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The influence of AI competency and design thinking skills on innovative entrepreneurial competency: The role of strategic intelligence amongst new age entrepreneurs in Thailand

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ABSTRACT

This study investigates the impact of Artificial Intelligence (AI) competency and design thinking skills on the innovative capacities of new-age entrepreneurs in Thailand, based on a sample of 187 students enrolled in business management and entrepreneurship programs. Utilizing Structural Equation Modeling (SEM) and factor analysis, the study evaluates how these competencies influence entrepreneurial innovation. The findings reveal that both AI competencies and design thinking skills significantly enhance the innovation capacity of entrepreneurs. The study underscores the importance of cultivating these skills to improve competitiveness and adaptability in the digital age. Moreover, it presents policy recommendations and necessary training initiatives to effectively integrate AI and design thinking into the entrepreneurial processes of new age entrepreneurs in Thailand. These strategic directions aim to equip them with the requisite skills to navigate evolving challenges within the business sector, thus preparing them for successful entrepreneurial endeavors in increasingly digital market environments.

1. Introduction

The pervasive influence of Artificial Intelligence (AI) and Design Thinking on the domain of innovation has become a foundation for entrepreneurial ventures in the digital era, particularly within rapidly evolving economies like Thailand. The integration of these competencies not only propels the development of innovative business models but also equips entrepreneurs with the essential tools to navigate the complexities of a dynamic global market. Thailand's unique position as a rapidly developing economy within the ASEAN region makes it an intriguing case for studying the impacts of AI and Design Thinking (Gozzoli et al., 2022). The country is experiencing swift economic and societal transformations, driven by both internal initiatives and external pressures to modernize and remain competitive on the global stage. These factors create a distinct environment where traditional business practices are being challenged and there is a strong push towards digital innovation (Shahadat et al., 2023). This study addresses a crucial gap in the literature by exploring the immediate relevance and impact of AI and Design Thinking skills in today's fast-paced economic landscape. The necessity to examine these competencies is heightened by the ongoing digital transformation and the strategic importance of Thailand's economic positioning within the ASEAN region (Yaqub & Alsabban, 2023). According to Farayola et al. (2023), the demand for AI and Design Thinking skills is increasingly critical in Thailand, where economic and societal shifts demand robust responses. Giuggioli and Pellegrini (2022) suggest that leveraging these capabilities in the innovation process fosters the creation of efficient, customer-responsive solutions that are sustainable and adaptable to market fluctuations. This integration is vital for Thai entrepreneurs facing the challenges and uncertainties of a fast-changing global economy and a digitally oriented

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business landscape.

Furthermore, AI is revolutionizing business operations and serving as a catalyst for entrepreneurial innovation by enabling the rapid, accurate analysis of vast data sets. This capability enhances the prediction of market trends and consumer behaviors (Hamdan et al., 2021) as well as bringing the design thinking mindset and reflective thinking skills to be effectively aligned with the AI integration (Saritepeci & Durak, 2024), thereby facilitating the development of new products and services that align closely with consumer demands (Broekhuizen et al., 2023). Concurrently, Design Thinking emphasizes a deep understanding of user needs, fostering a problem-solving approach that prioritizes empathy and user-centric innovation (Saritepeci & Durak, 2024). Amalia and von Korflesch (2022) also note that this approach encourages a collaborative, iterative process of development, enhancing creativity and resulting in products or services that are not only innovative but also highly relevant and valuable to consumers. Rösch et al. (2023) further argue that such an integrated approach is essential for driving the continuous improvement and relevance of entrepreneurial outputs. The theoretical framework adopted in this study is built upon the integration of Experiential Learning Theory (ELT) to understand the experiential aspects of learning AI and Design Thinking, the Technology Acceptance Model (TAM) to explore the factors influencing the adoption of AI, and Core Competency Development Theory to investigate how these skills develop core entrepreneurial competencies. Understanding and harnessing the synergy between AI, Design Thinking, and strategic intelligence is therefore crucial for Thai entrepreneurs to adapt and thrive in the evolving business outlook.

This research delineates essential insights for academics, policymakers, and entrepreneurs focused on the development and enhancement of educational and training programs tailored to entrepreneurship and innovation, specifically within the domains of Artificial Intelligence (AI) and Design Thinking. As Wannamakok and Yonwikai (2023) assert, mastering these elements is crucial for emerging Thai entrepreneurs striving to forge businesses that are not only sustainable but also competitive globally. This study delves into the role of strategic intelligence in amalgamating these competencies with the capacity for innovative entrepreneurship, offering novel perspectives that are vital for the formulation of supportive policies and strategies aimed at fostering innovation and business growth (Somwethee et al., 2023). By examining the impact of AI and Design Thinking skills on entrepreneurial innovation competency, this research not only enriches the academic discourse but also unveils new pathways for Thai entrepreneurs to develop solutions that adeptly meet global market demands (Chang & Tsai, 2021).

The core aim of this investigation is to elucidate the influence of AI competency and Design Thinking skills on the cultivation of innovative entrepreneurial capabilities in Thailand. This entails an exploration of strategic intelligence as a pivotal link between these skills and enhanced entrepreneurial proficiency. The anticipated findings are expected to accentuate the significance of integrating such competencies into the curricular and training frameworks tailored for nascent entrepreneurs, especially as Thailand navigates through its transition into a digital and creative economic era. The imperative for this research stems from Thailand's evolution as a nucleus of technological innovation within the ASEAN region, where proficiency in AI and Design Thinking is not merely instrumental for business success in the digital epoch but also for reinforcing Thailand's influence on the international stage (Wongwuttiwat & Lawanna, 2018; Giuggioli & Pellegrini, 2022).

In this inquiry, the effects of AI competency and Design Thinking skills on bolstering innovative entrepreneurship in Thailand—a country experiencing swift economic and social shifts—are thoroughly examined. The research aims to bridge extant knowledge gaps while providing robust support for the development of public policy and strategic frameworks that will enhance Thailand's future human resource capabilities. By highlighting the critical importance of embedding AI and Design Thinking into educational and training programs for budding entrepreneurs, the study not only anticipates stimulating the creation of innovative strategies and approaches to support business growth but also aims to enhance the theoretical underpinnings in this field. Such deep insights into the synergy between these competencies and entrepreneurial innovation will not only solidify the academic knowledge base but also generate new entrepreneurial opportunities, thereby contributing significantly to the socio-economic advancement of Thailand.

2. Literature review

To frame the study, three theoretical frameworks are utilized: Experiential Learning Theory (ELT), the Technology Acceptance Model (TAM), and Core Competency Development Theory. These theories provide a comprehensive lens through which to examine the influence of AI competency and Design Thinking skills on innovative entrepreneurial capabilities.

2.1. Experiential learning theory - ELT

Developed by David Kolb in 1984, Experiential Learning Theory (ELT) serves as a cornerstone for understanding the human learning process through a lens that emphasizes the important role of learning from experience (Kolb, 1984). This theory posits that learning unfolds across a cyclical sequence of four distinct stages: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE) (Kolb & Fry, 1975). This cyclical process stresses the dynamic and iterative nature of learning, where each stage builds upon the preceding one to enhance the overall learning experience.

The first stage, Concrete Experience (CE), involves learners engaging directly with activities or events, thus gaining firsthand experience. This stage is crucial as it provides the foundational experiences necessary for subsequent reflection. Following this, the Reflective Observation (RO) stage occurs, where learners critically analyze their experiences, examining various perspectives and extracting meanings from what they have encountered. This reflective process is essential for deepening understanding and preparing learners for the next stage.

