professional reasoning can reinforce broader understandings of engineering competence. Such approaches signal that engineering involves more than technical knowledge alone.

Feedback is equally important because it functions as a form of recognition. Students develop stronger engineering identities when their contributions are acknowledged and when they receive constructive feedback that supports growth and competence development. Consistent with the work of Carlone and Johnson (2007) and Godwin (2016), recognition remains a critical mechanism through which students come to see themselves as legitimate engineering participants.

Consequently, assessment and feedback should be understood not only as educational processes but also as identity-forming mechanisms that influence confidence, belonging, and professional self-perception.

Teamwork and Professional Socialisation

Engineering practice is inherently collaborative, and engineering identity often develops through interaction with others. Teamwork experiences provide opportunities for students to negotiate roles, contribute expertise, manage

conflict, and participate in collective problem-solving. These activities mirror important aspects of professional engineering practice and contribute to professional socialisation.

Research from Malaysia supports the importance of teamwork in engineering education. Tang (2021) found that teamwork competencies were significant predictors of academic performance among first-year engineering students. Although the study did not directly examine engineering identity, the findings suggest that collaborative participation plays an important role in students' engineering learning experiences.

From an identity perspective, teamwork supports the development of belonging, competence, and recognition. Students learn how to contribute within engineering communities, how to communicate technical ideas, and how to work effectively with others. These experiences help students move beyond individual academic achievement toward participation in engineering as a collective professional practice.

Accreditation and Professional Formation

Institutional influences on engineering identity extend beyond classroom experiences and include broader professional expectations embedded within accreditation systems. Accreditation standards communicate what counts as legitimate engineering preparation and define the competencies expected of future engineers.

In Malaysia, the Engineering Programme Accreditation Standard 2024 emphasises professional competence, engineering training, ethical responsibility, and readiness for engineering practice (Engineering Accreditation Council Malaysia, 2024). These expectations influence curriculum design, learning activities, and assessment practices across engineering programmes.

From an identity perspective, accreditation serves an important signalling function. It communicates professional expectations and helps connect academic experiences with future engineering roles. When accreditation outcomes are meaningfully integrated into students' learning experiences, they can contribute to professional self-understanding and identity development. Students begin to recognise that engineering education is not simply preparation for examinations but preparation for participation in a professional community.

Institutional Conditions as Identity-Forming Processes

Taken together, the literature suggests that institutional and pedagogical conditions should be understood as active influences on engineering identity development. Curriculum design, student-centred learning, project experiences, assessment practices, teamwork, and accreditation structures do more than support academic achievement. They shape how students participate in engineering, experience recognition, develop competence, and imagine themselves as future engineers.

Importantly, these institutional influences operate as a bridge between cultural influences and professional readiness. Cultural and societal factors may influence students' entry into engineering and initial perceptions of the profession, but institutional experiences shape how those perceptions evolve during higher education. Through participation in learning environments, students begin to translate external expectations into personal and professional self-understanding.

Therefore, a contextualised understanding of engineering identity must recognise universities as identity-development environments. Engineering programmes do not simply educate future engineers; they also provide the institutional conditions through which students learn what it means to become engineers.

Industry Readiness and Employability as Identity-Forming Processes

Engineering education has traditionally treated industry readiness and employability as desired graduate outcomes. Within this perspective, engineering programmes are expected to equip students with the technical knowledge, professional competencies, and transferable skills required for employment and professional practice. While this outcome-oriented approach remains important, it provides only a partial understanding of how students prepare for engineering careers. From an engineering identity perspective, industry readiness and

employability are not merely end products of education. They are developmental processes through which students evaluate their capability, receive professional validation, and gradually construct a sense of themselves as future engineers.

This distinction is significant because engineering identity develops through students' perceptions of who they are becoming rather than solely through what they know. Students may successfully complete engineering coursework and demonstrate technical competence while still feeling uncertain about their ability to function within professional engineering environments. Conversely, experiences that expose students to authentic engineering practice can strengthen confidence, legitimacy, and professional self-understanding. Industry readiness therefore represents more than preparation for employment; it represents a pathway through which students connect academic participation with future professional identity.

Engineering Identity and Professional Transition

Engineering identity is inherently future-oriented. Students do not simply develop an identity as engineering learners; they gradually develop an identity as future engineering professionals. This transition requires students to envision themselves occupying professional roles and to evaluate whether they possess the competencies, behaviours, and dispositions expected within engineering practice.

Theoretical perspectives on identity support this future-oriented understanding. Possible selves theory suggests that individuals are motivated by images of who they may become in the future (Markus & Nurius, 1986). Similarly, identity-based motivation theory proposes that future identities influence present behaviours and educational choices (Oyserman, 2015). Applied to engineering education, these perspectives suggest that students' engagement is strengthened when they can imagine themselves successfully functioning as engineers.

Professional readiness therefore becomes closely linked to identity formation. Students who perceive themselves as capable of meeting workplace expectations may be more likely to internalise an engineering identity. Conversely, students who perceive substantial gaps between university learning and engineering practice may struggle to see themselves as future engineers, even when they perform well academically.

