

Personal Interest and Persistence among Female Engineering Doctoral Students at an International Islamic University in Malaysia

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Abstract

Although women's participation in STEM has expanded, doctoral persistence remains influenced by complex psychological and contextual factors. In Malaysia, existing research largely emphasizes undergraduate retention, with limited qualitative attention to women's persistence at the PhD level. This study explores the role of personal interest in shaping persistence among female engineering doctoral students at the International Islamic University Malaysia (IIUM). Guided by Social Cognitive Career Theory (SCCT), a qualitative approach was employed using semi-structured interviews with nine female lecturers in multiple engineering disciplines. Data were analyzed through thematic analysis. Findings indicate that personal interest operates as a dynamic and developmental mechanism across four dimensions: early formation through exposure and encouragement; identity-integrated interest shaped by belonging and academic success; value-integrated interest linked to societal contribution; and sustained passion functioning as motivational energy. Interest evolved from early academic socialization into a deeply internalized commitment that reinforced persistence throughout prolonged doctoral challenges. The findings extend SCCT by conceptualizing interest as an evolving psychological process central to doctoral completion in STEM within a Malaysian higher education context.

Keywords: *Doctoral persistence, female STEM students, personal interest, contextual support, Social Cognitive Career Theory*

INTRODUCTION

Globally, Science, Technology, Engineering, and Mathematics (STEM) disciplines are central to innovation, economic competitiveness, and sustainable development. The World Economic Forum (2023) emphasizes that women's inclusion in STEM is essential for technological advancement and long-term global competitiveness. Although women's participation in higher education has expanded significantly, their representation in advanced STEM pathways, especially at the doctoral and professional levels, remains uneven. UNESCO (2023) reports that while women constitute approximately 44% of PhD candidates globally, their representation declines at successive academic and professional stages, reflecting a persistent "leaky pipeline" (i.e., the systemic attrition of women from academic and professional pathways where their representation diminishes disproportionately at every successive career transition from graduate training to tenure and leadership despite high initial participation rates) (Schneegans et al., 2021). This attrition limits not only individual career trajectories but also national innovation capacity.

In Malaysia, significant investments have been made to enhance STEM education and boost female participation, with policies promoting women's enrolment in STEM programs to improve national competitiveness (USAID, 2022). Despite advancements at the undergraduate level, disparities persist at higher academic and professional stages, with women comprising 43% of PhD graduates in science and technology and less than 10% of licensed professional engineers (Nguyen, 2021; USAID, 2016). Participation alone does not ensure persistence in STEM doctoral programs, as women's continuation and completion rates are often lower than men's (Koch et al., 2022; Ng et al., 2011). Additionally, some individuals with STEM doctoral degrees do not pursue related careers (Beede et al., 2011; Shapiro & Sax, 2011). This underscores the importance of focusing on persistence, not just access.

The persistence of women in STEM doctoral programs is influenced by a complex interplay of sociocultural, academical, and psychological factors. The Social Cognitive Career Theory (SCCT) posits that personal, and contextual supports shape career-related interests and goals (Lent et al., 2005). In this study, the persistence of women pursuing doctoral degrees in engineering is examined, focusing on personal interest development to enhance female representation in STEM and its socioeconomic impact. According to the Social Cognitive Career Theory (SCCT), persistence is defined as choice stability, indicating the length of time individuals remain committed to their initial academic or career choices. Persistence is shaped by personal agency and environmental gatekeepers (Lent et al., 2013). Persistence plays a crucial role in the advancement and visibility of women in STEM fields by establishing them as essential role models. The presence of female role models, in turn, significantly enhances persistence by fostering a sense of belonging, self-efficacy, and professional identity. This creates a reinforcing cycle that supports the success of PhD students and their continued commitment to the field (Amon, 2017; Bostwick & Weinberg, 2022; Gillooly et al., 2021; Lambert et al., 2024). Enhancing women's representation in STEM fields is therefore crucial for driving inclusive innovation and ensuring equitable opportunities (UNESCO, 2023).

Despite national initiatives and increasing enrolment of women in STEM disciplines, gender disparities persist at advanced academic and professional levels in Malaysia. While policy discourse often emphasizes recruitment and representation, less attention has been given to understanding women's experiences of persistence through the demanding trajectory of doctoral education (Mirick, & Wladkowski, 2020). Research has largely focused on undergraduate retention and workforce participation (Goy et al., 2018; Nor Huzir et al., 2025), with limited qualitative exploration of the challenges faced by women in doctoral programs. Studies in Malaysia have looked at structural barriers and support frameworks for women in engineering and STEM, as well as gender disparities in enrollment and retention (Oliveira, et al., 2025).