In the Abstract Conceptualization (AC) stage, learners synthesize their reflections, transforming them into generalized theories or principles that extend beyond the specific instances of their experiences. This stage involves a significant cognitive process where theoretical frameworks are developed from practical insights. Finally, the cycle culminates in the Active Experimentation (AE) stage, where the derived theories and concepts are applied in new scenarios to test their validity and to glean further learning from these applications. According to Kolb, effective learning is achieved when learners engage thoroughly in each of these stages, thereby equipping them to apply acquired knowledge to real-world situations effectively (Kolb, 1984).

Within the context of fostering Design Thinking skills and enhancing AI competency, ELT offers a robust framework through which learners can cyclically reflect on, conceptualize, and apply knowledge gained from practical experiments and real-world applications. This iterative learning process is critical for nurturing the capabilities necessary for driving innovation and entrepreneurship effectively, as identified by Pratomo and Wardani (2021). The theory's emphasis on learning through active engagement and reflection makes it particularly relevant in areas where adaptive and innovative thinking is required.

2.2. Technology acceptance model - TAM

The Technology Acceptance Model (TAM), devised by Davis in 1989, has been instrumental in explicating the determinants of technology adoption and usage within organizational settings. This model aims to delineate the primary factors that influence the acceptance and use of new technologies in the workplace, thus offering a comprehensive

framework for understanding technological integration (Davis, 1989). According to TAM, the propensity to accept and use technology is predominantly driven by two principal constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Perceived Usefulness is conceptualized as the user's belief that utilizing the technology will augment their job performance. Conversely, Perceived Ease of Use denotes the user's belief that the technology can be operated without undue effort (Davis, 1989).

Over the years, the TAM has been refined and expanded through numerous studies that have introduced additional variables such as Social Influence and Perceived Facilitating Conditions. These elements further elucidate the multifaceted nature of technology acceptance by highlighting how social norms and infrastructural support can also significantly affect individual and organizational technology adoption decisions (Pan, 2020). The adaptability of the TAM across diverse technological domains features its enduring relevance and applicability.

In recent applications, in the context of AI adoption within business and entrepreneurial domains, the TAM has been employed to investigate how businesses perceive the value and usability of AI technologies. This model serves as a foundational theoretical framework to explore how perceptions about the utility and ease of use of AI influence organizational decisions to integrate these technologies into business processes and innovation strategies (Wang et al., 2023; Kelly et al., 2023). By leveraging the insights provided by TAM, researchers and practitioners can better understand the dynamics of AI acceptance and its potential impacts on operational efficiency and competitive advantage in the marketplace. Thus, the TAM not only facilitates a deeper understanding of the initial acceptance but also supports ongoing engagement with technological innovations, aligning technology implementation with strategic business objectives.

2.3. Core competency development theory

Core Competency Development Theory, essential in the domains of strategic management and personnel development, was introduced by C. K. Prahalad and Gary Hamel in their influential 1990 work, "The Core Competence of the Corporation." They conceptualize core competencies as the fusion of organizational learning activities, specifically those that enhance the coordination of disparate technologies and effective teamwork (Prahalad & Hamel, 1990). This theory posits that the development of core competencies is vital not only for prevailing in current market conditions but also for establishing a robust groundwork for future competitive scenarios. Core competencies are characterized by profound, specialized knowledge in domains where an organization can distinctly surpass its rivals.

In the evolving area of Artificial Intelligence (AI) and design thinking, the development of core competencies is seen as crucial for fostering sustainable innovation and achieving competitive advantages in product or service offerings. The integration of deep technical knowledge with creative ideation forms a foundation of competencies that are challenging for competitors to replicate (Hamel & Prahalad, 1994; Teece, Pisano & Shuen, 1997). Specifically, the application of AI in analyzing big data and forecasting market trends can significantly refine business decision-making processes, adding both depth and efficiency (Bag et al., 2020). This technological leverage, when combined with core competencies in design thinking, empowers organizations to apply their knowledge and technological capabilities in creating solutions that are finely tuned to meet specific customer demands.

Further, as outlined by Mikalef and Gupta (2021) and Borges et al. (2021) the strategic alignment of AI competency and design thinking within the framework of core competencies enables organizations to innovate continuously and adaptively. By nurturing these competencies, organizations can maintain a dynamic capability framework that not only supports current competitive needs but also anticipates and responds to future challenges (Dwivedi & Wang, 2022). Thus, Core Competency Development Theory provides a strategic lens through which organizations can view their growth and adaptation, ensuring they remain at the forefront of their industries by harnessing their unique strengths and continuously evolving these capabilities in response to technological advancements and market demands.

2.4. AI competency

In the digital age, where Artificial Intelligence (AI) plays a critical role across all sectors of society and the economy, "AI Competency" has emerged as a crucial factor for organizations and individuals to remain competitive and successful in a rapidly changing market (Wamba-Taguimdje et al., 2020). AI Competency encompasses the ability to use AI tools and technology, applying AI to drive innovation, improve decision-making, and enhance business development (Mikalef et al., 2023). Integrating AI into business processes enhances efficiency, reduces costs, and creates new opportunities for adding value to customers and building brand identity (Haleem et al., 2022). Studies indicate that having a deep understanding of AI, integrating AI with business processes, managing and curating data effectively, and promoting continuous learning are essential for maintaining a competitive edge in the digital age (Mikalef et al., 2023). Knowledge about AI affects both the development and application of technology in various fields, and plays a crucial role in enhancing the capabilities of businesspeople and entrepreneurs (Enholm et al., 2022). AI knowledge includes fundamental theories and practical applications in solving real-world problems, such as machine learning, natural language processing, computer vision, automation, and robots (Kietzmann & Pitt, 2020; Makarius et al., 2020; Collins et al., 2021; Raisch & Krakowski, 2021; Sarker, 2022). Applying AI in business requires continuous development and learning from data to improve and offer solutions that meet customer needs (Sjödin et al., 2021).

Effective data management is crucial for optimizing AI performance. This involves detailed data curation, including the collection, management, preservation, and administration of data to ensure its sustainable and efficient utilization (Aldoseri et al., 2023). Superior data management practices, such as data cleaning, transformation, and enrichment with metadata, are essential for improving data quality and utility for AI applications (Martín et al., 2023). Additionally, fostering an organizational culture that prioritizes continuous learning is vital in an era marked by rapid technological advancements. Implementing strategies that promote continuous learning—such as blended learning models, online platforms, and targeted training programs in AI and emerging technologies—are crucial for maintaining a competitive advantage and fostering the perpetual development of organizational capabilities (Borges et al., 2021; Füller et al., 2022; Kamalov et al., 2023; Mirchi et al., 2023). These elements collectively highlight the dynamic interplay between technology, strategic management, and continuous organizational learning, emphasizing the complexity of effectively integrating AI into contemporary business and innovation strategies.

2.5. Design thinking skills

Understanding and presenting the significance of Design Thinking in the context of entrepreneurship and innovation is crucial for developing products and services that truly meet user needs (Sarooghi et al., 2019). Design Thinking focuses on creative problem-solving with the user at the center, enabling organizations to generate meaningful and valuable innovations (Daymond & Knight, 2023). Studies have shown that deep empathy with users, accurate problem identification, effective prototyping, and thorough feedback analysis are critical components in developing successful innovations (Lor, 2017; Dalton & Kahute, 2016; Bjarnason et al., 2023; Deininger et al., 2019). Empathy is at the heart of the Design Thinking process, enabling designers and entrepreneurs to deeply understand the needs and problems of actual users (Gasparini, 2015). Methods such as observation, interviews, and simulated experiences help uncover users' emotional needs and unspoken desires, which

are essential for identifying explicit and hidden needs (Kamińska et al., 2023). Problem identification is a critical step in Design Thinking, setting the direction for creating solutions and allowing teams to focus resources and efforts on the most critical issues (Škėrienė & Jucevičienė, 2020; Imjai et al., 2024). Precise problem identification enables the development of effective solutions that meet user needs, allowing teams to concentrate their creativity on the most appropriate solutions (Morrison-Smith & Ruiz, 2020).

