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From Generative AI-Supported Education to Student Entrepreneurial Performance: An Opportunity Recognition and AI Literacy Perspective through Male Students vs. Female Students

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Abstract: The rapid integration of generative artificial intelligence (GenAI) into entrepreneurship education is creating new opportunities to enhance students' entrepreneurial performance (EP). However, limited attention has been given to whether the benefits of generative AI-supported entrepreneurial education (GAISEE) differ between male and female students. This study examines the relationship between GAISEE and student EP by incorporating entrepreneurial opportunity recognition (EOR) as a mediator and entrepreneurial AI literacy as a moderator. Data was collected from 184 students through a structured questionnaire and analyzed using partial least squares structural equation modelling (PLS-SEM). The findings show that GAISEE significantly enhances EOR and student EP. EOR also provides a significant indirect pathway between GAISEE and student EP. Entrepreneurial AI literacy significantly strengthens the relationship between GAISEE and student EP, although its moderating effect on opportunity recognition is insignificant. Importantly, the multi-group analysis reveals a significant gender difference in the GAISEE–performance relationship. The relationship is stronger among male students ($\beta = 0.342$) than female students ($\beta = 0.221$), with a significant group difference ($p=0.035$). These findings highlight the importance of gender-sensitive and AI-literate entrepreneurship education.

Keywords: Student Entrepreneurial Performance, AI-Supported Entrepreneurial Education, Entrepreneurial AI Literacy, Entrepreneurial Opportunity Recognition, Generative Artificial Intelligence, Gender Differences.

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1. Introduction

The rapid advancement of generative artificial intelligence (GenAI) is transforming the way knowledge is created, accessed, and applied across educational contexts (Alier Forment et al., 2024; Cordero et al., 2025; Samala et al., 2025). Unlike conventional digital

learning technologies, GenAI tools can generate content, provide interactive feedback, support problem-solving, analyses information, and assist learners in developing context-specific ideas (Liyanagamage & Gallage, 2026). These capacities provide new opportunities for entrepreneurship education that require students to learn theory as well as recognize opportunities, think creatively, make business plans and deal with uncertainty (Dwivedi, 2025; Kusetogullari et al., 2025). Therefore, the incorporation of GenAI in entrepreneurship education has become a crucial area to enhance students' entrepreneurship skills and performance.

Entrepreneurial education with generative AI (GAISEE) can offer more interactive and technology-supported learning experiences to students (Bell & Bell, 2023). Students use AI-powered learning experiences to investigate business models, analyze market currents, brainstorm business concepts and plan for new businesses. This application of GenAI in entrepreneurship education might prolong the traditional scope of entrepreneurial learning (Amoakohene et al., 2026) by enabling students to quickly access information and decision support. The literature indicate that the integration of GenAI into entrepreneurship education can positively impact entrepreneurial outcomes (Le et al., 2026) by boosting students' confidence and offering institutional support for entrepreneurial learning (Xie & Wang, 2025). In this context, the question arises whether GAISEE leads to better student entrepreneurial performance (EP) is becoming more relevant.

Another mechanism by which GAISEE can impact EP is via entrepreneurial opportunity recognition (EOR). Opportunity recognition is the skill in which students can detect opportunities for new ventures and stay aware of new opportunities for entrepreneurs (Otache et al., 2024). Learners who are more attuned to potential opportunities may be more likely to be able to turn knowledge and learning experiences into entrepreneurial action. Therefore, EOR is a mediator between GAISEE and student EP in the present study. This view aligns with the conceptualization of opportunity recognition as one of the key entrepreneurial skills, which helps the entrepreneur to recognize and assess possible venture opportunities (Wang et al., 2013). The study takes a step beyond just looking at the direct impact of AI in education and explores the potential for educational experiences to be transferred into entrepreneurial results through the lens of opportunity recognition.

Concurrently, the success of entrepreneurial education with the help of GenAI can also rely on students' understanding and utilization of AI. Entrepreneurial AI literacy is one of the key individual abilities for this context (Duong, 2025) as students should be familiar with the role AI technologies can play in entrepreneurial activities and with the applications of AI relevant to entrepreneurship (Duong, 2026a). An increase in entrepreneurial AI literacy can potentially help students make more effective use of AI-enabled learning experiences and apply AI-generated information in entrepreneurial settings (Duong, 2026b). Therefore, this study explores the moderating role of entrepreneurial AI literacy in the relationships between GAISEE, EOR, and student EP. The introduction of this boundary condition helps to provide a fuller picture on when AI-supported entrepreneurship education will be more effective. Moreover, students' reactions to entrepreneurial education supported by GenAI can vary. The translation of educational experiences and technology supported learning to entrepreneurial outcomes could be different for males and females. Considering gender differences can also help determine if the relationship between GAISEE and student EP is the same within student groups. This study aims to empirically investigate the relationship between GenAI-supported education and the

benefits it brings to both male and female students, as one group does not necessarily gain more from this experience.

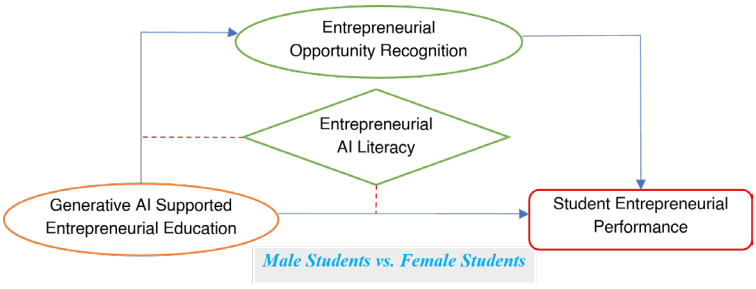
Based on these arguments, the current study proposes an integrated framework that links GAISEE with student EP by focusing on EOR with the consideration of entrepreneurial AI literacy as a moderator, and gender as a group comparison. The study addresses the pressing demand to better understand how emerging GenAI capabilities can be embedded within entrepreneurship education and contribute to the meaningful outcomes of entrepreneurship. Specifically, it investigates the direct relationship between GAISEE and EP, the mediation effect of EOR, the moderation effect of entrepreneurial AI literacy. Additionally, it addressed the difference between male and female students in the relationship between GAISEE and EP. The study combines these relationships in a single framework, offering a more holistic view of the impact of GenAI on modern entrepreneurship education. The study contributed to the ongoing debate regarding the role of AI in education and offers insight into both the nature of the relationship between GAISEE and EP and the potential pathway.

