Female students' Entrepreneurial Leadership and Education: A sequential mediation analysis of Entrepreneurial Knowledge and Mindset

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Abstract

Women are under-represented in business, especially in patriarchal countries like Malaysia, hence efforts to encourage female students to become entrepreneurs are needed. This study uses human capital theory to examine how entrepreneurial education affects female students' entrepreneurial leadership, showing the sequential mediating roles of entrepreneurial knowledge and mindset. The research surveyed 377 Malaysian female university students using a questionnaire. Data was analysed using PLS-SEM. The findings show that entrepreneurship education improves entrepreneurial knowledge and mindset. The sequential mediation of entrepreneurial knowledge and mindset leads to entrepreneurial leadership. The findings show how education, knowledge, and mindset develop entrepreneurial skills. In this research, we learn how entrepreneurial education programs might assist female students to develop the knowledge and mindset needed to lead their enterprises. The findings are important for educators, policymakers, and practitioners promoting female entrepreneurship and leadership in developing, and patriarchal countries. This study's key contribution is a step-by-step approach showing how entrepreneurial education builds female university students' knowledge and mindset to become entrepreneurial leaders in the context of patriarchal societies.

Keywords: *Entrepreneurial education, entrepreneurial knowledge, entrepreneurial mindset, entrepreneurial leadership, sequential mediation, female students*

1.0 Introduction

Entrepreneurship has increasingly been recognised as a key driver of economic growth, innovation, and societal progress. As nations strive to foster entrepreneurial ecosystems, the role of education in shaping entrepreneurial intentions and capabilities has garnered significant attention. In particular, entrepreneurial education (EE) is considered a crucial tool for equipping individuals with the knowledge, skills, and mindset needed to succeed in entrepreneurial ventures (Sahinidis et al., 2012). Despite significant strides in promoting gender equality, female students in Malaysia, like in many parts of the world, remain under-represented in entrepreneurial activities.

In Malaysia, the challenge for women entrepreneurs extends beyond competing in the highly competitive "red sea" of business. They also face societal challenges in being regarded as unequal to their male counterparts due to Malaysia's patriarchal society. This is reflected in the Global Gender Gap Index 2024, where Malaysia scored 0.668 (an index of 1.0 indicates there is no gender gap), ranking 114th out of 146 countries, a decline from 102nd place the previous year (World Economic Forum, 2024). This ranking highlights the significant gender gap in Malaysian women's economic participation and empowerment. By and large, Malaysian society anticipates women to assume the roles of devoted wives, nurturing mothers, and

primary household caretakers, even when they are actively involved in employment or business pursuits (Moorthy et al., 2022; Ping, 2023).

Like most countries, SMEs are the backbone of the Malaysian economy, comprising 97.2% of total business establishments, generating 38.2% of GDP, and employing 7.3 million people (SME Corp Malaysia, 2022). The number of women-owned firms in Malaysia has steadily increased over the years, rising from 127,533 in 2010 to 187,265 in 2015 and reaching 219,015 in 2022 (DOSM 2023). This upward trend highlights the growing role of women in the country's entrepreneurial landscape. Malaysia presents a compelling case where, despite 80% of women expressing aspirations to become entrepreneurs—higher than the global average of 72%. This suggests that only about 20% of entrepreneurs in the country are women, most of whom are concentrated in service-oriented sectors (Herbalife Nutrition, 2020; Monash University Malaysia, 2023). This gap between aspiration and realisation underscores the importance of understanding and addressing the barriers that female students face when pursuing entrepreneurship. These barriers are often shaped by societal norms, limited access to resources, and a lack of role models, which collectively hinder women's participation in entrepreneurial leadership (GEM, 2012; Fairlie and Robb, 2009).

Entrepreneurial education is posited to play a critical role in overcoming these barriers by enhancing entrepreneurial knowledge and fostering a mindset conducive to leadership (Verheul et al., 2006; Langowitz and Minniti, 2007). However, the specific impact of such education on female students' entrepreneurial leadership remains underexplored, particularly in the context of Malaysia. Moreover, the mediating roles of entrepreneurial knowledge and mindset in the relationship between entrepreneurial education and leadership outcomes have received limited empirical attention. This study aims to bridge these gaps by investigating the impact of entrepreneurial education on Malaysian female students' entrepreneurial leadership. The research focuses on the sequential mediation effects of entrepreneurial knowledge and mindset, offering insights into how educational interventions can be tailored to empower female students as entrepreneurial leaders. Grasping these dynamics is vital for promoting gender equality in entrepreneurship and for empowering female students to spur economic and social innovation in Malaysia.

2.0 Literature Review

2.1 Entrepreneurial leadership

This study draws from the perspective of the Human Capital Theory (HCT), which argues that individuals and society benefit from investments in education, training and other forms of knowledge acquisition because these investments enhance skills, productivity and economic outcomes (Mengesha and Singh, 2023). Previous studies have described entrepreneurial leadership as a behavioural outcome that emerges from the accumulation and activation of entrepreneurial human capital (Aboobaker, 2020; Martin, McNally, and Kay, 2013; Sweetland, 1996). Evidence has suggested that the relationship between human capital and entrepreneurial leadership is bidirectional, with human capital enabling leadership development and entrepreneurial leadership influencing human capital management to enhance firm performance (Hoang, Luu and Babalola, 2025; Ling and Jaw, 2011). The success of enterprises in the modern business environment relies not just on the leadership or entrepreneurial qualities of its managers, but also on the integration of both skill sets (Buntuang et al., 2024; Esmer and Dayı, 2017; Latief et al., 2024). These traits can facilitate the development of entrepreneurial leadership and spirit.

Entrepreneurial leadership continues to be a dynamic subject, persistently seeking its identity after over 50 years of quantitative and qualitative research (Esmer and Dayı, 2017; Leitch and Harrison, 2018; Renko et al., 2015).

Human capital, developed through education, professional experience, and social engagement, constitutes the foundation of entrepreneurial leadership (Jayawarna et al. 2014). Kempster et al. (2018) characterise leadership learning as a process propelled by practical interventions and interactions among owner-managers, whereas Leitch et al. (2013) observe that leadership growth is augmented via the cultivation of social capital. Ling and Jaw (2011) and Norena-Chavez and Thalassinos (2020) assert that entrepreneurial leadership influences human capital management, therefore affecting outcomes such as global competitiveness and innovation performance. Mosey and Wright (2007) further associate previous business experience with the establishment of efficient social networks. Peters (2005) asserts that anomalies in human resource management within small and medium firms may obstruct this relationship. The results demonstrate that the cultivation and use of human capital is essential for promoting entrepreneurial leadership.

Entrepreneurial leadership describes a form of leadership required by individuals in order to maintain their competitiveness in a complex and turbulent environment (Harrison et al., 2016). A considerable body of research in entrepreneurial leadership has been emerging since the 1980s due to its recognised value, the capacity to enhance organisational outcomes (Charan et al., 1980; Herlina et al., 2021; Leitch and Volery, 2017) and the growing need for entrepreneurial leaders (Nidhan and Singh, 2022; Surie and Ashley, 2008). However, there is no universal consensus on the concept of entrepreneurial leadership, due to lack of conceptual clarity and theoretical foundations, resulting in various dimensions of entrepreneurial leadership competencies and their development (Bagheri and Harrison, 2020; Balasi et al., 2023).

A study by Nidhan and Singh (2022) revealed that entrepreneurial leadership integrates entrepreneurial traits with leadership qualities, which are essential for fostering innovative products, methodologies, and expanding opportunities for current products. In addition, entrepreneurial leadership engages with social institutions and tackles neglected social issues. Austin et al. (2006) assert that entrepreneurial leaders must embrace risk, pursue creativity, and capitalise on opportunities, while Djordjevic (2013) emphasises the necessity for entrepreneurial leaders to possess a profound self-awareness and comprehension of their surroundings in order to identify new opportunities that will advantage entrepreneurs, stakeholders, and society. Other studies have characterised entrepreneurial leadership as a very successful leadership style for tackling corporate challenges, emphasising its proactive, inventive, and risk-taking attributes (Bagheri and Lope Pihie, 2013; Surie and Ashley, 2008). Harrison et al. (2018) characterise entrepreneurial leadership as a leadership style that utilises many abilities to cultivate opportunities in difficult situations. They delineate four fundamental skill categories vital for entrepreneurial leaders: technical/business, interpersonal, conceptual, and entrepreneurial talents. They suggest a competence model that includes personal, functional, interpersonal, technical, ethical, and environmental abilities to assist individuals in becoming effective entrepreneurial leaders.