Prototyping is crucial for exploring concepts, experimenting, and testing solutions rapidly before developing the final product or service (Bjarnason et al., 2023). It allows teams to transform ideas into tangible forms, facilitate communication, and test these ideas with real users and the team (Dam & Teo, 2020). Prototyping reduces risks and uncertainties by addressing problems early in the development process (Foster, 2021). Analyzing feedback from users and stakeholders is one of the most important steps in the Design Thinking process. It helps teams to understand the strengths and weaknesses of the product or service, highlighting opportunities for improvement and enabling them to respond more effectively to user needs (Deininger et al., 2019; Phadermrod et al., 2019). Effective feedback analysis leads to the development of solutions that meet user needs and differentiate in the market, creating sustainable value for the organization (Dwivedi et al., 2021). Based on a literature review of AI Competency and Design Thinking Skills, the researcher can hypothesize:

H1: AI Competency positively influences Design Thinking Skills.

2.6. Strategic intelligence

Strategic Intelligence involves processes and techniques used by organizations to gather, analyze, and utilize information about the competitive environment, market trends, risks, and opportunities to support strategic decision-making (Marín, 2020). Effective Strategic Intelligence enables organizations to anticipate changes and predict the future accurately, crucial in an era of rapid change and high uncertainty (Vecchiato, 2015). Strategic Intelligence aids in various aspects of management, supporting timely and relevant information for better decision-making and effective risk management (Alnoukari & Hanano, 2017). Building Strategic Intelligence requires collecting data from diverse sources and employing appropriate analysis techniques to ensure quality information for decision-making and strategic planning (Cavallo et al., 2021). Analytical thinking is essential in this process, helping individuals identify important trends and patterns, making informed decisions, and developing strategies aligned with organizational goals (Aldoseri et al., 2023; Mikalef et al., 2019).

Environmental scanning is critical for identifying opportunities and risks from external and internal environments, enabling organizations to adapt effectively to changes (YahiaMarzouk & Jin, 2022). This involves gathering data from various sources, analyzing trends, and presenting the results in a usable format to support decision-making and strategic planning (Ibn-Mohammed et al., 2021). Risk management in the context of Strategic Intelligence involves identifying, analyzing, and responding to risks that might impact organizational objectives. Effective use of Strategic Intelligence in risk management enables organizations to mitigate negative impacts and leverage emerging opportunities (Božić, 2023; Emrouznejad et al., 2023). Organizations must have robust processes for analyzing, interpreting, and presenting data to support high-quality decisions that benefit long-term goals (Sheri et al., 2021). Strategic Intelligence, therefore, plays a vital role in helping organizations understand and respond to changes in the competitive environment, forecast future scenarios, and support strategic decision-making (Feng et al., 2022; Sinnaiah et al., 2023). From the literature review on AI Competency, Design Thinking Skills, and Strategic Intelligence, the researcher can hypothesize as follows:

H2: AI Competency positively affects Strategic Intelligence.

H3: Design Thinking Skills positively affect Strategic Intelligence.

2.7. Innovative entrepreneurial competency

Innovative Entrepreneurial Competency encompasses a set of skills, knowledge, and abilities enabling individuals or organizations to create, develop, and deliver innovations that add value to the market and society effectively (Al Mamun & Fazal, 2018). In an era of high competition and rapid change, the ability to introduce new innovations is essential for organizations to differentiate themselves from competitors and gain a competitive edge (Farida & Setiawan, 2022). This capability allows for quick adaptation and response to market demands, maintaining customer bases, and attracting new clients (Martínez-Peláez et al., 2023). Innovation extends beyond products and services, including enhancements in processes, business models, and internal operations to sustain long-term viability (Ferlito & Faraci, 2022). Developing these competencies promotes continuous learning and development, essential for coping with changes and new challenges. Fostering a culture that supports innovation, investing in training and personnel development, and establishing processes conducive to creativity and experimentation are critical (Sedeh et al., 2021; Zhang et al., 2023). Business Model Innovation involves changing how organizations create, deliver, and capture value to meet evolving market demands and achieve a competitive edge (Ramdani et al., 2019). This innovation goes beyond product changes, impacting comprehensive business operations and profoundly affecting industries and markets (Ruggiero et al., 2021). Effective business models focus on creating customer and societal value, ensuring long-term sustainability (Gasparin et al., 2022).

Adaptability is a critical trait for successful entrepreneurs and organizations, enabling them to manage and anticipate changes (Martin et al., 2013). Lifelong learning allows individuals and organizations to continuously update their knowledge and skills, maintaining leadership and competitive abilities (Rožman et al., 2023). Organizations promoting a culture of learning and adaptability create an environment conducive to creativity, innovation, and experimentation, essential for long-term growth and success (Zhang et al., 2023). Leadership is crucial in fostering and supporting innovation within organizations. Effective leaders inspire and motivate employees to be creative and introduce new innovations, contributing to organizational growth and success (Huang et al., 2022). Leaders who support innovation are open to new ideas and accept the risks associated with introducing innovations (Kozioł-Nadolna, 2020). Building relationships is also key to driving innovative entrepreneurship and business growth. Developing and maintaining good relationships with customers, partners, and other stakeholders allows businesses to access essential resources, knowledge, and new markets for innovation and growth (Cardoso et al., 2022). Effective relationship-building enables businesses to create strong networks, access the latest information and market trends, and ensure support in various areas, including capital, knowledge, and resources (Pfajfar et al., 2022). Good customer relationships help businesses understand customer needs and expectations, offering products or services that meet those needs and enhancing the business's credibility and reputation (Rane et al., 2023). Based on a literature review on AI Competency, Design Thinking Skills, Strategic Intelligence, and Innovative Entrepreneurial Competency, the researcher can hypothesize the following:

H4: AI Competency positively affects Innovative Entrepreneurial Competency.

H5: Design Thinking Skills positively affect Innovative Entrepreneurial Competency.

H6: Strategic Intelligence positively affects Innovative Entrepreneurial Competency.

Additionally, further indirect relationships have been identified, illustrating the intricate interplay between various competencies and skills as can be seen in Fig. 1. First, AI competency has been found to positively influence strategic intelligence through the mediation of design thinking skills. Second, AI competency also enhances innovative entrepreneurial competency via design thinking skills. Third, there is a

