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Innovative Learning Strategies and Entrepreneurial intention Among Generation Z: The Mediating Role of Entrepreneurial Self-Efficacy and the Moderating Role of Campus Ecosystem Support

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Summary

Background: Innovative learning strategies are increasingly important in entrepreneurship education for Generation Z students. However, the combined roles of experiential and technology-assisted learning, entrepreneurial self-efficacy, and institutional support remain insufficiently understood.

Objective: This study examines the effects of challenge-based learning on entrepreneurial self-efficacy, gammification engagement, and opportunity recognition along with the influence of digital technology and AI-assisted ideation on gamification engagement and opportunity recognition. Additionally it explores the mediating function 0f entrepreneurial self-efficacy and the moderating influence of campus ecosystem support in the connection between innovtive learning strategies and entrepreneurial intention.

Methods: Data from 250 students at five private universities in Central Java, Indonesia, were collected through purposive sampling and analyzed using PLS-SEM with 5,000 bootstrap subsamples.

Results: Challenge-focused learning showed a positive correlation with entrepreneurial self-efficacy ($\beta = 0.38$, $p < 0.001$) as well as gamification engagement and opportunity identification ($\beta = 0.41$, $p < 0.001$). Digital technology and AI-enhanced brainstorming demonstrated the most significant direct correlation with gamification involvement and opportunity identification ($\beta = 0.45$, $p < 0.001$). Self-efficacy in entrepreneurship mediated the link between innovative learning approaches and entrepreneurial intention ($\beta = 0.30$, $p < 0.001$), whereas support from the campus ecosystem positively moderated this connection ($\beta = 0.21$, $p < 0.001$). The model accounted for 56% of the variation in entrepreneurial intention.

Conclusion: Entrepreneurial self-efficacy acts as a crucial psychological factor connecting innovative learning techniques to entrepreneurial intention, with campus ecosystem support enhancing this relationship. Universities ought to combine experiential and AI-supported digital learning with mentoring, incubation initiatives, and partnerships with industry to enhance students' entrepreneurial confidence and encourage entrepreneurial intention.

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INTRODUCTION

Higher education institutions have an important responsibility to cultivate entrepreneurial intention among students, particularly in an era characterized by rapid digital transformation. Given their extensive exposure to the digital world, an appropriate learning approach to entrepreneurship education for Generation Z learners (e.g., experiential learning and interactive learning supported by suitable digital media tools) is essential (Jiatong et al., 2021).

With Generation Z representing a key talent pool for the future workforce (Vieira & Gomes, 2024) and a growing cohort of prospective entrepreneurs, as noted by (Hossain et al., 2023) and (Id & Wang, 2023), higher education institutions particularly private universities play a central role in developing entrepreneurial capacity. On one hand, universities face increasing strategic management pressure to demonstrate that investments in innovative learning initiatives yield measurable entrepreneurial outcomes; on the other hand, empirical evidence on how integrated learning management practices function as mechanisms for human resource development remains limited. According to the Central Statistics Agency (BPS), the youth unemployment rate in Indonesia reached 19.4%, with graduate unemployment representing a significant challenge, highlighting the urgency of entrepreneurship education in higher education.

However, many private universities still exhibit weak alignment between learning-related management practices and institutional support systems. Such misalignment leads to fragmented human resource development and diminishes universities' capacity to effectively foster entrepreneurial intentions among students (Akpen et al., 2024). Conventional instructional approaches often fail to provide integrated management practices capable of enhancing entrepreneurial competence, recognizing opportunities, and fostering capacity building within a supportive organizational ecosystem (Tristya & Harald, 2021; Ju Xu & Xueying Zhang, 2023). In Indonesia, approximately 3,000 private universities serve more than 5.4 million students, yet only a small fraction implement an integrated entrepreneurial learning ecosystem that combines experiential, digital, and institutional support dimensions (Fa'uzobihi, 2025; Sholihah et al., 2025).

Recent research suggests that creative learning techniques, like challenge-based learning, gamification, and digital tools, including AI-supported brainstorming, can improve motivation, engagement, and opportunity identification when effectively combined with backing from the campus environment, such as mentoring, access to resources, and industry partnerships (Niño et al., 2025; (Winkler et al., 2023). These findings suggest that innovative learning should be conceptualized not merely as pedagogical innovation, but as a strategic management practice that directly contributes to the development of entrepreneurial human resources.

In many private universities in Indonesia and Southeast Asia, entrepreneurship education remains unevenly developed, particularly regarding the integration of innovative learning methods with institutional support systems. Entrepreneurship courses are often constrained by limited resources, fragmented learning designs, and varying levels of ecosystem readiness. Consequently, insights from the local context of Indonesian higher education are necessary to develop a learning strategy that is both contextualized and practically applicable.

This study's uniqueness stems from its concurrent analysis of particular experiential and digital learning elements, specifically challenge-based learning, gamification involvement, and AI-enhanced digital education, in relation to students' overall views on innovative learning methods. The model includes entrepreneurial self-efficacy as a psychological mediator and campus ecosystem support as an institutional moderating factor. This arrangement offers a deeper insight into how learning experiences, personal confidence, and institutional factors collectively influence Entrepreneurial intentions among Generation Z students in Indonesian private universities.

This research analyzes five structural connections: the impact of challenge-based learning on entrepreneurial self-efficacy and engagement with gamification; the influence of AI-supported digital learning on gamification engagement; the mediating role of entrepreneurial self-efficacy in associating innovative learning methods with entrepreneurial intention; and the moderating role of campus ecosystem support in enhancing this relationship.