2. Literature Review

2.1. Theoretical Foundation

The study is based on Social Cognitive Theory (SCT) (Martin & Guerrero, 2020) that explains the relationship between the personal factors, environmental factors, and behavioral processes to influence individual behavior and performance. SCT is an ideal approach to explain the role of GAISEE (Tang et al., 2025) as it is an environmental influence that can improve students' knowledge, abilities, and entrepreneurial learning experiences. As shown in Figure 1, GAISEE is likely to affect student EP directly and indirectly via EOR. It is an important cognitive process that is used by students to identify and assess entrepreneurial opportunities. Additionally, entrepreneurial AI literacy is a personal skill which can impact the extent to which students can reap the advantages of entrepreneurial learning with the aid of AI (Alkhalaileh & Qasim, 2026; Duong, 2026a). Therefore, students who are more AI-literate may be more likely to convert their experiences at GAISEE into entrepreneurial outcomes. Figure 1 combines the GAISEE, opportunity recognition, the individual AI literacy, and the student EP in a single SCT-based framework. The model also investigates the difference in the relationship between GAISE and performance between males and females.

Figure 1: Conceptual Model of the Study.



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2.2. Hypotheses Development

2.2.1. Generative AI-Supported Entrepreneurial Education and Student Entrepreneurial Performance

Generative AI entrepreneurial education (GAISEE) can offer students technology-enhanced learning experiences to enhance their understanding of entrepreneurship and their entrepreneurial skills (Dwivedi, 2025). GAISEE allows students to identify potential opportunities, strengthen their innovation and entrepreneurial skills, mitigate uncertainty, evaluate their business models and market conditions and create effective entrepreneurial strategies. These skills can be applied to students to enhance their entrepreneurial outcomes (Ayaz et al., 2025). The learning environment can affect the individual's ability and performance by offering learning opportunities and resources that can impact on the way an individual carries out entrepreneurial activities. From this perspective, AI-driven entrepreneurial education can provide students with valuable knowledge, analytical skills, and strategic competencies that can support their EP. Additionally, previous studies have shown that GenAI integration in entrepreneurship education has the potential to boost entrepreneurial outcomes by improving educational experiences and self-efficacy (Xie & Wang, 2025). Thus, it is expected that GAISEE will make a positive contribution to the EP of students, which is highlighted through following hypothesis:

Hypothesis 1: GAISEE has a significant influence on student EP.

2.2.2. Mediating role of Entrepreneurial Opportunity Recognition between Generative AI-Supported Entrepreneurial Education and Student Entrepreneurial Performance

GAISEE can improve students' ability to identify entrepreneurial opportunities (Rahal et al., 2026) by delivering AI-powered information, ideas, market insights, and analysis. Students can use AI-supported learning activities to explore possible venture ideas, discuss business models, study market trends (Gong et al., 2026) and gain a deeper understanding of the opportunities that can arise during the entrepreneurial process. EOR for the present study is defined as the ability of students to detect new venture opportunities in their daily activities, sensitivity to new opportunities, and the ability to naturally detect opportunities for entrepreneurship (Mary George et al., 2016). These features are especially useful in an educational setting where GenAI can offer students a variety of information and help guide them towards exploring entrepreneurial options. GAISEE, as seen from the perspective of Social Cognitive Theory (Bandura, 1991; Mehmood et al., 2024) is an environmental learning which can influence students' cognitive capabilities and entrepreneurial responses. Such exposure to entrepreneurial learning through AI can then enhance students' capacity to identify, understand and assess opportunities (Weng et al., 2025). Students who have higher EOR abilities also are more likely to be able to convert their entrepreneurial knowledge and learning experiences into EP. Furthermore, the impact of GAISEE on EP could be mediated at least in part by students increased EOR capability. Therefore, EOR is an important cognitive mechanism between AI-supported entrepreneurial education and entrepreneurial outcomes. Wang et al. (2013) view EOR as a key competency for detecting potential entrepreneurial opportunities in entrepreneurial learning environments. Hence, following hypotheses are proposed:

Hypothesis 2: GAISEE has a significant influence on EOR.
Hypothesis 3: EOR has a significant influence on student EP.

Hypothesis 4: EOR mediates the relationship between GAISEE student EP.

2.2.3. Moderating role of Entrepreneurial AI Literacy

Entrepreneurial AI literacy is the student's comprehension, identification and utilization of AI technologies in entrepreneurial initiatives (Iram et al., 2026). In this current study it represents students' knowledge of the support that AI can provide entrepreneurship (Gretchen et al., 2026), and the capacity to recognize AI technologies in entrepreneurial applications and products. Personal capabilities might affect the interpretation and transformation of the learning experiences in the environment into cognitive and behavioral outcomes. Therefore, students who are more knowledgeable about the AI literacy of entrepreneurs would be more capable of utilizing the knowledge and analytical support (Nurliana & Azis, 2026) they receive through GAISEE. This kind of literacy can enhance literacy skills in interpreting information provided by AI, in considering entrepreneurial opportunities and in finding ways for a potential business venture (Hajizadeh et al., 2026).

Hence, there is expected to be an increase in the positive correlation between GAISEE and EOR as entrepreneurial AI literacy improves. Likewise, students with higher AI literacy might have better ability to transform AI-supported entrepreneurial learning into actual entrepreneurial outcomes, through their ability to apply the knowledge and capabilities of AI to entrepreneurial activities. Therefore, entrepreneurial AI literacy could also enhance the EP of students and the relationship between GAISEE. Such connections place entrepreneurial AI literacy as an important boundary condition that impacts how students can benefit from entrepreneurial education with AI. Consequently, following hypotheses are proposed:

Hypothesis 5: Entrepreneurial AI literacy moderates the relationship between GAISEE and EOR.

Hypothesis 6: Entrepreneurial AI literacy moderates the relationship between GAISEE and student EP.

2.2.4. Difference between Male Students vs. Female Students while Considering the Relationship between Generative AI-Supported Entrepreneurial Education and Student Entrepreneurial Performance

Male and female students may have varying experiences in technology-supported learning environments (Dang et al., 2016) and may experience different ways of mapping learning experiences onto entrepreneurial results. Generative AI in entrepreneurial education (GAISEE) offers students chances to immerse themselves in entrepreneurial concepts (Huo et al., 2025), examine business models and market trends, boost their innovation skills, and create AI-driven entrepreneurial strategies. The impact of these learning experiences on EP might be gender-specific, as the level of involvement in technology, learning experiences, or the use of entrepreneurial knowledge may differ among the genders. Learning experiences from the environment affect subsequent capabilities and performance (Coleman & Kariv, 2013; Howard, 2014; Perryman et al., 2016), and these experiences are mediated by the individual's characteristics. Thus, gender could be an important grouping variable to consider in the analysis of the business activities (Hussain et al., 2023) along with GAISEE and EP relationship. This study does not assume that male or female students would necessarily gain more from GAISEE, but rather, if there is a significant difference in the strength of the relationship between the two. A multi-group comparison can offer more insight into the consistency

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of the effect of GAISEE on EP and whether gender is a relevant source of variability in the relationship between GAISEE and EP. Therefore, it is proposed that:

Hypothesis 7: The relationship between GAISEE and student EP significantly differs between male and female students.

