

Design Thinking-Drive Business Modelling and AI Utilization: A Study on University Students' Entrepreneurial Competencies

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Abstract

University-based entrepreneurship education is widely recognized as a critical component in fostering adaptability and enhancing startup competencies among youth. However, the proportion of new entrepreneurs remains relatively low in comparison to the national economic demands. This study investigates the extent to which the application of design thinking, supported by artificial intelligence (AI) tools, can enhance students' startup competencies. A quantitative research design was employed, utilizing structural equation modeling (SEM) for data analysis. The respondents were selected through judgmental sampling, comprising 179 students who had completed an entrepreneurship course. Data were collected via questionnaires and analyzed using SmartPLS 4 software. The findings indicate that design thinking has a significant positive impact on students' startup competencies. Furthermore, design thinking was found to significantly influence AI adoption; students engaged in design-thinking-based instruction were more inclined to utilize AI tools in developing their business models. However, the adoption of AI did not exhibit a significant direct effect on startup competency. As a result, the mediating role of AI adoption in the relationship between design thinking and startup competency was also found to be non-significant. These findings suggest the need for further investigation into how design thinking can be more effectively integrated with AI tools to optimize learning outcomes.

Keywords: design thinking, startup competency, artificial intelligence, university-based entrepreneurship education

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Introduction

Indonesia faces an urgent need to generate new entrepreneurs amid limited formal employment opportunities and a persistent unemployment rate, which reached 7.46 million people (4.85%) as of August 2025. In response to these structural challenges, university-based entrepreneurship education has been mandated for all undergraduate students. To be effective in preparing graduates for complex real-world challenges, such education must evolve beyond theory and integrate modern, experiential methodologies. Chief among these are Design Thinking (DT) for human-centered problem identification, structured Business Model Canvas (BMC) frameworks for strategic planning, and Artificial Intelligence (AI) tools for data-driven idea exploration and market analysis. Prior studies confirm that these approaches foster entrepreneurial attitudes, creativity, digital literacy, and critical reflection (Liang et al., 2025; Shirai et al., 2024; Thu et al., 2025).

Within the broader discourse on entrepreneurship education, the distinction between business and non-business student cohorts has been debated. Boldureanu et al. (2020) argue that differentiated instructional approaches are necessary to accommodate these groups. However, more recent evidence suggests otherwise. Arendt et al. (2025) demonstrate that competency-based entrepreneurship education yields positive long-term entrepreneurial outcomes across disciplines, regardless of program background.

In practice, business model frameworks such as at Business Model Canvas are widely adopted in university to facilitate structures ideation, opportunity recognition, and value creation (Al-Filali et al., 2024). Recent studies indicate that the BMC has evolved conceptually and pedagogically to address the demands of sustainability, digitalization, and competency-based learning, as reflected in the development of a sustainable and digital BMC comprising expanded elements that emphasize ecosystem collaboration, co-creation, and integrated economic, social, and environmental value propositions (Bachmann et al., 2024). From an educational perspective, the adaptation of the BMC within project-based learning (PBL) environments has been shown to enhance students' metacognitive awareness and entrepreneurial competencies through engagement with real-world ecosystem, and stakeholders (Moure et al., 2023). However, empirical evidence also suggests that not all BMC components contribute equally to performance outcomes, customers segmentation, value propositions, and channels are identified as the most influential elements in validating business hypotheses and improving team performance (Ladd, 2018).

Although competency-based measurement offers a robust approach to evaluating the outcomes of entrepreneurship education, particularly in contexts where longitudinal tracking is difficult (Alfantookh & Bakry, 2013; Ferreras-garcia, 2026). Research and pedagogical innovation involving DT, BMC, and AI have largely been concentrated within business and engineering disciplines (Duong et al., 2025; Thu et al., 2025). This leaves a critical gap in community-oriented academic programs, such as Community Education, which train students not only as individual entrepreneurs but as facilitators of community-based economic development and social innovation (Boothroyd & Davis, 1993; Clark, 1986; Saepudin & Mulyono, 2019). These "entrepreneur-facilitators" require a unique blend of competencies to empower grassroots initiatives, yet empirical studies examining entrepreneurship education within this specific context remain scarce, particularly those focusing on measurable competencies rather than short-term intentions.