However, there is a gap in understanding women's persistence through PhD completion in STEM, particularly regarding the intersections of race and gender and issues of belonging. Women in STEM face social biases and lack societal validation, leading to unequal resource distribution

between male and female researchers (Li et al., 2025). Despite ongoing efforts, women in engineering still encounter systemic barriers including discrimination, pay inequity, and labor market disadvantages; persistent stereotypes and biases further obstruct their professional growth and participation in STEM (Arrazola et al., 2025; Guo et al., 2025). Locally, tracer studies reveal a significant and growing cohort of female doctoral students in engineering at institutions like the International Islamic University Malaysia (IIUM) (Khalid et al., 2020; Yusof et al., 2018, 2019). This demographic presence indicates a critical need for deeper investigation into their academic persistence. While individual interest is widely recognized as a cornerstone of academic success (Hidi & Renninger, 2006, 2019), its specific impact on female PhD candidates in Malaysian public universities with international and Islamic orientations remains underexplored.

OBJECTIVES OF THE STUDY

This study explored the persistence of female engineering doctoral students at a Malaysian public university with an Islamic and international orientation, focusing on the role of personal interest in their PhD completion. Persistence in this research context means the continued enrolment and commitment of doctoral students to their programme until completion, despite academic, social, or personal challenges. A qualitative research design was chosen to effectively understand the complex psychological and contextual factors influencing persistence, as this process is shaped by motivation, beliefs, and environmental interactions. Employing a descriptive qualitative approach, the study aims to provide a contextualized understanding of how personal interest impacts STEM doctoral pathways. This method captures participants' experiences without imposing abstract theoretical frameworks while being informed by the Social Cognitive Career Theory, ensuring a grounded analysis. Ultimately, this design facilitates an in-depth exploration of how motivational beliefs and contextual supports influence the persistence of female engineering doctoral students at an Islamic higher learning institution.

LITERATURE REVIEW

The Role of Personal Interest in STEM Doctoral Persistence

Psychological factors, particularly personal interest, significantly influence academic persistence in STEM fields. Interest serves as a motivational force that guides attention and effort (Dewey, 1913). Eccles and Wigfield (2002) emphasize that enjoyment and perceived value of tasks affect academic choices and persistence, particularly in doctoral education where sustained interest is crucial for the successful completion of the programme. Research by Wu et al. (2024) reveals a bidirectional relationship between learning interest and academic persistence. Higher learning interest correlates with greater persistence, and vice versa. This relationship is mediated indirectly through academic performance, underscoring the role of self-regulated learning strategies in shaping these outcomes.

Furthermore, Verostek et al. (2024) showed that physics PhD students with clear research interests integrate better into groups and demonstrate stronger persistence. Hidi and Renninger's model (2006, 2019) further explains how situational interest can evolve into sustained interest in math and science.

While the linkage between interest and persistence is well-documented, the domain of career-related interest particularly in the context of women in engineering, has not been thoroughly examined with respect to personal-environmental factors impacting doctoral-level persistence (Gibbs & Griffin, 2013; Lent et al., 2005). Most research is rooted in Western contexts, leaving a gap in understanding how cultural expectations influence women's interest and persistence in non-Western societies like Malaysia. This calls for more context-specific studies on the evolution of interest among Malaysian female STEM students

Development of Interest: Early Influences and Environmental Supports

Interest in STEM doctoral pathways rarely emerges spontaneously; rather, it develops through cumulative educational and social experiences. Early exposure to STEM activities, supportive teachers, and hands-on engagement significantly influence long-term academic trajectories (Wan et al., 2021). Randler and Bogner (2007) found that prior knowledge and early interest positively predict sustained engagement and achievement in science-related fields. A teacher serves as a role model (Baba et al., 2021) by providing encouragement and showcasing successful STEM careers, influencing students' beliefs about their potential. According to the self-determination theory (SDT), this supportive teacher-student relationship fulfills the need for relatedness, a psychological factor that boosts intrinsic motivation. Creating a positive learning environment is key to fostering self-determined behaviors in students, enhancing engagement and personal best goals (Benlahcene et al., 2020).