3. Methodology

3.1. Research Design and Participants

This study aims to investigate the relationships between GAISEE, EOR, entrepreneurial AI literacy, and student EP by using quantitative methods. The research was conducted with students who had experienced entrepreneurship education and known about digital and AI-supported learning technologies. Eligible students were asked to fill out a structured questionnaire to gather data. Convenience sampling was used in this study, with questionnaires being given to students who were readily available. The respondents were asked to participate voluntarily, and their responses would only be used for academic research purposes.

3.2. Measurement

This study developed questionnaires by adapting the scale items from previous studies, as shown in Table 1. Six scale items were adapted from Xie and Wang (2025) to measure GAISEE. Furthermore, EOR was measured through three scale items adapted from Wang et al. (2013). Entrepreneurial AI literacy was measured by using three scale items adapted from Duong (2025). Finally, three scale items are adapted from Liu et al. (2024) to measure student EP.

Table 1: Questionnaire Item.

Variables		Items
Generative AI-Supported Entrepreneurial Education	1.	Participation in GAISEE deepens understanding of entrepreneurship.
	2.	The content of GAISEE courses has made me aware of new opportunities that may arise during the entrepreneurial process.
	3.	I believe that using generative artificial intelligence technology in entrepreneurship education enhances my innovation and entrepreneurial capabilities.
	4.	I trust that the generative artificial intelligence tools provided in the entrepreneurship education course will assist in reducing risks and uncertainties in future entrepreneurial endeavors.
	5.	The artificial intelligence models used in the course offer valuable insights for analyzing business models and market trends.
	6.	Through learning in the entrepreneurship education course, I am convinced that I can employ artificial intelligence support to develop effective entrepreneurial strategies.
Entrepreneurial Opportunity Recognition	1.	While going about routine day-to-day activities, I see potential new venture ideas all around me.
	2.	I have a special “alertness” or sensitivity toward new venture opportunities
	3.	“Seeing” potential new venture opportunities come very naturally to me.
Entrepreneurial AI Literacy	1.	I can distinguish between smart devices and non-smart devices while carrying out entrepreneurship activities.
	2.	I know how AI technology can help me while carrying out entrepreneurship activities.
	3.	I can identify the AI technology employed in the applications and products I use while carrying out entrepreneurship activities.
Student Entrepreneurial Performance	1.	Entrepreneurship can significantly increase income.
	2.	Entrepreneurship can significantly improve the quality of life.
	3.	Entrepreneurship will improve and enhance living conditions.

3.3. Sample Size and Data Collection

A structured questionnaire was used to gather data from students who had prior experience in entrepreneurship education and exposure to digital and AI-supported learning. Convenience sampling was used to administer 300 questionnaires. The study was voluntary, and the respondents were told the academic aim of the study and the confidentiality of the responses. Following the data collection procedure 184 complete questionnaires were received and were found to be appropriate for analysis, which is 61.33% response rate. The responses collected were screened prior to statistical analysis and only those questionnaires that were sufficiently completed were included in the final analysis. The final sample of 184 respondents was then analyzed for the measurement model and the structural model using PLS-SEM, both direct and indirect, multi-group (moderating) analyses, and gender-based analyses. Hence the sample size was considered sufficiently large to investigate the proposed relationships between GAISEE, EOR, entrepreneurial AI literacy, and student EP.

3.4. Data Analysis Technique

PLS-SEM was used to analyses the collected data. The multi-group comparison, the moderating relationship, the mediating relationship and the direct effects are the elements of the relatively complex model that necessitated using PLS-SEM. Measurement model was used to determine the reliability and validity. To assess internal consistency and convergent validity, the factor loadings, alpha, composite reliability (CR), and average variance extracted (AVE) were examined (Arshad & Fatima, 2026). The Fornell–Larcker criterion was then used to evaluate discriminant validity (Rasoolimanesh, 2022).

Secondly, the structural model was assessed to validate the proposed hypotheses (Magno et al., 2022). The direct effect of GAISEE and entrepreneurial AI literacy, the mediating effect of EOR, and the moderating effects of entrepreneurial AI literacy were examined. Path coefficient (β), t-value and p-values were used to check the significance of the relationships. Finally, a PLS Multi-Group Analysis (PLS-MGA) was performed to explore the potential differences in the relationship between GAISEE and student EP between male and female students. The two groups were compared using their respective path coefficients, the difference of the path coefficients and the level of significance.

4. Data Analysis

Descriptive statistics of the study variables and their measurement items such as mean, standard deviation, excess kurtosis and skewness are shown in Table 2. The mean values are between 2.793 and 3.391, which is a moderate level of agreement for the measurement items. The range of standard deviation values is between 1.168 and 1.402, indicating that students' responses are not too different from each other. The excess kurtosis values are in the range of –1.233 to –0.766 and the skewness values are in the range of –0.352 to 0.199. Overall, the values suggest that the responses are not significantly different from being approximately symmetrically distributed. The descriptive results are suitable for the next measurement and structural model evaluation.

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Table 2: Data Statistics.

Item	No.	Mean	Standard Deviation	Excess Kurtosis	Skewness
GAISEE1	1	3.234	1.227	-0.766	-0.224
GAISEE2	2	3.391	1.22	-0.839	-0.352
GAISEE3	3	2.891	1.193	-0.792	-0.021
GAISEE4	4	2.859	1.282	-0.984	0.095
GAISEE5	5	2.886	1.208	-0.92	0.072
GAISEE6	6	2.929	1.29	-1.097	0.194
EOR1	7	2.962	1.333	-1.186	0.126
EOR2	8	2.995	1.329	-1.091	0.15
EOR3	9	3.054	1.326	-1.146	0.097
EAIL1	10	3.082	1.402	-1.233	0.021
EAIL2	11	2.875	1.189	-0.803	0.088
EAIL3	12	2.935	1.168	-0.806	0.148
STEP1	13	2.897	1.262	-1.056	0.033
STEP2	14	2.793	1.251	-0.975	0.179
STEP3	15	2.793	1.26	-0.877	0.199

The factor loadings, Cronbach's alpha, CR, and AVE of the constructs of the study are shown in Table 3. Generally, the reported factor loadings are high (ranging from 0.844 to 0.947), which is acceptable as values are above 0.7. Cronbach's alpha values are between .868 and .933; composite reliability values range from .919 to .958. The items reliability is satisfactory with these values (Razzaq, 2020). In addition, the AVE values are between 0.791 and 0.883, which is higher than the threshold of 0.5 (Zeng et al., 2021). Therefore, the constructs have good convergent validity. The detail of the factor structure of the measurement model is further depicted in Figure 2, which demonstrates that the observed variables loaded strongly on their corresponding latent variables.