Literature Review

Learning as a strategic management practice

Entrepreneurship education has increasingly evolved beyond a purely pedagogical function and is now recognized as a strategic instrument for developing entrepreneurial human capital in dynamic and competitive environments. On the one hand, higher education learning initiatives can be presented as capacity-based organizational practices that affect students' entrepreneurial competence and adaptability. The literature on learning experience design highlights a contemporary understanding of the increasing importance of digital technology in

organizations, as members of Generation Z are digitally native learners.

Previous studies indicate that technology-supported entrepreneurship education enhances students' understanding of complex entrepreneurial concepts by providing more accessible and interactive learning experiences. Furthermore, the connection between business applications and social media creates a genuine learning environment, enabling students to engage directly with real market dynamics, thereby transforming entrepreneurship education into a method for skill enhancement through hands-on experience rather than mainly through theoretical concepts.

Innovative learning strategies, as conceptualized in this study, include three integrated dimensions: (1) challenge-based learning, which promotes experiential and problem-oriented engagement; (2) gamification, which uses elements of digital game design to reinforce motivation and participation; and (3) AI-assisted digital learning, which deploys generative AI tools to support idea generation, opportunity recognition, and cognitive scaffolding (Mukherjee & Hannah Chang, 2024). Despite these advances, the strategic integration of digital technologies combined with experiential learning is still underdeveloped, especially among private universities. Previous research has shown that technology-assisted learning only leads to significant entrepreneurial outcomes if integrated into experiential and field-based learning methods that successfully connect theory and practice (Tahat et al., 2023). These limitations highlight the importance of redefining innovative learning strategies as holistic management practices rather than as separate instructional programs.

Challenge-based learning and entrepreneurial capacity

Challenge-based learning emphasizes authentic problem-solving experiences that encourage learners to exercise autonomy, critical thinking, and continuous experimentation in addressing real-world challenges. In this sense, entrepreneurship education exposes students to unpredictable and diverse problems that mimic the conditions they would face in real-world markets, encouraging opportunity recognition, resilience, and adaptive decision-making. Challenge-based learning is supported by empirical evidence demonstrating that it can strengthen entrepreneurship because it encourages reflective experimentation and collaborative problem-solving processes in learners (Colombelli et al., 2022). Challenge-based learning, in conjunction with other supportive methods like design thinking, project-based learning, microlearning, and flipped classroom models, improves adaptive and personalized learning settings that promote entrepreneurial preparedness in a dynamic market environment.

Gamification and engagement-based learning

Gamification has emerged as an instructional approach that incorporates game-design principles to enhance learner motivation, engagement, and sustained participation in educational activities. Gamification can be considered a management phenomenon, as it acts to reinforce learners' diligence, goal attainment, and performance. The gamified learning environment emphasizes student performance, practical problem-solving skills, and confidence in entrepreneurial decision-making by simulating the entrepreneurial process through continuous feedback and evaluation of students' actions.

These features are particularly suitable for Generation Z learners, who are less inclined toward traditional learning environments that provide slower feedback and fewer experiential opportunities. As a result, gamification not only increases motivation but also serves as a management technique to promote the development of entrepreneurial abilities (Cain et al., 2022; Zou et al., 2023). For Generation Z learners, characterized by digital nativity, preference for interactive feedback, multitasking behaviors, and adaptability, gamification mechanisms operate through psychological pathways such as goal setting, direct reinforcement, and social comparison, collectively reinforcing entrepreneurial motivation and mindset formation (Chardonnens, 2023; Keshmiri, 2025); (Jaramillo-mediavilla et al., 2024).

AI-Assisted Learning and Entrepreneurial Cognition

The rapid development of generative artificial intelligence has expanded opportunities for supporting entrepreneurial learning by enhancing idea generation, opportunity evaluation, and

decision-making. AI-enabled learning platforms facilitate entrepreneurial idea development, opportunity assessment, and problem-solving by helping learners process information more efficiently and effectively. Empirical evidence suggests that learners who use AI-assisted tools show significant increases in entrepreneurship and entrepreneurial intention, particularly when combined with experiential learning supported by institutional infrastructure (Xie & Wang, 2025). Additionally, AI-based digital platforms foster entrepreneurial skills by supporting adaptive learning, experiential activities, problem-solving, and entrepreneurial decision-making, thereby helping students translate academic knowledge into entrepreneurial practice (Zhang, 2025).

Integrating AI within a lean-startup-oriented learning framework creates an environment conducive to pivoting strategies and iterative business model development, aligned with the dynamic competencies required in contemporary entrepreneurship (Mukherjee & Hannah Chang, 2024).

The Mediating Role of Entrepreneurial Self-efficacy

The relationship between educational interventions and entrepreneurial outcomes is often indirect, highlighting entrepreneurial self-efficacy as an important psychological mechanism. Based on Social Cognitive Theory, entrepreneurial self-efficacy reflects individuals' confidence in their ability to perform diverse entrepreneurial tasks, manage uncertainty, and optimize resource use. Previous studies indicate that experiential learning environments, gamification, and technology indirectly promote entrepreneurial intention by reinforcing entrepreneurial self-efficacy (Jiatong et al., 2021). Innovative learning strategies contribute to the development of entrepreneurial intentions by enhancing students' perceived entrepreneurial competence through mastery experiences, feedback mechanisms, and social reinforcement. Challenge-based learning fosters self-belief by providing authentic opportunities for students to apply knowledge and solve real-world problems. Likewise, peer interaction within gamified learning environments promotes observational learning, allowing students to strengthen their entrepreneurial confidence through collaboration and shared experiences. Moreover, AI-assisted feedback and instructor-guided mentoring provide continuous encouragement and performance-related insights, further reinforcing students' confidence in their entrepreneurial abilities (Jiatong et al., 2021). This mechanism is particularly evident in technology-assisted entrepreneurship education, where AI-generated feedback and gamification performance systems provide consistent reinforcement unmatched by traditional classroom settings.

