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How AI literacy shapes e-entrepreneurial intention: The roles of opportunity recognition, e-entrepreneurial self-efficacy, and entrepreneurial education

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ABSTRACT

This study examines the influence of AI literacy on e-entrepreneurial intention, focusing on the mediating roles of opportunity recognition and e-entrepreneurial self-efficacy, as well as the moderating role of entrepreneurial education. Data were collected through an online questionnaire administered to Thai university students familiar with digital technologies and AI-related tools. Based on 213 valid responses, partial least squares structural equation modelling (PLS-SEM) was employed to test the proposed hypotheses. The results show that AI literacy positively influences opportunity recognition ($\beta = 0.468$, $p < 0.001$), e-entrepreneurial self-efficacy ($\beta = 0.291$, $p < 0.001$), and e-entrepreneurial intention ($\beta = 0.173$, $p = 0.004$). Opportunity recognition ($\beta = 0.284$, $p < 0.001$) and e-entrepreneurial self-efficacy ($\beta = 0.417$, $p < 0.001$) also positively influence e-entrepreneurial intention. Furthermore, opportunity recognition (indirect effect $\beta = 0.133$, $p < 0.001$) and e-entrepreneurial self-efficacy (indirect effect $\beta = 0.121$, $p = 0.001$) partially mediate the relationship between AI literacy and e-entrepreneurial intention. Entrepreneurial education significantly moderates the relationship between opportunity recognition and e-entrepreneurial intention ($\beta = 0.119$, $p = 0.018$), indicating that educational support strengthens the conversion of recognized opportunities into entrepreneurial intentions. These findings extend the literature by demonstrating that AI literacy contributes to e-entrepreneurial intention through direct, cognitive, and self-efficacy-based pathways. The study highlights the importance of integrating AI competencies, opportunity recognition, and self-efficacy development into entrepreneurship education to promote AI-enabled digital entrepreneurship among university students.

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1. Introduction

Artificial intelligence (AI) is reshaping entrepreneurial activity by changing how individuals identify market needs, evaluate opportunities, generate business ideas, and develop digitally enabled ventures. AI-supported tools can assist with market analysis, customer insight, idea generation, decision-making, and business model development, thereby reducing some of the informational and operational barriers associated with digital entrepreneurship (Giuggioli and Pellegrini, 2023; Mariani et al., 2023). The economic significance of this transformation is substantial. Generative AI has been estimated to contribute between USD 2.6 trillion and USD 4.4 trillion annually to the global economy, illustrating the growing importance of AI-related capabilities for future business activity. These developments are particularly relevant to e-entrepreneurship, which takes place in technology-intensive environments characterized by rapid innovation, platform-based competition, and digitally connected markets (Bejjani et al., 2023; Kraus et al., 2019).

As AI becomes increasingly accessible, the capacity to use it effectively has emerged as an important competence for prospective entrepreneurs. AI literacy extends beyond the operational ability to use an AI application. It includes understanding how AI systems function, applying AI tools to practical tasks, critically evaluating AI-generated outputs, recognizing technological limitations, and considering the ethical

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implications of AI use (Ng et al., 2021; Southworth et al., 2023). These functional, analytical, and critical capabilities distinguish AI literacy from general digital literacy. In an entrepreneurial context, AI-literate individuals may be better positioned to connect technological developments with unmet customer needs, assess the commercial potential of AI applications, and develop products, services, or business models that create value in digital markets.

The growing importance of AI literacy is also evident in higher education. UNESCO (2025) reported that nearly two-thirds of educational institutions had introduced or were developing formal guidance concerning AI use. This trend indicates that universities are increasingly expected to prepare students not only to operate AI tools but also to evaluate and apply them responsibly. For students considering entrepreneurship, however, access to AI technologies does not necessarily produce entrepreneurial action. Students may understand or use AI without recognizing a viable business opportunity, and they may identify an opportunity without feeling capable of developing a digital venture. Understanding the mechanisms through which AI literacy becomes entrepreneurially relevant is therefore more important than examining AI use alone.

Existing research has established that digital competencies and technological knowledge are associated with entrepreneurial intention, innovation, and technology-enabled venture development (Bachmann et al., 2024; Giuggioli and Pellegrini, 2023). Recent studies have also begun to investigate the relationship between AI-related competencies and entrepreneurial outcomes (Duong, 2025; Imjai et al., 2024). However, three issues still require further attention. First, much of the prior literature focuses on technology adoption, AI acceptance, or general digital competence rather than AI literacy as a distinct entrepreneurial resource. This distinction matters because the entrepreneurial value of AI depends not only on access or frequency of use but also on the ability to evaluate outputs, identify limitations, and apply AI knowledge to business problems.

Second, prior studies have not fully explained the mechanisms through which AI literacy is associated with entrepreneurial intention. A direct relationship between technological competence and intention may conceal different cognitive and motivational processes. AI literacy may contribute to entrepreneurial intention by enabling individuals to detect market changes and identify AI-enabled opportunities. It may also strengthen individuals' confidence that they can use digital technologies, solve venture-related problems, and manage the uncertainty associated with digital entrepreneurship. Opportunity recognition and e-entrepreneurial self-efficacy may therefore represent complementary routes through which AI literacy becomes relevant to entrepreneurial intention. Third, the conditions that help students convert recognized opportunities into entrepreneurial intention remain underexplored. Opportunity recognition alone does not guarantee a willingness to establish a venture. Individuals may identify a potentially attractive idea but lack the knowledge, experience, or practical understanding required to evaluate and pursue it. Entrepreneurial education may assist this conversion process by providing business knowledge, experiential learning, opportunity evaluation skills, and exposure to venture-development activities (Branca et al., 2025). It may consequently strengthen the relationship between opportunity recognition and e-entrepreneurial intention.