Figure 2: Factor Analysis.

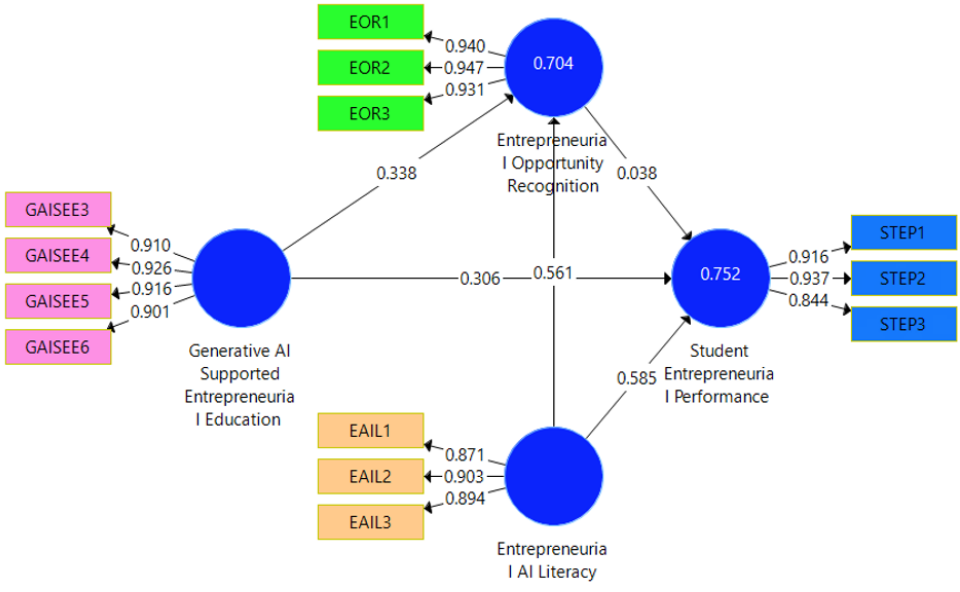

Table 3: Factor Analysis and Convergent Validity.

Construct	Item	Loading	Alpha	CR	AVE
Entrepreneurial AI Literacy	EAIL1	0.871	0.868	0.919	0.791
	EAIL2	0.903			
	EAIL3	0.894			
Entrepreneurial Opportunity Recognition	EOR1	0.94	0.933	0.958	0.883
	EOR2	0.947			
	EOR3	0.931			
Generative AI Supported Entrepreneurial Education	GAISEE3	0.91	0.934	0.953	0.835
	GAISEE4	0.926			
	GAISEE5	0.916			
	GAISEE6	0.901			
Student Entrepreneurial Performance	STEP1	0.916	0.882	0.927	0.81
	STEP2	0.937			
	STEP3	0.844			

The discriminant validity is conducted according to the Fornell–Larcker criterion and the results are presented in Table 4 (Afthanorhan et al., 2021). The diagonal values are the square root of the Ave for each construct and are greater than the inter construct correlations (Hilkenmeier et al., 2020). For instance, the square root of AVE for entrepreneurial AI literacy is 0.890, whereas the correlations are 0.806, 0.728, and 0.839 with EOR, GAISEE, and student EP, respectively. Likewise, the square root of AVE for EOR is 0.939, which is greater than that of the other constructs' correlations and also higher than the recommended threshold of 0.5 (Hussain et al., 2025). These results suggest that the various constructs showed more variation with their respective indicators than with the other constructs, thus demonstrating discriminant validity of the measurement model.

Table 4: Fornell-Larcker Criterion.

	Entrepreneurial AI Literacy	EOR	GAISEE	Student Entrepreneurial Performance
Entrepreneurial AI Literacy	0.89			
EOR	0.806	0.939		
GAISEE	0.728	0.745	0.914	
Student Entrepreneurial Performance	0.839	0.738	0.76	0.9

The results of the direct effects and moderation analysis are shown in Table 5. The results indicated that there are positive and significant relationships between entrepreneurial AI literacy and EOR ($\beta = 0.561$, $t = 11.978$, $p < 0.001$) and student EP ($\beta = 0.570$, $t = 8.976$, $p < 0.001$). GAISEE also has a positive and significant effect on EOR ($\beta = 0.338$, $t = 6.684$, $p < 0.001$) and student EP ($\beta = 0.285$, $t = 4.740$, $p < 0.001$). Thus, the direct-effect findings indicate the proposed links between GAISEE and entrepreneurial AI literacy. But the direct effect of EOR on student EP is not significant ($\beta = 0.038$, $t = 0.542$, $p = 0.588$). The structural path model is shown in Figure 3.

The results of the moderation further demonstrate the role of entrepreneurial AI literacy. The interaction between GAISEE and entrepreneurial AI literacy in predicting EOR is not significant ($\beta = 0.000$, $t = 0.006$, $p = 0.995$). However, the correlation between GAISEE and entrepreneurial AI literacy with student EP is positive and significant ($\beta = 0.158$, $t = 2.532$, $p = 0.012$). This suggests that the relationship between GAISEE and student EP is quite different when it is measured with entrepreneurial AI literacy. This important moderation effect is illustrated graphically in Figure 4.

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Figure 3: Path Analysis.

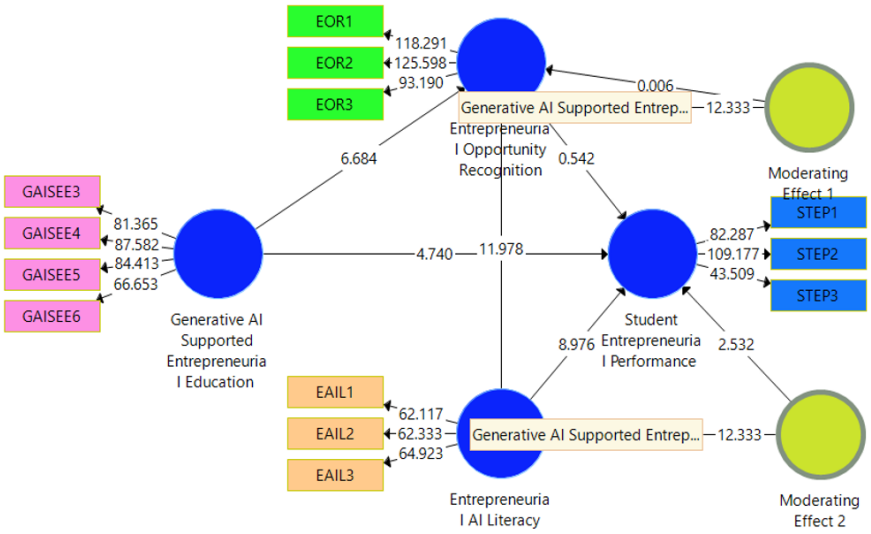

Table 5: Results-Direct Effect.