Campus Ecosystem Support as a Moderating Condition

Campus ecosystem support represents a critical institutional factor that facilitates the transformation of educational experiences into entrepreneurial outcomes. Although competencies may be abundant, a supportive campus ecosystem providing mentoring, entrepreneurial infrastructure, industry collaboration, and innovation networks enables students to apply theoretical knowledge in practice. Such support reduces perceived entrepreneurial risks while increasing access to resources and opportunity recognition, enhancing students' confidence in pursuing entrepreneurship. Empirical evidence suggests that universities functioning as entrepreneurial ecosystems reinforce the impact of educational interventions on Entrepreneurial intentions by providing contextual reinforcement that complements classroom learning. Consequently, the support from the campus ecosystem is anticipated to enhance the favorable connection between innovative learning methods and entrepreneurial intention (Guerrero et al., 2024).

Research gaps and conceptual positioning

Although previous studies have investigated challenge-based learning, gamification, and digital learning independently, limited attention has been given to understanding how these approaches interact within a unified entrepreneurial learning framework. Additionally, current research has infrequently explored the concurrent functions of entrepreneurial self-efficacy as a mediating factor and campus ecosystem support as a contextual moderator. Consequently, a more integrated framework is needed to explain how innovative learning strategies collectively

influence entrepreneurial intentions among Generation Z students. Moreover, research has primarily focused on the direct effects of learning innovations on entrepreneurial outcomes, with limited attention to the psychological and institutional mechanisms shaping these relationships. Research examining the joint impact of entrepreneurial self-efficacy as a mediating factor and campus ecosystem support as a contextual moderator is still scarce, especially regarding Generation Z students in private universities in Indonesia. To fill this gap, this research presents innovative learning strategies as a cohesive educational method that merges experiential and digital learning components to analyze their impact on entrepreneurial intentions, including both personal and institutional elements.

In this study, innovative strategies refer to students' perceptions of coordinated, adaptive, and technology-supported instructional practices used in entrepreneurship education. This construct is conceptually distinguished from challenge-based learning, gamification engagement, and AI-assisted digital learning, which represent more specific learning experiences and mechanisms. This distinction is necessary to avoid conceptual overlap among the constructs included in the structural model.

Research questions

RQ1. To what extent does challenge-based learning influence entrepreneurial self-efficacy among Generation Z students?
RQ2. To what extent does challenge-based learning influence gamification engagement and opportunity recognition amaong Generation Z students?
RQ3. To what extent do digital technology and AI-assisted ideation influence gamification engagement and opportunity recognition among Generation Z students?
RQ4. To what extent does entrepreneurial self-efficacy mediate the relationship between innovative learning strategies and entrepreneurial intention among Generation Z students?
RQ5. To what extent does campus ecosystem support moderate the relationship between innovative learning strategies and entrepreneurial intention among Generation Z students, particularly by strengthening this relationship under conditions of high institutional support?

Hypothesis development

H1. Challeng-based learning has a positive and significant effect on entrepreneurial self-efficacy among Generation Z students. These experiences enable Generation Z students to develop mastery, evaluate their capabilities, and build confidence in performing entrepreneurial tasks under uncertain conditions. Accordingly, challenge-based learning is expected to strengthen students' entrepreneurial self-efficacy (Michel & Manuel, 2025).

Challenge-based learning promotes active student involvement in real-world and problem-focused educational tasks. Real-life challenges, teamwork in problem-solving, task-focused objectives, and ongoing feedback can enhance students' involvement in gamified educational settings. Such experiences can enhance their skills in recognizing and assessing entrepreneurial opportunities.

H2. Challenge-based learning has a positive and significant effect on gamification engagement and opportunity recognition among Generation Z students.

Generative AI-supported entrepreneurship education provides interactive and adaptive learning experiences through personalized feedback, business simulations, and assistance in generating and evaluating entrepreneurial ideas. These learning experiences strengthen students' entrepreneurial self-efficacy, including their confidence in identifying opportunities, developing innovative ideas, and managing entrepreneurial challenges (Xie & Wang, 2025).

H3. Digital technology and AI-assisted ideation have a positive and significant effect on gamification engagement and opportunity recognition among Generation Z students.

Innovative strategies provide students with adaptive, interactive, and technology-supported learning experiences. However, these learning experiences may not automatically translate into Entrepreneurial intention. Students are more likely to develop Entrepreneurial intentions when innovative learning experiences strengthen their confidence in their ability to perform entrepreneurial tasks. Thus, entrepreneurial self-efficacy functions as a psychological mechanism linking innovative strategies to Entrepreneurial intention (Quynh et al., 2026).