Internships and Workplace Exposure

Among the most influential professional experiences shaping engineering identity are internships and workplace placements. These experiences provide students with opportunities to participate directly in engineering environments, interact with practising engineers, and observe how engineering knowledge is applied in real-world contexts.

Internships contribute to identity development because they expose students to authentic professional expectations that cannot be fully replicated within classroom environments. Students encounter organisational cultures, multidisciplinary collaboration, workplace communication, professional responsibility, project constraints, and engineering decision-making processes. Through these experiences, students begin to understand engineering as a profession rather than merely an academic discipline.

From a sociocultural perspective, internships provide access to professional communities of practice (Wenger, 1998). Students move beyond educational participation and begin to engage, albeit temporarily, within professional engineering communities. These experiences allow students to test their competence, evaluate their fit within engineering environments, and develop confidence in their ability to contribute to engineering work.

However, internships do not automatically strengthen engineering identity. Their impact depends on the quality of participation students experience. Meaningful responsibilities, supportive mentoring, constructive feedback, and opportunities for reflection are more likely to strengthen identity than passive observation or routine administrative tasks. Consequently, the identity-forming value of internships depends not only on placement itself but also on the nature of students' engagement within professional environments.

Capstone Experiences and Authentic Engineering Practice

Capstone projects and design-based experiences provide another important mechanism through which employability and identity intersect. These experiences often require students to integrate technical knowledge, teamwork, communication, project management, and problem-solving skills while addressing authentic engineering challenges.

Unlike traditional coursework, capstone experiences approximate many features of professional engineering practice. Students must manage ambiguity, balance competing requirements, justify decisions, communicate with stakeholders, and work collaboratively toward practical solutions. Through these activities, students begin to perform engineering rather than simply learn about engineering.

Research supports the importance of authentic engineering experiences for identity development. Rohde et al. (2019) found that engineering design experiences contribute to engineering identity and belongingness. Similarly, Choe et al. (2019) demonstrated that professional aspects of engineering improve prediction of undergraduate engineering identity. These findings suggest that identity is strengthened when students engage in activities that closely resemble professional engineering practice.

Importantly, capstone projects also provide opportunities for recognition. Students receive feedback from educators, industry representatives, project sponsors, and peers, all of whom contribute to validating students' emerging professional identities.

Professional Skills and Identity Development

Employability is often associated with professional skills such as communication, teamwork, leadership, adaptability, ethical reasoning, and problem-solving. Although these skills are frequently discussed as graduate attributes, they also play an important role in engineering identity development.

Students may possess strong technical knowledge while remaining uncertain about their ability to operate effectively within professional environments. Professional skills help bridge this gap by enabling students to participate confidently within engineering communities. Communication skills allow students to articulate technical ideas, teamwork supports collaborative problem-solving, leadership enables coordination and decision-making, and adaptability helps students navigate uncertainty and change.

Mamaril et al. (2016) highlighted the importance of engineering self-efficacy, while Meyers et al. (2012) identified multiple factors influencing engineering identity formation. Together, these studies suggest that students' confidence in applying their knowledge is as important as the knowledge itself. Professional skills contribute to this confidence by enabling students to translate academic capability into practical engineering participation.

Consequently, employability skills should not be viewed solely as workplace requirements. They also function as identity resources that help students perceive themselves as capable future engineers.

Professional Recognition and Legitimacy

Recognition remains a central mechanism through which industry readiness influences engineering identity. While recognition within academic environments is important, recognition from practising engineers may carry particular significance because it originates from individuals who already occupy the professional roles students aspire to attain.

Professional mentors, internship supervisors, industry representatives, and employers can all contribute to students' identity development through feedback, encouragement, and validation. When students are trusted with meaningful responsibilities or recognised for their contributions, they receive signals that they are capable of participating within engineering communities. Such experiences strengthen perceptions of legitimacy and belonging.

Conversely, the absence of professional recognition may undermine identity development. Students who receive limited feedback, perform only peripheral tasks, or perceive themselves as outsiders within professional environments may struggle to develop confidence in their future engineering roles. This highlights the importance of meaningful engagement and mentorship within industry-based learning experiences.

Professional recognition therefore extends the concept of recognition beyond academic settings and reinforces the importance of connecting engineering education with engineering practice.

University-Industry Alignment and Identity Formation

The relationship between universities and industry also plays an important role in shaping engineering identity. Students develop stronger professional identities when they perceive continuity between what they learn in university and what is expected in professional practice. Conversely, substantial gaps between educational experiences and workplace realities may weaken confidence and create uncertainty regarding professional readiness.

Recent scholarship emphasises the importance of strengthening university–industry partnerships. Bilgin et al. (2023) argue that closer collaboration between academia and industry can support both engineering identity development and employability. Similarly, employability research highlights the importance of aligning educational experiences with evolving professional expectations (Souppez, 2025; Zhan et al., 2026).

From an identity perspective, university–industry alignment helps students interpret engineering education as preparation for meaningful professional participation. Industry engagement activities such as mentoring programmes, industrial seminars, collaborative projects, workplace visits, and industry-sponsored challenges provide opportunities for students to connect academic experiences with future professional roles.