Therefore, this study aims to measure students' entrepreneurial competencies after completing an entrepreneurship course that integrates design thinking-driven business modelling using the Business Model Canvas and AI tools for business idea exploration and development. By focusing on students from a community education program, this research contributes to the growing literature on inclusive and competency-based entrepreneurship education and provides empirical evidence on how design thinking and AI adoption interact in shaping entrepreneurial competencies beyond traditional business disciplines.

Literature Review

Entrepreneurial Competencies

The concept of competency first emerged as an innovative approach to predicting academic and professional success in the 1970s, pioneered by David McClelland. McClelland (1973) emphasized that measurable clusters of behavioural patterns, such as communication skills and goal setting, were more effective predictors than intelligence (IQ) tests. At its core, competency relates to a person's ability or capability to satisfactorily complete tasks (Hager & Gonczi, 1996, 2009).

Subsequent theoretical developments by Boyatzis (Boyatzis, 2008) deepened the understanding by highlighting the distinction between the expected results of an action and the skills and characteristics needed to achieve them. Competency is defined as the capability that builds expertise, knowledge, and attributes to achieve performance in a job or task (Boyatzis, 2008; Costa et al., 2026; Hines et al., 2017). This definition refers to consistent and sustained habits of thinking and acting.

Spencer and Spencer (2008) made significant contributions by expanding the definition of competency to include deeper characteristics, such as motivation, personality traits, self-concept, attitudes, values, technical knowledge, and cognitive or behavioral competencies. They popularized the *Competency Iceberg Model*, which distinguishes between explicit competencies which is related to knowledge and skills and implicit competencies related to psychological characteristics such as traits, self-concept, and motives. These components can be grouped into three levels (Mohamad Rosman et al., 2022; Spencer & Spencer, 2008): surface tools, most easily developed which consist of skills and knowledge; self-image attributes, consist of self-concept and social role; core personal characteristics, most difficult to change, consist of traits and motives.

In the context of entrepreneurship and education, the competency approach focuses on developing students' abilities and adaptability to real-world scenarios (Ferreira et al., 2022; Trabelsi-Zoghلامي & Touzani, 2019). Entrepreneurial competency involves not only skills but also specialized knowledge and attitudes required to identify business opportunities and transform them into sustainable business models (Al-Filali et al., 2024; Jackson, 2015; Tehseen et al., 2018). Therefore, competency-based measurement becomes a robust approach for evaluating the outcomes of entrepreneurship education (Alfantookh & Bakry, 2013; Romero-Frías & Robinson-garcía, 2017).

Prior studies highlight that entrepreneurship education contributes to the development of entrepreneurial attitudes and intentions (Boldureanu et al., 2020), creativity and resilience (Amirul et al., 2025), digital and artificial intelligence (AI) literacy (Liang et al., 2025; Thu et al., 2025), critical reflection (Blanckesteijn et al., 2024), and design thinking-driven business

modelling (Liang et al., 2025; Shirai et al., 2024) as well as the ability to apply knowledge in real-world contexts and to enhance perceived desirability and feasibility of entrepreneurial ventures (Thu et al., 2025). In parallel, recent findings highlight that students tend to adopt and explore AI tools in a natural and immediate manner, while interdisciplinary collaboration is strengthened through co-creation strategies; nevertheless, sustained engagement and idea fluency depend on adequate training and scaffolding in AI tool usage (Miranda, 2025).

Design Thinking-Drive Business Modelling

Design Thinking is defined as a human-centered, iterative methodology that prioritizes empathy, multidisciplinary collaboration, prototyping, and creative problem-solving to develop solutions profoundly aligned with user needs and market expectations (Sreenivasan & Suresh, 2024). This conceptualization elevates design thinking from a mere creative toolkit to a strategic framework essential for business model innovation and digital transformation. It serves as a critical bridge between human creativity and data-driven technological insights, enabling ventures to develop desirable, feasible, and viable value propositions. The methodology's iterative nature, emphasizing prototyping and stakeholder feedback, is fundamental for refining both products and their underlying business logic in response to real-world validation.

The process of developing this integrated identity is operationalized through transformative experiential learning. Grounded in Kolb's (2003) pedagogical cycle, this process involves concrete experience, reflective observation, abstract conceptualization, and active experimentation. When applied to entrepreneurship education, this cycle allows students to engage with ill-defined, real-world problems, applying design thinking principles iteratively (Blankestijn et al., 2024). Through this "learning by doing" and reflection, abstract concepts become internalized competencies, and a professional identity is forged.