This study draws on entrepreneurial cognition theory and social cognitive theory to explain these relationships. From an entrepreneurial cognition perspective, AI literacy may expand the information structures and interpretive capabilities individuals use to detect technological change, identify customer problems, and recognize commercially meaningful opportunities. AI literacy may therefore be associated with stronger opportunity recognition. From a social cognitive perspective, knowledge and experience with AI may strengthen e-entrepreneurial self-efficacy by increasing individuals' confidence in their ability to use digital tools, perform entrepreneurial tasks, and respond to technological uncertainty. Opportunity recognition represents a cognitive pathway, whereas e-entrepreneurial self-efficacy represents an efficacy-based pathway. Examining both mechanisms provides a more specific account of how AI literacy may be related to e-entrepreneurial intention.

The study also considers perceived entrepreneurial education as a boundary condition in the opportunity-to-intention relationship. Entrepreneurial education, as operationalized in this study, reflects students' perceptions that entrepreneurship-related courses and activities help them understand venture creation, develop business skills, strengthen confidence, and translate opportunities into practical action. Students who perceive greater educational support may be more capable of evaluating an identified opportunity and connecting it with a feasible course of entrepreneurial action. Accordingly, the positive relationship between opportunity recognition and e-entrepreneurial intention may be stronger among students reporting higher levels of perceived entrepreneurial education.

Thailand provides a relevant setting for examining these relationships. The country has increasingly promoted AI adoption, digital capability development, and technology-enabled entrepreneurship as part of its broader economic transformation agenda (Imjai et al., 2024; Thawesaengskulthai et al., 2024). Thailand aims to equip approximately 20 million people with AI-related skills over the next four years. At the same time, available evidence indicates that only approximately 1% of the Thai population possesses advanced digital expertise, while 28% demonstrates intermediate digital competency. This gap between

national ambitions and existing capabilities highlights the importance of understanding how AI literacy may contribute to entrepreneurial development among university students. Thailand also represents an emerging-economy context in which access to digital technologies is expanding rapidly, while advanced capabilities and educational support remain uneven.

Against this background, the present study develops and tests a moderated mediation model linking AI literacy with e-entrepreneurial intention. Specifically, it examines whether AI literacy is associated with e-entrepreneurial intention directly and indirectly through opportunity recognition and e-entrepreneurial self-efficacy. It further investigates whether perceived entrepreneurial education strengthens the relationship between opportunity recognition and e-entrepreneurial intention.

The study makes three focused contributions. First, it clarifies AI literacy as a distinct entrepreneurial resource that involves more than general digital competence or the operational use of AI tools. Second, it distinguishes two complementary mechanisms through which AI literacy may be associated with e-entrepreneurial intention: a cognitive opportunity-recognition pathway and an efficacy-based pathway. Third, it evaluates perceived entrepreneurial education as a contextual condition that may strengthen the conversion of recognized opportunities into entrepreneurial intention. The study explains that AI literacy alone is not sufficient to generate entrepreneurial intention; instead, its relevance depends on the development of opportunity perceptions, capability beliefs, and supportive educational experiences.

The rest of the paper proceeds as follows. The next section reviews the literature and develops the hypotheses. The research methodology is then presented, followed by the empirical findings. The subsequent section discusses the theoretical and practical implications of the results, and the paper concludes with its main contributions, limitations, and recommendations for future research.

2. Literature review

Previous research has confirmed that AI literacy represents a critical capability shaping individuals' participation in digitally mediated environments (Ng et al., 2021). In line with human capital theory and entrepreneurial cognition theory, individuals possessing stronger AI-related competencies are more likely to recognize technological opportunities, interpret market changes, and strategically leverage digital technologies for entrepreneurial purposes (Odukale, 2024). Such competencies enhance individuals' ability to process information, evaluate the potential of emerging technologies, and identify unmet customer needs that can be transformed into entrepreneurial opportunities (Park and Kim, 2025; Skandalis, 2025). In the context of digital entrepreneurship, individuals with high levels of AI literacy are more capable of understanding how AI technologies can be utilized to create innovative products, services, and business models within digitally connected markets. Moreover, AI literacy enables individuals to reduce uncertainty associated with entrepreneurial decision-making by improving analytical capability, technological adaptability, and digital problem-solving ability (Odukale, 2024). Therefore, individuals possessing stronger AI literacy are more likely to recognize entrepreneurial opportunities emerging from digital transformation and AI-enabled business environments.

Additionally, Social Cognitive Theory suggests that individuals' beliefs regarding their capabilities significantly influence their behavioral intentions and entrepreneurial actions (Saeedikiya et al., 2024). Individuals who possess stronger technological competencies are more likely to develop confidence in their ability to initiate, manage, and sustain entrepreneurial activities within technology-intensive environments. In the context of AI-enabled entrepreneurship, AI literacy may strengthen e-entrepreneurial self-efficacy by increasing individuals' perceived capability to utilize digital technologies, solve business-related problems, and manage uncertainty associated with digital ventures (Duong, 2025).

Moreover, individuals possessing strong AI literacy may perceive digital entrepreneurship as more feasible, manageable, and attainable, thereby increasing their intention to pursue entrepreneurial opportunities within digitally mediated environments (Nguyen et al., 2024). Drawing on the preceding theoretical arguments, this study proposes that AI literacy is positively associated with opportunity recognition, e-entrepreneurial self-efficacy, and e-entrepreneurial intention. The hypotheses are stated as follows:

H1: AI literacy positively influences opportunity recognition (OR).
H2: AI literacy positively influences e-entrepreneurial self-efficacy (SE).
H3: AI literacy positively influences e-entrepreneurial intention (INT).

According to Entrepreneurial Cognition Theory, opportunity recognition represents a fundamental cognitive process through which individuals identify, evaluate, and exploit entrepreneurial opportunities arising from technological and market changes (Aziz et al., 2025; Camelo-Ordaz et al., 2020). Individuals who are capable of recognizing emerging opportunities are more likely to perceive entrepreneurship as an attractive and achievable career path. In digitally mediated environments, opportunity recognition enables individuals to identify innovative applications of AI technologies, anticipate market demands, and create value through digital business initiatives. Prior research suggests that opportunity recognition significantly influences entrepreneurial intention because individuals who perceive viable opportunities are more likely to develop commitment toward

entrepreneurial action (Al-Ayed, 2024). Therefore, opportunity recognition is expected to influence e-entrepreneurial intention positively.