These activities also contribute to students' understanding of what constitutes legitimate engineering practice, thereby strengthening the connection between educational participation and professional identity formation.

Industry Readiness as an Identity-Forming Process

Taken together, the literature suggests that industry readiness and employability should be understood as identity-forming processes rather than merely employment outcomes. Internships, workplace exposure, capstone projects, professional skills development, industry mentoring, and university–industry partnerships all provide opportunities for students to evaluate their competence, receive recognition, and imagine themselves as future engineers.

Importantly, industry readiness does not replace established engineering identity dimensions such as interest, performance and competence, and recognition. Rather, it provides a professional context within which these dimensions are enacted and validated. Interest becomes more meaningful when students understand engineering practice. Performance and competence become more visible when students apply knowledge in authentic settings. Recognition becomes more powerful when it is provided by both academic and professional communities.

Therefore, a contextualised understanding of engineering identity must recognise employability and industry readiness as integral components of identity development. Students do not simply prepare for engineering careers; they develop an understanding of themselves as future engineers through engagement with professional practices, expectations, and communities. Engineering education should therefore view professional readiness not only as preparation for employment, but also as preparation for professional identity.

The literature reviewed across Sections 4, 5, and 6 demonstrates that engineering identity is influenced by multiple contextual factors operating across cultural, societal, institutional, and professional domains. Table 2 synthesises these influences and highlights the mechanisms through which they contribute to engineering identity development.

Table 2. Contextual Influences Shaping Engineering Identity Development

Contextual Influence	What It Captures	Identity-Forming Mechanism	Supporting Literature
Family expectations and parental influence	Family encouragement, parental aspirations, family-based career expectations, and intergenerational views of professional success.	Shapes students' initial entry into engineering, perceived legitimacy of engineering as a career, and early motivation toward STEM or engineering pathways.	Ortiz et al. (2019); Tan and Tay (2019); Tey et al. (2020)
Social recognition and community validation	Recognition from peers, lecturers, family members, community networks, mentors, and wider society.	Strengthens students' sense of belonging and legitimacy when others acknowledge them as capable future engineers.	Carlone and Johnson (2007); Godwin (2016); Patrick et al. (2018)
Cultural values and collectivist expectations	Collective decision-making, family responsibility, social approval, and culturally shaped meanings of respectable careers.	Influences whether engineering is understood as personally meaningful, socially valued, or externally expected.	Koul (2018); Tey et al. (2020); Co and Chen (2025)
Gendered and emotional experiences	Gender norms, stereotypes, psychological well-being, affective experiences, confidence, and feelings of fit or exclusion.	Shapes whether students feel recognised, included, and emotionally able to sustain an engineering identity.	Wang et al. (2022); Espino et al. (2024); Treadway et al. (2025); Mastam et al. (2025)
Societal perceptions of engineering	Social prestige, perceived job security, public image of engineering, and societal understanding of engineering work.	Can legitimise engineering as a desirable identity, but may also create tension when societal expectations are not matched by personal interest or professional understanding.	DeBoer et al. (2019); Mastam et al. (2025); Koul (2018)
Curriculum design and early exposure	Introductory engineering courses, structured exposure to engineering roles, and curriculum links between theory and practice.	Helps students understand what engineers do and connect academic learning with future professional identity.	Sadikin et al. (2019); Zakaria et al. (2020); Stevens et al. (2008)
Student-centred and collaborative learning	Cooperative learning, teamwork, active participation, peer discussion, and shared problem-solving.	Allows students to participate meaningfully, demonstrate competence, receive recognition, and develop belonging within engineering learning communities.	Syed Hassan et al. (2020); Tang (2021); Wenger (1998)
Project-based, problem-based, and design learning	Authentic design tasks, open-ended problems, capstone-like learning, and applied engineering challenges.	Enables students to perform engineering practices, test competence, and experience engineering as a real professional activity.	Rohde et al. (2019); Chen et al. (2022); Choe et al. (2019)
Assessment and feedback practices	Lecturer feedback, peer feedback, design justification, reflective assessment, and recognition of professional skills.	Influences students' confidence, perceived competence, and sense of being recognised as legitimate engineering participants.	Carlone and Johnson (2007); Godwin (2016); Patrick et al. (2018)

Accreditation and professional formation	Programme outcomes, professional competence requirements, engineering training expectations, and accreditation standards.	Signals what counts as legitimate engineering preparation and links academic learning with professional role formation.	Engineering Accreditation Council Malaysia (2024); Syed Hassan et al. (2020)
Internships and industrial training	Workplace placement, industry supervision, professional tasks, and exposure to organisational engineering practice.	Helps students test their competence, understand workplace expectations, and imagine themselves as future practising engineers.	Stevens et al. (2008); Bilgin et al. (2023); Souppez (2025)
Capstone projects and authentic engineering practice	Integrative projects, design application, teamwork, professional communication, and real-world problem solving.	Provides opportunities for students to enact engineering identity through authentic performance and professional recognition.	Choe et al. (2019); Rohde et al. (2019); Bilgin et al. (2023)
Professional skills and employability readiness	Communication, teamwork, adaptability, leadership, ethical judgement, autonomy, and workplace confidence.	Strengthens students' belief that they can function as engineers in real professional environments.	Mamaril et al. (2016); Meyers et al. (2012); Souppez (2025)
University-industry alignment	Collaboration between universities and industry, industry mentoring, professional seminars, and employer feedback.	Connects academic engineering with workplace engineering and validates students' emerging professional self-concept.	Bilgin et al. (2023); Choe et al. (2019); Engineering Accreditation Council Malaysia (2024)