The practical application of this theoretical synthesis is often facilitated by structured business model tools, most notably the Business Model Canvas (BMC). The BMC provides a common language and framework for structured ideation, opportunity recognition, and value proposition design, making it a staple in university entrepreneurship programs (Al-Filali et al., 2024). Pedagogically, its strength lies in its adaptability. Recent scholarly work reflects its evolution to meet contemporary demands, giving rise to conceptual expansions like the sustainable and digital BMC, which emphasize ecosystem collaboration, co-creation, and integrated value propositions (Bachmann et al., 2024). Integrating the BMC within Project-Based Learning (PBL) environments has been shown to enhance metacognitive awareness and entrepreneurial competencies by forcing engagement with real ecosystems and stakeholders (Moure et al., 2023). Empirical studies further refine its use, indicating that not all BMC components are equally impactful; elements like customer segments, value propositions, and channels are often most critical for hypothesis testing and venture performance (Ladd, 2018).

This framework finds concrete expression in pedagogical practices where an adapted BMC template is used within a PBL context. As noted by Moure Abelenda et al. (2023), "the direct interaction with potential clients allows the students to apply the design thinking methodology focused on the user" (p. 11). In such settings, the BMC ceases to be a static planning document and becomes a dynamic tool for integrating the iterative, human-centered design process. Students use stakeholder empathy and feedback gathered through primary market research to continuously refine their prototypes and business model hypotheses,

ensuring their solutions are not only technically sound but also market-validated and desirable.

AI Utilization

AI functions primarily as a catalytic stimulus within the entrepreneurial process, activating cognitive mechanisms according to an integrated Stimulus-Organism-Response (SOR) and Entrepreneurial Event Model (EEM) perspective (Duong et al., 2025; Thu et al., 2025). Exposure to and adoption of AI tools, such as generative AI platforms, AI-competency development, and immersion in an AI-positive ecosystem, serve as external drivers that directly influence an individual's internal psychological state, setting the stage for entrepreneurial consideration.

This stimulus is processed through core cognitive pathways centre on perceived desirability and feasibility. AI enhances the perceived attractiveness (desirability) of entrepreneurial ventures by infusing them with innovation and novel potential, while simultaneously bolstering the perceived practicality (feasibility) by offering concrete tools for planning, problem-solving, and execution (Duong et al., 2025; Thu et al., 2025). Crucially, the framework underscores that entrepreneurial intention peaks when these two perceptions are not only high but also in cognitive alignment; significant dissonance between what is desired and what is believed possible can substantially dampen commitment, highlighting a key leverage point for educational intervention.

The effectiveness of this AI-to-cognition pathway is not uniform but is critically moderated by an individual's technology integration capacity and knowledge competencies. Specifically, AI literacy and deep entrepreneurial knowledge (EK) act as essential moderators that determine whether AI acts as a true enabler (Awal & Chowdhury, 2024; Qin, 2024). Possessing knowledge of AI (KAI) equips potential entrepreneurs to practically deploy technologies like IoT, blockchain, and generative AI for specific outcomes such as frugal innovation or sustainable business modelling. This knowledge transforms AI from an abstract stimulus into a tangible toolkit, thereby directly strengthening the feasibility pathway and enabling the translation of innovative ideas into actionable plans.

Moving beyond intention formation, the framework explicitly incorporates AI as an instrumental educational and skill-development tool. AI applications, such as analytics-driven video pitch evaluation, provide objective, granular feedback on critical entrepreneurial behaviours like communication, confidence, and emotional expression (Giuggioli et al., 2026). This creates a direct feedback loop where AI not only inspires the ambition to venture but also actively trains the precise skills, such as persuasive pitching, required to successfully secure funding and execute the venture, thereby bridging the gap between intention and competent action.

Ultimately, this entire process is embedded within and dynamically interacts with a broader entrepreneurial ecosystem. Factors such as social influence, institutional support structures, market volatility, and a collective openness to technological innovation can significantly amplify or constrain the influence of AI on the individual (Popa & Breazu, 2025). The framework concludes that while AI is a transformative enabler for entrepreneurial education, influencing intention, enhancing skills, and providing evaluative insights, its full potential is realized only within a supportive ecosystem. Furthermore, it remains a complement to, not a

replacement for, essential human intuition and judgment in navigating the uncertainties inherent to entrepreneurship.