2.2 Entrepreneurial leadership (EL) among female university students

Entrepreneurial leadership (EL) has been widely studied for its potential to enhance organizational performance, with most past research focusing on business organizations and

small and medium enterprises (SMEs) (Ahmed and Harrison; Kautsar et al., 2018; Naushad, 2021). While the theoretical foundation of entrepreneurial leadership originates from the business world, there is a growing recognition of the role universities play as organizations that nurture future entrepreneurs and entrepreneurial leaders. Studies such as Yang (2018) on Korean university students and Handayati et al. (2020) on vocational students in Indonesia highlight the positive impact of entrepreneurship education on entrepreneurial leadership, entrepreneurial intentions, and mindset. Similarly, Bodolica and Spraggon (2021) explored entrepreneurial education ecosystems in less advanced countries, emphasizing the role of university-based centres of innovation in fostering leadership.

Despite these advancements, there remains a gap in research focused specifically on female university students. Earlier studies often suggested that male-owned businesses outperformed female-owned ones, attributing the difference to a lack of entrepreneurial capital among females during the start-up stage (Ahl and Marlow, 2012; Minniti, 2009). However, recent research shows that female entrepreneurship is now a significant driver of economic development (Aparisi-Torrijo and Ribes-Giner, 2022; Khalid et al., 2022; Neumeyer et al., 2019). Exploring entrepreneurial leadership through a gendered lens opens opportunities to understand the unique experiences of female entrepreneurs (Carter and Jones-Evans, 2006). Modern theories of leadership emphasise attributes traditionally associated with femininity, such as emotional intelligence, which is vital for fostering innovation, growth, and value creation in organisations (Galloway et al., 2015).

Scholars have also debated gender disparities in entrepreneurial leadership. While some studies report differences in entrepreneurial intentions and predictors between males and females (Díaz-García and Jiménez-Moreno, 2010; Wah et al., 2017), others find no significant gender-based differences in entrepreneurial leadership among students (Buntuang et al., 2024). This contradiction suggests a need for further research to understand the role of gender in shaping entrepreneurial outcomes. For instance, Dhakal et al. (2024) and Marsinah et al. (2024) documented a significant increase in university-level entrepreneurial programs designed to equip students with the skills needed to navigate an increasingly dynamic business environment. Similarly, Ardolino et al. (2024) highlighted the critical role of educators in stimulating students' entrepreneurial leadership.

In addition to the conceptual exploration of entrepreneurial leadership, substantial literature examines its dimensions, such as strategic, communicative, personal, motivational, and leadership behaviours (Ranjan, 2018). Soomro et al. (2019) identified positive relationships between these dimensions and entrepreneurial leadership, while Naushad (2021) identified five determinants of entrepreneurial leadership: the ability to absorb uncertainty, build commitment, frame challenges, clear paths, and specify limits. As knowledge and innovation are critical to organisational survival, and female entrepreneurship is increasingly recognised as significant to economic development, the importance of studying entrepreneurial leadership among female university students is evident. Addressing this gap will provide more profound insights into how entrepreneurial education, mindset, and leadership can be fostered effectively to empower female students to become successful entrepreneurial leaders.

2.3 Entrepreneurial education (EE)

Historically, men have had greater access to education, knowledge acquisition, and practical experience, fostering the belief that successful leadership and entrepreneurial qualities are predominantly male traits (Wheadon and Duval-Couetil, 2017). To challenge this stereotype, entrepreneurial education (EE) can play a pivotal role by addressing societal barriers and

personal insecurities, empowering women to see themselves as equally capable of entrepreneurial success.

EE encompasses short-term teaching and training programs delivered through various mediums, offering skill-building in areas such as negotiation, leadership, product development, creative thinking, career awareness, venture capital sourcing, intellectual property protection, and technological innovation (Dana et al., 2021). Additionally, EE emphasizes the development of entrepreneurial personality traits, and the adaptive changes required at different stages of venture creation (Bégin et al., 2014).

As part of university curricula, EE equips students with the essential skills and knowledge needed to thrive in the business world (Marsinah et al., 2024). For instance, Chika and Uzoagba Bethel (2024) advocate incorporating EE programs into university education to enhance entrepreneurial capabilities among students. Studies show that EE significantly enhances students' entrepreneurial skills (Otache et al., 2024) and facilitates the initiation of entrepreneurial activities (Vaicekauskaite and Valackiene, 2018). Moreover, Rae et al. (2014) highlight the global recognition of EE's value in preparing students for entrepreneurship. The growing emphasis on EE within higher education worldwide is evidenced by its integration into university programs, with research affirming its positive impact on students' knowledge, skills, perceptions, attitudes, psychological capital, and engagement in entrepreneurial activities (Christy and Wu, 2022; Karlidag-Dennis et al., 2020; Mei et al., 2020; Zaring et al., 2021; Cui and Bell, 2022). For example, Handayati et al. (2020) demonstrated the influence of EE on fostering entrepreneurial intentions and mindsets among vocational students in East Java, Indonesia.

Research also underscores the transformative impact of EE on female students. Enhanced entrepreneurial curricula and shifts in perceptions of EE have been shown to significantly increase the participation of female students in entrepreneurial ventures (Dey et al., 2024; Dutta, 2022). This highlights the critical role of EE in bridging gender gaps in entrepreneurship and promoting gender-inclusive entrepreneurial ecosystems.

2.4 Entrepreneurial knowledge (EK)

A major barrier to women's participation in business is the lack of entrepreneurial skills (Abdulla and Albattat, 2023). Entrepreneurial knowledge forms the basis of the entrepreneurial process, enabling individuals to establish and sustain businesses (Latief et al., 2024; Liguori et al., 2019). It enables entrepreneurs to understand, assess, analyse, and utilise knowledge from their environment and internal resources to achieve optimal outcomes (Jack and Anderson, 1999). Moreover, entrepreneurial knowledge signifies an individual's organised ability to create competitive advantages, emphasising opportunity identification, knowledge development, and dissemination, rather than focussing just on financial gains (Ha et al., 2021).

Entrepreneurial knowledge, seen as a crucial element for success, should be included into education from an early age, starting in schools, to effectively prepare students for entrepreneurial endeavours (Permatasari and Anggadwita, 2019). In Indonesia, vocational high schools (SMK) emphasise the development of knowledge and entrepreneurial skills as fundamental educational goals (Siahaan and Sholeh, 2024). Universities impart entrepreneurial knowledge and business competencies through many programs and courses. Research by Norhisham and Sahid (2022) demonstrates that students with entrepreneurial expertise have an increased interest in entrepreneurship. Studies demonstrate that female students obtain knowledge from university programs, which fosters creativity, innovation, and the ability to

transform ideas into viable business operations (De Moortel et al., 2021; Ode et al. 2023). Furthermore, entrepreneurial knowledge increases awareness and interest in entrepreneurship (Trihudiyatmanto, 2018), reduces uncertainties associated with entrepreneurial activities, and positively affects attitudes and perceptions regarding the pursuit of entrepreneurship (Kore, 2020). This highlights the imperative of incorporating entrepreneurial knowledge into educational curriculum to cultivate entrepreneurial mindsets and enhance the success of women in business.

