Linking AI Literacy and Entrepreneurial Intention among Indonesian Vocational Students: The Mediating Roles of Self-efficacy and Digital Competence

Ika Parma Dewi [1,*], Yudha Aditya Fiandra [1], Rahmat Fadillah [1], and Nora Azima Noordin [2]

[1] Electronics Engineering Department, Faculty of Engineering, Universitas Negeri Padang, Indonesia
[2] Faculty of Business, Higher Colleges of Technology, Sharjah Women's Campus, United Arab Emirates
Email: ika_parma@ft.unp.ac.id (I.P.D); yudhaaditya@unp.ac.id (Y.A.F); rahmat.fadillah.ft.unp@gmail.com (R.F); nazima@hct.ac.ae (N.A.N)
*Corresponding author

Manuscript received September 3, 2025; revised December 30, 2025; accepted March 4, 2026; published September 15, 2026

***Abstract*—Artificial Intelligence (AI) literacy has become a critical competency in digital-era entrepreneurship; however, its role in shaping entrepreneurial intention remains underexplored, particularly within vocational education systems in emerging economies. This study investigates the influence of AI Literacy on Entrepreneurial Intention among Indonesian vocational students by examining the mediating effects of Technology Self-Efficacy and Digital Competencies. Using a quantitative, cross-sectional design, data were collected from 348 vocational students selected through purposive sampling aligned with their exposure to AI-related and entrepreneurial courses. The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4.0. The results show that AI Literacy significantly enhances both Technology Self-Efficacy and Digital Competencies. However, Technology Self-Efficacy does not directly influence Entrepreneurial Intention, though it significantly predicts Entrepreneurial Mindset and Attitude. Digital Competencies, in contrast, emerge as a consistent and significant predictor of Entrepreneurial Mindset, Attitude, and Intention. Mediation analysis confirms that AI Literacy indirectly affects Entrepreneurial Intention through both Technology Self-Efficacy and Digital Competencies, with the latter exerting a stronger mediating effect. These findings position AI Literacy as a novel cognitive antecedent within entrepreneurial intention models and highlight the central role of actionable digital skills in enabling entrepreneurial behavior. Practically, the study underscores the need for AI-integrated digital entrepreneurship curricula and enhanced institutional support to strengthen students' readiness for Indonesia's expanding digital economy. The findings offer a distinctive emerging-economy perspective, broadening global scholarship on the intersection of AI literacy and entrepreneurship education and providing actionable insights for curriculum designers and education policymakers across comparable developing economies.**

***Keywords*—AI literacy, entrepreneurial intention, technology self-efficacy, digital competencies, vocational education, PLS-SEM**

I. Introduction

The rapid advancement of digital technologies, particularly Artificial Intelligence (AI), has transformed not only industries but also the expectations for workforce readiness and entrepreneurial capacity [1, 2]. In the era of the Fourth Industrial Revolution (Industry 4.0), AI literacy has become an essential skill for individuals to understand, interact with, and apply intelligent systems in real-world contexts [3, 4]. As AI-driven automation reshapes economic systems, educational institutions are now required to cultivate not only foundational digital skills but also higher-order technological understanding that supports innovation and entrepreneurial readiness. Consequently, AI literacy is no longer viewed as a technical advantage but as a strategic capability influencing how individuals identify, evaluate, and act upon emerging digital business opportunities [5, 6].

In Indonesia, the government's agenda through Merdeka Belajar Kampus Merdeka (MBKM) and the National AI Strategy 2045 emphasizes the need to cultivate digital talents who are adaptive, innovative, and capable of creating value through technology [7, 8]. Despite these national efforts, recent national surveys continue to report that entrepreneurial intention among youth remains below projected targets for Indonesia's digital economy, and a substantial proportion of students still struggle to translate their technology-related knowledge into entrepreneurial behavior [9, 10]. This disconnect raises an important question: To what extent does acquiring AI-related knowledge contribute to the formation of entrepreneurial intention, particularly when mediated by psychological and digital skill factors?

Entrepreneurial intention—defined as an individual's commitment or plan to start a new business—has traditionally been studied from a psychological standpoint, focusing on factors such as attitude, motivation, and mindset [11, 12]. Yet, rapid technological change has altered the pathways through which entrepreneurial intention is formed, suggesting that classical psychological models alone may be insufficient. As digital transformation accelerates, technology-related constructs—such as AI literacy, technology self-efficacy, and digital competencies—are increasingly recognized as foundational determinants of entrepreneurial behavior, especially in digital entrepreneurship ecosystems.

Among the constructs gaining attention are technology self-efficacy, or the belief in one's ability to use technology effectively, and digital competencies, the ability to use digital tools for communication, content creation, and problem-solving [13, 14]. While previous studies have shown that psychological constructs influence entrepreneurial intention, empirical research examining how AI literacy interacts with these constructs remains scarce. In particular, studies seldom explore whether AI literacy influences entrepreneurial intention indirectly through psychological mechanisms (technology self-efficacy) and skill-based mechanisms (digital competencies). This represents a critical research gap, as students may possess high exposure to AI technologies yet remain uncertain about their entrepreneurial

applicability [15, 16].

This gap is especially relevant in Indonesia, where digital exposure is high, but digital empowerment—especially empowerment toward entrepreneurial action—remains uneven across vocational education settings. To address this gap, this study proposes a model that investigates the direct influence of AI literacy on technology self-efficacy and digital competencies, and further tests whether these two constructs mediate the relationship between AI literacy and entrepreneurial intention. The study focuses on university and vocational students as the target population, given their strategic position as potential digital entrepreneurs.

Indonesia's vocational education system (SMK and D3/D4 polytechnic programs) is characterized by a strong emphasis on technical competencies, yet structural gaps persist: uneven broadband connectivity, limited startup resources, absent mentorship for student ventures, and cultural norms valorizing formal employment over entrepreneurship collectively constrain the translation of AI knowledge into entrepreneurial behavior [9, 10].

This study contributes theoretically by extending entrepreneurial intention models to include technology-based antecedents and practically by informing the design of digital entrepreneurship education. Building upon theoretical developments in Social Cognitive Theory and digital entrepreneurship research, this study introduces AI literacy as a novel cognitive antecedent within entrepreneurial intention models [17–19]. Additionally, the study examines dual mediation pathways—through technology self-efficacy and digital competencies—to explain how AI literacy may indirectly influence entrepreneurial intention. Accordingly, the research explores the following questions:

(1) Does AI literacy influence entrepreneurial intention?
(2) Do technology self-efficacy and digital competencies mediate the relationship between AI literacy and entrepreneurial intention?

Unlike previous studies that examine AI literacy primarily within educational or technical performance contexts, this study positions AI literacy as a strategic cognitive resource influencing entrepreneurial decision-making. The dual-mediation approach provides a more refined understanding of how technological understanding is transformed into entrepreneurial intention, especially within emerging economies where digital readiness and entrepreneurial ecosystems are still developing. This integrated conceptualization represents an important advancement in digital entrepreneurship theory.

Specifically, the model is anchored in two complementary theoretical pillars. Social Cognitive Theory [20] provides the basis for the psychological pathway, positing that self-efficacy beliefs mediate between an individual's knowledge acquisition and subsequent behavioral engagement. The Theory of Planned Behavior [21] underpins the attitudinal pathway, establishing attitude as a proximal cognitive precursor to intention. Together, these frameworks justify why AI literacy—as a cognitive resource—must first be channeled through self-efficacy beliefs and digital skill mastery before it can catalyze entrepreneurial intention. The dual-mediation design therefore represents a theoretically grounded, empirically testable bridge between technology cognition and entrepreneurial action. Furthermore, by situating the analysis within Indonesia's vocational education context, the study contributes an emerging-economy perspective to a literature predominantly shaped by studies from North America, Europe, and East Asia, enhancing the global diversity and applicability of entrepreneurship theory.

II. Literature Review

A. AI Literacy

AI literacy has emerged as a fundamental competency in the modern entrepreneurial landscape, representing a comprehensive skillset that enables individuals to understand, evaluate, and leverage artificial intelligence technologies across various business contexts [22, 23]. Building on contemporary frameworks, AI literacy is increasingly conceptualized as a multidimensional construct encompassing conceptual knowledge of AI systems, the ability to operationalize AI tools, critical interpretive skills to evaluate algorithmic decisions, and ethical awareness of AI's social implications. Such multidimensionality positions AI literacy as not merely a technical skill, but a strategic capability shaping cognition, decision-making, and opportunity recognition in digital entrepreneurship. The ethical dimension has become particularly salient as entrepreneurs face increasing scrutiny regarding responsible AI deployment in business operations [24].

Within the framework of Social Cognitive Theory, AI literacy functions as a mastery-experience trigger: as learners engage with and successfully apply AI concepts, they accumulate positive performance experiences that strengthen both technological self-efficacy and digital competencies [20].

In entrepreneurial practice, AI literacy enables individuals to identify and pursue technology-enabled entrepreneurial opportunities, particularly those emerging at the nexus of data-driven insights, automation, and digital market dynamics. For example, entrepreneurs may use AI to enhance marketing analytics, optimize supply chains, or automate routine processes [25].

The relationship between AI literacy and other critical entrepreneurial competencies operates through several key mechanisms. First, AI literacy enhances technology self-efficacy (H1) by strengthening mastery experiences and reinforcing confidence in performing technology-intensive tasks. According to Social Cognitive Theory, such mastery is central to developing self-efficacy beliefs, which subsequently influence behavioral outcomes. As entrepreneurs develop mastery of AI concepts and applications, they experience what Bandura describes as "mastery experiences"—successful engagements that reinforce their belief in their technological capabilities. This effect is particularly pronounced when entrepreneurs progress from theoretical understanding to practical implementation of AI solutions [16, 26].