Methodology

Research Design and Approach

This study employed an analytical survey research design. This design is suitable for describing a situation and explaining the relationships between phenomena by examining why certain conditions exist (Barroga & Matanguihan, 2022; Malik, 2013). It involves investigating two or more variables to answer research questions and test hypotheses, thereby allowing for the examination of relationships and the drawing of conclusions from those relationships.

Conceptual Definitions

Entrepreneurial Competencies (Y) are defined as the integrated clusters of capabilities encompassing knowledge, skills, attributes, motives, and traits that enable an individual to successfully perform entrepreneurial tasks, identify opportunities, and develop sustainable business models (Boyatzis, 2008; Spencer & Spencer, 2008; Tehseen et al., 2018).

Design Thinking-Driven Business Modelling (X1) refers to the application of a human-centered, iterative design thinking methodology, emphasizing empathy, prototyping, and user feedback, to the structured development and validation of a business model, often operationalized through tools like the Business Model Canvas.

AI Utilization (X2) is conceptualized as the adoption and application of artificial intelligence tools (e.g., generative AI, analytics platforms) within the entrepreneurial process, serving as a stimulus that enhances perceived desirability and feasibility of ventures and acts as a catalyst for skill development and business modelling.

Populations and Sample

The research population was sixth-semester students from the Community Education program at four universities in Indonesia: Universitas Bengkulu, Universitas Negeri Jakarta, Universitas Pendidikan Indonesia, dan Universitas Singaperbangsa, with a total population (N) of 240 students. The sample size was determined using the Slovin formula with a 5% margin of error, yielding a minimum sample size of 150. Data were collected from 179 respondents using a simple random sampling technique.

Data Collection Instrument

Data was collected using a questionnaire, which is a technique for gathering data by providing a set of written questions or statements to respondents to answer. The instrument measured three variables: Entrepreneurial Competencies (EC) with 20 items, Design Thinking-Driven Business Modelling (DT) with 9 items, and AI Utilization (AI) with 9 items. All items used a Likert-type scale.

Validity and Reliability

The instrument's validity and reliability were established through two stages. First, expert judgment was sought to assess content validity. Second, an empirical test was conducted with 66 pilot respondents. The results confirmed that the instrument was both valid and reliable for measuring the intended constructions.

Table 1

V Result

Item	Pearson Correlation	Result
Design Thinking-Drive Business Modelling (DT)		
DT.1	0,64	Valid
DT.2	0,705	Valid
DT.3	0,714	Valid
DT.4	0,715	Valid
DT.5	0,717	Valid
DT.6	0,814	Valid
DT.7	0,692	Valid
DT.8	0,728	Valid
DT.9	0,753	Valid
AI Utilization (AI)		
AI.1	0,746	Valid
AI.2	0,707	Valid
AI.3	0,668	Valid
AI.4	0,748	Valid
AI.5	0,824	Valid
AI.6	0,739	Valid
AI.7	0,695	Valid
AI.8	0,699	Valid
AI.9	0,721	Valid
Entrepreneurial Competencies (EC)		
EC.1	0,75	Valid
EC.2	0,722	Valid
EC.3	0,687	Valid
EC.4	0,661	Valid
EC.5	0,645	Valid
EC.6	0,64	Valid
EC.7	0,676	Valid
EC.8	0,645	Valid
EC.9	0,726	Valid
EC.10	0,711	Valid
EC.11	0,719	Valid
EC.12	0,764	Valid
EC.13	0,768	Valid
EC.14	0,661	Valid
EC.15	0,73	Valid
EC.16	0,8	Valid
EC.17	0,801	Valid
EC.18	0,651	Valid
EC.19	0,686	Valid
EC.20	0,709	Valid

Validity test results show at Table 1 demonstrate that the research instrument possesses adequate content and construct validity. Each item functions effectively in measuring its intended latent variable (AI Utilization, Design Thinking-Driven Business Modelling, and Entrepreneurial Competencies). Consequently, this instrument is suitable and reliable for use in primary data collection to test the research hypotheses. No revisions or item deletions are required, as all items have met the statistical criteria as valid measures.

Table 2
Reliability Result

Variable	Cronbach's Alpha	N of Items	Result
AI	.881	9	Reliable
DT	.887	9	Reliable
EC	.950	20	Reliable

Table 2 shows that all three constructions demonstrate excellent internal consistency, as indicated by Cronbach's Alpha values significantly exceeding the commonly accepted threshold of 0.70. The value for Entrepreneurial Competencies (EC) is exceptionally high (.950), confirming superb reliability for its 20-item scale. The values for AI Utilization (.881) and Design Thinking (.887) also denote high and very satisfactory reliability for their respective 9-item scales.