Furthermore, research demonstrates that active learning environments enhance belonging and motivation among women in STEM. These findings highlight that interest is not purely internal; it is socially cultivated and institutionally reinforced (Dost, 2024; Tsakalerou et al., 2024). Research on Malaysian female doctoral students is limited, particularly regarding how early interest development, socio-academic factors, and familial influences impact their persistence in doctoral programs. This reveals a notable gap in the existing literature. Research in Malaysia shows a significant gap in STEM studies, mainly focusing on undergraduate participation and early retention, which highlights enrolment patterns and gender disparities (Goy et al., 2018; Nor Huzir et al., 2025). However, there is limited understanding of persistence at the doctoral level, which entails unique academic and social challenges, such as stereotyping and discrimination, which can diminish interest and persistence in STEM (Golde, 2000; Litalien et al., 2024). Therefore, findings from undergraduate studies do not apply to PhD contexts. While some research has explored barriers for women in engineering and education (Mokhtar & Hassan, 2014), they fall short of addressing PhD completion persistence, revealing a critical research gap.

Second, a contextual gap remains. Although women's participation in STEM has been widely examined in Western contexts (Arnaboldi et al., 2025; Smith & White, 2025) there is insufficient qualitative exploration of women's lived persistence experiences within Malaysian research universities. In particular, studies situated in Islamic higher education institutions such as IIUM are scarce, despite the potential influence of cultural and religious frameworks on motivation and identity.

Third, a psychological mechanism gap persists. While prior research highlights the importance of interest and contextual supports in shaping persistence in engineering (Lent et al., 2005; 2013), the roles of sustained personal interest in doctoral completion remain under-examined in the Malaysian STEM context. Addressing these gaps is essential for developing contextually grounded strategies to support women's sustained engagement and successful completion in STEM doctoral programs.

Islamic Perspective on Persistence in Seeking Knowledge

In Islamic thought, STEM excellence is a spiritual and social imperative for *tajdīd* (renewal) and *islah* (reform). According to the principles of *maqāsid al-sharī'ah*, scientific pursuit must foster justice, welfare, and the preservation of God's creation (Kamali, 2018). Central to this mission is the concept of *niyyah* (sincere intention) ("Actions are according to intentions, and everyone will get what was intended." (Sahih al-Bukhari, 1997)); emphasizing that actions are judged by their underlying purpose, a sincere intention to serve humanity transforms research into an act of worship (*'ibadah*) (Kamali, 2018).

Furthermore, STEM serves as a primary vehicle for economic empowerment and *islah al-bilād* (the reform and building of the nation). By mastering technical fields, female engineers contribute to the community's self-reliance and civilizational independence, ensuring that society flourishes through its own innovation. Implementing these Islamic civilizational values

has a tangible, positive impact on welfare distribution, increases access to education, and promotes economic stability within communities (Kamali, 2018, Syafi'i, 2024).

This path is sustained through *istiqamah* (steadfastness), a continuous and unwavering effort essential for progress. Just as the Qur'an exhorts believers to "*remain steadfast as you have been commanded*" (Surah Hud, 11:112), female engineers are called to maintain persistence despite the "anonymous challenges" and systemic biases they encounter. Ultimately, this approach harmonizes ethical integrity with global collaboration, ensuring that STEM education advances human flourishing and the sustainable development of the nation.

In the context of the present Islamic university where Islamic values influence culture, understanding persistence may involve psychological and spiritual aspects. However, limited research explores how Islamic principles affect interest development among female STEM doctoral students. This perspective could offer valuable insights into persistence mechanisms in Malaysian Islamic higher education.

Theoretical Framework

This study is grounded in Social Cognitive Career Theory (SCCT) (Lent et al., 1994), which builds on Bandura's (1986) Social Cognitive Theory. Both frameworks emphasize the interaction of personal beliefs, behaviors, and environmental factors in shaping human functioning. SCCT focuses on how academic and career interests develop through three components: self-efficacy (belief in abilities), outcome expectations (beliefs about consequences), and personal goals (intentions for outcomes). Self-efficacy and positive expectations foster interest, goal-setting, performance and persistence (Lent et al., 2005)

Though persistence was not initially a focus of SCCT (Lent et al., 1994), it became significant in later revisions (Lent et al., 2013). For female students in STEM doctoral programs, persistence is associated with alignment of personal interests with research, adequate support, and feelings of competence. Insufficient support can undermine commitment, highlighting the importance of personal interest in doctoral persistence.

METHODOLOGY

Research Design

This study employed a qualitative research design grounded in an interpretivist paradigm to explore female doctoral students' experiences in pursuing STEM at IIUM. Qualitative inquiry is appropriate when the objective is to understand participants' meanings, perceptions, and experiences within specific social contexts (Creswell & Poth, 2018; Merriam & Stuckey-Peyrot, 2025; Tisdell et al., 2025). Given the study's focus on persistence as a complex psychological and contextual phenomenon, a case study approach was adopted to enable in-depth exploration within a bounded institutional setting (Yin, 2018).