	β	Mean	(STDEV)	T Statistics	P Values
Entrepreneurial AI Literacy -> EOR	0.561	0.561	0.047	11.978	0
Entrepreneurial AI Literacy -> Student Entrepreneurial Performance	0.57	0.574	0.063	8.976	0
EOR -> Student Entrepreneurial Performance	0.038	0.029	0.071	0.542	0.588
GAISEE -> EOR	0.338	0.333	0.051	6.684	0
GAISEE -> Student Entrepreneurial Performance	0.285	0.285	0.06	4.74	0
Moderating Effect 1 (GAISEE* Entrepreneurial AI Literacy -> EOR)	0.00	0.004	0.073	0.006	0.995
Moderating Effect 2 (GAISEE* Entrepreneurial AI Literacy -> Student Entrepreneurial Performance)	0.158	0.163	0.063	2.532	0.012

Figure 4: Moderation Effect Histogram (Moderating Effect 2-GAISEE* Entrepreneurial AI Literacy -> Student Entrepreneurial Performance).

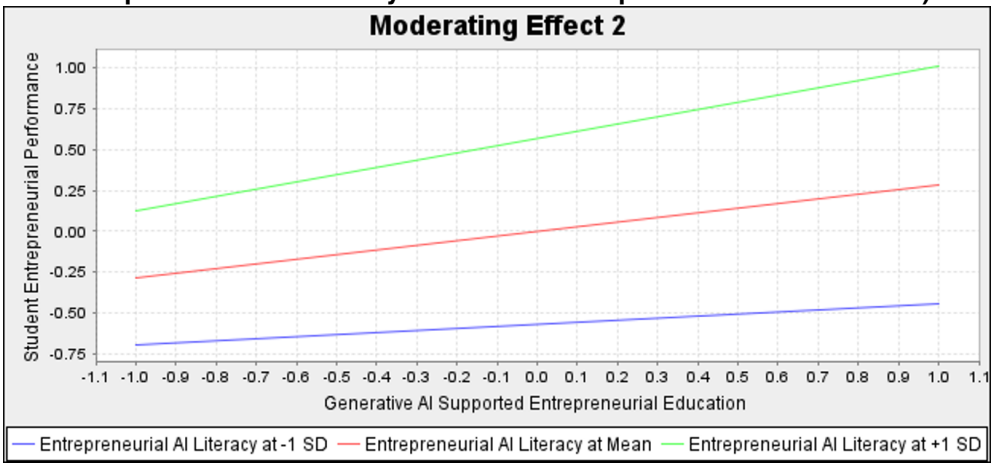

Table 6 shows the indirect effect of GAISEE on student EP via EOR. The indirect effect is positive and statistically significant (β = 0.023, t = 2.030, p = 0.039). This finding suggests that there is an indirect effect of GAISEE on student EP through EOR. The bootstrapping result in Table 5 suggests an insignificant direct pathway between EOR and student EP, although indirect pathway is statistically significant. Thus, the results support the mediation effect of EOR between GAISEE and student EP.

Table 6: Results-Indirect Effect.

	β	Mean	(STDEV)	T Statistics	P Values
GAISEE -> EOR -> Student Entrepreneurial Performance	0.023	0.01	0.011	2.03	0.039

The multi-group analysis is presented in Table 7 to determine if there is a difference in the relationship between GAISEE and student EP between males and females. The path coefficient of male students is (β = 0.342) and female students is (β = 0.221) and the difference between male and female students is (0.121). The reported t-statistics of 2.110 and p-value of 0.035 suggest that the difference between the two groups is statistically significant at the 5% level. This indicates that the relationship between GAISEE and student EP varies significantly for males and females, supporting Hypothesis 7. The findings indicate that there is a relatively higher association of EP with the male students than with the female students in the case of GAISEE.

The overall results of the structural analysis indicate that the GAISEE significantly predicts both EOR and student EP. Additionally, there are strong direct relationships between entrepreneurial AI literacy and both outcomes, which further strengthen the GAISEE–student EP relationship. Furthermore, there is an indirect relationship between GAISEE and student EP via EOR. Finally, the multi-group analysis indicates that the GAISEE–student EP relationship differs significantly between male and female students. The structural model and the estimated relationships between the variables are summarized visually in Figure 3, and the significant moderation pattern is summarized in Figure 4.

Table 7: Results of Multi-Group Analysis: Male Students vs. Female Students.

Relationship	Male Students β	Female Students β	Difference (Male – Female)	T Statistics	P Values	Decision
GAISEE → Student Entrepreneurial Performance	0.342	0.221	0.121	2.110	0.035	Supported

5. Discussion

The results support the proposed framework and show that GAISEE has a relationship with important entrepreneurial outcomes. First, the positive and significant relationship between GAISEE and EP of students (β = 0.285, t = 4.740, p < 0.001) proves that GAISEE has a positive and significant influence on EP of students, supported H1. The implies that AI-based entrepreneurial learning can be helpful for students to convert their learning experiences to better entrepreneurial outcomes. GAISEE offers the opportunity to analyze business models, gain insight into market trends, identify entrepreneurial opportunities, and develop strategies using AI. The findings are similar to Xie and Wang (2025), who determined that GAISEE had a positive impact on entrepreneurial intention and entrepreneurial self-efficacy. These results also show that incorporating GenAI into entrepreneurship education can improve students' entrepreneurial skills and results.

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H2 is also supported, GAISEE positively affects the EOR (β = 0.338, t = 6.684, p < 0.001). It suggests that using AI in learning can help students to be aware of entrepreneurial opportunities. GenAI can enable students to access a wide range of market data, business concepts, and new trends, thereby broadening their cognitive field to consider new opportunities. These results align with the previous studies highlight the relationship between AI and EOR in entrepreneurship (Alam, 2026; Latif et al., 2026; Pirhadi, 2026; Sajed et al., 2026) and highlight that the use of AI in education can increase students' entrepreneurial awareness. However, H3 is rejected since EOR does not have a significant direct effect on student EP (β = 0.038, t = 0.542, p = 0.588). This unexpected finding implies that just identifying entrepreneurial opportunities is not enough to yield better EP. Even though students can recognize potential opportunities, they may still need further knowledge, technological ability, resource or implementation skills to turn opportunities into worthwhile entrepreneurial products. Therefore, opportunity recognition can be cognitively relevant but not necessarily performance relevant. However, these results are inconsistent with studies highlighting the relationship between entrepreneurship opportunity and EP (Alim et al., 2022; Mathafena & Msimango-Galawe, 2022; Wu et al., 2020).