H4. Entrepreneurial self-efficacy mediates the relationship between innovative strategies and Entrepreneurial intention among Generation Z students**.**

Innovative learning strategies provide interactive and experiential opportunities that strengthen students' confidence in identifying opportunities, developing ideas, and addressing entrepreneurial challenges. This confidence, reflected in entrepreneurial self-efficacy, encourages stronger entrepreneurial intention. Accordingly, entrepreneurial self-efficacy is expected to mediate the relationship between innovative strategies and entrepreneurial intention among Generation Z students (Xie & Wang, 2025).

H5. Campus ecosystem support positively moderates the relationship between innovative strategies and Entrepreneurial intention, such that the relationship becomes stronger when campus ecosystem support is high.

Campus ecosystem support encompasses entrepreneurial mentoring, incubation and acceleration programs, institutional resources, networking opportunities, digital infrastructure, and university–industry collaboration. Such an environment provides the resources and practical support necessary for students to translate innovative and technology-supported learning experiences into stronger entrepreneurial intentions. A supportive university entrepreneurial environment can increase students' access to expertise, networks, facilities, and opportunities to test and implement entrepreneurial ideas. Accordingly, the positive influence of innovative strategies on entrepreneurial intention is expected to be stronger when campus ecosystem support is high (Xie & Wang, 2025).

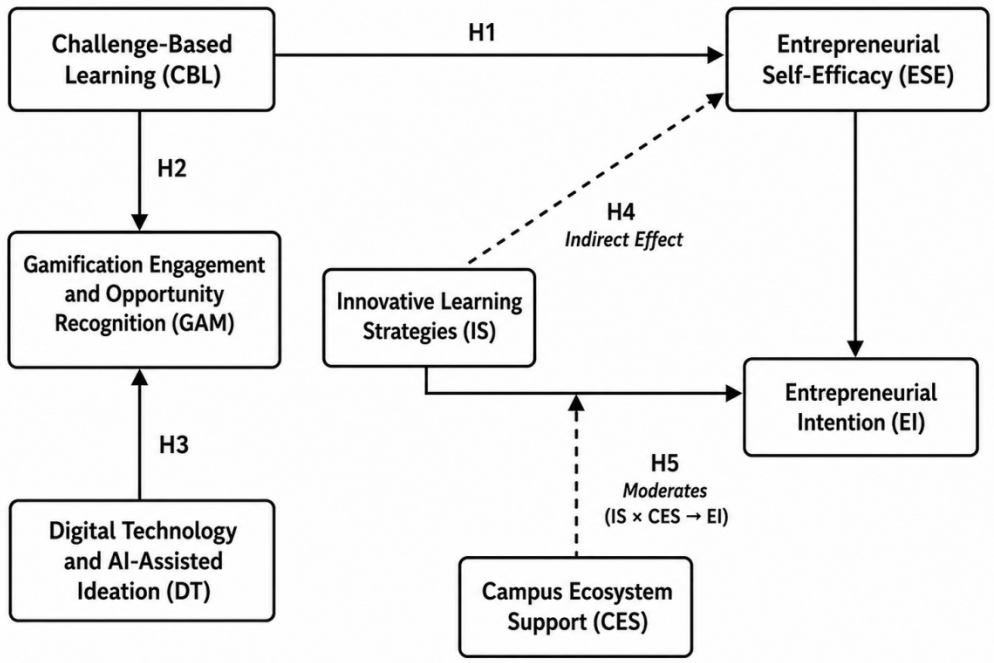

Figure 1. Conceptual Framework

METHOD

Research Design

This study employed a quantitative explanatory design to examine the structural relationships among innovative learning strategies, entrepreneurial self-efficacy, campus ecosystem support, and Entrepreneurial intention among Generation Z students. Partial Least Squares Structural Equation Modeling (PLS-SEM) was selected because the proposed model involved multiple latent constructs, simultaneous structural relationships, a mediating mechanism, and a moderating effect. The model comprised seven latent constructs: Challenge-Based Learning (CBL), Gamification Engagement and Opportunity Recognition (GAM), Digital Technology and AI-Assisted Ideation (DT), Innovative Strategies (IS), Entrepreneurial Self-Efficacy (ESE), Campus Ecosystem Support (CES), and Entrepreneurial intention (EI) (Xie & Wang, 2025). This design enabled rigorous hypothesis testing through statistical analysis, was well-suited for investigating mediation and moderation effects in structural models, and was

consistent with the epistemological assumptions of Social Cognitive Theory supporting the proposed framework (Hair et al., 2022).

Population and Sample

The target population consisted of undergraduate students enrolled at private universities in Central Java, Indonesia, who had participated in entrepreneurship-related learning activities. Respondents were selected using purposive sampling based on two criteria: they were currently enrolled in or had completed an entrepreneurship course and had experienced at least one of the learning approaches examined in this study, including challenge-based learning, gamified learning, or AI-assisted digital learning. A total of 280 questionnaires were distributed, of which 250 were complete and suitable for analysis, A total of 280 questionnaires were distributed, of which 250 were complete and suitable for analysis, resulting in a valid response rate of 89.3% (Malathi & Venugopal, 2025). The sample size of 250 respondents exceeded the minimum threshold recommended for PLS-SEM analysis, which requires at least ten times the largest number of structural paths leading to a construct (Hair, J.F., & Alamer, 2022). Sample adequacy was determined based on the maximum number of structural predictors directed toward a single endogenous construct. Entrepreneurial intention represented the most complex endogenous construct because it was predicted by Innovative Strategies, Entrepreneurial Self-Efficacy, Campus Ecosystem Support, and the interaction term between Innovative Strategies and Campus Ecosystem Support. Based on the preliminary 10-times heuristic, the minimum sample requirement was 40 respondents. Therefore, the final sample of 250 respondents was considered adequate for estimating the proposed PLS-SEM model, testing indirect and interaction effects, and conducting bootstrapping with 5,000 subsamples.