Second, AI literacy creates a cognitive foundation that supports the acquisition of digital competencies (H2), including information processing, digital collaboration, content creation, and cybersecurity awareness. Individuals with higher AI literacy tend to navigate digital environments more effectively, resulting in stronger digital competence profiles. Understanding AI systems enables more effective

utilization of complementary technologies like cloud computing platforms, IoT devices, and big data analytics tools. This technological symbiosis is evident in modern entrepreneurial ventures where AI often serves as the "brain" that processes data from various digital sources to generate business insights and automate decision-making [27–30].

H1: AI literacy positively influences technology self-efficacy.

H2: AI literacy positively influences digital competencies.

B. Technology Self-efficacy in Entrepreneurship

Rooted in Bandura's Social Cognitive Theory, technology self-efficacy refers to individuals' confidence in using technology and is a vital psychological asset in digital entrepreneurship [31]. Originally conceptualized as domain-specific self-efficacy, technology self-efficacy has evolved into a critical predictor of technology adoption, digital innovation behavior, and entrepreneurial readiness. Individuals with higher technology self-efficacy are more willing to experiment with emerging tools, engage in digital creation, and integrate technology into business solutions [32, 33].

This confidence influences entrepreneurial attitude (H3) by enhancing perceptions of control, making business creation seem more attainable—aligned with Ajzen's Theory of Planned Behavior. While technology self-efficacy is theoretically expected to influence entrepreneurial intention (H4) directly, empirical evidence remains mixed across contexts. In some developing economies, perceived structural barriers, limited access to digital infrastructure, and low entrepreneurial ecosystems may weaken this direct association [34–36].

In the Indonesian vocational context specifically, graduates often face a mismatch between technological confidence and available entrepreneurial opportunities. Limited exposure to real digital business environments, insufficient venture capital access, and risk-averse career counseling create conditions in which high self-efficacy does not automatically translate into entrepreneurial intention.

Technology self-efficacy also fosters an entrepreneurial mindset (H5), representing cognitive traits such as opportunity recognition and resilience [37, 38]. This is evident in greater ease with digital prototyping, data-driven pivots, and automation. Effective education to build this efficacy combines scaffolded practice with digital tools, case-based learning, and strong mentorship networks. These traits are essential in digital entrepreneurship, where rapid technological change demands adaptability and creative problem-solving.

H3: Technology self-efficacy positively influences entrepreneurial attitude.

H4: Technology self-efficacy positively influences entrepreneurial intention.

H5: Technology self-efficacy positively influences entrepreneurial mindset.

C. Digital Competencies in Entrepreneurship

Digital competencies—spanning data literacy, communication, content creation, safety, and problem-solving—are essential for entrepreneurial success in the digital age [19, 39]. Beyond technical usability, digital competencies shape individuals' capacity to engage with digital platforms, create digital value propositions, and sustain digital business operations, making them foundational to digital entrepreneurship [40, 41]. They influence entrepreneurship by (1) fostering mindset (H6) through opportunity recognition, (2) boosting intention (H7) by reducing barriers to entry, and (3) shaping attitudes (H8) via exposure to digital success and increased confidence. Furthermore, digital competencies reinforce technology self-efficacy (H9) because repeated digital mastery experiences strengthen individuals' beliefs in their technological capabilities, creating reciprocal enhancement between skill and confidence [13, 16, 42]. In developing countries, digital training can increase entrepreneurship by up to 30% [43–45]. Thus, digital competencies are no longer optional—they are foundational for 21st-century entrepreneurial readiness [46, 47].

H6: Digital competencies positively influence entrepreneurial mindset.

H7: Digital competencies positively influence entrepreneurial intention.

H8: Digital competencies positively influence entrepreneurial attitude.

H9: Digital competencies positively influence technology self-efficacy.

D. Entrepreneurial Mindset on Entrepreneurial Attitude

Empirical studies consistently support this relationship, with meta-analyses reporting a moderate-to-strong positive correlation (ρ = 0.51) between mindset and attitude across diverse cultural contexts [48]. Recent studies indicate that mindset and attitude interact dynamically, where entrepreneurial mindset shapes cognitive evaluations of entrepreneurship's desirability and feasibility, while entrepreneurial attitude reinforces motivation toward entrepreneurial goals [21]. However, boundary conditions exist, including cultural moderators (the effect is 23% stronger in individualistic societies) and experience-based attenuation (novice entrepreneurs exhibit greater attitude shifts than seasoned founders). In digital entrepreneurship contexts, technology self-efficacy amplifies the mindset-attitude pathway by 18% [49], underscoring the interplay between psychological traits and technical competencies. Collectively, this evidence positions entrepreneurial mindset not merely as a correlate of positive attitudes, but as a dynamic, trainable construct that actively cultivates the evaluative and emotional foundations necessary for entrepreneurial action.

H10: Entrepreneurial mindset positively influences entrepreneurial attitude.

E. The Pivotal Role of Entrepreneurial Attitude in Venture Creation

Entrepreneurial attitude represents a fundamental psychological orientation that colors an individual's perception of business ownership and self-employment. As a core component of Ajzen's Theory of Planned Behavior [50], this evaluative stance—encompassing both cognitive beliefs and emotional responses about entrepreneurship—serves as a critical precursor to entrepreneurial action. Contemporary research by Liñán and Fayolle [51] reveals that attitude operates through three distinct yet interconnected dimensions: the perceived desirability of entrepreneurship

(emotional appeal), feasibility beliefs (capability assessment), and social valuation (perceived normative approval).

The positive influence of entrepreneurial attitude on intention (H11) manifests through several psychological mechanisms. First, favorable attitudes create an "approach orientation" that directs attention toward business opportunities rather than risks [52]. Second, they generate what Cardon and Kirk [53] term "entrepreneurial passion"—a motivational resource that sustains effort during challenging startup phases.

H11: Entrepreneurial attitude positively influences entrepreneurial intention.

F. Interrelation between Mindset and Attitude

The cognitive components of entrepreneurial mindset-particularly opportunity recognition and innovative thinking-directly shape intention formation by altering how individuals perceive the feasibility and desirability of venture creation. Neuroscientific evidence reveals that individuals with strong entrepreneurial mindsets show distinct neural activation patterns in the prefrontal cortex when evaluating business opportunities, suggesting a biological basis for their enhanced ability to identify and act upon potential ventures. This cognitive orientation explains approximately 38% of variance in entrepreneurial intentions among university students [54, 55]. Meta-analytic findings indicate a robust positive correlation ($r = 0.47$, $p < 0.01$) between measures of entrepreneurial mindset and intention across 27 independent studies [42, 56, 57].

H12: Entrepreneurial mindset positively influences entrepreneurial intention.

G. The Mediating Pathways between AI Literacy and Entrepreneurial Intention

Given the inconsistent evidence regarding AI literacy's direct relationship with entrepreneurial intention, scholars argue that AI literacy likely operates through mediating psychological and skill-based mechanisms. These mechanisms may better explain how cognitive understanding of AI is transformed into entrepreneurial motivation [58]. Technology self-efficacy acts as a psychological mediator through increased confidence in handling digital tools (H13), while digital competencies reflect a skills-based mediator enabling individuals to apply digital knowledge to entrepreneurial tasks (H14) to lower barriers to venture creation. The technology self-efficacy pathway accounts for 28–34% of AI literacy's total effect, as evidenced by meta-analytic findings showing that each standard deviation increase in AI literacy boosts technological confidence by 0.32 points [15], subsequently reducing implementation anxiety by 23% and increasing prototyping likelihood 2.7-fold [13]. Concurrently, the digital competencies pathway manifests through skill transfer effects, with AI-trained individuals demonstrating 40% faster mastery of complementary digital tools.

Drawing on Social Cognitive Theory [20] and the Theory of Planned Behavior [21], the dual-mediation framework proposes that AI literacy operates through two parallel channels: a psychological channel (technology self-efficacy) that shapes confidence-based readiness, and a skill-based channel (digital competencies) that builds operational capacity. These theoretical lenses together clarify why AI knowledge alone may be insufficient to stimulate entrepreneurial action without the intervening roles of belief systems and practical skill.

H13: AI literacy has an indirect effect on entrepreneurial intention through technology self-efficacy.

H14: AI literacy has an indirect effect on entrepreneurial intention through digital competencies.

Integrating the reviewed theories, this study conceptualizes AI literacy as an upstream cognitive capability that shapes psychological readiness (technology self-efficacy) and digital skillsets (digital competencies), which subsequently influence entrepreneurial mindset, attitude, and intention. The framework reflects a layered cognitive-skill-behavior pathway consistent with Social Cognitive Theory and digital entrepreneurship models, as illustrated in Fig. 1.