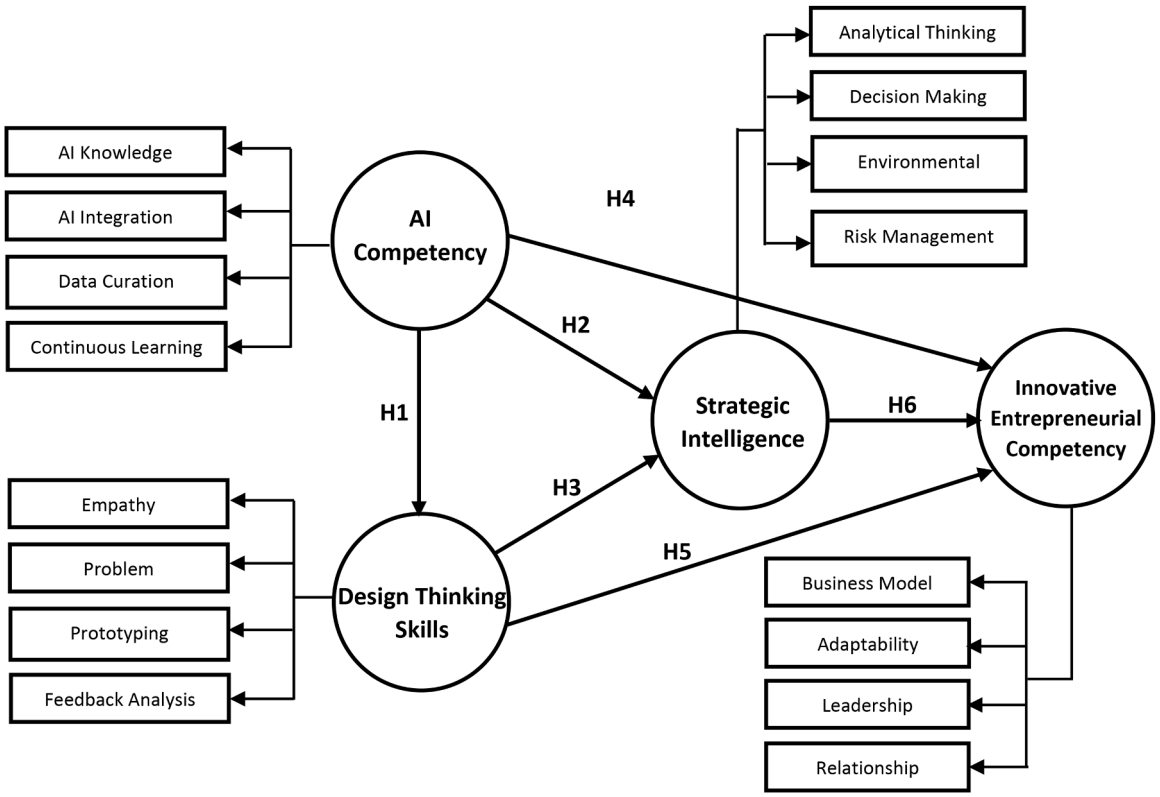

Fig. 1. Research Framework.

positive effect of AI competency on innovative entrepreneurial competency through strategic intelligence. Moreover, design thinking skills themselves positively impact innovative entrepreneurial competency by enhancing strategic intelligence. Finally, AI competency significantly boosts innovative entrepreneurial competency through the combined mediation of design thinking skills and strategic intelligence. Fig. 1 presents the conceptual framework of the research, while Table 1 outlines the research component variables and indicators, providing a comprehensive overview of the study's analytical structure.

Moreover, the information in Table 1 presents the components and indicators of four key variables: AI Competency, Design Thinking Skills, Strategic Intelligence, and Innovative Entrepreneurial Competency. Each variable is broken down into specific component variables, with indicators providing detailed descriptions of the necessary skills and knowledge. AI Competency (Ai C) includes AI Knowledge (Ai K), which involves understanding AI principles and communicating its benefits and limitations, AI Integration (Ai I) for enhancing efficiency with AI tools, Data Curation (DC) for managing data quality, and Continuous Learning (CL) to ensure ongoing development of AI expertise. Design Thinking Skills (DTS) encompass Empathy (ET) for understanding others' experiences, Problem Identification (PI) for discerning primary issues, Prototyping (PT) for creating and using prototypes, and Feedback Analysis (FA) for leveraging feedback to improve work. Strategic Intelligence (SI) involves Analytical Thinking (AT) to analyze data and identify significant factors, Decision Making (DM) based on data analysis, Environmental Scanning (ES) for recognizing opportunities and risks, and Risk Management (RM) to handle unexpected situations. Innovative Entrepreneurial Competency (IEC) includes Business Model Innovation (BMI) for adapting operations to global changes, Adaptability (AD) for proposing new approaches and leading through uncertainty, Leadership (LS) for motivating teams and fostering collaboration, and Relationship Building (RB) for maintaining high-quality relationships through effective communication.

2.8. Contribution of this study

2.8.1. Novel insights and practical implications

This study contributes to the literature by empirically examining the direct and indirect effects of AI competency, design thinking skills, and strategic intelligence on innovative entrepreneurial competency within the context of Thailand. By leveraging a sample of business administration students, this research provides contemporary insights into how these competencies can be integrated into educational and training programs to foster innovation and entrepreneurship in rapidly evolving economies.

2.8.2. Theoretical framework

The study extends the existing literature by integrating Experiential Learning Theory (ELT), Technology Acceptance Model (TAM), and Core Competency Development Theory to explore the experiential learning aspects of AI and design thinking, the factors influencing AI adoption, and the development of core entrepreneurial competencies.

The review on previous studies demonstrate the critical need for integrating AI and design thinking skills into educational frameworks, as well as the importance of strategic intelligence in supporting innovative entrepreneurship. The findings offer robust support for policy recommendations and strategic initiatives aimed at enhancing the entrepreneurial landscape in Thailand, providing a blueprint for future research and practical applications (Table 2).

Table 1
Component Variables and Indicators of AI Competency, Design Thinking Skills, Strategic Intelligence and Innovative Entrepreneurial Competency.

Variables	Component Variables	Indicators	References
AI Competency (Ai C)	AI Knowledge (Ai K)	Understanding the basic principles and concepts of artificial intelligence. Explaining the benefits and limitations of artificial intelligence to others clearly.	(Enholm et al., 2022; Sarker, 2022)
	AI Integration (Ai I)	Applying artificial intelligence to consistently enhance operational efficiency. Selecting appropriate artificial intelligence tools and technologies for specific tasks.	(Sjödin et al., 2021; Makarius et al., 2020)
	Data Curation (DC)	Managing and improving data quality before analysis with artificial intelligence tools. Choosing data management tools to support and enhance artificial intelligence operations.	(Aldoseri et al., 2023; Martín et al., 2023)
	Continuous Learning (CL)	Committing to continuous development of personal artificial intelligence knowledge and skills. Effectively integrating new artificial intelligence knowledge into projects or other work tasks.	(Füller et al., 2022; Kamalov et al., 2023)
Design Thinking Skills (DTS)	Empathy (ET)	Consistently striving to understand the experiences and feelings of others before planning operations to achieve the best outcomes. Regularly identifyng needs that are not explicitly expressed by others.	(Gasparini, 2015; Elsbach and Stigliani, 2018)
	Problem Identification (PI)	Consistently distinguishing primary issues from noise or secondary problems. Understanding that accurately identifying problems is the crucial first step in the workflow.	(Škėrienė & Jucevičienė, 2020; Morrison-Smith & Ruiz, 2020)
	Prototyping (PT)	Always prioritizing the drafting of prototypes, both tangible and conceptual. Frequently using prototypes as a key tool for communicating ideas with the team and stakeholders.	(Bjarnason et al., 2023; Dam & Teo, 2020)
	Feedback Analysis (FA)	Welcoming feedback from others, both positive and negative, without personal bias. Continuously using feedback from others to make adjustments and improvements in your work.	(Deininger et al., 2019; Phadermrod et al., 2019)
Strategic Intelligence (SI)	Analytical Thinking (AT)	Effectively analyzing data and complex situations to identify causes that may impact outcomes. Excellently distinguishing important data from irrelevant information.	(Aldoseri et al., 2023; Mikalef et al., 2019)
	Decision Making (DM)	Making confident decisions on important matters primarily based on data and analysis. Making quick decisions when faced with situations that require an immediate response.	(Sinnaiah et al., 2023; Feng et al., 2022)
	Environmental Scanning (ES)	Analyzing trends in business operations and new technologies to identify potential opportunities and risks. Assessing the impact of changes in the business environment and using that information to plan strategies and operations.	(YahiaMarzouk & Jin, 2022; YahiaMarzouk & Jin, 2022)
	Risk Management (RM)	Clearly identifying and assessing risks that may impact your work. Responding effectively to unexpected situations with appropriate risk management planning.	(Božić, 2023; Barraza de la Paz et al., 2023)
Innovative Entrepreneurial Competency (IEC)	Business Model Innovation (BMI)	Regularly devising creative ways to improve or modify operations in response to rapidly changing global conditions. Understanding the importance of integrating innovation into work processes to gain a competitive edge.	(Ramdani et al., 2019; Ruggiero et al., 2021)
	Adaptability (AD)	Demonstrating flexibility and openness to learning, consistently proposing new approaches to work. Leading your team and work through periods filled with uncertainty.	(Martin et al., 2013; Zhang et al., 2023)
	Leadership (LS)	Excellently motivating and fostering team collaboration to drive new innovations. Leading the team towards achieving goals with a clear vision and inspiration.	(Huang et al., 2022; Kozioł-Nadolna, 2020)
	Relationship Building (RB)	Prioritizing open and honest communication to build trust and maintain lasting relationships. Effectively establishing and maintaining high-quality relationships with colleagues and stakeholders.	(Cardoso et al., 2022; Rane et al., 2023)