Variables and Measurements

The study operationalized five reflective constructs: Challenge-Based and Innovative Learning, Digital Entrepreneurial Engagement, Entrepreneurial Self-Efficacy, Campus Ecosystem Support, and Entrepreneurial Intention. The constructs were measured using 15 indicators on a five-point Likert scale, with three indicators assigned to each construct. These constructs captured students' challenge-based and innovative learning experiences, engagement with gamification and AI-assisted entrepreneurial activities, confidence in performing entrepreneurial tasks, perceived institutional support, and intention to pursue entrepreneurship. The measurement model was developed in accordance with established entrepreneurship education literature and reflective measurement principles in PLS-SEM (Morselli & Orzes, 2023; Bell & Bell, 2023; Mwaanga et al., 2026). A pilot test involving 30 students was conducted to assess item clarity and preliminary reliability, after which ambiguous or weak items were refined before the main survey.

Data Collection

Data were collected over eight weeks, from January to February 2026, through a structured Google Forms questionnaire distributed to students at five private universities in Central Java. Participation was voluntary, and respondents received information regarding the study's purpose, confidentiality safeguards, and their right to withdraw. Common method bias was assessed using Harman's single-factor test; the first unrotated factor accounted for 28.7% of the total variance, below the 50% threshold, indicating no dominant single-factor bias, although this test was treated as an initial diagnostic measure (Podsakoff et al., 2003).

Data Analysis Techniques

Partial Least Squares–Structural Equation Modeling (PLS-SEM) was performed using SmartPLS 4 to examine the seven-construct model through two sequential stages. First, the reflective measurement model was evaluated using indicator loadings (> 0.70), composite reliability (> 0.70), average variance extracted (> 0.50), the Fornell–Larcker criterion, and heterotrait–monotrait ratios below 0.90, in accordance with established PLS-SEM recommendations (Henseler, J., Ringle, C.M., & Sarstedt, 2015). The structural model was then assessed using standardized path coefficients, t-values, p-values, coefficients of determination

(R^2), effect sizes (f^2), and predictive relevance (Q^2). Bootstrapping with 5,000 subsamples was employed to test the direct relationships proposed in H1–H3, the specific indirect effect of Innovative Strategies on Entrepreneurial intention through Entrepreneurial Self-Efficacy in H4, and the moderating role of Campus Ecosystem Support in H5. The interaction effect was further examined through simple slope analysis at one standard deviation above and below the moderator mean. Multicollinearity was assessed using the variance inflation factor, and all values were below 3.33, suggesting that collinearity did not materially affect the structural estimates (Hair et al., 2022).

Ethical Considerations

Participation was voluntary, and respondents reviewed the research objectives before completing the questionnaire. Throughout the study, strict adherence was maintained to anonymity and confidentiality. All data were used exclusively for academic purposes, in accordance with prevailing ethical standards in entrepreneurial research and management. The study was conducted following the ethical standards of the participating institutions. Ethical approval was obtained from the Research Ethics Committee of Universitas Duta Bangsa Surakarta (Ethical Approval No. DBU-REC/2025/01). Written informed consent was obtained from all participants prior to data collection. All data were securely stored and used exclusively for academic research. No conflicts of interest existed, and this research did not receive external funding.

RESULTS AND DISCUSSION

Results

The empirical data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). This section presents a systematic assessment of the measurement model and structural model, followed by hypothesis testing of the proposed mediating and moderating effects.

Measurement Model Review

Table 1. Indicator Reliability and Convergent Validity

Construct	Indicator	Loading	CR	AVE
CBL	CBL1	0.78	0.82	0.60
	CBL2	0.80		
	CBL3	0.74		
GAM	GAM1	0.82	0.85	0.65
	GAM2	0.79		
	GAM3	0.81		
DT	DT1	0.85	0.86	0.68
	DT2	0.83		
	DT3	0.79		
IS	IS1	0.84	0.84	0.64
	IS2	0.80		
	IS3	0.76		
ESE	ESE1	0.88	0.88	0.71
	ESE2	0.84		
	ESE3	0.81		
CES	CES1	0.86	0.87	0.69
	CES2	0.83		
	CES3	0.81		
EI	EI1	0.86	0.87	0.69
	EI2	0.83		
	EI3	0.80		

As shown in Table 1, all indicator loadings exceeded 0.70, while composite reliability values ranged from 0.82 to 0.88 and AVE values from 0.60 to 0.71. These results confirm

satisfactory indicator reliability, internal consistency, and convergent validity across all constructs.

Validity

These findings provide empirical support for the reliability and validity of the measurement model, thereby confirming its suitability for subsequent structural model assessment.

Table 2. Discriminant Validity: Fornell–Larcker Criterion

Construct	CBL	GAM	DT	IS	ESE	CES	EI
CBL	**0.77**						
GAM	0.56	**0.80**					
DT	0.49	0.61	**0.82**				
IS	0.52	0.64	0.58	**0.80**			
ESE	0.59	0.55	0.50	0.62	**0.84**		
CES	0.51	0.57	0.54	0.68	0.65	**0.83**	
EI	0.46	0.49	0.45	0.66	0.71	0.69	**0.83**

Table 2 demonstrates satisfactory discriminant validity because the square root of the AVE for each construct, presented in bold on the diagonal, exceeded its correlations with the other constructs. The diagonal values ranged from 0.77 to 0.84, indicating that each construct shared more variance with its own indicators than with the other constructs. Therefore, the measurement model satisfied the Fornell–Larcker criterion for discriminant validity (Henseler et al., 2015).