Similarly, e-entrepreneurial self-efficacy represents a critical psychological mechanism influencing entrepreneurial behavior and intention (Wang et al., 2019). Drawing upon social cognitive theory, self-efficacy reflects individuals' confidence in their capability to perform entrepreneurial tasks successfully (Lam et al., 2024). In the context of digital entrepreneurship, individuals possessing stronger e-entrepreneurial self-efficacy are more likely to believe that they can manage digital business activities, utilize AI technologies effectively, and overcome challenges associated with entrepreneurial uncertainty. Previous research indicates that individuals who possess stronger entrepreneurial self-efficacy are more likely to develop entrepreneurial intentions because they have greater confidence in their ability to perform entrepreneurial tasks successfully (Kurniawati et al., 2025; Soelaiman et al., 2024).

In light of these theoretical arguments, this study expects opportunity recognition and e-entrepreneurial self-efficacy to contribute positively to e-entrepreneurial intention. The hypotheses are presented below:

H4: Opportunity recognition (OR) positively influences e-entrepreneurial intention (INT).
H5: E-entrepreneurial self-efficacy (SE) positively influences e-entrepreneurial intention (INT).

Moreover, prior research suggests that technological competencies often influence behavioral intention indirectly through cognitive and psychological mechanisms rather than solely through direct effects (Al-Mamary et al., 2025; Duong, 2025). In this context, AI literacy may enhance individuals' ability to recognize entrepreneurial opportunities and strengthen confidence in their entrepreneurial capabilities, which subsequently increases entrepreneurial intention.

Opportunity recognition functions as a cognitive mechanism translating AI-related knowledge into entrepreneurial awareness, while e-entrepreneurial self-efficacy functions as a motivational mechanism facilitating entrepreneurial commitment and behavioral intention (Utama et al., 2026). Based on the preceding theoretical arguments, this study proposes that the relationship between AI literacy and e-entrepreneurial intention operates through opportunity recognition and e-entrepreneurial self-efficacy. The mediation hypotheses are formulated as follows:

H6: The relationship between AI literacy and e-entrepreneurial intention (INT) is mediated by opportunity recognition (OR).
H7: The relationship between AI literacy and e-entrepreneurial intention (INT) is mediated by e-entrepreneurial self-efficacy (SE).

Furthermore, entrepreneurial education represents an important contextual mechanism that strengthens entrepreneurial capability development and enhances individuals' ability to transform entrepreneurial cognition into entrepreneurial intention and action (Duong, 2025; Jiatong et al., 2021). Entrepreneurial education provides individuals with experiential learning opportunities, business-related knowledge, practical skills, and exposure to entrepreneurial problem-solving processes (Branca et al., 2025). Such educational experiences may enhance individuals' ability to convert recognized entrepreneurial opportunities into stronger intentions to initiate and manage digital ventures successfully (Hu et al., 2024). In digitally mediated entrepreneurial environments, entrepreneurial education may further strengthen the relationship between opportunity recognition and e-entrepreneurial intention by reinforcing individuals' understanding of entrepreneurial processes and increasing their perceived behavioral control (Duong, 2025). The proposed framework further suggests that entrepreneurial education serves as a contextual condition influencing how opportunity recognition translates into e-entrepreneurial intention. Based on this rationale, the following moderation hypothesis is formulated:

H8: The positive relationship between opportunity recognition (OR) and e-entrepreneurial intention (INT) is strengthened under higher levels of entrepreneurial education (EE).

Fig. 1 presents the conceptual model examined in this study. The model proposes that AI literacy influences e-entrepreneurial intention both directly and indirectly through opportunity recognition and e-entrepreneurial self-efficacy, while entrepreneurial education strengthens the relationship between opportunity recognition and e-entrepreneurial intention.

3. Methods

A quantitative survey design was adopted to examine the proposed research model. Data were collected through a structured questionnaire to evaluate the direct effect of AI literacy on e-entrepreneurial intention, the mediating roles of opportunity recognition and e-entrepreneurial self-efficacy, and the moderating effect of entrepreneurial education on the relationship between opportunity recognition and e-entrepreneurial intention. The research framework was developed based on Entrepreneurial Cognition Theory and Social Cognitive Theory, as well as insights from prior studies related to AI literacy, digital entrepreneurship, and entrepreneurial intention, to provide a comprehensive explanation of the cognitive and psychological mechanisms underlying AI-enabled entrepreneurial intention among university students. The target population comprised Thai undergraduate university students

who were familiar with digital technologies and AI-related tools. A purposive sampling approach was employed to target undergraduate university students who had experience using digital platforms, AI applications, or online technologies relevant to digital entrepreneurial activities. The respondents were recruited from undergraduate programs at universities in Thailand through online student networks and university-related communication channels. Data collection was conducted using a structured online questionnaire developed in Microsoft Forms and disseminated through university-related online channels and social media platforms. To reduce the risk of common method bias (CMB), the study incorporated several procedural safeguards recommended by Podsakoff et al. (2003). Respondents participated voluntarily, their anonymity and confidentiality were assured, and they were informed that the survey was intended solely for academic research. Participants were also encouraged to answer honestly without concern for correct or incorrect responses. Furthermore, all measurement items were adapted from established and validated instruments reported in previous studies to improve the reliability and validity of the measurement model.