Research Procedure

The research procedure consisted of several key stages:

1. Obtaining research permits and conducting preliminary observations;
2. Determining the population and sample;
3. Developing and presenting the research proposal;
4. Constructing and validating the research instrument (questionnaire);
5. Administering the pilot test and revising the instrument accordingly;
6. Distributing the final questionnaire and collecting data from the main sample;
7. Performing data analysis, including model validity tests (e.g., normality, model fit), hypothesis testing, and interpretation of results; and
8. Finalizing the research findings.

Data Analysis

Data were analyzed using Structural Equation Modeling (SEM), specifically the Partial Least Squares (PLS) approach. PLS-SEM is a variance-based technique suitable for developing and testing causal models, combining aspects of confirmatory factor analysis, path analysis, and regression (Narimawati & Sarwono, 2017). It is appropriate for this study as it does not require strict assumptions about data distribution (non-parametric), is effective for theory development, and allows for the assessment of complex models with latent variables. The model's explanatory power was evaluated using the coefficient of determination (R^2). Analysis was performed using SmartPLS software.

Hypothesis Testing

Hypotheses were tested by examining the significance of the path coefficients in the PLS-SEM model. The significance of individual paths and the overall model was assessed. The research hypotheses were:

- H1: Design Thinking-Driven Business Modelling (DT) and AI Utilization (AI) simultaneously have a significant positive effect on Entrepreneurial Competencies (EC).
- H2: Design Thinking-Driven Business Modelling (DT) individually has a significant positive effect on Entrepreneurial Competencies (EC).
- H3: AI Utilization (AI) individually has a significant positive effect on Entrepreneurial Competencies (EC).

Results and Discussion

Convergent validity was assessed by examining the outer loadings presented in Table 3. In the first convergent validity test, several indicators were found to be invalid—specifically, those with factor loadings below 0.70. This included 5 indicators from Design Thinking (DT1, DT2, DT5, DT8, DT9), 6 indicators from Artificial Intelligence (AI1, AI2, AI3, AI4, AI5, AI7), and 7 indicators from Entrepreneurial Competencies (EC1, EC2, EC4, EC5, EC9, EC18, EC20). Thus, the remaining number of indicators was reduced from 38 to 20.

A second convergent validity test was then conducted using the remaining 20 indicators. This round resulted in one additional indicator from Entrepreneurial Competencies being deemed invalid (DT3), bringing the total number of indicators down to 19. In the third and final calculation, all 19 indicators were confirmed to be valid.

Table 3
Convergent Validity

	<i>Convergent Validity 1</i>			<i>Convergent Validity 2</i>				<i>Convergent Validity 3</i>				
	AI	EC	EC	Note	AI	EC	EC	Note	AI	EC	EC	Note
DT1		0.669		Not Valid								
DT2		0.691		Not Valid								
DT3		0.724		Valid		0.805		Valid		0.803		Valid
DT4		0.719		Valid		0.757		Valid		0.759		Valid
DT5		0.689		Not Valid								
DT6		0.700		Valid		0.722		Valid		0.720		Valid
DT7		0.710		Valid		0.723		Valid		0.726		Valid
DT8		0.681		Not Valid								
DT9		0.654		Not Valid								
AI1	0.687			Not Valid								
AI2	0.683			Not Valid								
AI3	0.666			Not Valid								
AI4	0.648			Not Valid								
AI5	0.676			Not Valid								
AI6	0.740			Valid	0.711			Valid	0.707			Valid
AI7	0.672			Not Valid								
AI8	0.703			Valid	0.864			Valid	0.865			Valid
AI9	0.712			Valid	0.874			Valid	0.876			Valid
EC1			0.598	Not Valid								
EC2			0.564	Not								