Table 2
Summary of Previous Studies and Contributions.

Author(s)	Key Findings	New Contribution
Wamba-Taguimdje et al. (2020)	Importance of AI competency in enhancing organizational efficiency and innovation	Examines the direct impact of AI competency on entrepreneurial innovation
Dalton and Kahute (2016)	Empathy as crucial for user-centric innovation	Investigates the role of empathy within design thinking skills in entrepreneurial success
YahiaMarzouk and Jin (2022))	Environmental scanning for identifying business opportunities and risks	Explores strategic intelligence as a mediator between AI competency and entrepreneurial innovation
Ramdani et al. (2019)	Business model innovation creates competitive advantages	Analyzes the influence of business model innovation on entrepreneurial competency
Huang et al. (2022)	Leadership fosters a culture of innovation	Assesses the impact of leadership on fostering innovative entrepreneurship

3. Methodology

3.1. Research design

This study adopted a quantitative research design, leveraging data from business administration students who provided informed consent to participate. The participants were selected from various universities across Thailand, ensuring a diverse representation of students specializing in business management and entrepreneurship. The sample size determination was facilitated by G* Power 3.1 software, with parameters set to an effect size of 0.15, a significance level of 0.05, and a power of 0.95, considering three key variables. This analysis prescribed a minimum required sample of 150 participants, which was increased by 25 % to address potential discrepancies and ensure comprehensive data coverage. Participants were chosen using a stratified random sampling method to ensure that different strata within the student population, such as different academic years and areas of specialization, were adequately represented. The choice of business administration students as participants offers insights into the prevailing trends and challenges encountered by emerging entrepreneurs in the digital era, particularly highlighting how technological proficiency is integrated with innovative management practices for strategy development and market entry. Data collection was conducted using a specifically designed questionnaire, based on extensive literature review, and subsequently validated for content validity index (CVI) by subject matter experts. The reliability of the collected data was confirmed through statistical testing and a consistency ratio (CV), thus providing a robust foundation for analyzing how skills and capabilities are integrated in contemporary digital environments.

3.2. Measurement tool

The development of the measurement tools utilized in this research involved an arduous refinement process, underpinned by the expertise of three specialists in the field of innovation management, specifically within the domain of fraud detection. These experts conducted an in-depth analysis of the content validity and determined the consistency index for each survey question, ensuring that each item was both clear and directly relevant to the objectives of the study. The resultant questionnaire was structured into two primary sections: the first section aimed to gather general demographic information from the respondents, providing critical context and background insights into the participant group. The second section was designed to evaluate attitudes and opinions concerning the principal variables under investigation—AI Competency, Design Thinking Skills, Strategic Intelligence, and Innovative Entrepreneurial Competency—using a 5-point Likert scale that ranged from 1 ('least') to 5 ('most'). This part of the questionnaire comprised a total of 32 thoroughly constructed items.

Table 3
Cronbach's Alpha Values for Observable Variables in Each Construct.

Construct	Observable Variables	Cronbach's Alpha
AI Competency	AI Knowledge 1	0.753
	AI Knowledge 2	
	AI Integration 1	0.698
	AI Integration 2	
	Data Curation 1	0.743
	Data Curation 2	
	Continuous Learning 1	0.822
	Continuous Learning 2	
Design Thinking Skills	Empathy 1	0.791
	Empathy 2	
	Problem Identification 1	0.823
	Problem Identification 2	
	Prototyping 1	0.594
	Prototyping 2	
	Feedback Analysis 1	0.718
	Feedback Analysis 2	
Strategic Intelligence	Analytical Thinking 1	0.837
	Analytical Thinking 2	
	Decision Making 1	0.919
	Decision Making 2	
	Environmental Scanning 1	0.765
	Environmental Scanning 2	
	Risk Management 1	0.940
	Risk Management 2	
Innovative Entrepreneurial Competency	Business Model Innovation 1	0.807
	Business Model Innovation 2	
	Adaptability 1	0.768
	Adaptability 2	
	Leadership 1	0.927
	Leadership 2	
	Relationship Building 1	0.664
	Relationship Building 2	

Prior to its wider distribution, the questionnaire underwent a pilot test with a small sample group of 30 individuals to ascertain the reliability of the measurement instrument. The reliability analysis employed Cronbach's alpha coefficient as the benchmark for assessment, revealing that the instrument was highly reliable, with alpha values for each item meeting the acceptable thresholds established by Fornell and Larcker (1981). Moreover, to address potential concerns regarding nonresponse bias, a comparative analysis between the first 30 and last 30 datasets collected revealed no statistically significant differences, thus affirming the consistency of the data. To facilitate efficient data collection and ensure the privacy of the respondents, the distribution of the questionnaire was conducted electronically, with specific details and protocols outlined in Table 3. This methodological approach not only streamlined the data collection process but also enhanced the overall integrity and confidentiality of the research data.

The variables used in this research are observable variables that are employed to explain the factors associated with the proposed structural equation model. This model posits that AI Competency, Design Thinking Skills, and Strategic Intelligence influence Innovative Entrepreneurial Competency. Consequently, these variables are measured using Likert scales, with scoring ranges from the least (0.00–1.00) to the most (4.01–5.00).

3.3. Data collection

Data was collected electronically to ensure efficient data collection and respondent privacy. The detailed protocols for data collection are

Table 4
Characteristics of the sample group.

Measure and Value	Frequency	Percentage
1. Gender		
- Male	27	14.40 %
- Female	160	85.60 %
2. Field of study		
- Management	95	50.80 %
- Human resource management	28	15.00 %
- Marketing	11	5.90 %
- Accounting	22	11.80 %
- Entrepreneurship	31	16.60 %
3. Grade point average		
- <2.00	0	0 %
- 2.01 - 2.50	19	10.20 %
- 2.51 - 3.00	65	34.80 %
- 3.01 - 3.50	66	35.30 %
- 3.51 - 4.00	37	19.80 %
Total	187	100 %

outlined in Table 4.