2.5 Entrepreneurial mindset (EM)

The entrepreneurial mindset is a cognitive perspective that enables individuals to create value by recognizing and acting on opportunities, making decisions with limited information, and remaining adaptable and resilient in uncertain and complex situations (Daspit et al., 2023; Mohapeloa, 2017). It is crucial for enhancing competitiveness and fosters the capacity to positively leverage opportunities. Defined as the interplay of thoughts, feelings, and actions, the entrepreneurial mindset reflects how individuals think about tasks or opportunities, their emotions during entrepreneurial activities, and their resulting actions (Kuratko et al., 2021; Naumann, 2017). Female entrepreneurs have often been perceived to lack certain characteristics, such as a propensity for risk-taking, which is traditionally associated more with men than women (Tselepis and Nieuwenhuizen, 2023). However, cultivating an entrepreneurial mindset empowers female students to generate innovative ideas, evaluate opportunities and risks, and take the necessary steps to start and manage a business effectively (Karyaningsih, 2020). With an entrepreneurial mindset, female students develop a strong sense of autonomy, initiative, and self-motivation. They become independent thinkers who are driven to take ownership of their ideas, projects, and ventures (Maziriri et al., 2024). This mindset not only enhances their ability to navigate the challenges of entrepreneurship but also equips them to thrive in dynamic and competitive environments.

3.0 Hypotheses Development

3.1 Entrepreneurial Education and Entrepreneurial Knowledge

EE plays a crucial role in equipping students with the necessary knowledge and skills to manage businesses effectively in the future. Saptono et al. (2020) emphasized that EE enhances students' entrepreneurial knowledge, attitudes, and competencies. This aligns with the findings of Din et al. (2016) and Keat et al. (2011), which highlighted that entrepreneurship programs offered to university students in the northern region of Peninsular Malaysia significantly improved their entrepreneurial knowledge and skills. Numerous studies have demonstrated that entrepreneurial education provides potential entrepreneurs with the foundational knowledge and practical skills needed to identify opportunities, allocate resources, and establish successful business ventures (Chen et al., 2022; Haddad et al., 2021; Ni and Ye, 2018; Yousaf et al., 2021). By fostering a deep understanding of the entrepreneurial process, education empowers students to navigate the complexities of entrepreneurship confidently. Hence, the following hypotheses is formulated:

H1: Entrepreneurial education has a positive impact on female students' entrepreneurial knowledge.

3.2 Entrepreneurial Education and Entrepreneurial Mindset

Interestingly, entrepreneurship education has positive relationship with entrepreneurial mindset, as it is able to increase entrepreneurial mindset (Solesvik, 2013). Not only entrepreneurial education provides attitude, knowledge and competencies, but it also increases motivation in developing an entrepreneurial mindset (Karyaningsih, 2020). Gupta and

Govindarajan (2002) also stated human's mindset evolve over time, and entrepreneurial mindset can be driven by past and current experiences, such as education and learning. The relationship between entrepreneurial education and entrepreneurial mindset is explained by the Social Cognitive Theory, where environmental factors affect personal and behavioural variables, indicating the positive relationship between these two variables (Cui and Bell, 2022). Lackéus (2020) confirmed that entrepreneurial education triggers learning events which will affect students' learning outcomes of competencies, hence, affecting the entrepreneurial mindset. Many of the literatures believed that entrepreneurial mindset can be boosted by entrepreneurial education as entrepreneurial education allows individual to have the capability, attitude, motivation and understanding on the concept of entrepreneurship (Cui et al., 2021; Karyaningsih, 2020; Saptono et al., 2020). A research by Fayolle and Gailly (2015) found that entrepreneurial education promotes two prominent entrepreneurial mindset roles, by allowing individuals to create a culture and understand entrepreneurship in depth, as well as promotes individuals to obtain experience in becoming entrepreneurs. Due to that, the second hypothesis is formulated thus:

H2: Entrepreneurial education has a positive impact on Female students' entrepreneurial mindset.

3.3 Entrepreneurial Knowledge and Entrepreneurial Mindset

The entrepreneurial mindset is also defined as a feeling or tendency to provide a critical and creative thinking ability (Nabi et al., 2017). The entrepreneurial human capital (EHC) theory stated that, individuals with entrepreneurial knowledge tends to become entrepreneurs as they are able to combine entrepreneurial knowledge with various information and skills to fulfil the market desires (Ni and Ye, 2018). They can seek out opportunities, challenges and maximises resources effectively, which according to Solesvik et al. (2013) , represents the entrepreneurial mindset. This is supported by the research of Handayati et al. (2020) which found that entrepreneurial mindset is closely related with the individual's thinking ability, looking for opportunities, and offering ideas to overcome problems. Researchers believed that the entrepreneurial mindset is a holistic recognition of fostering novel ideas, analysing opportunities and challenges, and running a business (Bosman, 2019; Saptono et al., 2020; Solesvik et al., 2013), which can be obtained through entrepreneurship programmes, entrepreneurial education, and knowledge (Cui and Bell, 2022; Handayati et al., 2020; Saptono et al., 2020). Thus, the third hypothesis states that:

H3: Entrepreneurial knowledge has a positive impact on Female students' entrepreneurial mindset.

3.4 Entrepreneurial education and entrepreneurial leadership.

Entrepreneurial education programs in the higher education systems have been growing tremendously over the year. The research of Vaicekauskaite and Valackiene (2018) found that, special education program ease the process of starting any entrepreneurial activity, which is also supported by Rae et al. (2014), stating that entrepreneurship education (EE) is highly valued in many countries. Entrepreneurial education programs are growing in the higher education systems across the world (Christy and Wu, 2022; Karlidag-Dennis et al., 2020; Mei et al., 2020; Zaring et al., 2021) as scholars agreed that university-based entrepreneurial education is effective on students' learning outcome including knowledge, skills, perceptions, attitudes, characteristics and psychological capital to entrepreneurship and stimulates students engagement in entrepreneurial activity (Cui and Bell, 2022). Research by Yang (2018) found that entrepreneurship education is essential for Korean university students in fostering their

entrepreneurial leadership. This is in line with the research of Kempster and Cope (2010) , which suggested that entrepreneurial leadership requires some typical competencies which can be acquired through entrepreneurial education. Therefore, the fourth hypothesis is:

H4: Entrepreneurial education has a positive impact on female students' entrepreneurial leadership.

3.5 Entrepreneurial knowledge and entrepreneurial leadership

The need for entrepreneurial leaders is paramount in today's dynamic and competitive business environment. Entrepreneurs take chances and seize opportunities that benefit themselves, other stakeholders, and society. Kempster and Cope (2010) emphasized that entrepreneurial leadership requires essential competencies and skills to manage businesses effectively. High-level knowledge and skills in identifying opportunities, resource allocation, and venture creation are vital attributes of entrepreneurial leaders (Chen et al., 2022; Ni and Ye, 2018). Yang (2018) demonstrated the importance of entrepreneurial knowledge and skills in fostering entrepreneurial leadership among Korean university students, highlighting the role of education in cultivating leadership qualities. Furthermore, Saptono et al. (2020) underscored how EE equips individuals with foundational knowledge that facilitates effective leadership development. Dhakal et al. (2024) and Marsinah et al. (2024) also observed that entrepreneurial knowledge cultivated through university programs significantly enhances students' ability to navigate leadership roles in increasingly complex business environments. The interplay between entrepreneurial knowledge and leadership is further strengthened by Ardolino et al. (2024), who emphasized the critical role of educators in nurturing leadership capabilities by imparting relevant knowledge and skills. Additionally, studies such as Haddad et al. (2021) and Yousaf et al. (2021) have shown that entrepreneurial knowledge not only empowers students but also equips them to lead and innovate in entrepreneurial ventures. Given the importance of entrepreneurial knowledge in developing leadership capabilities, the following hypothesis is formulated:

H5: Entrepreneurial knowledge has a positive impact on female students' entrepreneurial leadership

3.6 Entrepreneurial Mindset and Entrepreneurial Leadership

An entrepreneurial mindset is instrumental in enhancing entrepreneurial leadership by equipping individuals with the ability to make effective decisions and take decisive actions based on situational analysis (Ersarı and Naktiyok, 2022; Ranjan, 2018; Subramaniam and Shankar, 2020). This mindset fosters resilience, adaptability, and strategic thinking - qualities essential for entrepreneurial leaders. Newman (2013) highlighted the importance of integrating entrepreneurial mindset and leadership training into university programs, emphasizing that these attributes are critical for preparing students to navigate the complexities of modern entrepreneurship. Ireland et al. (2003) and Lassen (2007) developed models illustrating the influence of an entrepreneurial mindset on entrepreneurial leadership, demonstrating its role in shaping decision-making, innovation, and team management capabilities. Further evidence by Haddad et al. (2021) and Yousaf et al. (2021) suggests that entrepreneurial mindset contributes to leadership effectiveness by enhancing problem-solving skills and fostering a proactive approach to challenges. Saptono et al. (2020) also noted that cultivating an entrepreneurial mindset helps students build confidence and creativity, enabling them to lead and innovate effectively in dynamic environments. Moreover, Chen et al. (2022) and Ni and Ye (2018) found that entrepreneurial mindset, combined with relevant knowledge and skills, empowers leaders to recognize opportunities, allocate resources strategically, and drive organizational growth. Yang (2018) reinforced this by demonstrating how an entrepreneurial mindset is integral to

developing leadership qualities among university students. Building on these findings, the following hypothesis is proposed:

H6: Entrepreneurial mindset has a positive impact on Female students' Entrepreneurial Leadership.