Semi-structured interviews were utilized to generate rich, descriptive data that captured participants' perspectives on interest and persistence (Brinkmann, 2014). This design allowed for flexibility while maintaining alignment with the theoretical framework of SCCT. The qualitative approach facilitated a better understanding of how motivational beliefs, regulatory strategies, and contextual supports interact to shape doctoral completion experiences.

Researcher Description

Informing this study is the researcher's positionality as both a practitioner and an individual who embodies purposeful persistence. Having bypassed structural barriers through independent study to pursue experimental science and then becoming a science teacher, the researcher's trajectory

illustrates how intrinsic interest and self-belief function as critical internal mediators against institutional constraints. This personal resilience, synthesized with professional observations of disparate motivation and attrition among female students, provides a unique dual perspective. Consequently, this background triggered the inquiry into the specific factors sustaining the survival and degree completion of female doctoral candidates within the STEM pipeline.

Prior knowledge of STEM education and motivational theories, such as SCCT, informed the study but also posed a risk of bias. This occurs when personal experiences and theoretical assumptions inadvertently influence the analytical process or the interpretation of participant data. To mitigate this, the researcher adopted a reflexive approach, incorporating reflexive journaling during data collection and analysis to capture assumptions and evolving interpretations (Creswell & Poth, 2018; Tisdell et al., 2025). Interview questions were designed to be open-ended, allowing participants to define persistence and share their experiences freely. During thematic analysis, member checking and inter-rater discussions ensured that themes were based on participants' narratives rather than the researcher's own experiences (Lincoln & Guba, 1985). The researcher's teaching background provided contextual insight, while reflexive strategies enhanced the credibility and trustworthiness of the study.

Study Participants

This study involved nine lecturers in the Faculty of Engineering at the public Islamic university. Participants were selected through purposive sampling based on the inclusion and exclusion criteria listed in Table 1:

Table 1

Inclusion Criteria of the Participants

Criteria	Inclusion	Exclusion
Nationality	Malaysian	Non-Malaysian
Gender	Female	Male
Academic Level	Undergraduate, Master, and PhD graduates in STEM fields	Undergraduate, Master, and PhD graduates in non-STEM fields
Completion of the Doctoral Degree	Completed PhD in STEM fields	Completed PhD in non-STEM fields
Experience	Extensive experiences in STEM fields	Limited or no experience in STEM fields
Affiliation	Lecturers at the Islamic public University	Lecturers outside the Islamic public University
Willingness to Participate	Willing to share their experiences and insights related to STEM persistence	Unwilling or unavailable to participate in the study

The participants represented diverse engineering disciplines and varied educational and sociocultural backgrounds. The inclusion of individuals with family responsibilities, alongside those who were single, provided a range of work-life dynamics relevant to the PhD journey. These demographic factors are essential, as familial obligations, supervisory relationships, cultural norms, and institutional climate can significantly influence interest development and doctoral completion. The adequacy of the data was ensured through depth rather than breadth, consistent with qualitative inquiry (Creswell & Poth, 2016). The sample captured meaningful variation in disciplinary background, marital status, supervisory experiences, and stages of doctoral progression, thereby reflecting diverse pathways of persistence.

This variation strengthened the study's ability to explore how personal interests operate across different contextual conditions within the same institutional environment. The richness of the interview data, combined with theoretical alignment to SCCT, supports the adequacy and credibility of the findings.

Interview Protocol

The interviews were guided by an interview protocol consisting of questions and probes. The protocol is listed in Table 2.

Table 2

Interview Protocol

Central Research Question	Main Interview Questions	Probes
How does interest shape the persistence of IIUM female engineering students in completing their PhD programs?	How did you enter STEM education, and what contributed to your continued engagement in it?	What influenced your decision to join STEM school? What early experiences encouraged you to continue in STEM?
	Was continuing STEM education important to you?	Why was STEM personally important to you? Explain what attracted you most to continuing in STEM?
	What was your major interest in the science stream?	How would you describe your interest in STEM subjects? Was your interest stronger in mathematics or science? Why?
	How did you maintain your interest in continuing STEM education?	Can you explain how you sustained your interest over time? How did maintaining interest support your persistence from earlier education to your PhD?