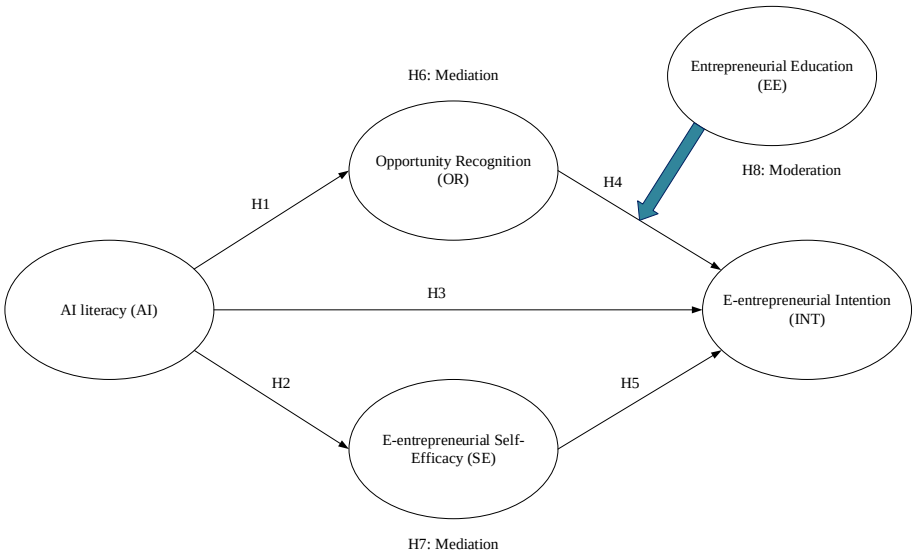

Fig. 1: The proposed conceptual framework

The survey instrument was organized into two sections. The first section collected respondents' demographic characteristics, including gender, age, year of study, field of study, frequency of AI use, and participation in entrepreneurship education or related activities. The second section assessed the five latent constructs examined in this study: AI literacy (AI), opportunity recognition (OR), e-entrepreneurial self-efficacy (SE), e-entrepreneurial intention (INT), and entrepreneurial education (EE). Measurement items were adapted from established scales reported in previous studies (Alkhalaileh et al., 2023; Ha et al., 2026; Lai and To, 2020) to ensure adequate content validity. All constructs were operationalized using multiple reflective indicators and evaluated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The final questionnaire comprised 30 measurement items, and the complete measurement specification is presented in Table 1.

4. Results

4.1. Descriptive statistics results

A total of 213 valid responses from Thai university students were included in the analysis. Female respondents represented a slightly higher proportion of the sample (52.1%) than male respondents (47.9%). Most respondents were aged 21–25 years (51.2%), followed by those below 20 years (27.2%), 26–30 years (14.6%), and 31 years and above (7.0%). Regarding year of study, second-year students represented the largest group (28.6%), followed by third-year (26.3%), first-year (22.5%), fourth-year (16.9%), and other categories (5.6%). In terms of academic performance, most respondents reported GPAs between 3.01–3.50 (34.7%) and 2.51–3.00 (33.8%). The majority of respondents reported using AI tools at least once per week, with the largest group using AI tools 3–4 times per week (30.5%), followed by those using AI tools seven times or more per week (27.7%). Regarding participation in entrepreneurial education activities, 36.6% of respondents reported participating 1–2 times, while 21.1% participated 3–5 times. Furthermore, respondents demonstrated varying levels of digital entrepreneurial intention, with 31.0% reporting a high level of intention and 18.8% reporting a very high level of intention, accompanied by a clear digital business plan. Table 2 presents the demographic characteristics of the respondents included in this study.

4.2. Measurement model

Prior to testing the structural model, the adequacy of the measurement model was assessed

to ensure that the constructs demonstrated acceptable reliability and validity. Consistent with recommended PLS-SEM procedures (Hair et al., 2021), the assessment covered indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. The results are summarized in Table 3. Individual indicator reliability was examined using outer loadings, all of which exceeded the recommended threshold of 0.70, ranging from 0.751 to 0.884, indicating that the indicators adequately represented their intended constructs. Internal consistency was evaluated using Cronbach's alpha and composite reliability (CR). Cronbach's alpha values ranged from 0.861 to 0.931, while CR values ranged from 0.905 to 0.943, both surpassing the recommended cutoff value of 0.70. Convergent validity was subsequently verified using the average variance extracted (AVE). The AVE values ranged from 0.621 to 0.724, exceeding the recommended minimum threshold of 0.50 and confirming that each construct explained a substantial proportion of the variance in its corresponding indicators.

Table 1: Constructs and items of this study

Constructs	Items	Observed variables
AI literacy (AI)	AI1	I have a basic understanding of how artificial intelligence works.
	AI2	I can explain how AI can be applied in work or business contexts.
	AI3	I understand the limitations of AI-generated outputs.
	AI4	I can use AI tools to search, analyze, or generate information.
	AI5	I can apply AI technologies in learning, work, or business-related activities.
	AI6	I can independently learn how to use new AI tools and applications.
	AI7	I can evaluate the accuracy and reliability of AI-generated information.
	AI8	I am aware of ethical issues related to AI usage.
Opportunity recognition (OR)	OR1	I can identify new business opportunities arising from AI technologies.
	OR2	I can identify customer problems or market needs that AI can help solve.
	OR3	I can connect the potential of AI with innovative business ideas.
	OR4	I believe AI can create competitive advantages for digital businesses.
	OR5	I can recognize business trends emerging from AI development.
E-entrepreneurial self-efficacy (SE)	SE1	I am confident that I can start a digital business successfully.
	SE2	I am confident that I can effectively manage a digital business.
	SE3	I am confident that I can utilize digital technologies to support my business operations.
	SE4	I am confident that I can solve problems arising from digital business activities.
	SE5	I am confident that I can transform digital business ideas into reality.
	SE6	I am confident that I can use AI technologies to support digital business operations.
E-entrepreneurial intention (INT)	INT1	I intend to start a digital business in the future.
	INT2	I plan to establish my own digital business.
	INT3	I seriously intend to become a digital entrepreneur.
	INT4	I will make every effort to start a digital business.
	INT5	I am committed to operating my own digital business.
	INT6	If given the opportunity, I would prefer digital entrepreneurship over other career paths.
Entrepreneurial education (EE)	EE1	Entrepreneurial education helps me understand the process of starting a business.
	EE2	Entrepreneurial education helps me develop skills necessary for business operations.
	EE3	Entrepreneurial education increases my confidence in developing business ideas.
	EE4	Entrepreneurial education helps me transform business opportunities into practical actions.
	EE5	Experiences gained from entrepreneurship-related courses or activities prepare me for entrepreneurship.