3.7 Entrepreneurial mindset as mediator between entrepreneurial education and entrepreneurial leadership

The mediating effect of an entrepreneurial mindset on the relationship between entrepreneurial education and entrepreneurial leadership highlights how education fosters a mindset conducive to opportunity recognition, resource allocation, and effective leadership. Entrepreneurial education equips individuals with critical knowledge and skills that enhance their ability to identify opportunities, adapt to challenges, and create innovative solutions, thereby strengthening their entrepreneurial mindset (Daspit et al., 2023; Outsios and Kittler, 2018; Saptono et al., 2020). An entrepreneurial mindset promotes creativity, resilience, and strategic thinking, all of which are crucial for entrepreneurial leadership (Ersarı and Naktiyok, 2022; Ranjan, 2018). Studies have shown that when students develop an entrepreneurial mindset through education, they are better prepared to lead and innovate in highly competitive and dynamic environments (Ireland et al., 2003; Lassen, 2007; Subramaniam and Shankar, 2020). Furthermore, Newman (2013) emphasized the integration of entrepreneurial mindset and leadership training in universities as a way to bridge the gap between theoretical learning and practical application. Haddad et al. (2021) and Yousaf et al. (2021) demonstrated that entrepreneurial mindset not only enhances leadership qualities but also acts as a bridge, connecting educational interventions with the cultivation of entrepreneurial leadership. Chen et al. (2022) and Ni and Ye (2018) provided evidence to demonstrate that EE fosters mindset development, which subsequently influences entrepreneurial leadership by equipping students with the ability to navigate uncertainties and capitalize on emerging opportunities. Similarly, Yang (2018) found that entrepreneurial mindset plays a pivotal role in translating educational outcomes into leadership effectiveness among university students. Thus, the following hypothesis is formulated:

H7: Entrepreneurial mindset mediates the relationship between Entrepreneurial education and Female students' Entrepreneurial Leadership.

3.8 Entrepreneurial mindset as mediator between entrepreneurial knowledge and entrepreneurial leadership

Building on previous discussions, the mediating effect of entrepreneurial mindset in the relationship between entrepreneurial knowledge and entrepreneurial leadership is evident. Entrepreneurial mindset reflects an individual's ability to think critically, recognize opportunities, and navigate challenges effectively (Handayati et al., 2020). According to human capital theory, an individual's knowledge level is directly linked to their entrepreneurial mindset, as greater knowledge enhances cognitive abilities and decision-making (Rashid, 2019). Entrepreneurs and managers with a strong entrepreneurial mindset are better equipped to apply their knowledge in uncertain business environments, enabling them to make optimal decisions and sustain their ventures (Boldureanu et al., 2020; Haddad et al., 2021). Entrepreneurial knowledge provides the foundation for understanding the complexities of running a business, while an entrepreneurial mindset empowers individuals to translate this knowledge into effective leadership practices. Empirical studies highlight the crucial role of entrepreneurial mindset in fostering leadership. Ireland et al. (2003) and Lassen (2007) demonstrated that individuals with high entrepreneurial mindset are more likely to exhibit entrepreneurial leadership traits. Similarly, Ranjan (2018) and Subramaniam and Shankar

(2020) emphasized how entrepreneurial mindset bridges the gap between knowledge and leadership, enabling leaders to adapt and innovate effectively. Yang (2018) further supported this, showing that entrepreneurial mindset enhances leadership potential among students by fostering resilience and strategic thinking. Chen et al. (2022) and Ni and Ye (2018) also revealed that entrepreneurial mindset enables individuals to maximize the value of their knowledge by identifying opportunities and addressing challenges proactively. Haddad et al. (2021) and Yousaf et al. (2021) added that entrepreneurial mindset complements knowledge by providing the cognitive tools necessary for effective leadership in complex environments. Thus, the following hypothesis is proposed:

H8: Entrepreneurial mindset mediates the relationship between Entrepreneurial knowledge and Female students' Entrepreneurial Leadership.

3.9 Entrepreneurial knowledge and entrepreneurial mindset as sequential mediator between entrepreneurial education and entrepreneurial leadership

Based on the earlier discussions and hypotheses, it is suggested that entrepreneurial knowledge and entrepreneurial mindset act as sequential mediators in the relationship between entrepreneurial education and entrepreneurial leadership. EE is a key driver of entrepreneurial knowledge, which, in turn, fosters entrepreneurial mindset - both of which are instrumental in shaping entrepreneurial leadership. Entrepreneurial knowledge is the cognitive ability to acquire, retain, and apply information related to entrepreneurial activities. This knowledge equips individuals with the necessary skills to engage in entrepreneurial activities confidently (Mambu et al., 2019). Entrepreneurial education significantly enhances entrepreneurial knowledge by exposing students to concepts, theories, and real-world applications, as demonstrated by Hutasuhut (2018) and Roxas (2014). Studies have also shown that EE positively influences students' confidence and willingness to pursue entrepreneurship, providing them with a strong foundation for future leadership roles. Students with higher entrepreneurial knowledge tend to exhibit a more positive attitude toward entrepreneurship (Cui et al., 2021; Watchravesringkan et al., 2013). This knowledge shapes their entrepreneurial mindset, which includes critical thinking, creativity, and resilience in navigating entrepreneurial challenges (Saptono et al., 2020).

As entrepreneurial knowledge grows, it enhances the entrepreneurial mindset, enabling students to recognize and effectively act on opportunities (Subramaniam and Shankar, 2020). Entrepreneurial mindset reflects an individual's capacity to think and act entrepreneurially, characterized by intentionality, behaviour, and actions that support entrepreneurship (John, Selvaraj, and Jisham, 2024; Renko et al., 2015; Ireland et al., 2003). Renko et al. (2015) further highlighted that entrepreneurial leaders inherently possess an entrepreneurial mindset, which allows them to guide their ventures and teams successfully. By fostering entrepreneurial knowledge through education, students gain the skills and understanding needed to develop an entrepreneurial mindset, which subsequently enhances their leadership capabilities. Studies by Chen et al. (2022), Haddad et al. (2021), and Ni and Ye (2018) emphasize the interconnectedness of these factors, demonstrating that entrepreneurial education initiates a sequential process that culminates in entrepreneurial leadership. Thus, the following hypothesis is formulated:

H9: Entrepreneurial knowledge and Entrepreneurial mindset will sequentially mediate the relationship between Entrepreneurial education and Female students' Entrepreneurial Leadership.

Figure 1 illustrates the conceptual framework that integrates the relationship between the various variables.

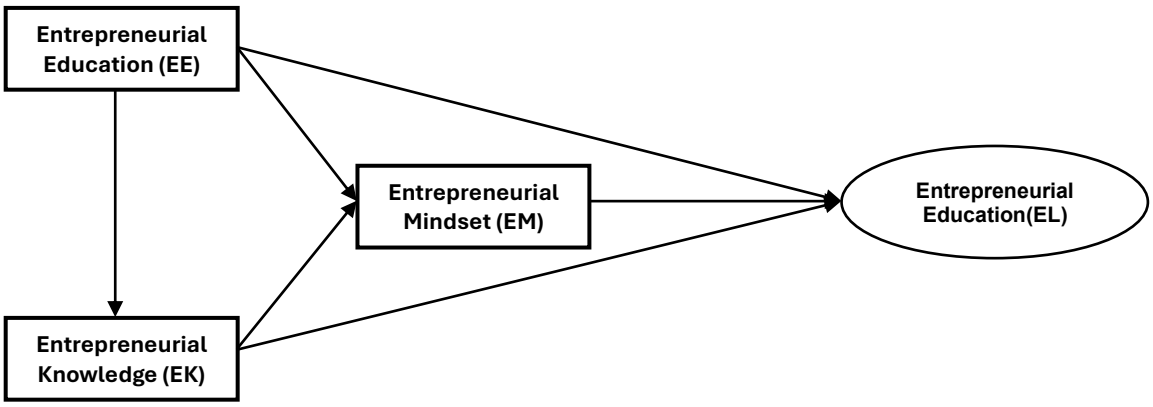

Figure 1: The Research Framework.