However, interestingly, the relationship between GAISEE and EP of the students is significantly mediated by EOR (β = 0.023, t = 2.030, p = 0.039), supported H4. This finding suggests that one of the ways in which GAISEE affects EP is to enhance the recognition of entrepreneurial opportunities for students. The outcome is especially significant as it implies that the benefits of education with the help of artificial intelligence are not only manifested in direct learning results. Rather, GAISEE can facilitate opportunity-related cognitive processes that lead to entrepreneurial outcomes. This is an important mechanism in addition to entrepreneurial self-efficacy that has been identified in relation to GAISEE. For instance, while entrepreneurial self-efficacy was found to be a mediator between GAISEE and entrepreneurial intention by Xie and Wang (2025), however, EOR was identified in the present study.

Nevertheless, this study found mixed findings in relation to entrepreneurial AI literacy. The interaction of GAISEE and entrepreneurial AI literacy is not significant in influencing EOR (β = 0.000, t = 0.006, p = 0.995), which is why H5 is not supported. This implies that, self-evidently, students› AI literacy does not significantly impact the contribution of GAISEE to opportunity recognition. But entrepreneurial AI literacy significantly contributes to the relationship between GAISEE and EP of students (β = 0.158, t = 2.532, p = 0.012), supported H6. Therefore, AI literacy seems to be more valuable when it comes to the students transitioning from identifying or learning about AI opportunities to entrepreneurial outcomes. Students that are more AI literate could be better equipped to utilize AI-integrated knowledge, assess information, and convert learning experiences into entrepreneurial productivity.

Lastly, H7 is supported, with a significantly different relationship between GAISEE and performance for males and females in the multi-group analysis. Male students have a stronger relationship (β = 0.342) than female students (β = 0.221) and there is a significant difference between the two groups (p = 0.035). This finding indicates that the impact of entrepreneurial education with the support of AI is not uniform among student groups. Therefore, there is a difference between groups. The results confirm that the relationships between GAISEE and EP occur in both direct and indirect ways and that entrepreneurial AI literacy and gender are significant conditions of these relationships.

6. Conclusion

This research offers a comprehensive insight into the role generative AI-enabled entrepreneurial education (GAISEE) plays in the EP of students. The results indicate that EOR and student EP are significantly improved by using GAISEE. It suggests that the importance of using GenAI in modern entrepreneurship education is important. Another indirect path by which GAISEE influences EP is EOR. Students' EOR ability also shows the importance of EOR as a means to EP, an indirect pathway of which GAISEE contributes. In addition, entrepreneurial AI literacy has a significant moderating effect on the relationship between GAISEE and EP of students, but not on opportunity recognition. The multi-group analysis additionally shows that the link between GAISEE and student EP varies significantly based on gender, with male students showing a stronger link between these variables than female students. Therefore, the results indicate that the success of entrepreneurship education using GenAI is both the educational opportunities offered by GenAI and students' competence in utilizing AI and converting AI-supported learning into entrepreneurial results.

6.1. Policy Implications

The results have significant policies and pedagogical implications for the improvement of entrepreneurship education using generative AI in educational institutions and policymakers. First, entrepreneurship education programs should include planned learning activities that support students' entrepreneurial knowledge, opportunity identification and EP supported by GenAI. Secondly, practical entrepreneurship AI literacy programmes should be implemented in the institutions as AI literacy improves the relationship between GAISEE and EP of students. These should involve teaching students how to appropriately use AI technologies to assist them in business-model analysis, market assessment, and strategy development. Third, policymakers need to make it more accessible for educational resources to be made available based on AI, leading the students to use the new technologies. Lastly, gender gap in student outcomes underscores the need to track the impact of AI-facilitated entrepreneurship education on students and to create inclusive educational support if any gender gaps are found.

6.2. Future Directions

Future studies are recommended to expand the current model and include other mechanisms between GAISEE and student EP, such as entrepreneurial self-efficacy, entrepreneurial intention, and innovation capability. Specifically, researchers could examine whether opportunity recognition is a sequential process between entrepreneurial self-efficacy or whether it is a mediator. It would also be beneficial to conduct future research that categorizes the various applications of GenAI, from idea generation to market analysis, business-model development to entrepreneurial decision support, and to identify which ones yield better results. Future research should adopt a gender specific PLS-MGA approach using the entire structural model with the significant gender difference observed in this study as opposed to the GAISEE–performance path. There is also an opportunity for further research in this area with longitudinal research to explore whether the impact of GAISEE continues as students transition from classroom-based entrepreneurial learning to the process of forming a business and implementing it with entrepreneurial AI literacy.

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References

Afthanorhan, A., Ghazali, P. L., & Rashid, N. (2021). Discriminant validity: A comparison of CBSEM and consistent PLS using Fornell & Larcker and HTMT approaches. *Journal of Physics: Conference Series, 1874*(1), 012085. https://doi.org/10.1088/1742-6596/1874/1/012085

Alam, M. Z. (2026). Artificial intelligence and entrepreneurial opportunity recognition: a judgement-centred conceptual framework. *International Journal of Innovation Science*, 1–22. https://doi.org/10.1108/ijis-12-2025-0656

Alier Forment, M., García Peñalvo, F. J., & Camba, J. D. (2024). Generative artificial intelligence in education: From deceptive to disruptive. *International Journal of interactive multimedia and artificial intelligence, 8*(5), 5–14. https://doi.org/10.9781/ijimai.2024.02.011

Alim, M. A., Tan, K.-L., Jee, T. W., Voon, B. H., Hossain, M. J., & Mia, M. U. (2022). To explain and to predict: analysis of opportunity recognition on the relationship between personal factors, environmental factors and entrepreneurs' performance. *Asia-Pacific Journal of Business Administration, 15*(5), 772–794. https://doi.org/10.1108/apjba-09-2021-0475

Alkhalaileh, M. Y., & Qasim, D. (2026). The impact of AI literacy on E-entrepreneurial intention: the mediating role of E-self-efficacy and innovation mindset. *Entrepreneurship Education.* https://doi.org/10.1007/s41959-026-00176-x

Amoakohene, G., Owusu-Agyeman, Y., & Adu, K. K. (2026). The transformative value of generative artificial intelligence among business students in higher education. *Journal of International Education in Business*, 1–19. https://doi.org/10.1108/jieb-04-2026-0084

Arshad, M. A., & Fatima, A. (2026). Artificial Intelligence-Driven Personalized Nutrition Entrepreneurship: A PLS-SEM Investigation of Innovation Capability, Entrepreneurial Self-Efficacy and Business Model Innovation Among Nutrition Professionals. *Journal of Artificial Intelligence, Machine Learning and Data Science, 9*(3), 3470–3480. https://doi.org/10.51219/JAIMLD/muhammad-arslan-arshad/686