Table 2: Descriptive statistics

Item	Description	Sample	(%)
Gender	Male	102	47.9
	Female	111	52.1
Age	Below 20 years	58	27.2
	21–25 years	109	51.2
	26–30 years	31	14.6
	31 years and above	15	7.0
Year of study	First year	48	22.5
	Second year	61	28.6
	Third year	56	26.3
	Fourth year	36	16.9
	Other	12	5.6
Current GPA	Below 2.00	9	4.2
	2.00–2.50	31	14.6
	2.51–3.00	72	33.8
	3.01–3.50	74	34.7
	3.51–4.00	27	12.7
AI usage frequency	Never used	16	7.5
	1–2 times/week	47	22.1
	3–4 times/week	65	30.5
	5–6 times/week	26	12.2
	7 times or more/week	59	27.7
Entrepreneurial education participation	0 times	60	28.2
	1–2 times	78	36.6
	3–5 times	45	21.1
	6–10 times	20	9.4
	More than 10 times	10	4.7
Digital entrepreneurial intention	Never	21	9.9
	Rarely	34	16.0
	Sometimes	52	24.4
	Often	66	31.0
	Very often/clear plan	40	18.8

Table 3: Reliability and convergent validity of the measurement model

Construct	Items	Loading	Cronbach's alpha	CR	AVE
AI literacy (AI)	AI1	0.814	0.903	0.918	0.621
	AI2	0.832			
	AI3	0.751			
	AI4	0.821			
	AI5	0.836			
	AI6	0.786			
	AI7	0.772			
	AI8	0.781			
Opportunity recognition (OR)	OR1	0.841	0.887	0.915	0.682
	OR2	0.826			
	OR3	0.854			
	OR4	0.812			
	OR5	0.831			
E-entrepreneurial self-efficacy (SE)	SE1	0.854	0.918	0.936	0.701
	SE2	0.872			
	SE3	0.821			
	SE4	0.836			
	SE5	0.861			
	SE6	0.824			
E-entrepreneurial intention (INT)	INT1	0.881	0.931	0.943	0.724
	INT2	0.884			
	INT3	0.872			
	INT4	0.841			
	INT5	0.829			
	INT6	0.818			
Entrepreneurial education (EE)	EE1	0.851	0.861	0.905	0.656
	EE2	0.814			
	EE3	0.798			
	EE4	0.792			
	EE5	0.790			

Discriminant validity was evaluated using the Fornell–Larcker criterion together with the Heterotrait–Monotrait ratio (HTMT) (Henseler et al., 2015). As shown in Table 4, the square root of the AVE for each construct was greater than its corresponding inter-construct correlations, satisfying the Fornell–Larcker criterion. The HTMT values ranged from 0.592 to 0.882, remaining below the recommended cutoff value of 0.90. Collectively, these results provide evidence that the study constructs are empirically distinguishable and demonstrate satisfactory discriminant validity.

Table 4: Discriminant validity (Fornell–Larcker criterion and HTMT ratio)

Construct	AI	OR	SE	INT	EE
AI	0.788				
OR	0.648 (0.731)	0.826			
SE	0.692 (0.768)	0.714 (0.803)	0.837		
INT	0.653 (0.729)	0.742 (0.826)	0.801 (0.882)	0.851	
EE	0.514 (0.592)	0.563 (0.647)	0.621 (0.705)	0.584 (0.669)	0.810

The square root of the average variance extracted (AVE) is presented on the diagonal; Values outside the diagonal represent the correlations among constructs. Values in parentheses indicate the HTMT; AI = AI literacy; OR = Opportunity recognition; SE = E-entrepreneurial self-efficacy; INT = E-entrepreneurial intention; EE = Entrepreneurial education

Multicollinearity was examined using full collinearity variance inflation factor (VIF) values. The VIF values ranged from 1.74 to 2.68, remaining below the recommended thresholds of 3.0 (Hair et al., 2021) and 3.3 (Kock, 2015), indicating that neither multicollinearity nor common method bias was likely to pose a serious concern. To further reduce the potential influence of common method bias (CMB), several procedural safeguards recommended by Podsakoff et al. (2003) were implemented.

Participation was voluntary and anonymous; respondents were assured of the confidentiality of their responses, and all measurement items were adapted from previously validated instruments. In addition, Harman's single-factor test was performed using an unrotated principal component analysis. Multiple factors with eigenvalues greater than one were extracted, and the first factor explained only 38.47% of the total variance, below the recommended cutoff value of 50%. Taken together, these procedural and statistical assessments provide evidence that common method bias was unlikely to materially affect the study findings.

4.3. Structural model and hypotheses testing

The proposed structural model was evaluated using PLS-SEM with a bootstrapping procedure based on 5,000 resamples. The structural path estimates are reported in Table 5. AI literacy showed a significant positive association with opportunity recognition (OR) ($\beta = 0.468$, $t = 7.214$, $p < 0.001$, $f^2 = 0.183$), supporting H1. Likewise, AI literacy was positively associated with e-entrepreneurial self-efficacy (SE) ($\beta = 0.291$, $t = 4.106$, $p < 0.001$, $f^2 = 0.082$), providing support for H2. In addition, AI literacy exhibited a significant positive relationship with e-entrepreneurial intention (INT) ($\beta = 0.173$, $t = 2.891$, $p = 0.004$, $f^2 = 0.036$), supporting H3. Opportunity recognition was also positively associated with e-entrepreneurial intention ($\beta = 0.284$, $t = 4.017$, $p < 0.001$, $f^2 = 0.097$), confirming H4. Similarly, e-entrepreneurial self-efficacy demonstrated a significant positive relationship with e-entrepreneurial intention ($\beta = 0.417$, $t = 6.238$, $p < 0.001$, $f^2 = 0.214$), thereby supporting H5. Overall, the findings provide empirical support for the proposed direct relationships specified in the

structural model. Model explanatory power was examined using the coefficient of determination (R^2). The estimated model explained 26.4% of the variance in opportunity recognition, 24.1% in e-entrepreneurial self-efficacy, and 51.7% in e-entrepreneurial intention. These findings suggest that the proposed structural model provides satisfactory explanatory power, with the strongest predictive capability observed for e-entrepreneurial intention.