Global, Southeast Asian, And Malaysian Perspectives

Engineering identity scholarship has expanded substantially over the past two decades, generating important insights into how students develop belonging, confidence, persistence, and professional aspirations within engineering education. Much of this scholarship has been guided by established dimensions such as interest, performance and competence, and recognition, together with broader constructs including belonging, agency, emotional experience, and professional formation. These contributions have significantly advanced understanding of how students come to identify with engineering and remain committed to engineering pathways.

Despite this progress, the geographical distribution of engineering identity research remains uneven. The majority of foundational theories, measurement instruments, and empirical studies have been developed within Western higher education systems, particularly in the United States. As a result, dominant engineering identity models largely reflect educational environments characterised by individualistic cultural orientations, specific institutional structures, and distinct professional pathways. While these models have demonstrated considerable explanatory value, their direct transfer to different cultural and educational contexts requires careful consideration.

This issue is important because engineering identity does not develop independently of context. Students' interpretations of engineering, perceptions of professional success, experiences of recognition, and pathways into engineering are influenced by broader social and cultural environments. Consequently, dimensions such as interest, performance and competence, and recognition may be expressed differently across societies. The underlying constructs may remain relevant, but the mechanisms through which identity develops can vary substantially depending on cultural expectations, family influence, educational systems, labour market conditions, and professional norms.

Global Developments in Engineering Identity Scholarship

Globally, engineering identity research has evolved from a relatively narrow focus on persistence and retention toward a broader examination of belonging, agency, emotional experience, and professional formation. Reviews by Morelock (2017) and Rodriguez et al. (2018) demonstrate the growing diversity of theoretical and methodological approaches within the field. More recent work continues to expand engineering identity scholarship by incorporating issues such as gender, well-being, affect, social responsibility, and professional transition (Wang et al., 2022; Polmear et al., 2024; Treadway et al., 2025).

These developments indicate increasing recognition that engineering identity is dynamic, multidimensional, and socially situated. However, they also reveal that much of the literature continues to focus on educational settings where the original theories and instruments were developed. Consequently, questions remain regarding how engineering identity operates in contexts where educational participation, family expectations, professional aspirations, and societal values differ from those typically represented in dominant engineering identity research.

As Co and Chen (2025) note, engineering identity remains an evolving construct that continues to be interpreted through multiple theoretical lenses. This theoretical diversity provides opportunities for contextual expansion, particularly in regions where engineering identity research remains limited.

Emerging Perspectives from Southeast Asia

Compared with North America, Europe, and Australia, engineering identity research in Southeast Asia remains relatively limited. Existing studies suggest that engineering identity is influenced by many of the same core dimensions identified in Western research, yet the broader sociocultural context may shape how those dimensions are experienced and interpreted.

One of the earliest regional contributions comes from Thailand. Koul (2018) examined the relationship between engineering identity, work identity, and family identity among undergraduate engineering students. The findings suggest that engineering identity may develop alongside broader life-role identities rather than as an isolated academic construct. This perspective is particularly important in collectivist societies, where educational and career decisions are often closely connected to family responsibilities, social expectations, and future life planning.

Emerging evidence from Indonesia further supports the applicability of engineering identity constructs within Southeast Asian contexts. Saputra et al. (2024) applied Godwin's engineering identity model among undergraduate engineering students and found support for the established dimensions of interest, performance and competence, and recognition. Similarly, Saputra et al. (2025) examined relationships among STEM interest, engineering-oriented career identity, academic self-efficacy, and engineering study intentions. Together, these studies indicate that established engineering identity constructs remain relevant in Southeast Asia.

However, these studies also highlight an important limitation. While existing models can be applied within Southeast Asian contexts, relatively little research has examined how local cultural expectations, educational structures, and societal conditions influence the development of engineering identity. Consequently, the region remains underrepresented in broader engineering identity theory-building efforts.

The Malaysian Context

Malaysia provides a particularly valuable context for examining engineering identity because engineering education operates at the intersection of professional accreditation requirements, national development priorities, graduate employability concerns, and sociocultural expectations. These conditions create an environment in which engineering identity may be shaped by factors extending beyond those typically emphasised in dominant engineering identity models.

Although direct engineering identity research in Malaysia remains limited, existing studies provide important contextual insights. DeBoer et al. (2019) examined the experiences of Malaysian women engineers and found

that professional identity development was shaped by workplace participation, gendered expectations, and professional legitimacy. This study demonstrates that engineering identity continues to evolve beyond university and is influenced by broader professional and social experiences.