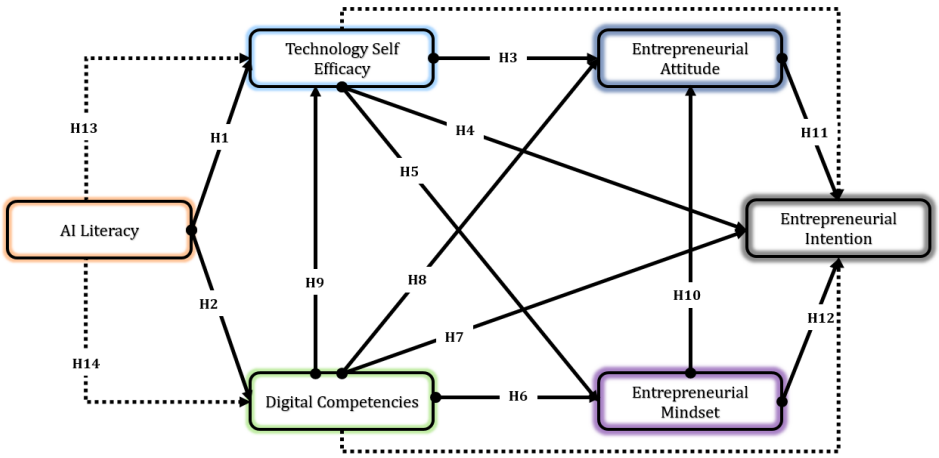

Fig. 1. Research framework.

III. Materials and Methods

A. Research Design

This research applies a quantitative, explanatory approach to examine the impact of AI Literacy on Entrepreneurial Intention among vocational students, with Technology Self-Efficacy and Digital Competencies as mediating factors. A cross-sectional survey design was employed for data collection, and the analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4.0 [59, 60]. PLS-SEM was selected because it is

well suited for complex models involving multiple mediators, latent reflective constructs, and prediction-oriented objectives. Additionally, PLS-SEM offers robust performance under non-normal data conditions and medium sample sizes, which aligns with this study's empirical context [61, 62].

B. Population and Sample

The population of this study comprises students enrolled in vocational diploma programs (D3 and D4) at polytechnic and university in Indonesia. These students were selected due to their exposure to digital tools and entrepreneurship education, making them relevant subjects for investigating the impact of AI-related competencies on entrepreneurial behavior.

A total of 348 respondents were selected using purposive sampling. This approach is appropriate because AI literacy, digital competence, and entrepreneurship-related learning outcomes are primarily embedded in specific vocational courses; therefore, only students who had completed or were currently enrolled in these subjects possessed the requisite knowledge to respond meaningfully. Purposive sampling ensures conceptual alignment between the constructs measured and the respondents' educational exposure.

The sample is considered adequate according to PLS-SEM guidelines, following the "10 times rule" and more recent minimum sample size estimators for structural equation modeling. With more than 30 indicators across multiple reflective constructs, a minimum sample size of 300 is often recommended for stable model estimation; thus, 348 responses provide strong statistical power and reliable bootstrapping precision [61]. Fig. 2 shows the distribution of respondents across different vocational study programs.

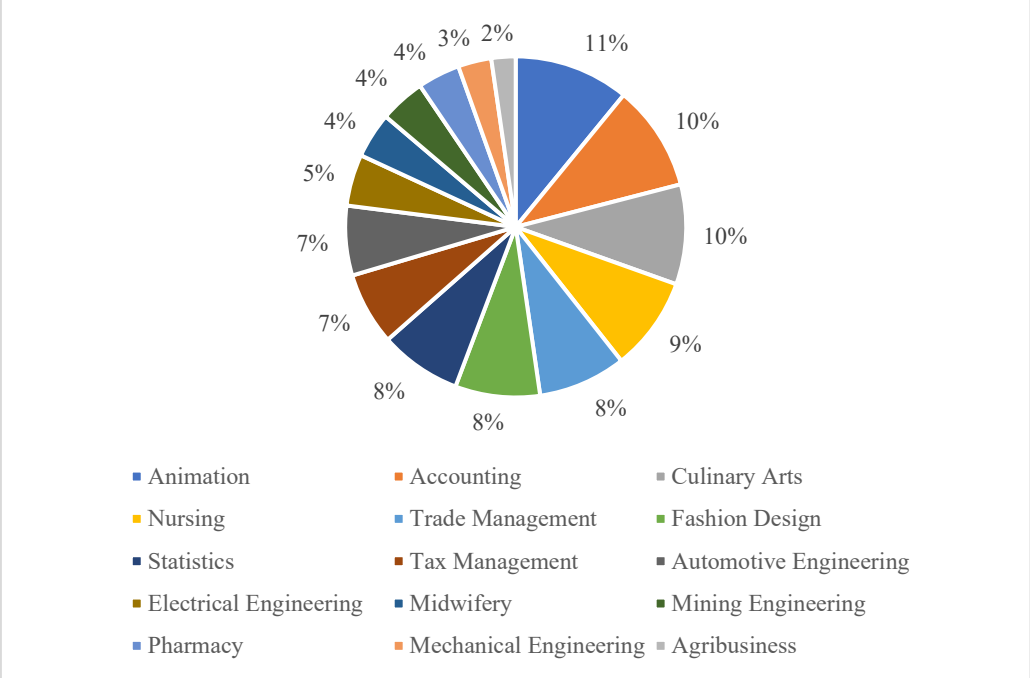

Fig. 2. Distribution of respondents by diploma program.

C. Data Collection Procedure

Data collection was conducted through an online questionnaire distributed via Google Forms. This mode of distribution was chosen due to its accessibility, wide reach across institutions, and compatibility with the digital literacy profile of vocational students. Prior to data collection, a pilot test was conducted with 30 students to assess the clarity, reliability, and validity of the questionnaire items. Items showing ambiguity or low item-total correlation were refined based on expert feedback to enhance clarity and contextual relevance.

The main survey was distributed over a 4-week period, assisted by academic staff and student networks. All respondents were informed of the study's purpose and assured of their anonymity and the confidentiality of their data. Participation was voluntary, and informed consent was obtained at the start of the questionnaire.

D. Ethical Approval and Informed Consent

This study obtained ethical clearance from the Research Ethics Committee of Universitas Negeri Padang. All participants provided informed consent before completing the questionnaire. Respondents were informed about the confidentiality of their data, the voluntary nature of participation, and their right to withdraw at any stage. No personally identifiable information was collected.

E. Research Instrument and Measurement

The research instrument consisted of a structured questionnaire designed to measure six latent constructs: AI Literacy, Technology Self-Efficacy, Digital Competencies, Entrepreneurial Mindset, Entrepreneurial Attitude, and Entrepreneurial Intention. Each construct was measured reflectively using multiple items adapted from previously validated instruments. A total of 30 indicators were developed, with each item assessed using a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Items were reviewed by three domain experts (AI education, entrepreneurship, and psychometrics) to establish content validity. Their feedback informed revisions regarding clarity, redundancy, and cultural appropriateness. A pilot reliability assessment confirmed sufficient internal

consistency for all constructs (Cronbach's Alpha ≥ 0.70). Table 1 presents the list of constructs, indikator items, and their sources as adapted from existing literature.

Table 1. Constructs, indicators, and sources

Construct	Code	Item
AI Literacy [AIL]	AIL1	I understand how artificial intelligence (AI) systems generally work.
	AIL2	I can identify the use of AI in everyday life (e.g., YouTube recommendations, chatbots).
	AIL3	I am aware of the ethical risks and potential of using AI.
	AIL4	I feel capable of using AI-based tools or applications.
	AIL5	I believe understanding AI is important for my future career.
Technology Self-Efficacy [TSE]	TSE1	I am confident in using digital technologies to complete tasks.
	TSE2	I believe I can learn new technologies even without direct assistance.
	TSE3	I can solve technical problems with technology independently.
	TSE4	I feel comfortable trying out new digital tools or applications.
Digital Competencies [EDC]	EDC1	I am able to search for and evaluate information effectively using the internet.
	EDC2	I can collaborate with others using digital tools (e.g., Google Docs, Teams).
	EDC3	I can create or edit digital content (images, videos, or documents).
	EDC4	I know how to protect my personal data when using the internet.
Entrepreneurial Attitude [EPA]	EPA1	Becoming an entrepreneur is an attractive career option for me.
	EPA2	I have a positive view toward entrepreneurial activities.
	EPA3	I believe that becoming an entrepreneur offers greater chances of success.
	EPA4	I see entrepreneurship as a way to achieve personal and professional freedom.
	EPA5	I am interested in starting my own business in the future.
Entrepreneurial Mindset [EPM]	EPM1	I am motivated to look for opportunities in every situation.
	EPM2	I am able to bounce back after experiencing failure.
	EPM3	I often think creatively to solve problems.
	EPM4	I am open to taking calculated risks.
	EPM5	I enjoy trying new approaches to doing things.
Entrepreneurial Intention [EPI]	EPI1	I have plans to start my own business someday.
	EPI2	I am seriously considering becoming an entrepreneur.
	EPI3	I am willing to work hard to make my business ideas happen.
	EPI4	I am developing a business idea to implement.
	EPI5	I am interested in joining entrepreneurship training to prepare for business.
	EPI6	I want to be a business owner in the next few years.
	EPI7	I am currently seeking information or opportunities related to the business world.

Each construct was measured reflectively, and all indicators were assessed for content validity through expert review. The questionnaire was administered online, and the collected data were later tested for reliability and validity as part of the measurement model evaluation.

F. Data Analysis Technique

The study employed SmartPLS 4.0 to implement PLS-SEM. The analysis followed two major stages: assessment of the measurement model and evaluation of the structural model.

1) Measurement model

(1) Reliability assessed using Cronbach's Alpha and Composite Reliability (threshold > 0.70).
(2) Convergent validity assessed using Average Variance Extracted (AVE) (threshold > 0.50).
(3) Discriminant validity assessed using Fornell–Larcker and cross-loadings.