4.0 Methodology

This study explores the relationship between entrepreneurial education and female students' entrepreneurial leadership, with a focus on the sequential mediation of entrepreneurial knowledge and mindset. A quantitative research design was adopted, using a cross-sectional survey to gather data from female university students. The study used a sequential mediation model to test the indirect effects of entrepreneurial knowledge and mindset on the relationship between entrepreneurial education and entrepreneurial leadership. This approach was chosen to capture the sequential nature of how entrepreneurial education influences leadership through the development of knowledge and mindset, aligning with prior research on mediation analysis in educational and leadership studies (Preacher and Hayes, 2008; Hayes, 2018). The partial least squares structural equation modelling (PLS-SEM) technique was employed to analyse the data because it is suitable for complex models with multiple mediation pathways (Hair et al., 2019).

4.1 Population and Sample

The target population for this study consisted of female undergraduate students in Malaysian universities. A total of 377 female university students were selected using a stratified random sampling technique. This sampling method ensures representation across different universities and regions in Malaysia, enhancing the generalisability of the findings. The sample size was determined based on guidelines for mediation analysis and PLS-SEM, with consideration for the complexity of the model and the number of parameters to be estimated (Cohen, 1992; Kock and Hadaya, 2018). The research concentrated on female undergraduate students as this population represents a vital pipeline for future business leaders, especially within patriarchal environments (Ode et al. 2023). The inclusion requirements mandated that participants be female and enrolled in full-time undergraduate programs. The selection guaranteed that participants received equivalent exposure to formal entrepreneurship instruction, hence enhancing the validity of the analysis.

4.2 Data Collection

Data were collected through a structured questionnaire administered online. The questionnaire was designed to capture the variables of interest, including entrepreneurial education, entrepreneurial knowledge, entrepreneurial mindset, and entrepreneurial leadership. The survey was distributed via email to female students from selected universities, and participation was voluntary. The data collection process took approximately three months to complete, with

follow-up emails sent to non-respondents to increase the response rate. Prior to distribution, a pilot test was conducted with a smaller sample to assess the clarity and reliability of the questionnaire items.

4.3 Measures

The constructs in this study were measured using validated scales from previous research. Each item was rated on a five-point Likert type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Entrepreneurial education was assessed using a six-item scale that measured students' exposure to entrepreneurial courses, workshops, and experiential learning opportunities (Hasan et al., 2017; Denanyoh et al., 2015; Saptono et al., 2020). Entrepreneurial knowledge was measured with a six-item scale that evaluated students' perceptions of their knowledge acquisition in areas such as business planning, opportunity recognition, and resource management (Roxas, 2014; Saptono et al., 2020). Entrepreneurial mindset was measured using a seven-item scale adapted from the Entrepreneurial Mindset Inventory (Mathisen and Arnulf, 2013; Saptono et al., 2020), focusing on traits like innovation, risk-taking, and proactivity. Entrepreneurial leadership was assessed with an eight-item scale developed by Renko et al. (2015) and Ataei et al. (2024), capturing leadership qualities specific to entrepreneurship, including vision, creativity, and the ability to influence others in entrepreneurial contexts; refer to Table 7.

5.0 Data Analysis and Results

This section presents the analysis of the collected data and the results of the study, which explored the sequential mediation of entrepreneurial knowledge and mindset in the relationship between entrepreneurial education and female students' entrepreneurial leadership. The analysis was conducted in three stages: descriptive statistics, measurement model assessment, and structural model assessment using Partial Least Squares Structural Equation Modelling (PLS-SEM).

5.1 Descriptive Statistics

The demographic profile of the respondents, as summarised in Table 1, includes 377 female university students from various Malaysian institutions. Most respondents (90.5%) were aged 18–22, with smaller proportions aged 23–27 (6.4%) and above 27 (3.1%). Science-related fields were the majority (73.5%), while non-science disciplines accounted for 26.5%. Ethnic composition comprised 43.2% Malay, 42.7% Chinese, 8.8% Indian, and 5.3% from other groups. Only 32.4% had taken entrepreneurship courses, and 67.6% had not. The results show that 46.7% had no business experience, 35.3% had less than a year, and 18% had one or more years. Additionally, 59.7% came from families with a business background. This diverse sample provides essential context for understanding the relationships between entrepreneurial education, knowledge, mindset, and leadership.

Table 1: Demographic profile of respondents.

Variables		Frequency	%
Age	18-22	341	90.5
	23-27	24	6.4
	28-33	8	2.0
	Above 34	4	1.1
Education - Area of Study	Science	277	73.5
	Non-Science	100	26.5
Ethnicity	Malay	163	43.2

	Chinese	161	42.7
	Indian	33	8.8
	Others	20	5.3
Have you taken entrepreneurship courses?	Yes	122	32.4
	No	255	67.6
Prior business experiences	None	176	46.7
	Less than 1 year	133	35.3
	1-2 years	30	7.9
	More than 2 Years	38	10.1
Family business background	Yes	225	59.7
	No	152	40.3

5.2 Measurement Model Assessment

The reliability and validity of the constructs were evaluated using the measurement model; the results are presented in Table 2 and the measurement model in Figure 2. Reliability was assessed using Cronbach's alpha and composite reliability (CR), with all constructs demonstrating high internal consistency as Cronbach's alpha values exceeded the recommended threshold of 0.70. The CR values for all constructs were above 0.80, indicating strong construct reliability. Convergent validity was confirmed as the factor loadings for all items exceeded the 0.70 threshold, and the average variance extracted (AVE) values for entrepreneurial education (0.61), entrepreneurial knowledge (0.63), entrepreneurial mindset (0.66), and entrepreneurial leadership (0.68) were all above the 0.50 threshold and cross-loadings shown in Table 3. Discriminant validity, assessed using the Fornell-Larcker criterion, demonstrated that the square root of the AVE for each construct was greater than the correlations with other constructs. These results confirmed that each construct shared more variance with its indicators than with those of other constructs, ensuring satisfactory discriminant validity (refer to Table 4). This study used Harman's single factor test to assess common method bias. The results shows a variation of 37.57%, which is line with the findings of Ahmad (2025), suggesting that the threshold was below 50% recommended for common method bias.

Table 2: Reliability and validity analysis.