More recently, Mastam et al. (2025) explored engineering identity among female engineering students in relation to career selection decisions. Their findings suggest that engineering identity is associated not only with interest and recognition but also with self-concept, social contribution, and future aspirations. These findings reinforce the importance of considering broader contextual influences when examining engineering identity within Malaysian higher education.

Other Malaysian engineering education studies, although not explicitly focused on engineering identity, identify institutional conditions that may contribute to identity formation. Sadikin et al. (2019) demonstrated the value of introductory engineering courses in helping students understand engineering roles and responsibilities. Zakaria et al. (2020) highlighted the importance of integrated first-year engineering experiences that combine technical learning with professional exposure. Tang (2021) emphasised the significance of teamwork within engineering learning environments, while Syed Hassan et al. (2020) highlighted the role of student-centred learning approaches in engineering education.

Collectively, these studies suggest that engineering identity in Malaysia may be influenced by a combination of cultural expectations, institutional experiences, professional preparation, and employability considerations. However, these influences have generally been examined separately rather than through an integrated engineering identity perspective.

Why Context Matters

The global, Southeast Asian, and Malaysian literature reviewed in this paper suggests that engineering identity should not be viewed as a culturally neutral construct. While foundational dimensions such as interest, performance and competence, and recognition remain important across contexts, the processes through which these dimensions develop may vary according to local realities.

In Western contexts, recognition may be strongly associated with academic achievement and disciplinary participation. In collectivist contexts, recognition may additionally involve family approval, community expectations, and societal perceptions of engineering. Similarly, interest may reflect personal passion in some contexts but may also be intertwined with family aspirations, economic security, and professional status in others. Employability and professional readiness may likewise carry different meanings depending on labour market conditions and societal expectations regarding engineering careers.

These contextual differences do not invalidate existing engineering identity models. Rather, they highlight opportunities for extending and enriching them. A contextualised perspective acknowledges that engineering identity develops through interactions among individual experiences, educational environments, sociocultural influences, and professional conditions. Consequently, engineering identity may be best understood as a context-sensitive construct whose expression varies across educational, cultural, and professional environments.

Toward Contextualised Engineering Identity Scholarship

Taken together, the evidence suggests that future engineering identity scholarship would benefit from stronger engagement with non-Western perspectives. Southeast Asia and Malaysia provide particularly important contexts because they combine collectivist social influences, rapidly evolving engineering education systems, strong employability agendas, and growing professional demands. These characteristics create opportunities to examine how engineering identity develops under conditions that differ from those represented in much of the existing literature.

A contextualised approach does not seek to replace established engineering identity theories. Rather, it seeks to extend them by examining how identity develops within diverse cultural, societal, institutional, and professional environments. Such work can contribute to both local educational improvement and broader international theory

development by generating a more inclusive understanding of how students become engineers across different parts of the world. The contextual differences identified across global, Southeast Asian, and Malaysian studies suggest that future engineering identity scholarship requires approaches that are both theoretically robust and contextually responsive. This need provides the basis for the research directions proposed in the following section.

Toward A Contextualised Engineering Identity Research Agenda

The preceding sections suggest that engineering identity scholarship has reached an important stage of theoretical maturity. Existing models have established a strong foundation for understanding how interest, performance and competence, and recognition contribute to engineering identity development. More recent work has expanded this foundation by incorporating belonging, agency, emotional experience, gender, and professional formation. Collectively, these contributions have significantly strengthened understanding of how students come to identify with engineering.

However, the review also highlights an important challenge. Much of the existing literature continues to conceptualise engineering identity primarily through individual-level and educational dimensions. Although these dimensions remain valuable, they may not fully explain how engineering identity develops within diverse cultural, societal, institutional, and professional environments. Consequently, future research must move beyond asking whether students possess engineering identity and instead examine how engineering identity is shaped by the broader systems within which students learn, participate, and prepare for professional practice.

Expanding Engineering Identity Beyond Individual-Level Explanations

A first priority for future research is the development of more context-sensitive understandings of engineering identity. Existing models have been highly successful in identifying core identity dimensions and demonstrating their relationships with persistence, belonging, and career intentions. However, the review suggests that identity development cannot be fully understood without considering the social and cultural environments in which these dimensions operate.

For example, interest may be influenced not only by personal curiosity but also by family expectations, societal values, and perceptions of engineering as a desirable career. Recognition may extend beyond educators and peers to include family members, employers, community networks, and professional organisations. Similarly, performance and competence may be interpreted differently depending on how engineering capability is defined within particular educational and professional contexts.

Further investigation is needed to understand how established engineering identity dimensions are interpreted, negotiated, and enacted across different cultural and institutional environments. Such work would contribute to a more nuanced understanding of engineering identity while retaining the strengths of existing theoretical frameworks.

Reframing Cultural and Societal Influences as Identity-Forming Forces

The review has demonstrated that cultural and societal influences should not be treated as background variables. Family expectations, cultural values, social recognition, gender norms, and societal perceptions of engineering actively shape students' experiences of engineering education and professional aspirations.

An important direction for future scholarship is to move beyond documenting the existence of these influences and instead examine the mechanisms through which they contribute to identity development. Several questions deserve greater attention, including how family expectations shape students' interpretations of engineering success, how societal prestige influences commitment to engineering pathways, how cultural values affect experiences of recognition and belonging, and how students negotiate tensions between personal interests and external expectations. Addressing such questions would help position culture and society as integral components of engineering identity theory rather than peripheral contextual factors.