DATA COLLECTION AND DATA ANALYSIS

Data Collection

Data were collected through semi-structured, in-depth interviews, selected for their flexibility in exploring participants' experiences of persistence in doctoral-level STEM studies while remaining aligned with the study's theoretical framework (Brinkmann, 2014). This approach enabled in-depth examination of personal interests and contextual supports influencing doctoral persistence. Nine interviews were conducted between August and November 2023, each lasting 50–75 minutes (average ≈ 60 minutes). This duration allowed participants to provide detailed accounts of their doctoral journeys, including challenges and coping strategies. Follow-up clarifications were conducted via email to ensure accuracy.

Interviews were guided by open-ended questions (see Table 2) to elicit rich, reflective responses, with probing questions used to clarify meanings and deepen reflection. While the overall data-collection strategy remained consistent, minor iterative refinements were made as analysis progressed. For instance, insights from early interviews informed more focused probes in subsequent interviews, consistent with qualitative research practices where data collection and analysis occur concurrently (Tisdell et al., 2025). All interviews were audio-recorded with consent and transcribed verbatim. Data collection continued until thematic saturation was achieved, defined as the point at which no new themes or substantive insights emerged (Guest et al., 2006).

Data Analysis

Data were analyzed using thematic analysis to identify patterned meanings related to the role of personal interest in shaping doctoral persistence (Braun & Clarke, 2006, 2019). This approach was selected for its flexibility and suitability in exploring lived experiences within a theoretically informed qualitative framework. The analysis aimed to examine how interest was initiated, sustained, and transformed over time, and how it functioned as a central mechanism supporting PhD completion.

The analysis followed Braun and Clarke's (2006) six-phase iterative process. The researcher first immersed herself in the data through repeated reading of verbatim transcripts and careful listening to audio recordings to ensure accuracy and depth of engagement. Reflective memos were recorded to capture early insights concerning expressions of curiosity, value, identity, belonging, and commitment. Initial codes were then generated systematically across the dataset. Coding focused on meaning units related to early STEM exposure, intrinsic curiosity, perceived value of engineering, identity formation, mastery experiences, contextual supports. Both deductive and inductive strategies were employed. Deductive codes were informed by SCCT (Lent et al., 1994; 2005), while inductive coding allowed culturally grounded expressions of interest to emerge. Codes were collated into broader themes capturing sustained and identity-integrated interest. Themes were reviewed and refined across transcripts to ensure internal coherence and conceptual stability. An evolving codebook was developed to maintain consistency in code application and reduce interpretive drift.

Data Credibility and Trustworthiness

Analytic credibility (i.e., the extent to which qualitative findings are trustworthy, well-substantiated, and grounded in the data rather than researcher bias), was enhanced through peer debriefing with a PhD-qualified colleague from the Islamic university's Faculty of Education. This process enabled external review and critical examination of emerging interpretations (Lincoln & Guba, 1985). Member checking was conducted by returning thematic summaries to two participants for clarification and validation. When inconsistencies arose, transcripts were re-examined and themes refined to strengthen analytic accuracy. Trustworthiness was further ensured through the maintenance of a detailed audit trail documenting coding decisions and theme development, thereby supporting dependability and confirmability. Reflexive journaling was used to bracket researcher assumptions and monitor positionality throughout the analytic process (Tisdell et al., 2025), enhancing transparency and methodological rigor.

RESEARCH ETHICS

This study adhered to established ethical guidelines for research involving human participants. Informed consent was obtained from all participants before the interviews were conducted. Participants were provided with detailed information about the study's purpose, procedures, voluntary nature, and their right to withdraw at any time without penalty. Confidentiality was ensured through the use of pseudonyms and removal of identifying information from transcripts. Audio recordings and transcripts were securely stored in password-protected files accessible only to the researcher.

Given the potential sensitivity of discussing academic challenges, the interviews were conducted in a respectful and non-evaluative manner. Participants were reminded that they could decline to answer any question. These measures safeguarded participants' autonomy, privacy, and well-being throughout the research process.

FINDINGS

The findings indicate that personal interest functioned as a dynamic and evolving mechanism shaping doctoral persistence among female engineering students. Rather than emerging as a static trait, interest developed progressively across educational stages and was reinforced through identity formation, value integration, and mastery experiences. Four interrelated dimensions of interest were identified: (1) Early Formation through Exposure and Encouragement, (2) Identity-Integrated Interest Shaped by Belonging and Academic Success, (3) Value-Integrated Interest Linked to Societal Contribution, and (4) Sustained Passion Functioning as Motivational Energy.