3.4. Data analysis methods

In this study, data analysis commenced with the utilization of descriptive statistics to delineate the general characteristics and attributes of the sample group, employing frequencies and percentages to provide a preliminary overview. Following the derivation of observable variables from the responses to the questionnaire, the analysis advanced through the computation of means and standard deviations, which facilitated a detailed assessment of the distribution of each observed variable. To evaluate the integrity and quality of the measurement instruments, both convergent and discriminant validity were examined. This involved analyzing factor loadings and calculating the Average Variance Extracted (AVE), which ensured data consistency. Additionally, the Heterotrait-Monotrait ratio (HTMT) was employed to discern the differentiation between factors, further substantiating the validity of the constructs used. Subsequent phases of the analysis included structural model analysis and hypothesis testing, which were undertaken through measurements of causal relationships and the computation of R2 values to determine the predictive power of the identified relationships. This comprehensive analysis was conducted using Partial Least Squares (PLS) software, chosen for its appropriateness to the sample size. A significance level of <0.05 was stipulated as a criterion to affirm the validity of the hypotheses and the results obtained, ensuring rigorous and precise statistical evaluation.

4. Result

First, the analysis results provide a detailed characterization of the study's sample group, consisting of 187 participants. The gender distribution within the group includes 27 males (14.40 %) and 160 females (85.60 %), highlighting a predominant female representation. Academic specializations among the participants varied, with 95 students (50.80 %) from Management, 28 (15.00 %) from Human Resource Management, 11 (5.90 %) from Marketing, 22 (11.80 %) from Accounting, and 31 (16.60 %) from Entrepreneurship. The academic performance, measured by cumulative GPA, revealed a distribution in which no student had a GPA below 2.00. Specifically, 19 students (10.20 %) had a GPA ranging from 2.01 to 2.50, 65 students (34.80 %) had a GPA between 2.51 and 3.00, 66 students (35.30 %) between 3.01 and 3.50, and 37 students (19.80 %) between 3.51 and 4.00. This distribution points out the academic diversity and performance characteristics of the sample group, which are further detailed in Table 4 of the research document.

In this research, the model fit was thoroughly assessed by comparing the saturated model with the estimated model across multiple variables to determine the quality of the model. Both models achieved a Standardized Root Mean Square Residual (SRMR) of 0.049, indicative of a strong fit to the collected data. Furthermore, the Unweighted Least Squares Discrepancy (d_ULS) and Geodesic Discrepancy (d_G) for both models were consistently recorded at 0.325 and 0.269, respectively, demonstrating negligible discrepancies between the anticipated outcomes of the model and the actual data. The Chi-Square value, standing at 290.598 for both models, quantitatively reflects the deviation between the hypothesized and the observed data, suggesting a substantive alignment. Additionally, the Normed Fit Index (NFI) was reported at 0.902, affirming an excellent overall model fit, as values nearing 1 are indicative of a highly congruent model. Collectively, these metrics substantiate the consistency and effectiveness of the research model in explaining the data, with detailed results displayed in Table 5.

Table 5
Model Fit Assessment.

	Saturate Model	Estimate Model
SRMR	0.049	0.049
d_ULS	0.325	0.325
d_G	0.269	0.269
Chi-Square	290.598	290.598
NFI	0.902	0.902

The factor analysis for indicators of digital excellence demonstrated Loadings, Weights, and Variance Inflation Factor (VIF) values for each indicator. The examined indicators include AI Knowledge with a loading of 0.847, weight of 0.262, and a VIF of 2.237; AI Integration loaded at 0.885, with a weight of 0.261 and VIF of 2.798; Data Curation showing a loading of 0.920, weight of 0.286, and VIF of 3.726; Continuous Learning loaded at 0.909, with a weight of 0.313 and VIF of 3.275; Empathy with a loading of 0.921, weight of 0.299, and VIF of 3.643; and extending to Relationship Building, which loaded at 0.842, with a weight of 0.247 and VIF of 2.339. These high loadings indicate the capability of each indicator to reflect the variance of the measured variable, the weights indicate the support of the indicators in the overall model, and the low VIF values suggest minimal multicollinearity issues, confirming that these variables can be reliably used in statistical analysis, as illustrated in Table 6.

The reliability and validity testing of the indicators for latent variables in this research included observed variables and indicators, with values for Cronbach's Alpha, rho_A, Composite Reliability, and Average Variance Extracted (AVE). For the variable "AI Competency," consisting of indicators such as AI Knowledge, AI Integration, Data Curation, and Continuous Learning, the values were Cronbach's Alpha at 0.913, rho_A at 0.919, Composite Reliability at 0.939, and AVE at 0.793, indicating high reliability and acceptable validity for this variable. Similar

Table 6
Factor Analysis Results.

Indicator	Loadings	Weights	VIF
AI Knowledge (Ai K)	0.847	0.262	2.237
AI Integration (Ai I)	0.885	0.261	2.798
Data Curation (DC)	0.920	0.286	3.726
Continuous Learning (CL)	0.909	0.313	3.275
Empathy (ET)	0.921	0.299	3.643
Problem Identification (PI)	0.898	0.279	3.141
Prototyping (PT)	0.901	0.283	3.075
Feedback Analysis (FA)	0.838	0.261	2.138
Analytical Thinking (AT)	0.912	0.265	3.504
Decision Making (DM)	0.911	0.271	3.546
Environmental Scanning (ES)	0.929	0.279	4.173
Risk Management (RM)	0.914	0.276	3.576
Business Model Innovation (BMI)	0.893	0.305	2.851
Adaptability (AD)	0.891	0.274	2.929
Leadership (LS)	0.912	0.301	3.258
Relationship Building (RB)	0.842	0.247	2.339

Table 7
Reliability and validity test.

Latent variables	Observable variables	Cronbach's alpha	rho_A	Composite reliability	Average variance extracted
AI Competency (Ai C)	AI Knowledge (Ai K) AI Integration (Ai I) Data Curation (DC) Continuous Learning (CL)	0.913	0.919	0.939	0.793
Design Thinking Skills (DTS)	Empathy (ET) Problem Identification (PI) Prototyping (PT) Feedback Analysis (FA)	0.912	0.916	0.939	0.793
Strategic Intelligence (SI)	Analytical Thinking (AT) Decision Making (DM) Environmental Scanning (ES) Risk Management (RM)	0.936	0.937	0.954	0.84
Innovative Entrepreneurial Competency (IEC)	Business Model Innovation (BMI) Adaptability (AD) Leadership (LS) Relationship Building (RB)	0.907	0.914	0.935	0.783

Table 8
Discriminant validity.

Constructs	Fornell–Larcker Criterion				HTMT			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
(1) AI Competency	0.891							
(2) Design Thinking Skills	0.743	0.890			0.809			
(3) Strategic Intelligence	0.746	0.818	0.916		0.803	0.884		
(4) Innovative Entrepreneurial Competency	0.714	0.769	0.840	0.885	0.777	0.843	0.906	