	<i>Convergent Validity 1</i>		<i>Convergent Validity 2</i>		<i>Convergent Validity 3</i>	
		Valid				
EC3	0.706	Valid	0.680	Not Valid		
EC4	0.618	Not Valid				
EC5	0.685	Valid				
EC6	0.750	Valid	0.768	Valid	0.762	Valid
EC7	0.737	Valid	0.772	Valid	0.780	Valid
EC8	0.747	Valid	0.756	Valid	0.763	Valid
EC9	0.700	Not Valid				
EC10	0.785	Valid	0.800	Valid	0.809	Valid
EC11	0.740	Valid	0.769	Valid	0.772	Valid
EC12	0.758	Valid	0.772	Valid	0.771	Valid
EC13	0.770	Valid	0.781	Valid	0.781	Valid
EC14	0.733	Valid	0.750	Valid	0.749	Valid
EC15	0.768	Valid	0.785	Valid	0.793	Valid
EC16	0.801	Valid	0.813	Valid	0.815	Valid
EC17	0.726	Valid	0.725	Valid	0.720	Valid
EC18	0.676	Not Valid				
EC19	0.730	Valid	0.724	Valid	0.727	Valid
EC20	0.629	Not Valid				

As shown in Table 3, convergent validity was established through an iterative refinement of indicators, resulting in a final set of 19 valid items (loading > 0.70) from an initial pool of 38. The retained constructs exhibited excellent internal consistency, with Cronbach's Alpha values of 0.745 for DT, 0.755 for AI, and 0.938 for EC (Table 4), confirming the instrument's reliability.

Table 4
Reliability Result

	Cronbach's alpha	Note
Design Thinking	0.745	Valid
Entrepreneurial Competencies	0.938	Valid
AI Utilization	0.755	Valid

The overall model fit was assessed as acceptable. Key indices, including the Standardized Root Mean Square Residual (SRMR = 0.084) and the Normed Fit Index (NFI = 0.709), met the threshold for a reasonable fit, although the significant Chi-square statistic indicated some discrepancy common in complex models with larger samples (Hair et al., 2019). The predictive power of the model, evaluated through R² values (Table 6), showed that DT and AI together explained a moderate 44.2% of the variance in Entrepreneurial Competencies. Notably, DT alone was a weak predictor of AI Utilization (R² = 0.185), suggesting other significant factors influence AI adoption.

Tabel 5
Model Fit Test Result

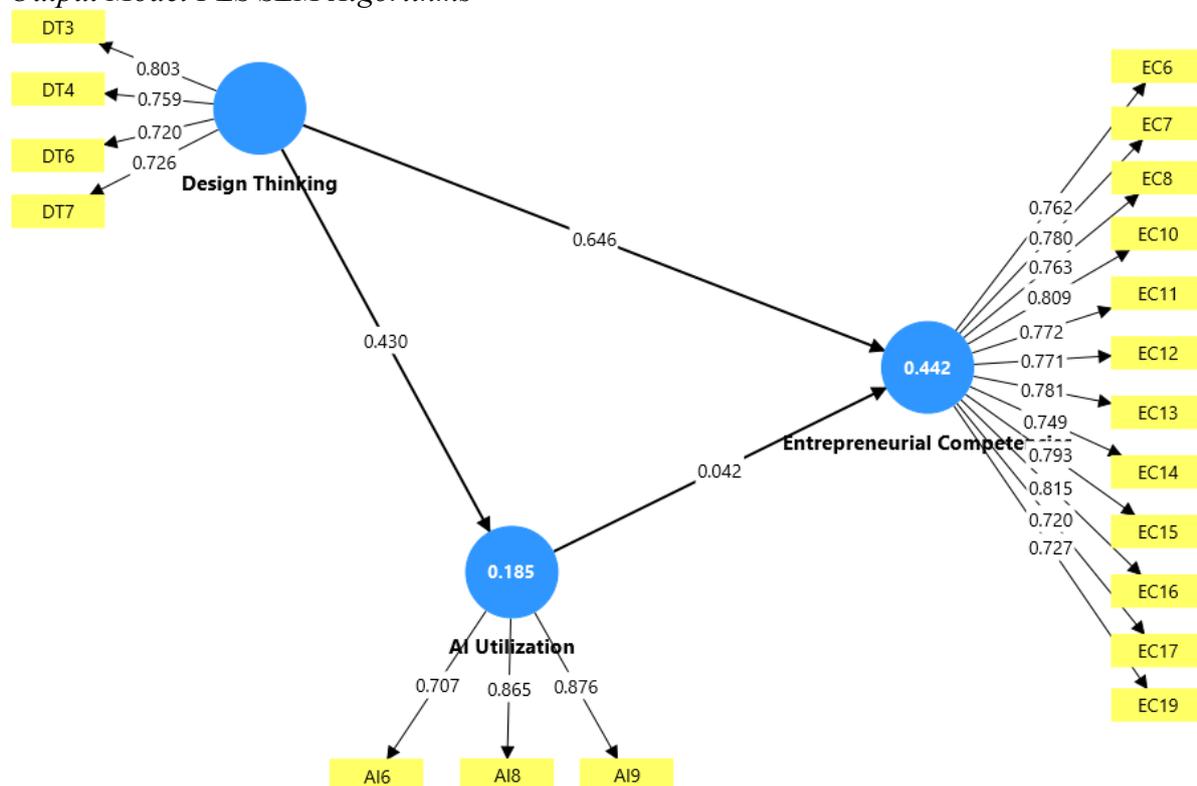
Parameter	Rule of Thumb	Nilai Parameter	Note
SRMR	Less than 0.10	0.084	Fit
d-ULS	> 0.05	1.335	Fit
d-G	> 0.05	0.662	Fit
Chi Square	χ^2 statistic \leq X ² table	662.724	Not Fit
NFI	Approaching a value 1	0.709	Fit