Theme 1: Early Formation through Exposure and Encouragement

Participants' interest in STEM was rooted in early educational exposure and reinforced through family and teacher influences. Many described being placed in science-stream environments where STEM subjects were normalized and academically privileged. For some, entry into STEM was structured by institutional expectations. As Participant 1 explained,

“Because I'm from boarding school... we had to choose all subjects in the science stream.” (P1)

Similarly, Participant 3 reflected on a continuous academic trajectory:

“Since my school time, my secondary I was already into STEM... after that continuing to my matriculation, bachelor, I'm already in engineering.” (P3)

Family exposure further strengthened early interest. Participant 4 described how her father nurtured her curiosity from childhood:

“Since I was young, he preferred to buy me tools instead of dolls... he saw my interest in tools and science. He encouraged me to do science since young.” (P4)

Participant 9 similarly attributed her sustained interest to maternal encouragement:

“Every night she [my mother] looked at our books... she always asked us to do well in our studies, especially in STEM and especially math.” (P9)

Teachers also played a catalytic role in transforming exposure into genuine interest. Participant 8 recalled a turning point in Form Three:

“There was one teacher who really encouraged me to love math... she explained mathematics in the easiest way and helped us understand the concepts clearly. From that point, I began to love math.” (P8)

These accounts illustrate how structured exposure, familial reinforcement, and teacher encouragement constituted formative learning experiences that nurtured early interest. Consistent with Social Cognitive Career Theory (Lent et al., 1994), such mastery experiences and social persuasion served as foundational precursors to later interest development and persistence.

Theme 2: Identity-Integrated Interest Shaped by Belonging and Academic Success

As participants progressed academically, interest became integrated into their identity. Rather than describing STEM as merely a subject area, many articulated a sense of belonging to the “science stream” that shaped their self-concept. Participant 2 stated,

“I’m from a science background... I am one from the science stream, so I learned physics, biology, and chemistry.” (P2)

Similarly, Participant 4 reflected,

“Actually, since primary school... the path was already there, and I just followed it.” (P4)

These expressions suggest that STEM was not experienced as a temporary academic choice but as an identity-consistent trajectory. Academic success further reinforced this identification. Participant 8 explained how strong examination performance solidified her place in STEM:

“When I got good grades... I was offered a place in the science stream. That was a turning point for me.” (P8)

Participant 9 similarly noted the reinforcing effect of achievement:

“When I study hard and then I got a good score... it made me feel great. Want to do more.” (P9)

Such mastery experiences strengthened perceived competence and self-efficacy, key determinants of persistence within Social Cognitive Career Theory (Lent et al., 1994; Lent et al., 2013). Consistent with Bandura’s (1986) assertion that successful performance builds efficacy beliefs, academic progression validated participants’ capabilities and consolidated their STEM identity.

Movement from undergraduate to doctoral levels was therefore described as a continuation of an established path rather than a disruptive shift. Through repeated achievement and institutional validation (e.g., scholarships, academic advancement), interest became identity-integrated. Participants did not merely pursue engineering as a field of study; they increasingly understood themselves as engineers. This internalization of disciplinary identity aligns with research suggesting that identity formation strengthens long-term commitment and persistence in STEM pathways (Carlone & Johnson, 2007).

Theme 3: Value-Integrated Interest Linked to Societal Contribution

For many participants, personal interest deepened when STEM was perceived not only as intellectually engaging but as socially meaningful. Interest became integrated with values related to societal contribution, national development, and community advancement. Rather than pursuing a PhD solely for academic achievement, participants framed their doctoral journey as part of a broader mission.

Participant 4 articulated this national-development perspective clearly

“A nation needs to have a young generation who are in STEM... otherwise the nation will not flourish. If we cannot maintain the number of STEM people in the nation, it’s hard for the nation to thrive.” (P4)

Similarly, Participant 7 emphasized STEM’s economic and problem-solving function:

“STEM professionals are problem solvers for the country... we try to make the country a better place.” (P7)

For Participant 3, the value of her research extended to technological reliability and disaster prediction:

“Using these data we can predict rain attenuation... this is important in broadcasting and data transformation... and also to predict weather and flood.” (P3)

Participants also expressed a desire to move beyond technological dependency. As Participant 9 stated:

“We do not want to just be users... we want to be developers too.” (P9)

These narratives reflect outcome expectations as conceptualized in Social Cognitive Career Theory (Lent et al., 1994, 2013), where anticipated positive societal impact strengthens commitment to career paths. When participants believed their work could contribute to national growth, technological independence, or community benefit, their motivation intensified.