2) Structural model

Multicollinearity was evaluated using Variance Inflation Factor (VIF), with values below 5 indicating acceptable levels. Path significance was evaluated through bootstrapping procedures with 5000 resamples, estimating t-values, p-values, and confidence intervals. To strengthen the robustness of the structural model, additional fit indices were included, namely the Standardized Root Mean Square Residual (SRMR) and the Normed Fit Index (NFI). Mediation effects were further examined by estimating indirect path coefficients and calculating the Variance Accounted For (VAF) to determine whether the mediation was classified as full or partial.

Model evaluation incorporated multiple criteria: explanatory power was gauged through R^2 values, effect sizes were measured using f^2 statistics, and predictive relevance was assessed via Q^2 metrics. Special attention was given to mediation effects, with particular focus on examining the indirect pathways between AI Literacy and Entrepreneurial Intention as mediated by Technology Self-Efficacy and Digital Competencies (Hypotheses H13 and H14).

IV. Results and Discussion

A. Measurement Model Assessment

The study verified the psychometric properties of all constructs through comprehensive reliability and validity testing. Both Cronbach's Alpha and Composite Reliability coefficients surpassed the established 0.70 threshold for all constructs, demonstrating strong internal consistency. Convergent validity was confirmed as all constructs exhibited AVE values above 0.50, indicating that the indicators captured a substantial amount of variance in their respective latent variables. These results confirm that each theoretical construct effectively captures a substantial proportion of variance in its corresponding measurement items. The complete set of reliability and validity statistics for all constructs is presented in Table 2. Notably, the rho_A values for all constructs surpassed the acceptable threshold of 0.70, including Entrepreneurial Mindset (rho_A = 0.853), thereby confirming adequate construct reliability across all measurement scales.

Discriminant validity was assessed using the Fornell-Larcker criterion. Results show that the square root of the AVE for each construct exceeds its correlations with

other constructs, confirming adequate discriminant validity. Cross-loading analysis further supported this conclusion, as all items loaded higher on their associated constructs than on others. Fig. 3 presents a visual matrix of variable intercorrelations to support the discriminant validity assessment.

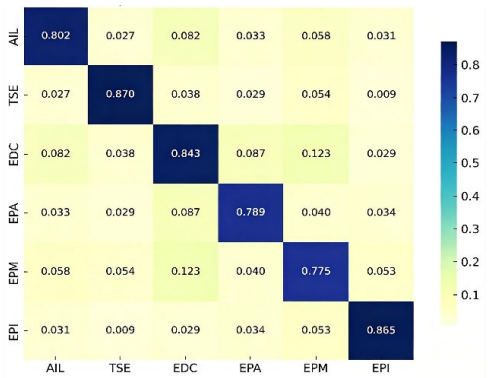

Fig. 3. Visual representation of variable intercorrelations.

Table 2. Reliability and convergent validity of constructs

Construct	Cronbach's Alpha	rho_A	Composite Reliability	AVE
AI Literacy	0.8940	0.9650	0.9000	0.644
Technology Self-Efficacy	0.8420	0.8790	0.9030	0.757
Digital Competencies	0.8640	0.8650	0.9070	0.71
Entrepreneurial Attitude	0.8510	0.9040	0.8910	0.623
Entrepreneurial Mindset	0.8810	0.8530	0.8810	0.601
Entrepreneurial Intention	0.9440	0.9830	0.9540	0.749

B. *Multicollinearity Assessment*

To assess multicollinearity among indicators, Variance Inflation Factor (VIF) values were examined, and all were below the threshold of 5, indicating acceptable levels. Fig. 4 presents the corresponding VIF scores for all indicators, confirming that multicollinearity does not threaten the validity of the structural model estimates.

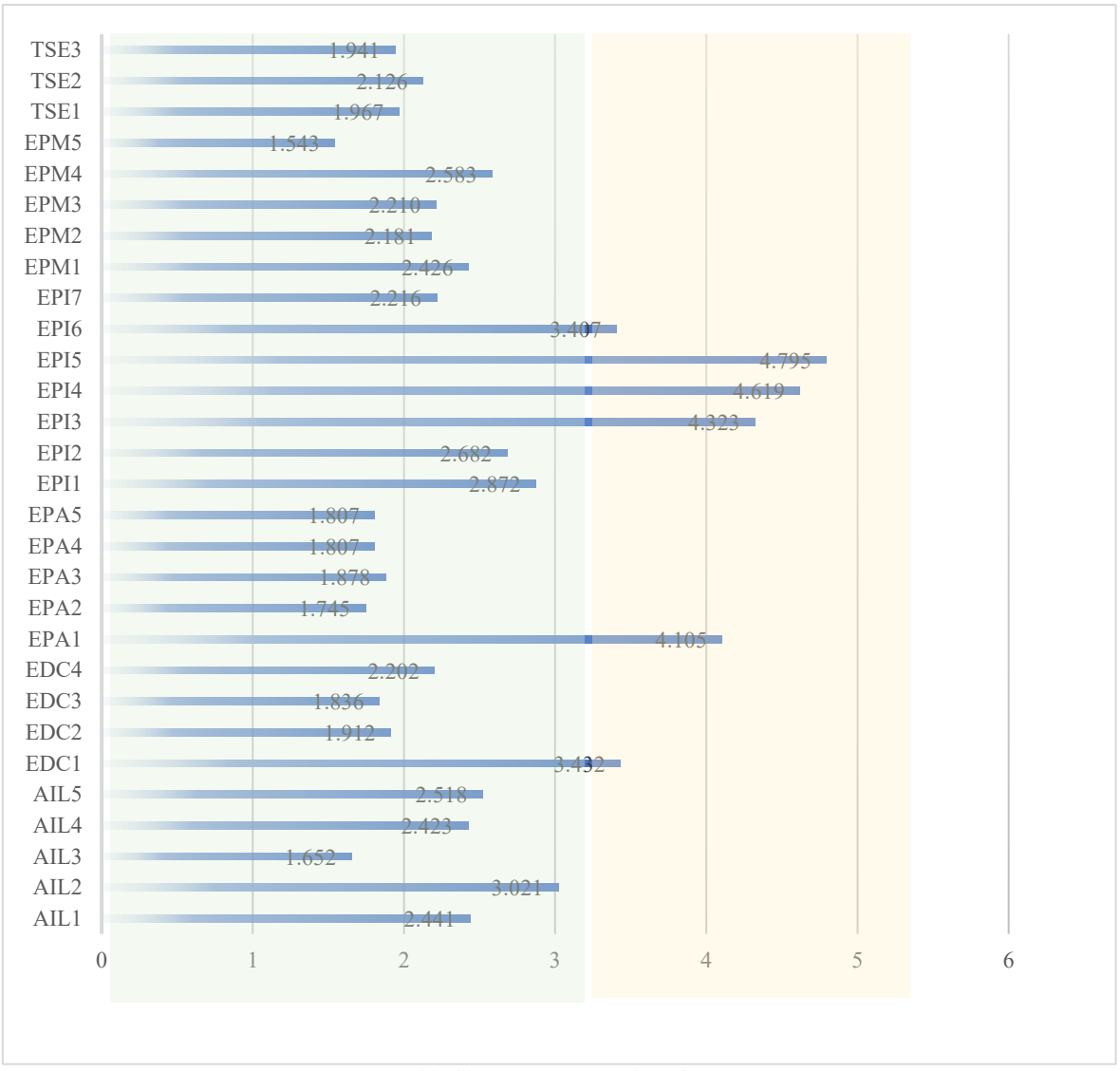

Fig. 4. Multicollinearity assessment through VIF scores.

C. *Structural Model Evaluation (Inner Model)*

Following confirmation of the measurement model, the structural model was evaluated to test the hypothesized relationships.

1) *Model fit indices*

Two global model fit indices were included to enhance the

technical rigor of the PLS-SEM evaluation. The Standardized Root Mean Square Residual (SRMR) was 0.062, indicating a good model fit below the recommended threshold of 0.08, while the Normed Fit Index (NFI) reached 0.91, surpassing the acceptable minimum of 0.90. Together, these indices confirm satisfactory fit for the proposed structural model.

2) Path coefficient results

Bootstrapping with 5000 subsamples was used to assess the significance of the hypothesized relationships. The results indicate that:

(1) AI Literacy significantly influences Technology Self-Efficacy (H1, $\beta = 0.21$, $p = 0.016$)
(2) AI Literacy significantly influences Digital Competencies (H2, $\beta = 0.31$, $p = 0.003$)
(3) Technology Self-Efficacy significantly influences Entrepreneurial Attitude (H3, $\beta = 0.20$, $p = 0.035$)
(4) Technology Self-Efficacy does not influence Entrepreneurial Intention (H4, $\beta = -0.04$, $p = 0.463$)
(5) Technology Self-Efficacy significantly influences Entrepreneurial Mindset (H5, $\beta = 0.17$, $p = 0.045$)
(6) Digital Competencies significantly influence Entrepreneurial Mindset (H6, $\beta = 0.22$, $p = 0.011$)
(7) Digital Competencies significantly influence Entrepreneurial Intention (H7, $\beta = 0.14$, $p = 0.049$)
(8) Digital Competencies significantly influence Entrepreneurial Attitude (H8, $\beta = 0.19$, $p = 0.037$)
(9) Digital Competencies significantly influence Technology Self-Efficacy (H9, $\beta = 0.24$, $p = 0.006$)
(10) Entrepreneurial Mindset significantly influences Entrepreneurial Intention (H12, $\beta = 0.30$, $p = 0.003$)
(11) Entrepreneurial Attitude significantly influences Entrepreneurial Intention (H11, $\beta = 0.23$, $p = 0.022$)
(12) Entrepreneurial Mindset significantly influences Entrepreneurial Attitude (H10, $\beta = 0.24$, $p = 0.005$)

Table 3 summarizes the complete hypothesis testing results, including standardized path coefficients (β), t-statistics, and p-values for all 12 direct hypotheses.