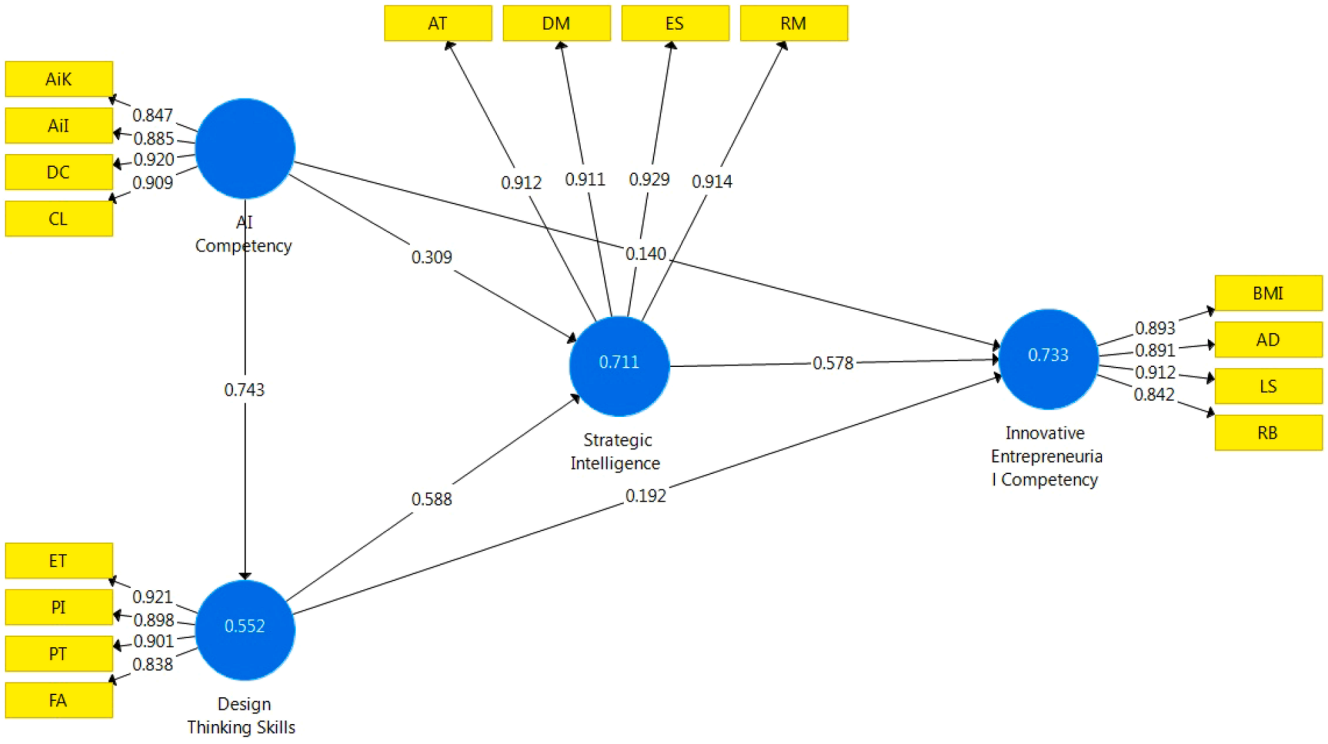

Fig. 2. The structural model.

methodologies were applied to "Design Thinking Skills", "Strategic Intelligence", and "Innovative Entrepreneurial Competency" with various indicators such as Empathy, Analytical Thinking, and Business Model Innovation, all of which also demonstrated high values for Cronbach's Alpha, rho_A, Composite Reliability, and AVE, e.g., 0.936, 0.937, 0.954, and 0.84 for Strategic Intelligence with indicators such as Analytical Thinking. These results reflect the reliability and validity of the measurement tools used to analyze these variables in the research, as depicted in Table 7.

Moreover, discriminant validity testing was conducted for the latent variables to ascertain their distinctiveness from one another, utilizing both the Fornell–Larcker criterion and the Heterotrait-Monotrait ratio (HTMT). The variables assessed included AI Competency, Design Thinking Skills, Strategic Intelligence, and Innovative Entrepreneurial

Table 9
Summary Results.

Hypotheses	Effect	Path coefficients	t-Statistic	p-Value	Results
H1	Ai C -> DTS	0.743	18.243	0.000	Supported
H2	Ai C -> SI	0.309	3.651	0.000	Supported
H3	DTS -> SI	0.588	1.635	0.103	Not Supported
H4	Ai C -> IEC	0.140	7.475	0.000	Supported
H5	DTS -> IEC	0.192	2.116	0.035	Supported
H6	SI -> IEC	0.578	7.266	0.000	Supported

Competency. According to the Fornell–Larcker criterion, for discriminant validity to be established, the square root of the Average Variance Extracted (AVE) for each variable—represented diagonally in the matrix—must surpass the correlations between it and other variables, which are displayed horizontally and vertically. For example, AI Competency demonstrated a square root of AVE value of 0.891, which exceeded its correlation with Design Thinking Skills at 0.743, Strategic Intelligence at 0.746, and Innovative Entrepreneurial Competency at 0.714. Furthermore, under the HTMT criterion, values below 0.90 are indicative of satisfactory discriminant validity; in this study, the HTMT values between AI Competency and Design Thinking Skills stood at 0.809, with Strategic Intelligence at 0.803, and with Innovative Entrepreneurial Competency at 0.777. These results confirm that the variables are sufficiently distinct as per the thresholds set by the validation criteria, thereby supporting the reliability and validity of the measurement instruments used in this study, as detailed in Table 8.

An analysis using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method was conducted to evaluate the hypotheses we established, examining the relationships and impacts among AI Competency, Design Thinking Skills, Strategic Intelligence and Innovative Entrepreneurial Competency within the sample group, as depicted in Fig. 2.

The hypothesis testing in this research evaluates the impact among variables, presented in a table showing the Effect, Path Coefficients, t-statistics, and p-values for each tested hypothesis. Additionally, more detailed information about the sub-factors within each group is provided:

1. AI Competency consists of four sub-factors: AI Knowledge (AiK), AI Integration (AiI), Data Curation (DC), and Continuous Learning (CL). The loadings for these sub-factors are 0.847, 0.885, 0.920, and 0.909, respectively.
2. Design Thinking Skills comprises four sub-factors: Empathy (ET), Problem Identification (PI), Prototyping (PT), and Feedback Analysis (FA). The loadings for these sub-factors are 0.921, 0.898, 0.901, and 0.838, respectively.
3. Strategic Intelligence includes Analytical Thinking (AT), Decision Making (DM), Environmental Scanning (ES), and Risk Management (RM). The loadings for these sub-factors are 0.912, 0.911, 0.929, and 0.914, respectively.
4. Innovative Entrepreneurial Competency has four sub-factors: Business Model Innovation (BMI), Adaptability (AD), Leadership Skills (LS), and Relationship Building (RB). The loadings for these sub-factors are 0.893, 0.891, 0.912, and 0.842, respectively.

Table 10
Indirect Relationship.

Indirect Effect	Path coefficients	t-Statistic	p-Value
Ai C -> DTS -> SI	0.437	6.359	0.000
Ai C -> DTS -> IEC	0.143	2.125	0.034
Ai C -> SI -> IEC	0.179	3.229	0.001
DTS -> SI -> IEC	0.340	5.081	0.000
Ai C -> DTS -> SI -> IEC	0.252	4.480	0.000

The hypothesis testing results provide a comprehensive understanding of the relationships among AI Competency (Ai C), Design Thinking Skills (DTS), Strategic Intelligence (SI), and Innovative Entrepreneurial Competency (IEC). Hypothesis 1 (H1), which examines the effect of AI Competency on Design Thinking Skills, shows strong statistical support with a path coefficient of 0.743, a t-statistic of 18.243, and a p-value of 0.000. This indicates that AI Competency significantly enhances Design Thinking Skills. Similarly, Hypothesis 2 (H2) reveals that AI Competency positively affects Strategic Intelligence, with a path coefficient of 0.309, a t-statistic of 3.651, and a p-value of 0.000, confirming its statistical significance. In contrast, Hypothesis 3 (H3), which tests the effect of Design Thinking Skills on Strategic Intelligence, is not supported, as indicated by a non-significant p-value of 0.103. However, Hypothesis 4 (H4) demonstrates that AI Competency significantly influences Innovative Entrepreneurial Competency, with a path coefficient of 0.588, a t-statistic of 7.475, and a p-value of 0.000. Furthermore, Hypothesis 5 (H5) shows that Design Thinking Skills have a significant positive impact on Innovative Entrepreneurial Competency, supported by a path coefficient of 0.192, a t-statistic of 2.116, and a p-value of 0.035. Lastly, Hypothesis 6 (H6) highlights the strong effect of Strategic Intelligence on Innovative Entrepreneurial Competency, with a path coefficient of 0.578, a t-statistic of 7.266, and a p-value of 0.000. These findings underscore the critical roles of AI Competency and Strategic Intelligence in fostering Innovative Entrepreneurial Competency, while also recognizing the importance of Design Thinking Skills in this dynamic. These test results show that each hypothesis was tested and evaluated based on the correlations between variables and their statistical significance. Reliable analytical procedures were used to confirm the research findings, as indicated in Table 9.