This pattern also aligns with expectancy-value theory (Eccles, 1994), which posits that persistence is strengthened when individuals attach personal and societal value to a domain. Interest therefore evolved from enjoyment-based engagement to purpose-driven commitment. STEM was not merely a field of study; it became a vehicle for meaningful contribution.

Thus, value integration functioned as a stabilizing force in doctoral persistence. When personal interest aligned with broader social purpose, participants demonstrated stronger resolve to complete their PhD programs despite challenges.

Theme 4: Sustained Passion Functioning as Motivational Energy

Beyond early exposure, identity formation, and value integration, participants described a sustained passion for STEM subjects and research that functioned as emotional and motivational energy throughout their doctoral journey. This passion was characterized by enjoyment in problem-solving, intellectual curiosity, and fascination with scientific discovery.

Participant 3 expressed the intrinsic pleasure she experienced in mathematics:

“I love mathematics... I feel like doing mathematics is fun... there will always be a creative way and a few methods to solve a problem.” (P3)

Similarly, Participant 2 highlighted her enthusiasm for interdisciplinary engineering:

“I love mechatronics because it is a combination of mechanical, electrical, computer engineering and software.” (P2)

For Participant 5, fascination with nanotechnology reinforced her engagement:

“I was amazed by how these small particles were created... I love nanotechnology because I observed something that cannot be seen by the naked eye.” (P5)

Importantly, passion was sustained through incremental achievements. Participant 5 noted:

“Even small achievement is still good for me... when you feel happy with the knowledge, you maintain the interest.” (P5)

Participant 9 similarly explained:

“When I study hard and then I got a good score... it made me feel great. Want to do more.” (P9)

Consistent with SCCT, mastery experiences enhance interest and commitment, creating positive feedback loops that sustain persistence (Lent et al., 1994, 2013). When learning such as mathematics, is perceived as meaningful and relevant, interest deepens and functions as a resilience resource, supporting creative problem-solving and sustained effort (Ibrahim et al., 2025). This demonstrates a reciprocal relationship between interest and persistence, mediated by self-regulation and academic

performance, whereby sustained interest predicts long-term persistence (Talley & Martinez Ortiz, 2017).

Thus, sustained passion functioned as motivational fuel, enabling participants to persist through the prolonged and demanding nature of doctoral education. Interest, when reinforced by achievement and intrinsic enjoyment, became a durable psychological mechanism supporting completion.

Integrative Synthesis of Findings

Taken together, the four themes illustrate that personal interest among female engineering doctoral students at IIUM is not static but developmental and multidimensional. Interest began with early exposure and socialization into STEM environments, where structured academic pathways, family encouragement, and teacher support established familiarity and confidence. Over time, repeated mastery experiences strengthened self-efficacy and transformed interest into identity-integrated commitment, whereby participants no longer merely studied engineering but came to see themselves as engineers. As their academic trajectories progressed, interest further deepened through value integration; STEM was perceived as a vehicle for societal contribution, national development, and meaningful impact. This alignment between personal engagement and broader purpose reinforced outcome expectations and stabilized persistence. Finally, sustained passion functioned as motivational energy, maintained through intrinsic enjoyment, curiosity, and reinforcement from incremental achievements.

Collectively, these findings suggest that doctoral persistence is not driven by interest alone, but by the evolution of interest, from exposure, to identity, to value alignment, to enduring passion. These constructs and their dynamics, derived from the study's findings, are shown in Figure 1. Personal interest, therefore, operates as a dynamic psychological mechanism that interacts with personal belief and perceived societal contribution to sustain long-term commitment toward PhD completion.