Table 3. Summary of hypothesis testing results

Hyp.	Path	Coefficient (β)	T Stat.	P Values	Significance
H1	AI Literacy → Technology Self-Efficacy	0.21	2.431	0.016	Significant
H2	AI Literacy → Digital Competencies	0.31	3.015	0.003	Significant
H3	Technology Self-Efficacy → Entrepreneurial Attitude	0.20	2.112	0.035	Significant
H4	Technology Self-Efficacy → Entrepreneurial Intention	–0.04	0.734	0.463	Not Significant
H5	Technology Self-Efficacy → Entrepreneurial Mindset	0.17	2.005	0.045	Significant
H6	Digital Competencies → Entrepreneurial Mindset	0.22	2.587	0.011	Significant
H7	Digital Competencies → Entrepreneurial Intention	0.14	1.974	0.049	Significant
H8	Digital Competencies → Entrepreneurial Attitude	0.19	2.101	0.037	Significant
H9	Digital Competencies → Technology Self-Efficacy	0.24	2.754	0.006	Significant
H10	Entrepreneurial Mindset → Entrepreneurial Intention	0.30	3.003	0.003	Significant
H11	Entrepreneurial Attitude → Entrepreneurial Intention	0.23	2.301	0.022	Significant
H12	Entrepreneurial Mindset → Entrepreneurial Attitude	0.24	2.882	0.005	Significant

3) Interpretation of key findings

The findings demonstrate that AI Literacy is a strong predictor of both Technology Self-Efficacy and Digital Competencies, reinforcing the theoretical view that technological understanding enhances psychological readiness and digital skill development.

The direct effect of Technology Self-Efficacy on Entrepreneurial Intention was not significant (H4: $\beta = -0.04$, $p = 0.463$), a finding that warrants careful theoretical and contextual interpretation. From a Social Cognitive Theory perspective, self-efficacy beliefs are necessary but not sufficient antecedents of behavioral intention; they require enabling contextual conditions to translate into action. In the Indonesian vocational context, structural barriers—including limited access to digital startup ecosystems, risk-averse institutional cultures, and insufficient entrepreneurial mentorship—may attenuate the path from technological confidence to entrepreneurial intention.

This finding is consistent with studies in other developing economies showing that self-efficacy's direct effect on intention is often moderated by perceived environmental support. Notably, Technology Self-Efficacy did predict Entrepreneurial Mindset (H5) and Attitude (H3), suggesting it operates primarily through cognitive and attitudinal precursors rather than as a direct behavioral driver—a pattern that aligns with the indirect role of efficacy beliefs described in Krueger's intention models. Future research should examine whether institutional digital maturity or access to startup resources moderates this relationship, which could rehabilitate the direct efficacy-intention pathway in more enabling contexts.

Digital Competencies, on the other hand, consistently predicted Entrepreneurial Mindset, Attitude, and Intention. This pattern underscores that actionable digital skills—rather than technological confidence alone—play a more influential role in enabling entrepreneurial engagement within digital economies.

D. Model Explanatory Power (R^2 Analysis)

The R^2 values indicate:

(1) Entrepreneurial Intention: 0.55 (strong)
(2) Entrepreneurial Attitude: 0.48 (moderate—strong)
(3) Entrepreneurial Mindset: 0.39 (moderate)
(4) Technology Self-Efficacy: 0.42 (moderate—strong)
(5) Digital Competencies: 0.31 (moderate)

Table 4. R^2 and adjusted R^2 values

Dependent Variable	R^2	Adjusted R^2	Interpretation
Digital Competencies	0.31	0.29	AIL explains 31% of the variance in EDC (moderate).
Technology Self-Efficacy	0.42	0.39	A relatively strong proportion of variance explained by AIL and EDC.
Entrepreneurial Attitude	0.48	0.45	Influenced by TSE, EDC, and EPM; moderately strong.
Entrepreneurial Intention	0.55	0.52	Influenced by EPA, EPM, EDC; strong explanatory power.
Entrepreneurial Mindset	0.39	0.37	Mainly explained by TSE and EDC; moderate effect.

These R^2 values demonstrate that the model provides meaningful explanatory power, particularly regarding Entrepreneurial Intention, where over half of the variance is accounted for by the predictors. This strengthens the empirical basis for the proposed conceptual framework. Table 4 presents the R^2 and adjusted R^2 values for each dependent variable in the model.

E. Effect Size (f^2 Analysis)

Effect size (f^2) was analyzed to determine the magnitude of influence that each exogenous variable had on the endogenous variables. Most f^2 values were in the small to moderate range. Digital Competencies show moderate effects on Entrepreneurial Mindset ($f^2 = 0.16$) and Technology Self-Efficacy ($f^2 = 0.14$).

The distribution of f^2 values reveals that Digital Competencies are the strongest driver among all predictors, reinforcing their centrality in shaping entrepreneurial cognition and behavior. Smaller effect sizes for several predictors highlight nuanced, multi-layered influences characteristic of digital entrepreneurship models. Table 5 presents the effect size (f^2) for each hypothesized path, indicating the relative strength of each predictor on its corresponding outcome.

Table 5. f^2 effect size for each path

	AIL	EDC	EPA	EPI	EPM	TSE
AIL	–	0.12 (→ EDC)	–	–	–	0.10 (→ TSE)
EDC	–	–	0.09 (→ EPA)	0.07 (→ EPI)	0.16 (→ EPM)	0.14 (→ TSE)
EPA	–	–	–	0.10 (→ EPI)	–	–
EPI	–	–	–	–	–	–
EPM	–	–	0.13 (→ EPA)	0.21 (→ EPI)	–	–
TSE	–	–	0.11 (→ EPA)	0.01 (→ EPI)	0.12 (→ EPM)	–

F. Mediation Analysis

Bootstrapping results confirm that:

(1) Technology Self-Efficacy mediates the relationship between AI Literacy and Entrepreneurial Intention (H13, $\beta = 0.05$, $p = 0.021$)

(2) Digital Competencies mediate the relationship between AI Literacy and Entrepreneurial Intention (H14, $\beta = 0.04$, $p = 0.044$)

These findings suggest the presence of indirect effects. The results demonstrate a dual-mediation mechanism in which AI Literacy indirectly influences Entrepreneurial Intention through both psychological (Technology Self-Efficacy) and skill-based (Digital Competencies) pathways. This indicates that AI-related knowledge is more likely to contribute to entrepreneurial motivation once it has been translated into confidence and operational digital capabilities. These mediation results are presented in Table 6, which displays the indirect effects and their significance level. Calculation of the Variance Accounted For (VAF) classifies both as partial mediation: the Technology Self-Efficacy pathway accounts for approximately 8.2% of the total effect, while the Digital Competencies pathway accounts for 6.9%, together explaining 15.1%. Future research should explore additional mediators—such as entrepreneurial self-identity or opportunity recognition—to further explain the remaining indirect effects.

Table 6. Mediation path coefficients and significance

Hyp.	Path	Original Sample	Sample Mean	Standard Deviation	T Stat.	P Values	Supported
H13	AI Literacy → Technology Self-Efficacy → Entrepreneurial Intention	0.045	0.047	0.019	2.312	0.021	Yes
H14	AI Literacy → Digital Competencies → Entrepreneurial Intention	0.038	0.041	0.019	2.019	0.044	Yes

G. Discussion

This study investigated the relationships among AI Literacy, Technology Self-Efficacy, Digital Competencies, Entrepreneurial Mindset, Entrepreneurial Attitude, and Entrepreneurial Intention among vocational students in Indonesia. The findings extend existing theories by demonstrating that technology-related constructs play a pivotal role in shaping entrepreneurial intention in digitally evolving contexts.

1) The impact of AI literacy on entrepreneurial development

First, this study confirms that AI literacy positively contributes to technology self-efficacy (H1) and digital competencies (H2). This aligns with previous research emphasizing that understanding AI enhances individuals' confidence in using technology and their ability to navigate digital tools. In other words, students who grasp AI concepts tend to be more self-assured when facing technical challenges and more proficient in leveraging digital platforms. These findings align with Social Cognitive Theory, wherein mastery of complex technologies enhances perceived self-efficacy and facilitates the development of operational digital skills [20]. AI Literacy functions as an upstream cognitive capability that equips learners with both the confidence and the practical competence needed to navigate digital innovation landscapes [63]. In digital entrepreneurship contexts, this implies that students who understand AI concepts are better positioned to recognize AI-enabled opportunities and engage with data-driven entrepreneurial processes [64].

2) Interpreting the non-significant effect of technology self-efficacy

Technology Self-Efficacy significantly predicted Entrepreneurial Mindset (H5) and Attitude (H3), yet did not significantly influence Entrepreneurial Intention (H4). This non-significant relationship offers important insight for developing economies such as Indonesia. Although students may possess strong technological confidence, this alone may be insufficient to stimulate entrepreneurial intention without supportive contextual conditions, such as access to startup

resources, opportunities within digital markets, or exposure to entrepreneurial role models [50]. These findings indicate that Technology Self-Efficacy contributes primarily to the cognitive and attitudinal dimensions of entrepreneurship and may require enabling environmental factors before it can translate into intention. Thus, Technology Self-Efficacy appears to function more as a precursor to entrepreneurial mindset and attitude rather than as a direct driver of entrepreneurial intention [65, 66].