Integrating Employability and Professional Readiness into Identity Theory

A second major opportunity concerns the relationship between engineering identity and employability. Engineering education research has traditionally treated employability as an educational outcome, while engineering identity research has focused on belonging, competence, recognition, and persistence. This separation may overlook important connections between professional readiness and identity development.

The review suggests that internships, industry engagement, workplace mentoring, professional skills development, and authentic engineering experiences all contribute to students' perceptions of themselves as future engineers. Consequently, employability should not be viewed solely as preparation for employment but also as preparation for professional identity.

Research is needed to examine how students internalise workplace expectations, professional norms, and industry experiences as part of identity development. Such work could help bridge the current gap between engineering identity scholarship and employability research while providing a more comprehensive understanding of students' transition from education to professional practice.

Advancing Methodological Diversity

A third priority concerns research methodology. Engineering identity scholarship has benefited greatly from quantitative measurement instruments and survey-based studies. These approaches have helped establish theoretical consistency and demonstrate relationships between identity and important educational outcomes.

However, identity is inherently dynamic, contextual, and socially negotiated. Greater methodological diversity is needed to capture the complexity of engineering identity development. Qualitative approaches can provide deeper insights into how students construct meaning around engineering experiences, while mixed-method and longitudinal studies can capture identity development across time and educational transitions.

Engineering identity should be examined not only as a measurable construct but also as an evolving narrative shaped by participation, recognition, and experience. Such approaches may be particularly valuable for understanding engineering identity in underrepresented contexts where local meanings and experiences remain insufficiently explored.

Strengthening Research in Southeast Asian and Malaysian Contexts

The review also identifies a need for stronger engineering identity scholarship in Southeast Asia and Malaysia. Existing regional studies demonstrate that established engineering identity dimensions remain relevant, but they also suggest that local educational systems, family structures, societal expectations, and professional pathways may shape identity development in distinctive ways.

Scholars should move beyond the application of Western-derived instruments and examine how engineering identity develops within local contexts. Comparative studies across Southeast Asian countries may be particularly valuable because they can identify both shared and context-specific influences on engineering identity formation.

For Malaysia, research opportunities are especially significant. Existing studies highlight the importance of family influence, professional legitimacy, student-centred learning, teamwork, employability, and engineering career aspirations. However, these influences have rarely been examined within a unified engineering identity framework. A priority for Malaysian engineering identity scholarship is the integration of these strands into a more coherent understanding of engineering identity development.

Toward Ecosystemic Models of Engineering Identity

Perhaps the most important implication of this review is that engineering identity should be understood as an ecosystemic phenomenon shaped by interactions across personal, social, educational, institutional, and

professional systems. Existing research often examines individual dimensions, educational interventions, cultural influences, or employability factors separately. However, students experience these influences simultaneously rather than independently.

Engineering identity develops through interactions among personal interests, family expectations, educational experiences, institutional structures, professional opportunities, and societal narratives. Consequently, future models should seek to explain how these influences interact across different stages of students' educational and professional journeys.

An ecosystemic perspective recognises that engineering identity is not produced by any single factor. Rather, it emerges through the dynamic interaction of multiple social, educational, cultural, and professional systems. Such an approach may provide a more comprehensive explanation of how students develop confidence, belonging, professional aspirations, and commitment to engineering.

Building on the conceptual and contextual gaps identified throughout this review, Table 3 presents a proposed research agenda for advancing contextualised engineering identity scholarship, particularly in non-Western, Southeast Asian, and Malaysian engineering education contexts.

Table 3. Future Research Agenda for Contextualised Engineering Identity

Research Gap	Future Research Direction	Potential Contribution to Engineering Identity Scholarship
Western-centric development of dominant engineering identity models	Conduct more engineering identity studies in non-Western, Southeast Asian, and Malaysian contexts.	Expands the contextual validity of engineering identity theory beyond dominant Western higher education settings.
Limited cultural integration in engineering identity models	Examine how family expectations, collectivist values, cultural norms, and societal meanings of professional success shape engineering identity.	Positions culture as an active identity-forming force rather than a background variable.
Narrow treatment of recognition	Investigate recognition from multiple sources, including family, peers, lecturers, community members, industry mentors, employers, and professional bodies.	Broadens recognition theory by showing how identity validation operates across academic, social, and professional spaces.
Under-theorisation of societal influence	Explore how societal prestige, public perceptions of engineering, national development narratives, and social mobility expectations influence students' engineering pathways.	Explains how students' sense of becoming engineers is shaped by wider social meanings attached to engineering.
Limited integration of gendered and emotional experiences	Study how gender norms, emotional experiences, psychological well-being, confidence, and belonging shape engineering identity formation.	Provides a more inclusive and affective understanding of engineering identity development.
Employability treated mainly as a graduate outcome	Examine industry readiness, employability, internships, capstone projects, and professional skills as identity-forming processes.	Reframes employability as part of students' professional self-formation, not only as post-graduation employment preparation.
Weak university-industry identity linkage	Investigate how industry mentoring, workplace feedback, employer recognition, and professional exposure influence students' sense of legitimacy as future engineers.	Strengthens understanding of how professional communities validate and consolidate engineering identity.
Survey-dominant methodological tradition	Increase qualitative, interpretive, mixed-method, and narrative studies of engineering identity development.	Captures students' lived experiences, meaning-making processes, and contextual negotiations more deeply.
Limited longitudinal evidence	Conduct longitudinal studies across school, university, internship, graduation, and early career stages.	Explains how engineering identity develops, stabilises, weakens, or