Table 5: Results of hypothesis testing

Hypothesis path	β coefficient	T-statistics	P-value	Result
H1: AI → OR	0.468***	7.214	< 0.001	Supported
H2: AI → SE	0.291***	4.106	< 0.001	Supported
H3: AI → INT	0.173**	2.891	0.004	Supported
H4: OR → INT	0.284***	4.017	< 0.001	Supported
H5: SE → INT	0.417***	6.238	< 0.001	Supported

**: p < 0.01; ***: p < 0.001

Table 6 reports the mediation analysis examining the indirect relationships between AI literacy (AI) and e-entrepreneurial intention (INT) through opportunity recognition (OR) and e-entrepreneurial self-efficacy (SE). Both indirect pathways were statistically significant, supporting H6 and H7. The indirect effect through opportunity recognition was significant (β = 0.133, t = 3.661, p < 0.001), as was the indirect effect through e-entrepreneurial self-efficacy (β = 0.121, t = 3.287, p = 0.001). The direct relationship between AI literacy and e-entrepreneurial intention also remained significant (β = 0.173, t = 2.891, p = 0.004), indicating partial mediation. Moreover, the total effect of AI literacy on e-entrepreneurial intention was positive and significant (β = 0.427, t = 6.284, p < 0.001). Overall, the mediation analysis supports the proposed indirect relationships specified in the conceptual model.

The moderating role of entrepreneurial education (EE) was evaluated by estimating the interaction effect between opportunity recognition (OR) and entrepreneurial education using SmartPLS 4. The objective was to determine whether entrepreneurial education influences the relationship between opportunity recognition and e-entrepreneurial intention. The results, presented in Table 7, indicate that the interaction term is positive and statistically significant (β = 0.119, t = 2.372, p = 0.018), providing support for H8. These findings indicate that entrepreneurial education serves as a significant contextual condition in the relationship between opportunity recognition and e-entrepreneurial intention. Although the interaction effect is modest, higher levels of entrepreneurial education are associated with a stronger positive relationship between opportunity recognition and e-entrepreneurial intention.

Table 6: Results of the mediation analysis

Path	Effects	Estimate	S.E.	T-statistics	P-values	Conclusion
AI → OR → INT	Specific indirect	0.133***	0.036	3.661	< 0.001	Partial mediation
AI → SE → INT	Specific indirect	0.121**	0.037	3.287	0.001	Partial mediation
AI → INT	Direct	0.173**	0.060	2.891	0.004	
	Total	0.427***	0.068	6.284	< 0.001	

**: p < 0.01; ***: p < 0.001

Fig. 2 illustrates the moderating effect of entrepreneurial education on the relationship between opportunity recognition and e-entrepreneurial intention. The simple slope analysis demonstrates that the positive influence of opportunity recognition on e-entrepreneurial intention is stronger among respondents with high levels of entrepreneurial education (+1 SD) compared with those with low levels of entrepreneurial education (−1 SD). The steeper slope under conditions of high entrepreneurial education indicates that educational experiences strengthen individuals' ability to transform recognized opportunities into stronger intentions to engage in digital entrepreneurial activities. This visual pattern is consistent with the statistical results reported in Table 7, confirming the significant conditional role of entrepreneurial education in the proposed research model.

5. Discussion

This study advances the literature on AI literacy and digital entrepreneurship by examining how AI literacy is associated with e-entrepreneurial intention through opportunity recognition and e-entrepreneurial self-efficacy, while considering the moderating role of entrepreneurial education. Rather than acting solely as a technical skill, AI literacy functions as an entrepreneurial resource that supports both opportunity identification and confidence in undertaking digital entrepreneurial activities. Based on evidence from Thai university students, the findings suggest that AI literacy is related to e-entrepreneurial intention through complementary cognitive and efficacy-based pathways, with entrepreneurial education providing a supportive contextual condition.

Table 7: Results of moderating effects

Hypothesis	Path	Moderator	β coefficient	T-statistics	P-value	Result
H8	OR → INT	EE	0.119*	2.372	0.018	Supported

*: p < 0.05; OR = Opportunity recognition; INT = E-entrepreneurial intention; EE = Entrepreneurial education

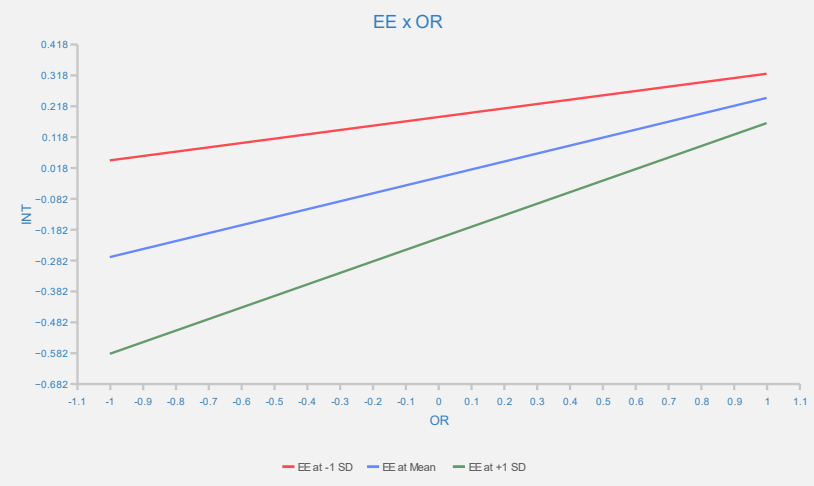

Fig. 2: Moderating effect of entrepreneurial education on the relationship between opportunity recognition and e-entrepreneurial intention

5.1. Theoretical implications

This study contributes to the literature by demonstrating that AI literacy is positively associated with opportunity recognition. Rather than functioning solely as a technical competency, AI literacy provides individuals with the cognitive capability to interpret technological developments, identify unmet market needs, and recognize entrepreneurial opportunities within AI-enabled business environments (H1: $\beta = 0.468$, $p < 0.001$). This finding is consistent with previous studies suggesting that technological competencies and digital literacy facilitate entrepreneurial cognition and opportunity identification (Latif et al., 2026; Renz et al., 2025). From the perspective of Entrepreneurial Cognition Theory, AI literacy enriches the knowledge structures individuals use to process information and interpret technological change, thereby improving their ability to recognize entrepreneurial possibilities in rapidly evolving digital environments (Odukale, 2024).