Table 6
R Square (R²) Test Result

	R-square	R-square adjusted
AI Utilization	0.185	0.181
Entrepreneurial Competencies	0.442	0.436

Based on the analysis results, the R-square for the dependent variable Artificial Intelligence is 0.185. This indicates that 18.5% of the variability in artificial intelligence (utilization) can be explained by Design Thinking, which falls into a weak category. Furthermore, the analysis yielded an R-square for the dependent variable Entrepreneurial Competencies of 0.442. This shows that 44.2% (or 40.2% for the adjusted R-square) of the variability in entrepreneurial competencies can be explained by the combined influence of Design Thinking and Artificial Intelligence, which is categorized as a moderate level.

Figure 1
Output Model PLS SEM Algorithms



The hypothesis testing results, summarized in Table 7 and Table 8, provided clear answers to the research questions. A critical finding emerged in the relationship between DT and AI.

H1: Design Thinking-Driven Business Modelling (DT) and AI Utilization (AI) simultaneously have a significant positive effect on Entrepreneurial Competencies (EC), Rejected, as the p-value was greater than 0.05 ($p = 0.601$).

The path from DT to AI was significant and positive ($\beta = 0.430$, $p = 0.000$), indicating that engagement with the design thinking methodology promotes the adoption and use of AI tools. However, the indirect effect path (DT \rightarrow AI \rightarrow EC) was not significant ($p = 0.601$). Consequently, Hypothesis H1 was rejected, as the simultaneous effect of DT and AI on EC was not statistically significant, primarily due to the non-significant direct role of AI.

H2: Design Thinking-Driven Business Modelling (DT) individually has a significant positive effect on Entrepreneurial Competencies (EC), accepted, with a p-value of less than 0.05 ($p = 0.000$).

Hypothesis H2 was strongly supported, with Design Thinking-Driven Business Modelling exhibiting a significant, positive direct effect on Entrepreneurial Competencies ($\beta = 0.646$, $p = 0.000$). This finding aligns with theoretical expectations that the iterative, human-centered, and experiential nature of DT fosters the deep cognitive and behavioral patterns essential for entrepreneurial competency development (Blanckesteijn et al., 2024; Moure et al., 2023).

H3: AI Utilization (AI) individually has a significant positive effect on Entrepreneurial Competencies (EC), rejected, with a p-value greater than 0.05 ($p = 0.592$). Hypothesis H3 was rejected, as AI Utilization did not show a significant direct effect on EC ($\beta = 0.042$, $p = 0.592$).

Hypothesis H3 was rejected, as AI Utilization did not show a significant direct effect on EC ($\beta = 0.042$, $p = 0.592$). This challenges the notion of AI as an independent, direct catalyst for competency acquisition in this educational context (Duong et al., 2025).

A critical finding emerged in the relationship between DT and AI. The path from DT to AI was significant and positive ($\beta = 0.430$, $p = 0.000$), indicating that engagement with the design thinking methodology promotes the adoption and use of AI tools. However, the indirect effect path (DT \rightarrow AI \rightarrow EC) was not significant ($p = 0.601$). Consequently, Hypothesis H1 was rejected, as the simultaneous effect of DT and AI on EC was not statistically significant, primarily due to the non-significant direct role of AI.