Ayaz, M. Q., Saleem, I., Hayat, N., & Rauf, A. (2025). How do generative artificial intelligence, entrepreneurial education and entrepreneurial capacity interact to spark entrepreneurial intentions among business graduates in the digital space? *Journal of Applied Research in Higher Education*, 1–16. https://doi.org/10.1108/jarhe-02-2025-0122

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*(2), 248–287. https://doi.org/10.1016/0749-5978(91)90022-L

Bell, R., & Bell, H. (2023). Entrepreneurship education in the era of generative artificial intelligence. *Entrepreneurship Education, 6*(3), 229–244. https://doi.org/10.1007/s41959-023-00099-x

Coleman, S., & Kariv, D. (2013). Gender, Performance and Financial Strategy: A Dynamic Capabilities Perspective. *Journal of Developmental Entrepreneurship, 18*(03), 1350020. https://doi.org/10.1142/s1084946713500209

Cordero, J., Torres-Zambrano, J., & Cordero-Castillo, A. (2025). Integration of Generative Artificial Intelligence in Higher Education: Best Practices. *Education Sciences, 15*(1), 32. https://doi.org/10.3390/educsci15010032

Dang, Y. M., Zhang, Y. G., Ravindran, S., & Osmonbekov, T. (2016). Examining Student Satisfaction and Gender Differences in Technology-Supported, Blended Learning. *Journal of Information Systems Education, 27*(2), 119–130. https://aisel.aisnet.org/jise/vol27/iss2/5

Duong, C. D. (2025). AI literacy and e-entrepreneurial intention: A serial mediation model of e-entrepreneurial self-efficacy and e-entrepreneurial identity aspiration. *International Journal of Information Management Data Insights, 5*(2), 100349. https://doi.org/10.1016/j.jjimei.2025.100349

Duong, C. D. (2026a). AI literacy and higher education students' digital entrepreneurial intention: A moderated mediation model of AI self-efficacy and digital entrepreneurial self-efficacy. *Industry and Higher Education, 40*(2), 242–255. https://doi.org/10.1177/09504222251370089

Duong, C. D. (2026b). Explore how AI literacy inspires higher education students' digital entrepreneurial intentions: the moderating role of technological support and educational support. *Asian Education and Development Studies*, 1–23. https://doi.org/10.1108/aeds-10-2025-0538

Dwivedi, Y. K. (2025). Generative Artificial Intelligence (GenAI) in entrepreneurial education and practice: emerging insights, the GAIN Framework, and research agenda. *International Entrepreneurship and Management Journal, 21*(1), 82. https://doi.org/10.1007/s11365-025-01089-2

Gong, J., Geyer, J., Lewis, D. W., Lee, H. Y., & Holley, K. (2026). Towards an AI-Augmented Graduate Model for Entrepreneurship Education: Connecting Knowledge, Innovation, and Venture Ecosystems. *Administrative Sciences, 16*(1), 33. https://doi.org/10.3390/admsci16010033

Gretchen, D. B., Karen Razelle, M. D., & Shujaullah, K. (2026). AI Literacy, Human-AI Interaction, and Generative-AI Decision Support for Entrepreneurial Opportunity Seeking: A Convergent Mixed-Methods Study. *International Journal of Computer Information Systems and Industrial Management Applications, 18*(9s), 1–14. https://doi.org/10.70917/ijcisim-2026-3418

Hajizadeh, A., Hassani, M., & Shirbagi, N. (2026). The Impact of Generative AI Language Tools and Digital Literacy on Entrepreneurial Intention and Behavior: The Mediating

Role of Self-Efficacy and the Moderating Role of Social Support in Academic Settings. *Journal of Entrepreneurship Development, 18*(5), 1–29. https://doi.org/10.22059/jed.2025.396673.654536

Hilkenmeier, F., Bohndick, C., Bohndick, T., & Hilkenmeier, J. (2020). Assessing Distinctiveness in Multidimensional Instruments Without Access to Raw Data – A Manifest Fornell-Larcker Criterion. *Frontiers in psychology, 11*, 223. https://doi.org/10.3389/fpsyg.2020.00223

Howard, R. W. (2014). Gender Differences in Intellectual Performance Persist at the Limits of Individual Capabilities. *Journal of Biosocial Science, 46*(3), 386–404. https://doi.org/10.1017/S0021932013000205

Huo, H., Abd Aziz, M. F. B., & Kunasegaran, M. (2025). The association between generative AI use and homogenization in entrepreneurship education: Manifestations, potential mechanisms, and implications. *Journal of Advances in Social Sciences, 1*(2), 25–50. https://doi.org/10.65192/tc7dtg34

Hussain, S., Rasheed, A., & Mahmood, M. (2023). Gender diversity effects on investment decisions: a study of Shark Tank. *Kybernetes, 54*(1), 358–370. https://doi.org/10.1108/k-07-2023-1311

Hussain, S., Rehman, S. U., Rehman, K. U., & Khasawneh, M. A. S. (2025). Digital transformation and green finance: the role of financial technology adoption in banking sustainability among Asian online users. *Journal of Islamic Marketing, 17*(3), 1013–1033. https://doi.org/10.1108/jima-03-2025-0213

Iram, T., Bilal, A. R., & Shahzad, M. F. (2026). From bias to breakthrough: AI literacy and self-efficacy as catalysts for overcoming behavioral biases in investment decision-making among French women entrepreneurs. *International Journal of Entrepreneurial Behavior & Research*, 1–22. https://doi.org/10.1108/ijebr-12-2024-1359

Kusetogullari, A., Kusetogullari, H., Andersson, M., & Gorschek, T. (2025). GenAI in entrepreneurship: A systematic review of generative artificial intelligence in entrepreneurship research: Current issues and future directions. *arXiv preprint arXiv:2505.05523.* https://doi.org/10.48550/arXiv.2505.05523

Latif, M. S., Soomro, M. A., Ahmad, A., & Syed, M. I. (2026). Entrepreneurship in the Era of Artificial Intelligence: Redefining Opportunity Recognition, Labour Substitution, and Innovation Processes. *Inverge Journal of Social Sciences, 5*(1), 173–186. https://doi.org/10.63544/ijss.v5i1.229

Le, A. D., Wach, K., Vu, A. T., Ngo, T. V. N., Van Bui, T., Duong, C. D., & Phan, T. T. H. (2026). GenAI incorporation in entrepreneurship education and higher education students' Fintech entrepreneurship: a cross-cultural approach in Vietnam and Poland. *Journal of Further and Higher Education, 50*(5), 771–792. https://doi.org/10.1080/0309877X.2026.2626977