Construct	Items	Loading	Alpha	rho_A	CR	AVE
Entrepreneurial Education (EE)	EE1	0.814	0.912	0.915	0.932	0.695
	EE2	0.867				
	EE3	0.883				
	EE4	0.858				
	EE5	0.785				
	EE6	0.790				
Entrepreneurial Knowledge (EK)	EK1	0.779	0.920	0.923	0.937	0.714
	EK2	0.831				
	EK3	0.893				
	EK4	0.832				
	EK5	0.873				
	EK6	0.858				
Entrepreneurial Mindset (EM)	EM1	0.855	0.935	0.939	0.948	0.723
	EM2	0.866				
	EM3	0.873				
	EM4	0.893				
	EM5	0.855				

	EM6	0.870				
	EM7	0.728				
Entrepreneurial Leadership (EL)	EL1	0.830	0.933	0.934	0.945	0.682
	EL2	0.822				
	EL3	0.804				
	EL4	0.864				
	EL5	0.816				
	EL6	0.829				
	EL7	0.831				
	EL8	0.811				

Note: FL = Factor Loadings; CA = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted

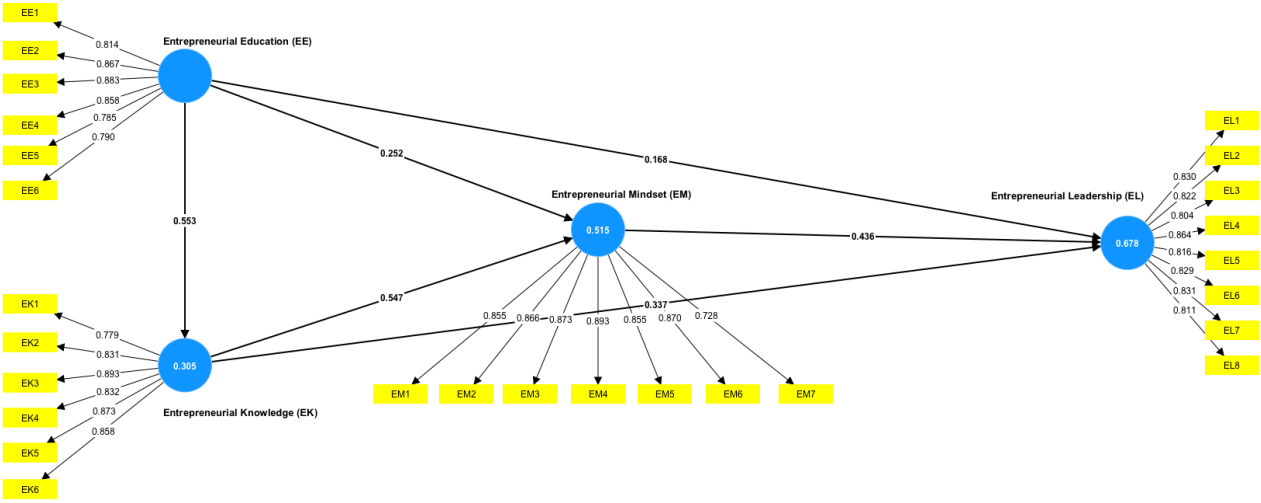

Figure 2: Measurement Model.

Table 3: ç

	EE	EK	EL	EM
EE1	**0.814**	0.42	0.466	0.422
EE2	**0.867**	0.414	0.447	0.427
EE3	**0.883**	0.463	0.502	0.459
EE4	**0.858**	0.47	0.458	0.409
EE5	**0.785**	0.548	0.578	0.542
EE6	**0.79**	0.417	0.498	0.483
EK1	0.419	**0.779**	0.538	0.498
EK2	0.466	**0.831**	0.57	0.535
EK3	0.465	**0.893**	0.648	0.565
EK4	0.522	**0.832**	0.663	0.635
EK5	0.475	**0.873**	0.637	0.623
EK6	0.447	**0.858**	0.626	0.609
EL1	0.56	0.619	**0.83**	0.656
EL2	0.457	0.615	**0.822**	0.595
EL3	0.43	0.661	**0.804**	0.607
EL4	0.48	0.594	**0.864**	0.619
EL5	0.548	0.528	**0.816**	0.62

EL6	0.505	0.619	**0.829**	0.614
EL7	0.478	0.563	**0.831**	0.65
EL8	0.477	0.613	**0.811**	0.661
EM1	0.436	0.557	0.631	**0.855**
EM2	0.463	0.576	0.67	**0.866**
EM3	0.516	0.612	0.656	**0.873**
EM4	0.504	0.632	0.68	**0.893**
EM5	0.484	0.579	0.68	**0.855**
EM6	0.47	0.602	0.668	**0.87**
EM7	0.419	0.521	0.529	**0.728**

Table 4: Discriminant Validity Assessment

	EE	**EK**	**EM**	**EL**
EE				
EK	0.595			
EM	0.639	0.784		
EL	0.593	0.737	0.812	

5.4 Structural Model Assessment

The structural model was assessed to examine the relationships between entrepreneurial education, entrepreneurial knowledge, entrepreneurial mindset, and entrepreneurial leadership. The PLS-SEM technique was used to estimate the path coefficients, and bootstrapping with 5,000 resamples was applied to test the significance of the relationships and the mediation effects.

5.4.1 Direct Effects

The direct effect of entrepreneurial education on entrepreneurial leadership was found to be positive and significant ($\beta = 0.38$, $p < 0.001$). This result indicates that entrepreneurial education directly contributes to the development of entrepreneurial leadership qualities in female students. The direct effect of entrepreneurial education on entrepreneurial knowledge was also significant ($\beta = 0.52$, $p < 0.001$), suggesting that students' exposure to entrepreneurial education enhances their entrepreneurial knowledge. In addition, entrepreneurial knowledge had a significant positive effect on entrepreneurial mindset ($\beta = 0.47$, $p < 0.001$), confirming that increased entrepreneurial knowledge fosters a proactive and innovative entrepreneurial mindset. Finally, entrepreneurial mindset had a significant positive effect on entrepreneurial leadership ($\beta = 0.44$, $p < 0.001$), demonstrating that a strong entrepreneurial mindset is a crucial determinant of entrepreneurial leadership.

5.4.2 Mediation Analysis

The mediation analysis was conducted to test whether entrepreneurial knowledge and entrepreneurial mindset sequentially mediated the relationship between entrepreneurial education and entrepreneurial leadership. The results indicated a significant indirect effect of entrepreneurial education on entrepreneurial leadership through entrepreneurial knowledge and mindset ($\beta = 0.22$, $p < 0.001$). This finding confirms that entrepreneurial education not only directly influences leadership but also works through the development of entrepreneurial

knowledge, which in turn enhances entrepreneurial mindset, ultimately leading to improved entrepreneurial leadership. The total effect of entrepreneurial education on entrepreneurial leadership (direct + indirect) was also significant ($\beta = 0.60$, $p < 0.001$), indicating that entrepreneurial education plays a substantial role in shaping leadership capabilities among female students. The sequential mediation pathway, where entrepreneurial education influences entrepreneurial leadership through both entrepreneurial knowledge and mindset, was also significant (indirect effect = 0.09, $p < 0.01$). This finding underscores the importance of both knowledge acquisition and mindset development in translating entrepreneurial education into leadership outcomes.

5.4.3 Model Fit and Predictive Power

The model fit and predictive power were assessed using key indicators. Substantial R^2 values for entrepreneurial knowledge ($R^2 = 0.305$), entrepreneurial mindset ($R^2 = 0.515$), and entrepreneurial leadership ($R^2 = 0.678$) exceeded the 0.26 threshold (Cohen, 1988), confirming the model's strong explanatory power. The SRMR value of 0.064 indicated good fit, and moderate effect sizes ($f^2 = 0.28$ for EE → EK; $f^2 = 0.20$ for EM → EL) emphasized the critical role of entrepreneurial education and mindset in shaping leadership. Table 5 summarizes these robust findings, validating the model's effectiveness in explaining key relationships.

Table 5: Variance explained in the endogenous latent variable.

	R-square	R-square adjusted
Entrepreneurial Knowledge (EK)	0.305	0.303
Entrepreneurial Leadership (EL)	0.678	0.675
Entrepreneurial Mindset (EM)	0.515	0.513

Note: R2 score interpretation (0.26 - substantial, 0.13 - moderate and 0.02 - weak) (Cohen, 1988).

5.4.4 Robustness Checks

To ensure the robustness of the findings, several additional analyses were performed. Alternative model specifications and sensitivity analyses confirmed the stability of the results. Additionally, cross-validation with a split sample approach corroborated the primary findings, reinforcing the validity of the sequential mediation effects.

5.5 Results

The results of the hypotheses testing, as summarized in Table 6, provide strong support for the proposed relationships within the study model.

Direct Effects - The findings demonstrate that entrepreneurial education (EE) has a significant positive impact on entrepreneurial knowledge (EK) (H1: $\beta = 0.553$, $t = 13.501$, $p < 0.001$) and entrepreneurial mindset (EM) (H2: $\beta = 0.252$, $t = 4.363$, $p < 0.001$). Furthermore, entrepreneurial knowledge significantly influences entrepreneurial mindset (H3: $\beta = 0.547$, $t = 11.851$, $p < 0.001$). Additionally, entrepreneurial education directly impacts entrepreneurial leadership (EL) (H4: $\beta = 0.168$, $t = 3.792$, $p < 0.001$), while entrepreneurial knowledge (H5: $\beta = 0.337$, $t = 5.824$, $p < 0.001$) and entrepreneurial mindset (H6: $\beta = 0.436$, $t = 7.420$, $p < 0.001$) also have significant direct effects on entrepreneurial leadership and refer Figure 3.