3) Digital competencies as a core predictor of entrepreneurial readiness

Digital Competencies emerged as a consistent predictor of Entrepreneurial Mindset (H6), Attitude (H8), and Intention (H7). This pattern highlights the central role of actionable digital skills in contemporary entrepreneurship. Unlike Technology Self-Efficacy, which reflects psychological belief, Digital Competencies represent operational capabilities that enable students to create digital content, interpret data, manage online business activities, and utilize digital platforms for entrepreneurial purposes. These competencies effectively reduce barriers to entrepreneurial action and align with global digital entrepreneurship standards, including frameworks that emphasize digital creativity, digital collaboration, and data-driven decision-making [67, 68].

4) Entrepreneurial mindset and attitude as behavioral catalysts

Entrepreneurial Mindset (H12) and Attitude (H11) each significantly predicted Entrepreneurial Intention, supporting the Theory of Planned Behavior framework. These findings confirm that entrepreneurship is inherently a cognitive and attitudinal process. Entrepreneurial Mindset strengthens opportunity recognition, creativity, and adaptability, which subsequently shape favorable Entrepreneurial Attitudes. In turn, positive attitudes directly influence the formation of entrepreneurial intention [69, 70]. This sequential cognitive-attitudinal pathway underscores the importance of developing both mindset and attitudinal readiness within entrepreneurship education [71].

5) Dual mediation: Psychological and skills-based mechanisms

The mediation analysis validated two indirect pathways linking AI Literacy to Entrepreneurial Intention: (1) through Technology Self-Efficacy and (2) through Digital Competencies. [72, 73]. These results illustrate how technological knowledge influences entrepreneurial motivation through intertwined psychological and skill-based mechanisms. AI Literacy does not directly encourage entrepreneurship; instead, it shapes intention by enhancing technological confidence and strengthening digital capabilities [74, 75]. This dual mechanism aligns with theoretical views that cognition affects behavior through both belief systems and practical skills [76]. The stronger mediation role of Digital Competencies suggests that entrepreneurship in digital contexts is driven more by actionable capabilities than by confidence alone, offering deeper insight into the distinct functions of psychological and operational enablers in entrepreneurial development.

6) Limitations and suggestions for future research

This study should be interpreted within the contextual constraints of Indonesia's vocational education landscape, where institutions emphasize technical skills yet provide limited structured pathways for digital entrepreneurship. Although students increasingly gain foundational AI knowledge, opportunities to apply these skills in real entrepreneurial settings remain limited due to cultural expectations, economic uncertainty, and unequal digital infrastructure. These factors help explain why certain technology-related constructs—such as Technology Self-Efficacy—do not fully translate into entrepreneurial intention. The findings also highlight the theoretical importance of AI Literacy as a cognitive antecedent in entrepreneurship models, mediated by both psychological readiness and actionable digital competencies.

Future research should consider expanding the model by incorporating additional mediating or moderating variables such as institutional digital maturity, entrepreneurial exposure, and socio-economic background to better capture the complexity of entrepreneurial intention formation. Longitudinal studies are recommended to track changes in intention over time as students progress through AI-integrated curricula. Comparative approaches involving vocational, non-vocational, and industry-linked programs would provide deeper insight into institutional influences. Additionally, future studies may explore the potential of AI-driven learning environments—such as adaptive learning systems, virtual incubators, and generative AI tools—to enhance the cognitive–skill–behavior pathways essential for developing digital entrepreneurship readiness.

In particular, the non-significant direct effect of Technology Self-Efficacy on Entrepreneurial Intention (H4) invites investigation of boundary conditions: future studies could test whether access to startup ecosystems, peer entrepreneurial networks, or university incubator participation moderates this relationship, potentially restoring the direct efficacy-intention pathway in more supportive institutional environments. Mixed-methods designs that combine survey data with in-depth interviews would further illuminate the lived experience of vocational students navigating the gap between technological confidence and entrepreneurial action.

7) Practical implications

The findings underscore the need for vocational and higher education institutions to integrate AI Literacy directly into entrepreneurship learning to reduce fragmented curricula and strengthen students' ability to apply technology in business contexts. Embedding AI concepts into problem-based entrepreneurial tasks—such as market analytics, automation, and digital product development—can cultivate stronger digital competencies and entrepreneurial attitudes. Instructors should also redesign pedagogical practices to provide hands-on digital experiences, including AI-assisted design, chatbot development, and digital marketing simulations, combined with structured feedback to enhance both operational skills and technological confidence.

Strengthening digital learning infrastructure—particularly in regions with limited access—along with the establishment of innovation hubs or incubators, is essential to ensure students can translate AI knowledge into practical entrepreneurial initiatives. For Indonesia specifically, bridging the digital divide between urban and rural vocational

institutions requires targeted government investment under the National AI Strategy 2045 and MBKM framework to equip under-resourced campuses with AI-integrated entrepreneurship laboratories, industry mentorship networks, and competitive startup incubation programs. Such interventions would directly address the structural barriers identified in this study as moderating the path from technological confidence to entrepreneurial intention.

At the policy level, aligning vocational education strategies with national AI and digital transformation agendas can support the development of AI-enabled entrepreneurship programs. Collaborative efforts among vocational institutions, universities, and industry partners can expand access to AI-focused entrepreneurship modules and experiential learning opportunities. Career development services should also integrate AI Literacy assessments, digital skills enhancement, and entrepreneurship coaching to empower students with the mindset and competencies needed for digital entrepreneurship. By reinforcing both cognitive readiness and practical capability, institutions can better prepare students to participate competitively in Indonesia's evolving digital economy.

V. Conclusion

This study demonstrates that AI Literacy plays a critical role in shaping entrepreneurial development among vocational students in Indonesia. AI Literacy was found to significantly enhance both Technology Self-Efficacy and Digital Competencies, reinforcing its position as a foundational competency in digital entrepreneurship. While Technology Self-Efficacy did not directly predict Entrepreneurial Intention, it contributed to the formation of Entrepreneurial Mindset and Attitude, suggesting that psychological readiness alone may be insufficient without supportive institutional or environmental conditions. In contrast, Digital Competencies emerged as a strong and consistent predictor of Entrepreneurial Mindset, Attitude, and Intention, highlighting the importance of practical digital skills in enabling entrepreneurship. The dual mediation of Technology Self-Efficacy and Digital Competencies further illustrates that AI Literacy influences entrepreneurial motivation through intertwined psychological and operational pathways. Collectively, these findings advance entrepreneurship theory by positioning AI Literacy as a cognitive antecedent and clarify the distinct roles of belief systems and digital capabilities in the technology-entrepreneurship nexus. Situated within Indonesia's dynamic vocational education system, this study provides a distinctive emerging-economy perspective that enriches predominantly Western-centric literature on digital entrepreneurship. The findings are transferable to comparable developing economies in Southeast Asia and beyond, offering evidence-based guidance for policymakers and curriculum designers seeking to develop AI-integrated entrepreneurship programs.

Several limitations should be acknowledged. The cross-sectional design restricts causal interpretation, indicating the value of future longitudinal studies to capture changes in entrepreneurial intention over time. The use of purposive sampling limits generalizability, suggesting the need for more diverse sampling approaches across regions and institution types. Additionally, the focus on vocational students invites future comparative studies involving non-vocational populations or investigations of moderating factors such as institutional digital readiness, socioeconomic background, and entrepreneurial exposure. As AI technologies continue to evolve, future research may also explore how AI-assisted learning environments, adaptive feedback systems, and generative AI tools shape entrepreneurial competencies, innovation behaviors, and digital venture creation.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

IPD and NAN conducted the research; YAF analyzed the data; RF wrote the paper; all authors have approved the final version.

References

[1] D. Chalmers, N. G. MacKenzie, and S. Carter, "Artificial intelligence and entrepreneurship: implications for venture creation in the fourth industrial revolution," *Entrepreneurship: Theory and Practice*, vol. 45, no. 5, pp. 1028–1053, 2021. doi: 10.1177/1042258720934581

[2] I. Hamburg, E. O'Brien, and G. Vladut, "Entrepreneurial learning and AI literacy to support digital entrepreneurship," *Balkan Region Conference on Engineering and Business Education*, vol. 2019-Octob, no. 1, pp. 132–144, 2019. doi: 10.2478/cplbu-2020-0016

[3] W. O. Odumu and E. B. Enya, "Bridging AI literacy skill sets gap: A critical priority now and the future in developing countries," *Newport International Journal of Scientific and Experimental Sciences*, vol. 6, no. 1, pp. 16–26, 2025. doi: 10.59298/nijses/2025/61.1626

[4] A. D. Samala *et al.*, "Global publication trends in augmented reality and virtual reality for learning: The last twenty-one years," *International Journal of Engineering Pedagogy*, vol. 13, no. 2, pp. 109–128, 2023. doi: 10.1007/978-981-19-8016-9

[5] I. Hojiyeva, "Knowledge economy and its prospects for student development," *Ilg'or iqtisodiyot va pedagogik texnologiyalar*, vol. 2, no. 2, pp. 81–85, 2025. doi: 10.60078/3060-4842-2025-vol2-iss2-pp81-85

[6] Ganefri, R. Fadillah, and H. Hidayat, "Designing interface based on digipreneur to increase entrepreneurial interest in engineering students," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 12, no. 1, pp. 78–84, 2022. doi: 10.18517/ijaseit.12.1.13915

[7] M. H. Muflihin and C. Warsito, "Independent learning policy for quality strategic educational management using IT skills: A case of Merdeka Campus (MBKM) program in Indonesia," *Quality - Access to Success*, vol. 25, no. 198, pp. 351–360, 2024. doi: 10.47750/QAS/25.198.37