Liu, F., Yang, G., & Singhdong, P. (2024). A Moderated Mediation Model of Entrepreneurship Education, Competence, and Environmental Dynamics on Entrepreneurial Performance. *Sustainability, 16*(19), 8502. https://doi.org/10.3390/su16198502

Liyanagamage, N., & Gallage, N. (2026). Integrating generative AI into entrepreneurship education: A reflective learning and teaching framework to promote critical thinking and ethical knowledge transfer. *The International Journal of Management Education, 24*(3), 101490. https://doi.org/10.1016/j.ijme.2026.101490

Magno, F., Cassia, F., & Ringle, C. M. (2022). A brief review of partial least squares structural equation modeling (PLS-SEM) use in quality management studies. *The TQM Journal, 36*(5), 1242–1251. https://doi.org/10.1108/tqm-06-2022-0197

Martin, J. J., & Guerrero, M. D. (2020). Social Cognitive Theory. In J. Haegele, S. Hodge, & D. Shapiro (Eds.), *Routledge Handbook of Adapted Physical Education* (pp. 280–295). Routledge. https://doi.org/10.4324/9780429052675-22

Mary George, N., Parida, V., Lahti, T., & Wincent, J. (2016). A systematic literature review of entrepreneurial opportunity recognition: insights on influencing factors. *International Entrepreneurship and Management Journal, 12*(2), 309–350. https://doi.org/10.1007/s11365-014-0347-y

Mathafena, R. B., & Msimango-Galawe, J. (2022). Entrepreneurial orientation, market orientation and opportunity exploitation in driving business performance: moderating effect of interfunctional coordination. *Journal of Entrepreneurship in Emerging Economies, 15*(3), 538–565. https://doi.org/10.1108/jeee-03-2021-0114

Mehmood, S., Hasan, Z., Ali, R., Nawaz, S., & Amjad, S. (2024). Social Cognitive Theory In Human Resource Management: Literature Review, Criticism and Research Agenda. *Bulletin of Business and Economics (BBE), 13*(2), 9–13. https://doi.org/10.61506/01.00287

Nurliana, & Azis, M. S. (2026). AI Literacy and Entrepreneurial Readiness among Economics Education Students: The Mediating Role of Digital Content Creation Skills. *Tamaddun, 25*(1), 50–67. https://doi.org/10.33096/tamaddun.v25i1.1174

Otache, I., Edopkolor, J. E., Sani, I. A., & Umar, K. (2024). Entrepreneurship education and entrepreneurial intentions: Do entrepreneurial self-efficacy, alertness and opportunity recognition matter? *The International Journal of Management Education, 22*(1), 100917. https://doi.org/10.1016/j.ijme.2023.100917

Perryman, A. A., Fernando, G. D., & Tripathy, A. (2016). Do gender differences persist? An examination of gender diversity on firm performance, risk, and executive compensation. *Journal of Business Research, 69*(2), 579–586. https://doi.org/10.1016/j.jbusres.2015.05.013

Pirhadi, H. (2026). Generative Artificial Intelligence and Entrepreneurial Opportunity Recognition in Emerging Economies: A Conceptual Framework. *Journal of Entrepreneurship Development, 19*(2), 124–154. https://doi.org/10.22059/jed.2026. 408930.654635

Rahal, F. E. Z., Farmanesh, P., Houmani, H., & Solati Dehkordi, N. (2026). Does Gen-AI Enhance the Link Between Entrepreneurship Education and Student Innovation Behavior? Insights for Quality and Sustainable Higher Education. *Sustainability, 18*(3), 1258. https://doi.org/10.3390/su18031258

Rasoolimanesh, S. M. (2022). Discriminant Validity Assessment in PLS-SEM: A Comprehensive Composite-Based Approach. *Data Analysis Perspectives Journal, 3*(2), 1–8. https://scriptwarp.com/dapj/2022_DAPJ_3_2/Rasoolimanesh_2022_DAPJ_3_2_DiscriminantValidity.pdf

Razzaq, S. (2020). Exploring the Integration of the Metaverse in Business Model Design Education: Enhancing ESL Learners' Language Acquisition and Proficiency in Higher Educational Institutions. *Journal of Metaverse Business Designs, 1*(1), 37–46. https://www.jmbd.org/index.php/home/article/view/5

Sajed, S., Bably, S. M., Rifat, S. M., Tahmid, S. M., Nabi, M. N. U., Masroor, I., Meghla, H. A., et al. (2026). Exploring the role of generative AI in entrepreneurial opportunity recognition: a TAM-based approach. *International Journal of Generative Artificial Intelligence in Business, 1*(1-2), 85–102. https://doi.org/10.1504/ijgaib.2026.151807

Samala, A. D., Rawas, S., Wang, T., Reed, J. M., Kim, J., Howard, N.-J., & Ertz, M. (2025). Unveiling the landscape of generative artificial intelligence in education: a comprehensive taxonomy of applications, challenges, and future prospects. *Education and Information Technologies, 30*(3), 3239–3278. https://doi.org/10.1007/s10639-024-12936-0

Tang, L., Lin, Q., Luo, X., Li, Y., & Lu, M. (2025). The role of AI and entrepreneurial ecosystem in shaping students' digital entrepreneurship intentions: evidence from a multi-group analysis. *Asia Pacific Journal of Education*, 1–25. https://doi.org/10.1080/02188791.2025.2577334

Wang, Y. L., Ellinger, A. D., & Jim Wu, Y. C. (2013). Entrepreneurial opportunity recognition: an empirical study of R&D personnel. *Management Decision, 51*(2), 248–266. https://doi.org/10.1108/00251741311301803

Weng, X., Gu, M. M., Xia, Q., & Chiu, T. K. F. (2025). SWOT analysis of AI empowered entrepreneurship education: Insights from digital learners in higher education. *Thinking Skills and Creativity, 56*, 101763. https://doi.org/10.1016/j.tsc.2025.101763

Wu, A., Song, D., & Yang, Y. (2020). Untangling the effects of entrepreneurial opportunity on the performance of peasant entrepreneurship: the moderating roles of entrepreneurial effort and regional poverty level. *Entrepreneurship & Regional Development, 32*(1-2), 112–133. https://doi.org/10.1080/08985626.2019.1640479

Xie, Y., & Wang, S. (2025). Generative artificial intelligence in entrepreneurship education enhances entrepreneurial intention through self-efficacy and university support. *Scientific Reports, 15*(1), 24079. https://doi.org/10.1038/s41598-025-09545-3

Zeng, N., Liu, Y., Gong, P., Hertogh, M., & König, M. (2021). Do right PLS and do PLS right: A critical review of the application of PLS-SEM in construction management research. *Frontiers of Engineering Management, 8*(3), 356–369. https://doi.org/10.1007/s42524-021-0153-5