		transforms across educational-to-professional transitions.
Fragmented regional evidence in Southeast Asia	Build a stronger cumulative body of Southeast Asian engineering identity research through comparative and country-specific studies.	Enables regional theory-building and identifies shared or distinctive identity-forming mechanisms across Southeast Asian contexts.
Limited Malaysian engineering identity frameworks	Develop and test contextualised Malaysian engineering identity frameworks that integrate cultural, societal, institutional, and employability influences.	Supports locally grounded theory development and practical improvement in Malaysian engineering education.
Separation between identity, pedagogy, and policy	Examine how curriculum, student-centred learning, accreditation, policy priorities, and professional standards jointly shape identity formation.	Encourages ecosystemic models that connect individual identity with educational, institutional, and professional systems.

Collectively, the proposed directions highlight opportunities to strengthen engineering identity scholarship through greater contextual sensitivity, theoretical integration, and methodological diversity. Taken together, the directions proposed in this section suggest a shift from viewing engineering identity primarily as an individual educational construct toward understanding it as a contextual, relational, and developmental process. This shift does not require abandoning established engineering identity models. Instead, it requires extending them by recognising that identity develops within broader cultural, societal, institutional, and professional environments.

Such an approach has the potential to strengthen both theory and practice. Theoretically, it can expand understanding of how engineering identity develops across diverse contexts. Practically, it can help educators, institutions, policymakers, and industry partners design environments that better support students' development as future engineers. Ultimately, a contextualised research agenda offers a pathway toward a more inclusive and globally relevant understanding of engineering identity in engineering education.

Implications For Engineering Education

The literature reviewed in this paper suggests that engineering identity should be viewed as a central educational outcome rather than a by-product of engineering training. Existing engineering identity scholarship has demonstrated that students' sense of belonging, competence, recognition, and professional self-understanding influences persistence, engagement, and commitment to engineering pathways. However, the review also shows that engineering identity is shaped by a wider range of influences, including cultural expectations, social recognition, institutional experiences, and professional readiness. Consequently, engineering education must move beyond a narrow focus on technical knowledge acquisition and graduate employability to support students' broader identity development as future engineers. These implications extend beyond curriculum reform and highlight the need for coordinated efforts across educational, professional, and policy environments that influence engineering identity development.

Implications for Curriculum Design

The findings suggest that curriculum should be designed not only to develop technical competence but also to support students' understanding of what it means to become engineers. Engineering identity is strengthened when students are able to connect academic learning with authentic engineering practice and professional purpose. Therefore, curricula should provide opportunities for students to engage with engineering problems, reflect on professional roles, and understand the societal significance of engineering work.

Early exposure to engineering concepts, professional responsibilities, and industry contexts appears particularly important. Introductory engineering experiences can help students develop realistic understandings of engineering practice while strengthening their motivation and sense of belonging within the discipline. Project-based learning, design experiences, interdisciplinary collaboration, and authentic engineering challenges can further support students' identity development by allowing them to apply knowledge in meaningful contexts.

Engineering curricula should therefore be viewed not only as knowledge-delivery systems but also as environments that support professional identity formation throughout students' educational journeys.

Implications for Teaching and Learning

The review highlights the importance of active participation, recognition, and belonging in engineering identity development. Students are more likely to develop strong engineering identities when they participate meaningfully in learning activities, receive constructive feedback, and experience recognition from educators and peers.

Consequently, teaching approaches should create opportunities for collaboration, discussion, problem-solving, reflection, and student ownership of learning. Student-centred learning approaches can support identity development by enabling students to contribute actively rather than functioning solely as recipients of knowledge. Similarly, collaborative learning environments allow students to experience engineering as a social and professional practice rather than an individual academic activity.

Educators also play an important role as sources of recognition. Through feedback, encouragement, mentoring, and classroom interactions, educators can influence whether students perceive themselves as capable future engineers. Recognition should therefore be intentionally embedded within teaching practices rather than occurring only through formal assessment processes.

Implications for Student Support and Inclusion

The review suggests that engineering identity develops differently across students because experiences of recognition, belonging, and participation are shaped by social and cultural factors. Family expectations, gendered experiences, cultural values, and societal perceptions of engineering may influence how students engage with engineering education and interpret their place within the profession.

Engineering programmes should therefore adopt inclusive approaches that recognise the diversity of students' backgrounds and experiences. Mentoring programmes, peer-support initiatives, role-model engagement, and reflective learning activities can help students navigate challenges related to belonging and professional identity development.