The findings further indicate that AI literacy is positively related to e-entrepreneurial self-efficacy (H2: $\beta = 0.291$, $p < 0.001$). Individuals with higher levels of AI literacy are more likely to feel confident in their ability to undertake digital entrepreneurial activities. This result is consistent with previous research highlighting the role of technological competencies and digital knowledge in strengthening entrepreneurial confidence (Duong, 2025). This finding suggests that AI-related competencies represent valuable resources contributing to entrepreneurial capability development. Accordingly, AI literacy strengthens not only individuals' knowledge of AI technologies but also their confidence in applying these technologies within entrepreneurial settings.

The positive association between AI literacy and e-entrepreneurial intention (H3: $\beta = 0.173$, $p = 0.004$) further suggests that AI-related competencies are relevant to entrepreneurial motivation in digital contexts. However, compared with the indirect pathways identified in this study, the direct effect is relatively modest, indicating that AI literacy alone may not be sufficient to stimulate entrepreneurial intention. Instead, its influence operates primarily through the development of entrepreneurial cognition and confidence. This finding extends previous research by suggesting that AI literacy functions as an enabling resource whose entrepreneurial value is realized through broader cognitive and psychological processes rather than through a direct motivational effect alone (Duong, 2026; Liu et al., 2025).

The findings also confirm that opportunity recognition positively influences e-entrepreneurial intention (H4: $\beta = 0.284$, $p < 0.001$). This result reinforces Entrepreneurial Cognition Theory by highlighting opportunity recognition as an important cognitive step preceding entrepreneurial intention. Individuals who are better able to identify AI-enabled business opportunities are more likely to consider pursuing digital entrepreneurial activities (Akçaba et al., 2026). The finding is also consistent with previous studies identifying opportunity recognition as a key antecedent of entrepreneurial intention, emphasizing that entrepreneurial decisions depend not only on motivation but also on the ability to perceive commercially meaningful opportunities.

Similarly, e-entrepreneurial self-efficacy demonstrates a positive relationship with e-entrepreneurial intention (H5: $\beta = 0.417$, $p < 0.001$). This finding supports Social Cognitive Theory by confirming that confidence in one's entrepreneurial capability remains an important determinant of entrepreneurial intention. Among the relationships examined in this study, e-entrepreneurial self-efficacy exhibits one of the strongest effects on e-entrepreneurial intention, highlighting its central role in translating AI-related competencies into entrepreneurial motivation (Duong, 2025). Together, these findings suggest that confidence represents an important psychological mechanism linking AI literacy with entrepreneurial intention (Ngo et al., 2025). The mediation analysis provides additional theoretical insight by demonstrating that

opportunity recognition and e-entrepreneurial self-efficacy partially mediate the relationship between AI literacy and e-entrepreneurial intention (H6 and H7). More importantly, these findings suggest that AI literacy is unlikely to influence entrepreneurial intention through a single direct pathway. Instead, its effects are transmitted through complementary cognitive and efficacy-based mechanisms. While previous AI-related entrepreneurship studies have primarily emphasized direct relationships between technological competencies and entrepreneurial outcomes, the present findings provide evidence that opportunity recognition and entrepreneurial confidence explain how AI literacy becomes entrepreneurially meaningful (Duong, 2025; Odukale, 2024). This extends existing literature by offering a more process-oriented explanation of the relationship between AI literacy and e-entrepreneurial intention.

Finally, entrepreneurial education positively moderates the relationship between opportunity recognition and e-entrepreneurial intention (H8: $\beta = 0.119$, $p = 0.018$). Although the interaction effect is modest, the findings suggest that entrepreneurial education provides a meaningful contextual condition that helps students translate recognized opportunities into stronger entrepreneurial intentions. Rather than directly generating entrepreneurial intention, entrepreneurial education complements students' opportunity recognition by providing knowledge, practical experience, and entrepreneurial competencies that facilitate opportunity evaluation and entrepreneurial decision-making. This finding is consistent with previous studies emphasizing the role of entrepreneurial education in entrepreneurial preparedness and intention formation (Lam et al., 2024; Sofiullah et al., 2023). Collectively, the results indicate that entrepreneurial education strengthens rather than replaces the cognitive processes through which AI literacy and opportunity recognition contribute to e-entrepreneurial intention.

5.2. Managerial and practical implications

This study provides several practical implications for universities, policymakers, entrepreneurship development agencies, and organizations seeking to promote AI-enabled entrepreneurship. The findings indicate that viewing AI literacy as an entrepreneurial capability, rather than just a technical skill, is essential. Accordingly, universities and training institutions should incorporate AI literacy into entrepreneurship education by emphasizing the practical use of AI in opportunity identification, business model development, customer analysis, digital marketing, and innovation management. Such initiatives may help students and aspiring entrepreneurs apply AI technologies to identify and exploit emerging business opportunities rather than simply learning how AI tools operate.

The findings also highlight the importance of opportunity recognition as a mechanism through which AI literacy contributes to e-entrepreneurial intention. Therefore, entrepreneurship education should move beyond technical skill development and place greater emphasis on developing entrepreneurial thinking. Universities and entrepreneurship support agencies can strengthen opportunity recognition through experiential learning activities such as AI-supported business simulations, innovation workshops, startup incubation programs, hackathons, and digital entrepreneurship competitions. These activities may improve students' ability to identify market needs and evaluate AI-enabled business opportunities in rapidly evolving digital environments.