Table 7

Hypothetic Result

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values	Note
AI Utilization -> Entrepreneurial Competencies	0.042	0.035	0.079	0.535	0.592	Rejected
Design Thinking -> AI Utilization	0.430	0.437	0.073	5.873	0.000	Accepted

Design Thinking -> Entrepreneurial Competencies	0.646	0.655	0.056	11.564	0.000	Accepted
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Table 8
Intervening Result

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Design Thinking -> AI Utilization -> Entrepreneurial Competencies	0.018	0.014	0.035	0.523	0.601

This study makes a distinct contribution by empirically testing a competency-based model within the under-researched context of Community Education, a discipline specifically dedicated to cultivating “entrepreneur-facilitators” capable of fostering grassroots economic and social innovation (Boothroyd & Davis, 1993; Saepudin & Mulyono, 2019). Unlike traditional business programs, community education emphasizes collaborative, asset-based development, requiring a unique blend of entrepreneurial and facilitative competencies.

The robust support for H2 underscores the foundational relevance of pedagogical frameworks such as Design Thinking (DT) and the Business Model Canvas (BMC) for this cohort. Grounded in Kolb’s (2003) experiential learning cycle, these methodologies enable students to engage iteratively with ill-defined, real-world problems, moving from concrete experience to reflective observation, abstract conceptualization, and active experimentation. This process effectively translates theoretical knowledge into internalized, actionable competencies, such as empathetic problem identification, stakeholder engagement, and adaptive venture planning. Such skills are not merely complementary but essential for students who must later navigate complex community ecosystems, mediate diverse interests, and co-create sustainable value propositions that align with local social and environmental contexts (Bachmann et al., 2024; Moure et al., 2023).

The rejection of H3 and H1, however, introduces a necessary and nuanced perspective on the role of emerging technology in competency-based entrepreneurship education. While AI is increasingly hailed as a transformative enabler that enhances perceived venture feasibility and desirability (Thu et al., 2025), this study reveals that its impact on deeper competency development is neither automatic nor direct. The significant path from DT to AI suggests that engagement with human-centered, iterative problem-solving methodologies may increase students' awareness and adoption of AI tools.

However, the non-significant path from AI to EC indicates that, in this educational context, AI functions primarily as an adopted tool within a human-centered process, rather than as a standalone competency builder. This finding aligns with growing scholarly caution that the effectiveness of AI in learning contexts is critically moderated by factors such as AI literacy, pedagogical integration, and the presence of scaffolded guidance (Awal & Chowdhury, 2024; Miranda, 2025). Without deliberate instructional design that explicitly connects AI tool usage, for example, in data-driven market validation or generative idea exploration, to the core DT competencies, students’ engagement with AI may remain superficial. Consequently, AI may fail to enhance higher-order entrepreneurial competencies such as critical reflection,

strategic decision-making, and resilience, which are cultivated through iterative application, feedback, and reflection in real-world scenarios (Blanckesteijn et al., 2024).

Furthermore, the model's moderate explanatory power ($R^2 = 0.442$) highlights that a substantial portion of variance in entrepreneurial competencies stems from factors beyond the current research model. This is consistent with the Competency Iceberg Model (Spencer & Spencer, 2008), which posits that observable competencies (knowledge and skills) are underpinned by deeper, less mutable attributes such as personal motives, traits, self-concept, and values. These implicit characteristics are difficult to influence through short-term educational interventions but fundamentally influence entrepreneurial behaviour and capability development.

Additionally, competencies are shaped by the broader entrepreneurial ecosystem, including institutional support mechanisms, mentoring networks, social norms, and market conditions (Popa & Breazu, 2025). Future research could therefore extend this model by incorporating these latent psychological constructs and contextual variables, potentially through mixed-methods or longitudinal designs, to provide a more holistic understanding of competency formation in community-oriented entrepreneurship education.

Summary: Conclusion

DT-driven pedagogy stands out as a potent mechanism for building entrepreneurial competencies in future community facilitators, the integration of AI requires more than mere tool exposure. It calls for intentionally designed learning experiences that embed AI within the DT process, coupled with explicit competency mapping and adequate literacy support. This approach ensures that technology adoption translates into meaningful capability development, ultimately preparing students not only to use digital tools but to leverage them thoughtfully within the complex, human-centered process of community empowerment.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author declares that Grammarly, an AI-assisted writing software, was used in proofreading and refining the language used in the manuscript. The usage was limited to correcting grammatical and spelling errors and rephrasing statements for accuracy and clarity. The author further declares that, apart from Grammarly, no other AI or AI-assisted technologies have been used to generate content in writing the manuscript. The ideas, design, procedures, findings, analyses, and discussion are originally written and derived from careful and systematic conduct of the research.

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