Mediation Effects - The study also highlights the significance of sequential mediation effects. Entrepreneurial mindset mediates the relationship between entrepreneurial education and entrepreneurial leadership (H7: $\beta = 0.110$, $t = 4.246$, $p < 0.001$). Entrepreneurial knowledge and mindset jointly mediate the relationship between entrepreneurial education and entrepreneurial leadership (H9: $\beta = 0.132$, $t = 5.055$, $p < 0.001$). Furthermore, entrepreneurial

knowledge mediates the relationship between entrepreneurial education and entrepreneurial mindset, which subsequently influences entrepreneurial leadership (H8: $\beta = 0.239$, $t = 5.996$, $p < 0.001$).

These findings, with all hypotheses supported at a significance level of $p < 0.001$, underscore the critical role of entrepreneurial education in fostering knowledge and mindset, which subsequently drive entrepreneurial leadership. The model demonstrates robust relationships and validates the proposed sequential mediation framework.

Table 6: Hypothesis Results

Hypothesis	Relationship	Std Beta	Std Dev	T Value	P values	Decision
H1	EE -> EK	0.553	0.041	13.501	0.000***	Supported
H2	EE -> EM	0.252	0.058	4.363	0.000***	Supported
H3	EK -> EM	0.547	0.046	11.851	0.000***	Supported
H4	EE -> EL	0.168	0.044	3.792	0.000***	Supported
H5	EK -> EL	0.337	0.058	5.824	0.000***	Supported
H6	EM -> EL	0.436	0.059	7.420	0.000***	Supported
H7	EE -> EM -> EL	0.110	0.026	4.246	0.000***	Supported
H8	EK -> EM -> EL	0.239	0.040	5.996	0.000***	Supported
H9	EE-> EK -> EM -> EL	0.132	0.026	5.055	0.000***	Supported

Note: 95% confidence interval with a bootstrapping of 5,000 was used.
***Correlation is significant at the 0.01 level (2-tailed) and *Correlation is significant at the 0.05 level (2-tailed).

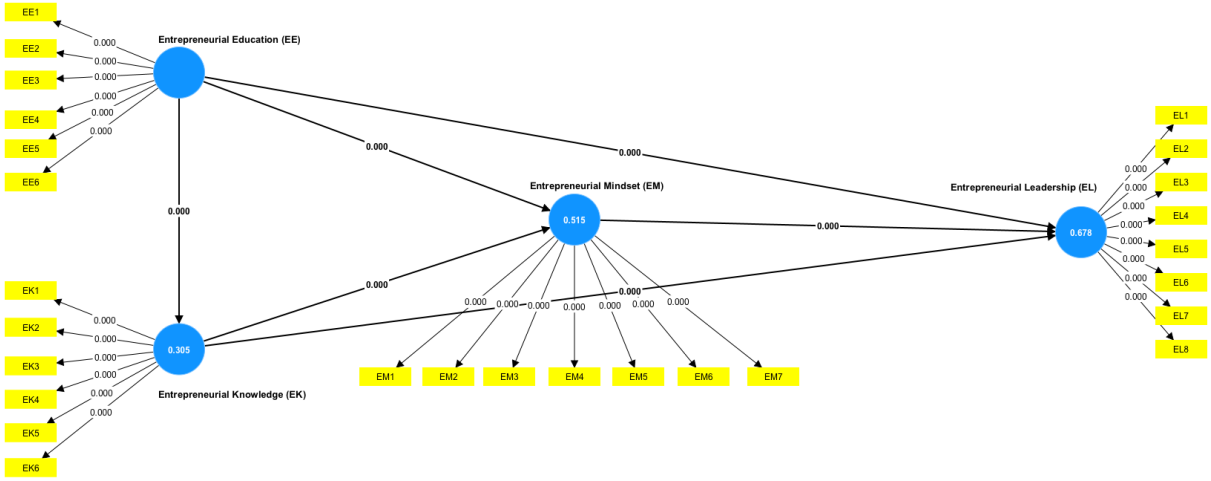

Figure 3: Structural model.

6.0 Discussion

This study investigates the relationships between entrepreneurial education, entrepreneurial knowledge, entrepreneurial mindset, and entrepreneurial leadership among female university students. Specifically, it explores the sequential mediation roles of entrepreneurial knowledge and mindset in linking entrepreneurial education to entrepreneurial leadership. The findings reveal significant and robust support for all proposed hypotheses, offering both theoretical contributions and practical implications. The positive relationship between EE and EK (H1)

aligns with existing literature, indicating that structured educational programs enhance students' entrepreneurial competencies. This finding aligns with prior studies (Saptono et al., 2020; Din et al., 2016), which emphasise the critical role of education in equipping students with the skills and knowledge required to navigate entrepreneurial challenges. Entrepreneurial education fosters students' understanding of business opportunities, resource allocation, and venture creation, as highlighted by Chen et al. (2022) and Yousaf et al. (2021). For female students, this knowledge is particularly empowering, preparing them to address barriers to entry in entrepreneurial environments such as Malaysia.

The significant direct effect of EE on EM (H2) suggests that entrepreneurship education imparts knowledge and cultivates an entrepreneurial mindset among female students. This finding supports the work of Solesvik (2013) and Karyaningsih (2020), who demonstrated the transformative effect of education on fostering entrepreneurial attitudes, motivation, and resilience. By providing both theoretical foundations and experiential learning opportunities, entrepreneurial education enhances students' ability to think critically, adapt to challenges, and seize opportunities—key components of an entrepreneurial mindset. The significant relationship between EK and EM (H3) underscores the role of entrepreneurial knowledge in shaping an entrepreneurial mindset. This finding resonates with the Entrepreneurial Human Capital Theory (EHC), which posits that individuals with greater entrepreneurial knowledge are better equipped to recognise opportunities, overcome challenges, and maximise resource utilisation (Ni and Ye, 2018; Handayati et al., 2020). As highlighted by Nabi et al. (2017) and Saptono et al. (2020), entrepreneurial knowledge forms the cognitive foundation for developing a proactive and innovative mindset, which is essential for entrepreneurial success.

The direct effect of EE on EL (H4) indicates that entrepreneurial education programs contribute to the development of the leadership qualities necessary for entrepreneurial success. This finding is in line with studies highlighting the importance of entrepreneurship education in fostering leadership skills among students, thereby preparing them for entrepreneurial roles (Christy and Wu, 2022; Karlidag-Dennis et al., 2020; Mei et al., 2020; Zaring et al., 2021). This finding aligns with research by Kempster and Cope (2010) and Yang (2018), which highlight the role of education in fostering the competencies and skills needed for effective entrepreneurial leadership. Entrepreneurial education equips female students with the confidence and strategic thinking abilities required to lead in dynamic business environments.

The significant relationships between EK and EL (H5) and EM and EL (H6) suggest that both knowledge and mindset are critical components in developing entrepreneurial leadership. This finding is consistent with prior studies (Chen et al., 2022; Ni and Ye, 2018; Saptono et al., 2020), which demonstrate that entrepreneurial knowledge enables individuals to identify opportunities, allocate resources effectively, and navigate complex business environments. For female students, this knowledge serves as a foundation for leadership development, fostering their ability to lead and innovate.

The mediation analyses (H7, H8) show an important step-by-step process where entrepreneurial education (EE) builds entrepreneurial knowledge (EK), which then improves the entrepreneurial mindset (EM). This pathway highlights the critical interplay between cognitive and attitudinal components in entrepreneurial development. Specifically, entrepreneurial education serves as the foundational step by equipping students with the necessary knowledge. This knowledge then cultivates a mindset that is conducive to opportunity recognition, resilience, and strategic thinking. These findings align with prior research by Haddad et al. (2021) and Yousaf et al. (2021), which emphasise the role of an

entrepreneurial mindset in bridging the gap between knowledge acquisition and leadership development. The results underscore the importance of designing entrepreneurship education programmes that integrate both cognitive learning (knowledge acquisition) and attitudinal development (mindset enhancement). Such programmes not only provide the theoretical and practical understanding of entrepreneurship but also nurture the psychological traits necessary for effective leadership. By fostering this dual development, educational initiatives can effectively prepare students to navigate complex entrepreneurial environments with confidence and innovation.