The significant role of e-entrepreneurial self-efficacy further suggests that entrepreneurship education should create learning experiences that strengthen students' confidence in applying AI technologies within entrepreneurial settings. Mentorship programs, startup coaching, entrepreneurial role models, and project-based learning involving AI-enabled business applications may provide practical experience that enhances entrepreneurial confidence. Such experiences may encourage students to view AI not only as a technological tool but also as a resource for developing and managing new digital ventures.

The mediation findings indicate that AI literacy alone may not be sufficient to foster entrepreneurial intention. The value of AI literacy is more likely to be realized when individuals can identify entrepreneurial opportunities and develop confidence in their entrepreneurial abilities. Therefore, policymakers and educational institutions should adopt a more integrated approach by combining AI competency development with entrepreneurship education, opportunity recognition training, and experiential venture creation activities. Such integration may better prepare graduates for AI-driven entrepreneurial ecosystems.

Finally, the moderating effect of entrepreneurial education suggests that educational support can strengthen the relationship between opportunity recognition and e-entrepreneurial intention. Although this effect is relatively modest, it indicates that well-designed entrepreneurship education can help students transform recognized opportunities into entrepreneurial intentions. Universities should therefore integrate AI-related competencies across entrepreneurship curricula and promote interdisciplinary collaboration among business, technology, and innovation programs. Collectively, these initiatives may contribute to developing graduates who are better equipped to recognize, evaluate, and pursue entrepreneurial opportunities in increasingly AI-enabled economies.

6. Conclusions

This study examined the relationship between AI literacy and e-entrepreneurial intention among university students in an emerging economy.

Drawing on human capital theory and entrepreneurial cognition theory, the study developed and tested a moderated mediation model in which opportunity recognition and e-entrepreneurial self-efficacy explain how AI literacy is associated with e-entrepreneurial intention, while entrepreneurial education strengthens the relationship between opportunity recognition and entrepreneurial intention. Overall, the findings suggest that AI literacy contributes to e-entrepreneurial intention both directly and indirectly through complementary cognitive and efficacy-based pathways.

Specifically, individuals with higher levels of AI literacy were more likely to recognize entrepreneurial opportunities, develop stronger entrepreneurial confidence, and express greater intentions to engage in digital entrepreneurship. Entrepreneurial education further strengthened the relationship between opportunity recognition and entrepreneurial intention, indicating that educational support facilitates the translation of recognized opportunities into entrepreneurial intentions.

The study makes several contributions to the literature. First, it refines current understanding of AI literacy by positioning it as an entrepreneurial resource rather than merely a technical or digital competency. Second, it provides a process-oriented explanation of how AI literacy is associated with e-entrepreneurial intention by identifying opportunity recognition and e-entrepreneurial self-efficacy as complementary mediating mechanisms. Rather than suggesting that AI literacy directly leads to entrepreneurial intention, the findings indicate that its entrepreneurial value is primarily realized through individuals' ability to recognize entrepreneurial opportunities and develop confidence in undertaking digital entrepreneurial activities.

Third, the study identifies entrepreneurial education as a contextual condition that strengthens the conversion of recognized opportunities into entrepreneurial intention, thereby extending the understanding of the conditions under which AI literacy becomes entrepreneurially meaningful within digital business environments.

From a practical perspective, the findings suggest that strengthening AI literacy alone may not be sufficient to encourage digital entrepreneurship. Educational institutions and entrepreneurship support organizations should integrate AI-related competencies with opportunity recognition training, experiential entrepreneurial learning, and activities that strengthen entrepreneurial confidence. Universities may also benefit from developing interdisciplinary learning environments that combine entrepreneurship, AI applications, innovation, and digital business development, thereby enabling students to apply AI technologies in identifying, evaluating, and pursuing entrepreneurial opportunities.

7. Limitations and future research

Several limitations should be acknowledged. First, the cross-sectional design limits the ability to draw causal conclusions, as the proposed relationships were examined at a single point in time. Future studies should employ longitudinal designs to investigate how AI literacy, entrepreneurial cognition, self-efficacy, and entrepreneurial intention develop over time. Second, the study relied on self-reported measures, including self-perceived AI literacy, which may introduce perceptual bias. Although both procedural and statistical remedies suggested that common method bias was unlikely to substantially affect the findings, future studies could combine self-reported measures with objective assessments, behavioral indicators, or multiple data sources to further reduce potential method bias. Third, researchers should exercise caution when generalizing the findings to other populations or institutional settings, as the study focused on university students in Thailand. Cross-country studies involving different educational and entrepreneurial ecosystems would provide valuable evidence regarding the robustness and generalizability of the proposed model. Fourth, entrepreneurial education was operationalized as students perceived educational support rather than objective educational exposure. Future research should use more specific and multidimensional measures to better capture the diverse components of entrepreneurship education. Finally, future studies may extend the proposed model by examining additional mechanisms, including innovation capability, digital creativity, AI readiness, institutional support, or entrepreneurial resilience. Examining these additional mechanisms across different technological, educational, and institutional contexts could provide a more comprehensive understanding of how AI literacy fosters digital entrepreneurial development.

List of abbreviations

AI	Artificial intelligence
AVE	Average variance extracted
CMB	Common method bias
CR	Composite reliability
EE	Entrepreneurial education
f^2	Effect size
GPA	Grade point average
HTMT	Heterotrait–Monotrait ratio
INT	E-entrepreneurial intention
OR	Opportunity recognition
p	Probability value
PLS-SEM	Partial least squares structural equation modelling
R^2	Coefficient of determination
S.E.	Standard error
SD	Standard deviation
SE	E-entrepreneurial self-efficacy
t	t-statistic
VIF	Variance inflation factor
β	Path coefficient

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Compliance with ethical standards

Ethical considerations

This study was reviewed and approved by the Ethics Committee for Human Research, Bangkok University (Reference No. 416912035). All participants provided informed consent prior to participation. Participation was voluntary, and anonymity and confidentiality were ensured throughout the study. The research was conducted in accordance with the Declaration of Helsinki.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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