Particular attention should be given to supporting students from groups that may experience additional barriers to recognition or inclusion. Identity-supportive educational environments can help students develop confidence, strengthen belonging, and sustain engagement throughout their engineering education.

Implications for Industry Engagement

The review highlights that industry readiness and employability are not merely graduate outcomes but also important identity-forming processes. Internships, workplace exposure, industry mentoring, and authentic engineering experiences help students connect academic learning with professional practice and strengthen their confidence as future engineers.

Universities should therefore treat industry engagement as an integral component of identity development rather than as a separate employability initiative. Structured internships, industry-linked projects, workplace mentoring, professional seminars, and industry-sponsored challenges can provide opportunities for students to receive professional recognition and develop realistic understandings of engineering practice.

Industry partners also have an important role to play. By providing meaningful tasks, constructive feedback, and mentoring support, industry professionals contribute directly to students' perceptions of legitimacy and readiness for engineering careers. Effective university–industry partnerships therefore support both employability and engineering identity development.

Implications for Accreditation and Policy

The findings also have implications for engineering accreditation and educational policy. Accreditation frameworks traditionally emphasise technical competence, professional skills, and graduate attributes. While these remain important, the review suggests that identity development should also be recognised as an important educational objective.

Professional competence and professional identity are closely connected. Students who develop confidence, belonging, and professional self-understanding are more likely to engage meaningfully with engineering learning and transition successfully into professional practice. Consequently, accreditation systems and educational policies should encourage learning environments that support participation, recognition, reflection, and professional formation alongside technical development.

In contexts such as Malaysia, where engineering education is closely linked to national development priorities and graduate employability goals, recognising engineering identity as an educational outcome may provide a valuable mechanism for strengthening both educational quality and workforce readiness.

Engineering Identity as a Shared Educational Responsibility

Perhaps the most important implication of this review is that engineering identity should not be viewed as the responsibility of students alone. Identity develops through interactions among individuals, families, educational institutions, professional communities, industry partners, and broader societal systems. Consequently, supporting engineering identity requires coordinated efforts across multiple stakeholders.

Educators contribute through teaching and recognition. Institutions contribute through curriculum design and learning environments. Industry partners contribute through professional exposure and mentoring. Policymakers contribute through accreditation standards and educational priorities. Together, these stakeholders help create the conditions through which students develop confidence, belonging, competence, and professional self-understanding.

Therefore, engineering identity should be viewed as a shared educational responsibility. Supporting students to become engineers involves more than preparing them for employment; it involves helping them develop a meaningful and sustainable sense of themselves as members of the engineering profession.

CONCLUSION

Engineering identity has become an increasingly important construct in engineering education because it helps explain how students develop belonging, confidence, persistence, and professional aspirations within engineering pathways. Existing scholarship has provided valuable foundations for understanding engineering identity through dimensions such as interest, performance and competence, and recognition. These dimensions have contributed significantly to understanding why students engage with engineering, remain committed to engineering programmes, and envision themselves as future engineers.

However, this review has argued that engineering identity cannot be fully understood through individual-level dimensions alone. Identity development occurs within broader cultural, societal, institutional, and professional environments that influence how students interpret engineering, experience recognition, and imagine their future roles within the profession. Consequently, engineering identity should be viewed as a socially situated and contextually mediated process rather than solely as an individual psychological construct.

Three key conclusions emerge from this review. First, cultural and societal influences play a significant role in shaping engineering identity. Family expectations, social recognition, cultural values, gendered experiences, and societal perceptions of engineering influence how students enter engineering pathways, develop belonging, and construct professional aspirations. Second, institutional and pedagogical conditions contribute substantially to identity development. Curriculum design, student-centred learning, project-based experiences, assessment practices, teamwork, and accreditation structures create opportunities for students to participate in engineering

practices and develop professional self-understanding. Third, industry readiness and employability should be understood as identity-forming processes rather than merely educational outcomes. Internships, workplace exposure, professional skills development, industry mentoring, and university–industry engagement help students connect academic learning with engineering practice and strengthen their confidence as future engineers.

The review also highlights the importance of contextualising engineering identity scholarship beyond the settings in which many dominant models were originally developed. While foundational dimensions such as interest, performance and competence, and recognition remain valuable across contexts, the processes through which these dimensions develop may differ according to cultural expectations, educational systems, societal conditions, and professional environments. This observation is particularly relevant for Southeast Asian and Malaysian engineering education, where engineering identity may be shaped by influences that extend beyond those commonly emphasised in existing models.

Taken together, the findings suggest that engineering identity research would benefit from greater attention to contextual influences and stronger integration of cultural, societal, institutional, and employability-related perspectives. Such an approach does not replace established engineering identity frameworks. Rather, it extends them by recognising that students develop engineering identities through interactions among personal experiences, educational environments, social relationships, and professional opportunities.

Ultimately, engineering identity should be understood not only as how students see themselves as engineers, but also as how educational institutions, communities, and professional systems support that becoming. As engineering education continues to evolve in response to changing societal, technological, and workforce demands, a contextualised understanding of engineering identity offers an important pathway for supporting students not only in learning engineering, but in becoming engineers.

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