Structural Model Results
Hypothesis Testing Results

Table 3. Hypothesis Testing Result and Selected Effect Sizes

Hypothesis	Relationship	Effect Type	β	t-value	p-value	f^2	Effect Size	Decision
H1	CBL → ESE	Direct effect	0.38	5.47	< 0.001	-	-	Supported
H2	CBL → GAM	Dirrect effect	0.41	6.12	< 0.001	0.23	Medium	Supported
H3	DT → GAM	Direct effect	0.45	7.03	< 0.001	0.27	Medium	Supported
H4	IS → ESE → EI	Specific indirect effect	0.30	6.84	< 0.001	N/A	N/A	Supported
H5	IS x CES → EI	Interation effect	0.21	4.96	< 0.001	0.18	Medium	Supported

Panel B. Selected Effect Sizes for the Mediation Component Paths

Relationship	Role in the Structural Model	f^2	Effect Size
IS → ESE	First-stage component of the mediation pathway	0.31	Medium
ESE → EI	Second-stage component of the mediation pathway	0.35	Large

Table 3 confirms that all five hypotheses were supported. CBL significantly affected ESE (β = 0.38, t = 5.47, p < 0.001) and GAM (β = 0.41, t = 6.12, p < 0.001; f^2 = 0.23), while DT produced the strongest direct effect on GAM (β = 0.45, t = 7.03, p < 0.001; f^2 = 0.27). ESE significantly

mediated the IS–EI relationship (β = 0.30, t = 6.84, p < 0.001), and CES positively moderated the effect of IS on EI (β = 0.21, t = 4.96, p < 0.001; f^2 = 0.18) (Zhao et al., 2010).

Table 4. Coefficient of Determination (R2)

Endogenous variable	**R^2**	**Interpretation**
GAM	0.48	Medium
ESE	0.42	Medium
EI	0.56	Medium

As reported in Table 4, the structural model accounted for 48% of the variance in gamification engagement, 42% in entrepreneurial self-efficacy, and 56% in entrepreneurial intention. Collectively, these R^2 values indicate that the model demonstrates moderate explanatory power for the endogenous constructs.

Table 5. Effect Size (f^2)

Relationships	**f^2**	**Effect size**
CBL → GAM	0.23	Medium
DT → GAM	0.27	Medium
IS → ESE	0.31	Medium
ESE → EI	0.35	Large
IS x CESE → EI	0.18	Medium

Table 5 presents the effect sizes of the structural relationships. Challenge-Based Learning had a medium effect on Gamification Engagement and Opportunity Recognition (f^2 = 0.23), while Digital Technology and AI-Assisted Ideation also produced a medium effect on the same endogenous construct (f^2 = 0.27). Innovative Strategies had a medium effect on Entrepreneurial Self-Efficacy (f^2 = 0.31). Entrepreneurial Self-Efficacy demonstrated the largest effect on Entrepreneurial intention (f^2 = 0.35), indicating that students' confidence in performing entrepreneurial tasks played a particularly important role in strengthening their Entrepreneurial intentions. The interaction between Innovative Strategies and Campus Ecosystem Support produced a medium effect on Entrepreneurial intention (f^2 = 0.18).

Table 6. Predictive Relevance of The Structural Model

Construct	Q^2	Predictive Relevance
GAM	0.31	Present
ESE	0.29	Present
EI	0.37	Present

As reported in Table 6, all endogenous constructs yielded positive Q^2 values, indicating that the structural model possesses predictive relevance. The Q^2 values were 0.31 for gamification engagement and opportunity recognition, 0.29 for entrepreneurial self-efficacy, and 0.37 for entrepreneurial intention. Among these constructs, entrepreneurial intention exhibited the highest predictive relevance.