[8] A. Yulastri, H. Hidayat, Ganefri, S. Yondri, and I. Ifdil, "Contribution of production-based learning, student engagement, and locus of control towards entrepreneurship learning outcomes in engineering education," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 10, no. 2, pp. 585–592, 2020. doi: 10.18517/ijaseit.10.2.9365

[9] S. Hidayat, N. Kusumawati, N. Affandi, E. Ende, and E. T. Afiah, "Determinants of entrepreneurial intention among undergraduate students in Indonesia," in *Proc. Conference: 4th Social and Humanities Research Symposium (SoRes 2021)*, 2022, Atlantis Press. doi: 10.2991/assehr.k.220407.123

[10] Yuliana and H. Hidayat, "How to implement technology science for entrepreneurship by using product-based learning approach and participatory action learning system in higher education?" *Adv. Sci. Lett.*, vol. 23, no. 11, pp. 10918–10921, 2017. doi: 10.1166/asl.2017.10186

[11] A. Pius, A. Habib, A. Ntia, C. Manian, and H. Alharahsheh, "Contextualizing entrepreneurial intentions: Psychological, traits and behavioral theory," *International Journal of Sustainable Approach to Education Practice*, pp. 1–8, 2022. doi: 10.59268/taas/010720222

[12] H. Hidayat, B. Y. Tamin, S. Herawati, Z. Ardi, and A. P. Muji, "The contribution of internal locus of control and self-concept to career maturity in engineering education," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 10, no. 6, pp. 2282–2289, 2020.

[13] N. Bachmann, R. Rose, V. Maul, and K. Hölzle, "What makes for future entrepreneurs? The role of digital competencies for entrepreneurial intention," *J. Bus. Res.*, vol. 174, 2024. doi: 10.1016/j.jbusres.2023.114481

[14] R. Mancha and G. Shankaranarayanan, "Making a digital innovator: antecedents of innovativeness with digital technologies," *Information Technology and People*, vol. 34, no. 1, pp. 318–335, 2021. doi: 10.1108/ITP-12-2018-0577

[15] T. T. Nguyen, T. T. Dao, T. B. Tran, H. T. T. Nguyen, L. T. N. Le, and N. T. T. Pham, "Fintech literacy and digital entrepreneurial intention: Mediator and moderator effect," *International Journal of Information Management Data Insights*, vol. 4, no. 1, 2024. doi: 10.1016/j.jjimei.2024.100222

[16] C. D. Duong, T. T. Le, N. S. Dang, N. D. Do, and A. T. Vu, "Unraveling the determinants of digital entrepreneurial intentions: do performance expectancy of artificial intelligence solutions matter?" *Journal of Small Business and Enterprise Development*, vol. 31, no. 7, pp. 1327–1356, 2024. doi: 10.1108/JSBED-02-2024-0065

[17] D. Long and B. Magerko, "What is AI literacy? Competencies and design considerations," in *Proc. on Human Factors in Computing Systems*, Association for Computing Machinery, Apr. 2020. doi: 10.1145/3313831.3376727

[18] Ganefri, W. Kamdi, M. Makky, H. Hidayat, and Y. Rahmawati, "Entrepreneurship education and entrepreneurial intention among university students: The roles of entrepreneurial mindset, digital literacy, and self-efficacy," *Journal of Social Studies Education Research*, vol. 15, no. 4, pp. 85–134, 2024.

[19] I. Hamburg, E. O'Brien, and G. Vlăduț, "Entrepreneurial learning and AI literacy to support digital entrepreneurship," in *Proc. Balkan Region Conference on Engineering and Business Education*, 2019, vol. 3, pp. 132–144.

[20] A. Bandura, "Social-cognitive theory," *An Introduction to Theories of Personality*, Psychology Press, 2014, pp. 341–360.

[21] A. Rattan and O. A. M. Georgeac, "Understanding intergroup relations through the lens of implicit theories (mindsets) of malleability," *Soc. Personal. Psychol. Compass*, vol. 11, no. 4, 2017. doi: 10.1111/spc3.12305

[22] M. M. Ghani, W. A. Mustafa, D. L. S. Bakhtiar, and M. Khairudin, "A comprehensive study: AI literacy as a component of media literacy," *Journal of Advanced Research in Applied Sciences and Engineering Technology*, vol. 53, no. 2, pp. 112–121, 2025. doi: 10.37934/araset.53.2.112121

[23] D. T. K. Ng, J. K. L. Leung, S. K. W. Chu, and M. S. Qiao, "Conceptualizing AI literacy: An exploratory review," *Computers and Education: Artificial Intelligence*, vol. 2, 2021. doi: 10.1016/j.caeai.2021.100041

[24] F. O. Olatoye, K. F. Awonuga, N. Z. Mhlongo, C. V. Ibeh, O. A. Elufioye, and N. L. Ndubuisi, "AI and ethics in business: A comprehensive review of responsible AI practices and corporate responsibility," *International Journal of Science and Research Archive*, vol. 11, no. 1, pp. 1433–1443, 2024. doi: 10.30574/ijsra.2024.11.1.0235

[25] N. Janković, D. Lečić-Cvetković, and T. Rajković, "Entrepreneurship empowered by artificial intelligence," in *Proc. 44th International Conference on Organizational Science Development*, University of Maribor Press, 2025. doi: 10.18690/um.fov.2.2025.26

[26] J. M. R. Asio, "AI literacy, self-efficacy, and self-competence among college students: Variances and interrelationships among variables," *Malaysian Online Journal of Educational Sciences (MOJES)*, vol. 12, no. 3, pp. 44–60, 2024. doi: 10.22452/aldad.vol12no3.4

[27] Y. Walter, "Embracing the future of artificial intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education," *International Journal of Educational Technology in Higher Education*, vol. 21, no. 1, 2024. doi: 10.1186/s41239-024-00448-3

[28] K. Stolpe and J. Hallström, "Artificial intelligence literacy for technology education," *Computers and Education Open*, vol. 6, 2024. doi: 10.1016/j.caeo.2024.100159

[29] A. S. Scarci, T. M. Teixeira, and L. F. Dal Forno, "Artificial intelligence and its relations with digital competencies and education," *Concilium*, vol. 24, no. 21, pp. 43–59, 2024. doi: 10.53660/clm-4374-24v38

[30] I. P. Dewi, Ambiyar, H. Effendi, M. Giatman, H. F. Hanafi, and S. K. Ali, "The impact of virtual reality on programming algorithm courses on student learning outcomes," *International Journal of Learning, Teaching and Educational Research*, vol. 23, no. 10, pp. 45–61, Oct. 2024. doi: 10.26803/ijlter.23.10.3

[31] Ansani and H. M. Samsir, "Teori pemodelan Bandura," *Jurnal Multidisiplin Madani*, vol. 2, no. 7, pp. 3067–3080, 2022. doi: 10.55927/mudima.v2i7.692

[32] M. A. Ariffien, M. Zakaria, S. N. Syed Yusuf, and J. H. Ahmad, "Technology adoption, self-efficacy and entrepreneurial business success," *Journal of Nusantara Studies (JONUS)*, vol. 8, no. 3, pp. 257–276, 2023. doi: 10.24200/jonus.vol8iss3pp257-276

[33] T. van der Westhuizen and M. J. Goyayi, "The influence of technology on entrepreneurial self-efficacy development for online business start-up in developing nations," *International Journal of Entrepreneurship and Innovation*, vol. 21, no. 3, pp. 168–177, 2020. doi: 10.1177/1465750319889224

[34] B. A. Balgiu, "Internet entrepreneurial self-efficacy and intention. The mediating role of the theory of planned behavior," *Revista de Psihologie*, vol. 71, no. 1, pp. 21–36, 2025. doi: 10.59277/rpsih.2025.1.02

[35] A. Alferaih, "Starting a new business? Assessing university students' intentions towards digital entrepreneurship in Saudi Arabia," *International Journal of Information Management Data Insights*, vol. 2, no. 2, 2022. doi: 10.1016/j.jjimei.2022.100087

[36] D. C. Doanh, "The moderating role of self-efficacy on the cognitive process of entrepreneurship: An empirical study in Vietnam," *Journal of Entrepreneurship, Management and Innovation*, vol. 17, no. 1, pp. 147–174, 2021. doi: 10.7341/20211715

[37] J. Almeida and A. D. Daniel, "Alertness required! Fostering students' alertness to scanning and search through entrepreneurial learning experiences," in *Proc. Conference: Encuentro Ibérico de Investigación y Educación de emprendimiento GEM-CEE*, 2020, IATED. doi: 10.21125/inted.2020.1113

[38] S. Saadat, A. Aliakbari, A. A. Majd, and R. Bell, "The effect of entrepreneurship education on graduate students' entrepreneurial alertness and the mediating role of entrepreneurial mindset," *Education and Training*, vol. 64, no. 7, pp. 892–909, 2022. doi: 10.1108/ET-06-2021-0231

[39] B. N. M. Alnasib, "Digital competencies: Are pre-service teachers qualified for digital education?" *International Journal of Education in Mathematics, Science and Technology*, vol. 11, no. 1, pp. 96–114, 2023. doi: 10.46328/ijemst.2842

[40] R. Fadillah, Ganefri, A. Yulastri, and H. Hidayat, "Development of mobile learning based on digital entrepreneurs using Raspberry Pi on TVET," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 13, no. 6, pp. 2231–2239, 2023. doi: 10.18517/ijaseit.13.6.18608