The mediation analysis of H9 reveals the context-dependent nature of the findings, suggesting that entrepreneurial leadership (EL) is not cultivated in isolation but through a sequential process commencing with education. In the context of Malaysia, entrepreneurial education fosters a knowledge base that encourages a mindset orientated towards leadership and creativity, eventually producing entrepreneurial leadership skills. This extended sequential mediation underscores the connection among education, knowledge, cognition, and leadership. These findings support the notion that developing entrepreneurial leaders, particularly among female students in patriarchal societies, requires a systematic and comprehensive approach. Subramaniam, Shankar (2020), and Renko et al. (2015) emphasise that this interconnected process promotes the enhancement of leadership capabilities through cognitive and attitudinal growth. The key contribution of this study lies in its demonstration of the sequential mediation effects of entrepreneurial knowledge and mindset. This insight highlights the importance of creating entrepreneurial education programs that holistically address both cognitive and attitudinal dimensions. By doing so, these programmes can establish a strong foundation for transforming female students into successful entrepreneurial leaders. This framework provides significant theoretical and practical contributions to the fields of entrepreneurship education and leadership development.6.1 Implications for Policy and Practice

This study offers significant implications for policy and practice in fostering entrepreneurial leadership, particularly among female students. The findings underscore the critical role of entrepreneurial education (EE) in developing entrepreneurial knowledge (EK) and mindset (EM), which collectively lead to entrepreneurial leadership (EL). Policymakers and educators must recognise the need to design and implement education programs that holistically integrate these components in order to create effective entrepreneurial leaders.

First, policymakers should prioritise including entrepreneurial education in academic curricula at both the secondary and higher education levels. As entrepreneurial knowledge serves as a key building block for fostering mindset and leadership (Subramaniam and Shankar, 2020), curricula should include theoretical foundations, practical training, and experiential learning opportunities such as internships, business simulations, and case studies. These approaches can help bridge the gap between knowledge acquisition and real-world application.

Second, entrepreneurship education programs should emphasise the development of an entrepreneurial mindset, which includes critical attributes such as opportunity recognition, resilience, and problem-solving skills. As Haddad et al. (2021) highlight, fostering these attitudinal qualities enables individuals to translate their knowledge into leadership actions. Programs should include mentorship initiatives, entrepreneurial role models, and peer learning environments to help students cultivate these critical psychological traits.

Third, policymakers must address the unique barriers faced by female students in entrepreneurship. Research suggests that women often face challenges such as limited access to resources, societal expectations, and under-representation in leadership roles (Brush et al., 2018). By creating targeted initiatives, such as funding opportunities for female-led startups,

networking events, and leadership workshops, policymakers can foster an enabling environment for female entrepreneurial leadership. These initiatives should aim to empower female students by providing equal opportunities and challenging traditional gender norms.

For practitioners, collaboration between academia and industry is essential. By partnering with businesses, universities can offer real-world exposure to female students, enabling them to gain practical insights into entrepreneurial leadership. These partnerships can also facilitate guest lectures, mentorship programs, and joint research projects, fostering a deeper connection between education and practice (Renko et al., 2015).

Finally, global organisations and governments should support policies that encourage a more inclusive approach to entrepreneurial leadership development. Investments in programs that target diverse groups, particularly women, can help reduce gender disparities in entrepreneurship and leadership. As highlighted by Yousaf et al. (2021), promoting diversity in leadership benefits not only individuals but also organisations and economies.

By addressing both structural and attitudinal barriers, these policy and practice implications can contribute to a transformative framework for empowering female students to become successful entrepreneurial leaders. This holistic approach has the potential to drive significant social and economic progress through inclusive leadership development.

6.2 Limitations and Directions for Future Research

While the study provides valuable insights, it is not without limitations. First, the cross-sectional nature of the data limits the ability to draw causal inferences. Longitudinal studies would provide a more comprehensive understanding of how entrepreneurial education influences leadership development over time. Future research could also explore the long-term effects of entrepreneurial education on career trajectories and business success among female entrepreneurs. Second, the study focused on a sample of female university students in Malaysia, which may limit the generalizability of the findings to other cultural or geographic contexts. Comparative studies involving students from different countries or regions could provide insights into the cross-cultural applicability of the model. Third, while the study examined entrepreneurial knowledge and mindset as mediators, other factors such as social capital, access to resources, and institutional support could also play important roles in shaping entrepreneurial leadership. Future research should consider these additional variables to provide a more holistic understanding of the factors that contribute to leadership development in entrepreneurship.

7.0 Conclusion

This study makes a significant contribution to the field of entrepreneurship education by uncovering the sequential mediation role of entrepreneurial knowledge (EK) and mindset (EM) in the relationship between entrepreneurial education (EE) and entrepreneurial leadership (EL). The findings highlight the critical need for providing female students with access to comprehensive and inclusive entrepreneurial education programs that not only build cognitive skills (knowledge) but also foster attitudinal attributes (mindset) essential for effective leadership in entrepreneurial contexts.

In addressing the unique challenges faced by women entrepreneurs, particularly in Malaysia, this research underscores the transformative power of entrepreneurship education in empowering women, strengthening their leadership potential, and advancing gender equity within the entrepreneurial ecosystem. By equipping female students with the knowledge and mindset to overcome structural and societal barriers, entrepreneurial education can act as a

catalyst for meaningful change, enabling women to emerge as innovative and influential leaders in the entrepreneurial landscape.

The findings align with global efforts to close gender gaps in entrepreneurship and emphasize the importance of integrating both knowledge development and mindset cultivation into education programs to ensure long-term success and inclusivity. This research makes both theoretical and practical contributions. Theoretically, it provides new insights into the pathways through which education influences leadership by demonstrating the sequential mediation of EK and EM. Practically, it offers actionable recommendations for designing entrepreneurship education programs that are holistic and inclusive, specifically tailored to empower female students to become dynamic entrepreneurial leaders.

Table 7: Constructs of the Variables.

Construct	Items	Sources
Entrepreneurial Education	I have adequate knowledge of the legal essential to start a venture I understand how to looking for the resources need to set up a business (e.g., financial support). I have adequate knowledge of how to organize a venture. I have adequate knowledge of how to promote products and services I have adequate knowledge in presenting a business idea. I have adequate knowledge of how to manage a business.	Hasan et al. 2017; Denanyoh et al. 2015; Saptono et al. 2020
Entrepreneurial Knowledge	I have adequate knowledge of the legal essential to start a venture I understand how to looking for the resources need to set up a business (e.g., financial support). I have adequate knowledge of how to organize a venture. I have adequate knowledge of how to promote products and services I have adequate knowledge in presenting a business idea. I have adequate knowledge of how to manage a business.	Roxas 2014; Saptono et al. 2020
Entrepreneurial Mindset	I have considered from both positive and negative consequences in engaging with the entrepreneurial activities. I have considered whether I have the time to become engaged in entrepreneurial activities. I have considered the financial opportunity to be involved in the entrepreneurial activities. I have considered for both negative and positive information related to entrepreneurial activities I have considered about possible business ideas in the entrepreneurial activities I have considered whether it is desirable for me to be involved in the entrepreneurial activities	Mathisen and Arnulf 2013; Saptono et al. 2020
Entrepreneurial Leadership	When I consider engaging in entrepreneurial activity, it sometimes feels right and other times wrong. Often comes up with radical improvement ideas for the products/services we are selling Often comes up with ideas of completely new products/services that we could sell. Takes risks. Has creative solutions to problems. Demonstrates passion for his/her work. Has a vision of the future of our business	Renko et al. 2015; Ataei et al. 2024

	Challenges and pushes me to act in a more innovative way.
	Wants me to challenge the current ways we do business.

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