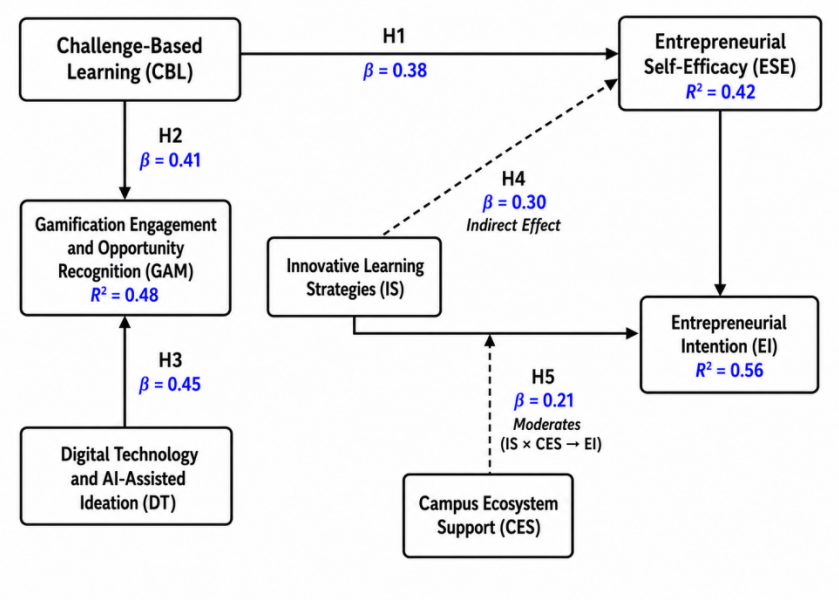

Figure 2. Structural Model and Hypothesis Testing Results

Figure 2 shows that Challenge-Based Learning positively influenced Entrepreneurial Self-Efficacy (β = 0.38) and Gamification Engagement and Opportunity Recognition (β = 0.41), while Digital Technology and AI-Assisted Ideation produced the strongest direct effect on GAM (β = 0.45). These predictors explained 48% of the variance in GAM, whereas Innovative Strategies explained 42% of the variance in Entrepreneurial Self-Efficacy. Entrepreneurial Self-Efficacy significantly mediated the relationship between Innovative Strategies and Entrepreneurial intention (β = 0.30), while Campus Ecosystem Support strengthened this relationship through a positive moderation effect (β = 0.21). Overall, the model explained 56% of the variance in Entrepreneurial intention, confirming the complementary roles of experiential learning, digital technology, psychological confidence, and institutional support in shaping students' Entrepreneurial intentions.

Discussion

The findings demonstrate that challenge-based learning, digital technology and AI-assisted ideation, entrepreneurial self-efficacy, and campus ecosystem support play distinct but complementary roles in entrepreneurship education among Generation Z students at Indonesian private universities. The structural model explained 56% of the variance in Entrepreneurial intention, indicating moderate explanatory power. Overall, the results suggest that experiential and technology-supported learning contributes to students' engagement and psychological readiness, while entrepreneurial self-efficacy and institutional support help translate innovative learning experiences into Entrepreneurial intention.

Regarding RQ1 and H1, challenge-based learning had a significant positive effect on entrepreneurial self-efficacy (β = 0.38, t = 5.47, p < 0.001). This result indicates that authentic entrepreneurial challenges, collaborative problem-solving, and iterative experimentation strengthen students' confidence in performing entrepreneurial tasks. Through mastery-oriented learning experiences, students can assess their capabilities, manage uncertainty, and develop stronger confidence in making entrepreneurial decisions. This finding is consistent with Social Cognitive Theory, which identifies mastery experiences as a principal source of self-efficacy. When students successfully address real-world business problems, they develop stronger beliefs in their ability to initiate, organize, and manage entrepreneurial activities. The result also supports previous studies showing that experiential and problem-based learning can strengthen entrepreneurial competence and self-confidence by connecting theoretical knowledge with practical application (Jiatong et al., 2021). Therefore, challenge-based learning represents an effective instructional approach for developing entrepreneurial self-efficacy among Generation Z students.

The study shows that innovative learning strategies integrating challenge-based learning,

gamification, and AI-assisted digital learning collectively drive entrepreneurial intention among Gen Z students at Indonesian private universities. These findings confirm that this approach serves not only as a pedagogical tool but also as an integrated strategic management practice for entrepreneurial human resource development (Tahat et al., 2023); (Cain et al., 2022). The structural model explains 56% of the variance in Entrepreneurial intentions, moderate explanatory power

Regarding RQ2 and H2, challenge-based learning had a significant positive effect on gamification engagement and opportunity recognition ($\beta = 0.41$, $t = 6.12$, $p < 0.001$). Authentic challenges, collaborative tasks, goal-oriented activities, and continuous feedback encourage students to participate more actively in gamified entrepreneurship learning. These experiences also stimulate analytical thinking, creativity, and the ability to identify and evaluate potential business opportunities. For Generation Z students, integrating real-world challenges with interactive and gamified elements creates a more relevant and meaningful learning environment. This finding is consistent with previous studies showing that experiential and gamified learning approaches enhance motivation, sustained engagement, and problem-solving capacity (Cain et al., 2022; Galdames-calder et al., 2024). Thus, challenge-based learning strengthens both students' engagement in the learning process and their entrepreneurial cognition.

Regarding RQ3 and H3, digital technology and AI-assisted ideation had a significant positive effect on gamification engagement and opportunity recognition ($\beta = 0.45$, $t = 7.03$, $p < 0.001$). This relationship represented the strongest direct effect in the structural model. AI-assisted tools can provide adaptive feedback, support idea generation, facilitate information processing, and assist students in evaluating entrepreneurial opportunities. These functions reduce cognitive barriers during ideation and allow students to devote greater attention to creativity, experimentation, and opportunity exploration. The findings are consistent with prior evidence that adaptive digital learning environments can improve student engagement and entrepreneurial learning outcomes, Zou (2023) They also support the view that artificial intelligence functions as a cognitive support mechanism that complements, rather than replaces, students' creativity and entrepreneurial judgment (Xie & Wang, 2025). Accordingly, the effective integration of AI-assisted tools can strengthen students' participation in interactive entrepreneurship learning.

Regarding RQ4 and H4, entrepreneurial self-efficacy significantly mediated the relationship between innovative strategies and Entrepreneurial intention ($\beta = 0.30$, $t = 6.84$, $p < 0.001$). This finding indicates that innovative, adaptive, and technology-supported learning experiences are associated with stronger Entrepreneurial intentions when they enhance students' confidence in performing entrepreneurial tasks. Entrepreneurial self-efficacy therefore serves as a psychological mechanism through which innovative learning strategies are translated into Entrepreneurial intention. This result is consistent with previous research emphasizing self-efficacy as a central mechanism linking entrepreneurship education and learning experiences to Entrepreneurial intention (Lihao Wu et al., 2022; Wang et al., 2023).