[41] S. Kraus, C. Palmer, N. Kailer, F. L. Kallinger, and J. Spitzer, "Digital entrepreneurship: A research agenda on new business models for the twenty-first century," *International Journal of Entrepreneurial Behaviour and Research*, vol. 25, no. 2, pp. 353–375, 2019. doi: 10.1108/IJEBR-06-2018-0425

[42] J. Jardim, "Entrepreneurial skills to be successful in the global and digital world: Proposal for a frame of reference for entrepreneurial education," *Education Sciences*, vol. 11, no. 7, 2021. doi: 10.3390/educsci11070356

[43] N. A. R. Efendi and A. Faisal, "Integrasi pelatihan kewirahusahaan berbasis digital untuk pengembangan UMKM dan peningkatan ekonomi lokal," *AKSIOMA: Jurnal Sains Ekonomi dan Edukasi*, vol. 2, no. 4, pp. 814–820, 2025. doi: 10.62335/aksioma.v2i4.1167

[44] K. Afawubo and Y. A. Noglo, "ICT and entrepreneurship: A comparative analysis of developing, emerging and developed countries," *Technol. Forecast. Soc. Change*, vol. 175, 2022. doi: 10.1016/j.techfore.2021.121312

[45] R. Fadillah *et al.*, "Digital entrepreneurship research for learning and teaching in education: A bibliometric analysis," *TEM Journal*, pp. 1997–2011, Aug. 2024. doi: 10.18421/tem133-28

[46] A. Gudi, R. Chinta, and A. Jin, "Competencies and capabilities as determinants of digital entrepreneurship: An empirical validation," *Journal of International Technology and Information Management*, vol. 32, no. 1, pp. 271–302, 2024. doi: 10.58729/1941-6679.1587

[47] A. R. Riyanda *et al.*, "Digital skills and technology integration challenges in vocational high school teacher learning," *Data and Metadata*, vol. 4, Jan. 2025. doi: 10.56294/dm2025553

[48] W. J. He and K. Zhang, "The moderating effect of cultural orientation on the relationship between growth mindset and learning self-efficacy: A dimension-specific pattern," *Behavioral Sciences*, vol. 14, no. 12, 2024. doi: 10.3390/bs14121155

[49] M. Obschonka *et al.*, "Artificial intelligence and entrepreneurship: A call for research to prospect and establish the scholarly AI frontiers," *Entrepreneurship Theory and Practice*, 2025, SAGE Publications Sage CA: Los Angeles, CA. doi: 10.1177/10422587241304676

[50] I. Ajzen, "The theory of planned behavior," *Handbook of Theories of Social Psychology: Volume 1*, vol. 50, no. 2, pp. 438–459, 2012. doi: 10.4135/9781446249215.n22

[51] F. Liñán and A. Fayolle, "A systematic literature review on entrepreneurial intentions: Citation, thematic analyses, and research

agenda," *International Entrepreneurship and Management Journal*, vol. 11, no. 4, pp. 907–933, 2015. doi: 10.1007/s11365-015-0356-5
[52] M. Der Foo, "Emotions and entrepreneurial opportunity evaluation," *Entrepreneurship: Theory and Practice*, vol. 35, no. 2, pp. 375–393, 2011. doi: 10.1111/j.1540-6520.2009.00357.x
[53] M. S. Cardon and C. P. Kirk, "Entrepreneurial passion as mediator of the self–efficacy to persistence relationship," *Entrepreneurship Theory and Practice*, vol. 39, no. 5, pp. 1027–1050, 2015.
[54] J. S. McMullen, A. W. Ding, and S. Li, "From cultural entrepreneurship to economic entrepreneurship in cultural industries: The role of digital serialization," *J. Bus. Venturing*, vol. 36, no. 6, 2021. doi: 10.1016/j.jbusvent.2021.106157
[55] Y. A. Fiandra, A. Yulastri, Ganefri, and R. H. Sakti, "The impact of work experience on entrepreneurial intention among vocational education students," *Journal of Technical Education and Training*, vol. 15, no. 4, pp. 37–49, Dec. 2023. doi: 10.30880/jtet.2023.15.04.004
[56] G. Nabi, F. Liñán, A. Fayolle, N. Krueger, and A. Walmsley, "The impact of entrepreneurship education in higher education: A systematic review and research agenda," *Academy of Management Learning and Education*, vol. 16, no. 2, pp. 277–299, 2017. doi: 10.5465/amle.2015.0026
[57] S. M. Hasan, E. A. Khan, and M. N. U. Nabi, "Entrepreneurial education at university level and entrepreneurship development," *Education and Training*, vol. 59, no. 7–8, pp. 888–906, 2017. doi: 10.1108/ET-01-2016-0020
[58] C. D. Duong, T. H. Nguyen, T. V. Chu, T. V. Pham, and N. D. Do, "Whether ChatGPT adoption inspires higher education students' digital entrepreneurial intention? An integrated model of the SCCT and the TPB," *International Journal of Innovation Science*, 2024. doi: 10.1108/IJIS-01-2024-0020
[59] I. P. Dewi *et al.*, "Explaining VR/AR learning in medical education: A comparative PLS-SEM analysis of TAM, SDT, TTF, and flow theory," *Seminars in Medical Writing and Education*, vol. 4, Sep. 2025. doi: 10.56294/mw2025799
[60] L. Rosalina, Y. A. Fiandra, R. Fadillah, R. Amran, and E. B. Işık, "Evaluating the impact of digital learning platforms on medical students' engagement: A SEM-PLS approach," *Seminars in Medical Writing and Education*, vol. 4, Nov. 2025. doi: 10.56294/mw2025789
[61] J. F. Hair, M. C. Howard, and C. Nitzl, "Assessing measurement model quality in PLS-SEM using confirmatory composite analysis," *J. Bus. Res.*, vol. 109, pp. 101–110, 2020. doi: 10.1016/j.jbusres.2019.11.069
[62] J. F. Hair, G. T. M. Hult, C. M. Ringle, M. Sarstedt, and K. O. Thiele, "Mirror, mirror on the wall: a comparative evaluation of composite-based structural equation modeling methods," *J. Acad. Mark. Sci.*, vol. 45, no. 5, pp. 616–632, 2017. doi: 10.1007/s11747-017-0517-x
[63] H. Chee, S. Ahn, and J. Lee, "A competency framework for AI literacy: Variations by different learner groups and an implied learning pathway," *British Journal of Educational Technology*, 2024. doi: 10.1111/bjet.13556
[64] D. Long and B. Magerko, "What is AI literacy? Competencies and design considerations," in *Proc. on Human Factors in Computing Systems*, 2020, pp. 1–16. doi: 10.1145/3313831.3376727
[65] N. Krueger, "Entrepreneurial intentions are dead: Long live entrepreneurial intentions," *International Studies in Entrepreneurship*, Springer, vol. 24, 2009, pp. 51–72. doi: 10.1007/978-1-4419-0443-0_4
[66] N. F. Krueger, "What lies beneath? The experiential essence of entrepreneurial thinking," *Entrepreneurship: Theory and Practice*, vol. 31, no. 1, pp. 123–138, 2007. doi: 10.1111/j.1540-6520.2007.00166.x
[67] S. Nambisan, M. Wright, and M. Feldman, "The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes," *Res. Policy*, vol. 48, no. 8, 2019. doi: 10.1016/j.respol.2019.03.018
[68] S. Nambisan, "Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship," *Entrepreneurship: Theory and Practice*, vol. 41, no. 6, pp. 1029–1055, 2017. doi: 10.1111/etap.12254
[69] D. Rae, "The contribution of momentary perspectives to entrepreneurial learning and creativity," *Entrepreneurial Learning: New Perspectives in Research, Education and Practice*, vol. 27, no. 6, pp. 92–116, 2015. doi: 10.4324/9781315857817
[70] D. Rae, "Entrepreneurial learning: A conceptual framework for technology-based enterprise," *Technol. Anal. Strateg. Manag.*, vol. 18, no. 1, pp. 39–56, 2006.
[71] Y. Y. Kor, R. G. McGrath, and I. MacMillan, *The Entrepreneurial Mindset: Strategies for Continuously Creating Opportunity in an Age of Uncertainty*, vol. 26, no. 3. Harvard Business Press, 2001. doi: 10.2307/259188
[72] P. Bahaw, A. Baboolal, A. J. Mack, and K. Carter-Rogers, "Exposure to entrepreneurship education interventions reveal improvements to vocational entrepreneurial intent: A two-wave longitudinal study," *Discover Education*, vol. 3, no. 1, 2024. doi: 10.1007/s44217-024-00241-4
[73] Z. Li and A. Y. M. A. Islam, "Entrepreneurial intention in higher vocational education: An empirically-based model with implications for the entrepreneurial community," *Sage Open*, vol. 11, no. 4, 215824402110591, 2021. doi: 10.1177/21582440211059179
[74] B. Dinger, S. E. Byun, and J. Park, "Integrating AI into curricula: project-based learning in digital entrepreneurship," *International Journal of Fashion Design, Technology and Education*, pp. 1–10, 2024. doi: 10.1080/17543266.2024.2438170
[75] Y. M. Lim, W. P. Lee, and T. M. Lim, "Entrepreneurial and commercialization pathway through project-based learning in higher-education," in Proc. *2019 IEEE International Conference on Engineering, Technology and Education,* 2019. doi: 10.1109/TALE48000.2019.9225964
[76] W. M. Jordan, C. C. Fry, and K. W. Van Treuren, "Promoting the entrepreneurial mindset through faculty development," in *Proc. 2016 ASEE Annual Conference & Exposition*, 2016. doi: 10.18260/p.26007