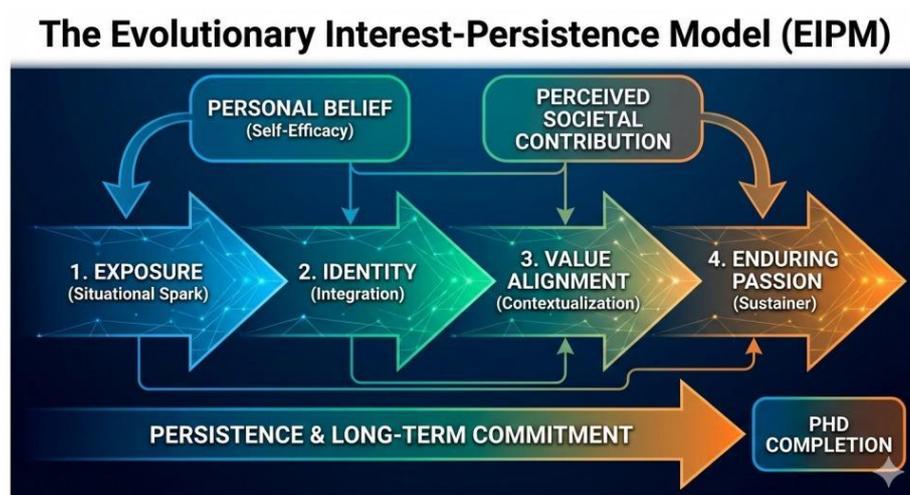


Figure 1: The Evolutionary Interest-Persistence Model (EIPM)

DISCUSSION

The investigation into doctoral persistence reveals a complex interplay between disciplinary understanding and contextual factors within a Malaysian STEM framework. Notably, Wu et al. (2024) discuss the reciprocal relationship between learning interest and persistence. While previous literature

has primarily focused on self-efficacy and outcome expectations as key predictors of persistence (Lent et al., 1994, 2013), this research highlights the significance of contextual influences that may shape these dynamics, illustrating how “national contribution” is being interpreted through the lens of the Islamic obligation to society, rather than implying the participants explicitly framed it as religious duty and personal interest evolved into a value-based commitment. This process is influenced by factors such as identity, a sense of belonging, and intention (*niyyah*) in the context of societal development and contributions to economic progress.

This study aligns with Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2020), showing that participants’ persistence shifted from intrinsic interest to integrated regulation, as STEM work became linked to identity, moral purpose, and societal contribution. Cultural values significantly enhanced motivation and resilience by embedding Western persistence models within a moral framework. This is evident in Participant 3, whose “value-integrated interest”—specifically the goal of predicting floods to protect the community—provided the necessary grit to overcome data collection obstacles. By aligning technical tasks with societal welfare, cultural values transform academic persistence into a purposeful, value-driven mission.

SCCT highlights the importance of contextual support and personal experiences in career development. This study shows how childhood experiences are shaped by contextual factors. The findings support existing research on belonging and identity in STEM, revealing that students’ persistence and motivation are influenced by recognition, inclusion, and identity alignment within STEM environments (Carlone & Johnson, 2007; Dost, 2024; Tsakalerou et al., 2024). Similar to prior studies, identity as an “engineer” strengthened persistence. However, unlike intersectionality-focused findings (Cannaerts et al., 2025), gender was not framed primarily as a barrier; instead, participants emphasized professional identity and contribution to the *ummah*. This contextual difference highlights the importance of cultural specificity in persistence research.

A major strength of this study is its contextual depth and theoretical integration, offering culturally grounded insights into women’s doctoral persistence in Malaysia. However, the findings are based on a single institutional context (IIUM) and a relatively small qualitative sample. Thus, transferability should be considered cautiously. Readers should avoid generalizing these findings to all STEM doctoral students or to secular institutional contexts where faith-based motivations may function differently. Overall, this study reframes persistence as a multidimensional construct, motivational, strategic, relational, and spiritual, expanding theoretical models of STEM doctoral completion within culturally diverse contexts.

CONCLUSION

This study explored the persistence of female engineering doctoral students at IIUM through the lens of Social Cognitive Career Theory (Lent et al., 2005). The findings underscore that persistence is not merely an outcome of intellectual ability but a dynamic process shaped by the development and internalisation of personal interest. Consistent with SCCT, participants’ self-efficacy beliefs and positive outcome expectations contributed to the formation and strengthening of interest, which subsequently reinforced commitment to doctoral completion. Interest evolved from early exposure and encouragement into identity-integrated and value-integrated commitment, functioning as a central psychological mechanism sustaining long-term engagement in STEM doctoral education.

This study suggests that institutions must cultivate continuous interest by fostering environments rich in mastery experiences, belonging, and meaningful research engagement (Lent et al., 2013). Strengthening self-efficacy requires structured mentoring and inclusive supervision to stabilise interest (Posselt, 2018), while doctoral programmes should align research opportunities with students’ intellectual passions and societal values to facilitate identity integration. Although these findings may be uniquely applicable to values-driven or faith-based contexts (Syafi’i, 2024), they demonstrate how anchoring technical pursuits in moral frameworks supports long-term commitment and the broader goal of societal reform.

Future research may employ longitudinal designs to examine how personal interest evolves across doctoral stages. Comparative studies across institutions or cultural contexts would further illuminate how environmental supports interact with interest to shape persistence in STEM doctoral pathways.

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