Finally, addressing RQ5 and H5, the findings demonstrate that Campus Ecosystem Support significantly strengthens the relationship between Challenge-Based and Innovative Learning and Entrepreneurial Intention. The positive influence of innovative learning experiences becomes more pronounced when universities provide well-established mentoring, incubation programmes, industry partnerships, and access to entrepreneurial networks. This moderating effect is consistent with (Xie & Wang, 2025), who found that a supportive university entrepreneurial environment amplifies the influence of innovative, AI-supported entrepreneurship education on students' entrepreneurial intentions. More broadly, the result supports an ecosystem-based perspective, which views institutional resources and entrepreneurship support programmes as essential mechanisms for translating students' learning experiences into stronger entrepreneurial confidence and intentions (Anjum et al., 2026); . The significant moderation effect observed in this study ($\beta = 0.21$) suggests that campus ecosystem support may strengthen the relationship between innovative learning strategies and Entrepreneurial intention. These findings may have relevance for comparable private higher education contexts in Southeast Asia, although cross-country validation is still required.

Academic and practical implications

This study provides both academic and practical implications for entrepreneurial education in higher education, particularly in private universities operating in evolving contexts. The results indicate that innovative learning strategies through challenge-based learning, gamification, and AI-assisted digital learning are associated with higher Entrepreneurial intentions among Gen Z students. It also highlights the importance of psychological factors, such as entrepreneurial self-efficacy, and institutional conditions, such as campus ecosystem support, in promoting the effectiveness of these learning approaches.

From a practical perspective, the findings suggest that higher education institutions can enhance entrepreneurial outcomes by creating experiential and digital learning environments with adequate institutional support. Strengthening mentoring programs, providing access to entrepreneurial resources, and fostering collaboration with industry can transform students' learning experiences into increased confidence and intention to pursue entrepreneurship. These implications are relevant not only for universities in Indonesia but also for other developing countries in Asia facing challenging educational and resource constraints.

CONCLUSION

This study examined the roles of challenge-based learning, digital technology and AI-assisted ideation, entrepreneurial self-efficacy, and campus ecosystem support in shaping entrepreneurship-related outcomes among Generation Z students at Indonesian private universities. The findings showed that challenge-based learning was positively associated with entrepreneurial self-efficacy and gamification engagement and opportunity recognition. Digital technology and AI-assisted ideation also demonstrated a significant positive relationship with gamification engagement and opportunity recognition, representing the strongest direct effect in the structural model

Entrepreneurial self-efficacy significantly mediated the relationship between innovative strategies and Entrepreneurial intention ($\beta = 0.30$, $t = 6.84$, $p < 0.001$). This finding indicates that innovative, adaptive, and technology-supported learning experiences are more strongly associated with Entrepreneurial intention when they enhance students' confidence in performing entrepreneurial tasks. Campus ecosystem support also positively moderated the relationship between innovative strategies and Entrepreneurial intention ($\beta = 0.21$, $t = 4.96$, $p < 0.001$), indicating that the relationship becomes stronger when students perceive greater institutional support. Overall, the model explained 56% of the variance in Entrepreneurial intention, demonstrating moderate explanatory power

In practical terms, universities, especially in the context of developing countries in Asia, are advised to integrate innovative learning strategies into a supportive campus ecosystem. The management's contribution highlights the need for university leaders to embed challenge-based learning, gamification, and AI-based virtual digital tools into the entrepreneurship curriculum, supported by structured mentoring systems, incubation programs, and industry collaborations to strengthen entrepreneurial readiness.

Policy implications include investment in digital infrastructure, AI integration, and university-industry collaboration to enhance the implementation of ecosystem-based entrepreneurship education, which can ultimately bolster graduates' entrepreneurial capacity and contribute to regional economic development. However, this study is cross-sectional and therefore does not permit causal conclusions; focusing on private universities in one region and relying on self-reported data may limit generalizability and introduce common method bias. Consequently, future research should adopt a longitudinal design, expand the sample across regions and types of institutions in Indonesia and other ASEAN countries, and examine additional psychological and contextual factors beyond entrepreneurial self-efficacy, potentially shifting the focus from intentions to actual business behaviors.

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AUTHOR CONTRIBUTION STATEMENT

Bangun Prajadi Cipto Utomo is responsible for conceptualization, methodology, formal analysis, writing (initial and revised concepts), and project administration, including the development of research concepts and theoretical frameworks, designing quantitative methodologies with the PLS-SEM approach, leading data collection and analysis with SmartPLS 4.0, drafting the first manuscript, and acting as a corresponding author during the submission and revision process. Tri Djoko Santoso contributes to the curation, research, validation, and editing of data, including the development and management of research tools, coordinating data collection at five private universities in Central Java, conducting initial data screening and validation, and reviewing manuscripts to ensure academic accuracy and consistency. Darwina Arshad contributed to conceptualization, oversight, resource allocation, and editing; provide academic guidance and critical feedback on the theoretical basis of the model, especially as it relates to Social Cognitive Theory and campus ecosystem perspectives; and supporting the inclusion of international references from the higher education context in Malaysia and Southeast Asia. All authors have reviewed and approved the final version of the manuscript and accept full responsibility for the integrity, accuracy, and accountability of all aspects of the work.

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