The analysis of indirect effects among variables in this research demonstrates significant relationships through various mediating pathways, as indicated by path coefficients, t-statistics, and p-values for each tested indirect effect. Firstly, the indirect effect of AI Competency (Ai C) through Design Thinking Skills (DTS) on Strategic Intelligence (SI) is substantial, with a path coefficient of 0.437, a t-statistic of 6.359, and a p-value of 0.000, confirming its statistical significance. Additionally, the indirect effect of Ai C through DTS on Innovative Entrepreneurial Competency (IEC) shows a path coefficient of 0.143, a t-statistic of 2.125, and a p-value of 0.034, indicating a statistically significant relationship. Furthermore, the indirect effect of Ai C through SI on IEC is also significant, with a path coefficient of 0.179, a t-statistic of 3.229, and a p-value of 0.001. The effect of DTS through SI on IEC is noteworthy, with a path coefficient of 0.340, a t-statistic of 5.081, and a p-value of 0.000, underscoring its statistical importance. Lastly, the more complex indirect effect of Ai C through both DTS and SI on IEC reveals a path coefficient of 0.252, a t-statistic of 4.480, and a p-value of 0.000, highlighting the robust statistical significance of this indirect effect. These findings collectively underscore the pivotal roles of AI Competency, Design Thinking Skills, and Strategic Intelligence in shaping Innovative Entrepreneurial Competency through multiple interrelated pathways. Moreover, the results also confirm that the variables in the estimated model have significant indirect effects on each other and provide evidence that these linkages are crucial for understanding work approaches and their impacts on innovative entrepreneurship, as shown in Table 10.

5. Discussion

This research critically examined the impact of AI competency and design thinking skills on fostering innovative entrepreneurship, particularly within the dynamic economic and social context of Thailand. Through statistical analysis of various related variables, a significant correlation was established between these competencies and the

enhancement of entrepreneurial capabilities. The findings emphasize the necessity of embedding AI and design thinking within educational and training programs aimed at budding entrepreneurs, suggesting that such competencies substantially bolster their competitive edge and success potential on a global scale. Building upon the theoretical lens of Experiential Learning Theory (ELT), Technology Acceptance Model (TAM), and Core Competency Development Theory, the results of this study are deeply contextualized within these frameworks. ELT posits that practical, hands-on experiences in AI and Design Thinking foster the deep learning required for effective entrepreneurial innovation, with its iterative processes of Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation providing a structured approach to developing these competencies in real-world scenarios. TAM provides insights into the adoption and utilization of AI technologies, emphasizing the importance of Perceived Usefulness and Perceived Ease of Use in driving the integration of AI into entrepreneurial practices. Core Competency Development Theory highlights how the strategic development of AI and Design Thinking skills can create a sustainable competitive advantage, reinforcing the importance of these competencies in innovative entrepreneurship. By analyzing and discussing these results through these theoretical frameworks, the study contributes valuable insights that can inform strategic planning and implementation, ensuring that educational institutions and policymakers leverage this information to cultivate an environment conducive to innovation and entrepreneurship. This discussion not only elucidates the critical role of these competencies in modern entrepreneurial ventures but also provides a roadmap for future actions to optimize the entrepreneurial landscape in Thailand and beyond.

5.1. Integration of AI competency and design thinking in enhancing entrepreneurial innovation

This research highlights the vital role of integrating Artificial Intelligence (AI) capabilities and design thinking skills in bolstering innovative entrepreneurship, particularly as a response to the rapidly evolving market demands of the digital era. The findings align with those of Mikalef et al. (2023), who emphasize that AI Competency extends beyond the mere use of AI tools and technologies; it involves a profound comprehension of how AI can be applied to foster innovation, enhance decision-making, and advance business development. AI competency significantly improves operational efficiency and data management, thereby not only refining business decisions but also opening new avenues for innovation and product development. This comprehensive approach to AI integration—encompassing deep AI knowledge, integration into business processes, effective data management, and ongoing learning—is crucial for sustaining competitive advantages in the digital age. Concurrently, design thinking skills are instrumental in enabling entrepreneurs to pinpoint user needs and develop tailored solutions that not only satisfy these needs but also bolster competitiveness. As Sarooghi et al. (2019) and Daymond & Knight, 2023 have explored, design thinking—a user-centered and creative problem-solving approach—facilitates the creation of meaningful and valuable innovations. The successful integration of these capabilities into business operations is essential for maintaining a competitive edge in an intensely competitive business landscape, highlighting the significance of both AI and design thinking in contemporary entrepreneurial innovation. Additionally, this study extends the work of Enholm et al. (2022) and Sarker (2022) by demonstrating how AI knowledge and continuous learning directly influence innovative outcomes in entrepreneurship. These contributions provide a nuanced understanding of how technological and creative skills can synergistically drive entrepreneurial success in the digital era.

5.2. Theoretical integration and empirical analysis of AI competencies and design thinking in entrepreneurship

This research synthesizes Experiential Learning Theory (ELT), the Technology Acceptance Model (TAM), and Core Competency Development Theory to interpret the substantial statistical linkages between AI competencies and design thinking skills in enhancing innovative entrepreneurial capabilities. Grounded in the principles of ELT, as articulated by Kolb (1984), the study underlines that experiential learning through direct engagement with AI and design thinking processes significantly bolsters entrepreneurs' abilities, facilitating effective application in practical settings—embodying ELT's axiom that "learning is through doing." Additionally, TAM, as developed by Davis (1989), provides insights into the key factors that influence the adoption and effective utilization of new technologies such as AI. The research findings indicate that Perceived Ease of Use and Perceived Usefulness are pivotal in motivating entrepreneurs to adopt AI technologies, where Perceived Usefulness is linked to the belief that the technology will augment work efficiency, and Perceived Ease of Use is associated with the belief that the technology will be straightforward to operate.

Furthermore, the Core Competency Development Theory, advocated by Hamel and Prahalad (1994), and expanded by Teece, Pisano and Shuen (1997), highlights the strategic importance of cultivating sustainable core capabilities that empower organizations and individuals to excel. The integration of AI and design thinking is shown to cultivate core competencies that not only boost competitiveness in the current market but also lay a robust foundation for future success. These competencies are characterized by deep, specialized knowledge that enables organizations to surpass competitors, fostering ongoing innovation and enhancement in products and services. The empirical results of this study not only align with these theoretical frameworks but also emphasize the practical importance of applying these theories to enhance the capabilities of new entrepreneurs in the digital era. This analysis highlights the critical need for ongoing development of such integrative skills to sustain leadership and competitive edge in the rapidly evolving business landscape.

5.3. Enhancing innovation and economic growth through AI and design thinking amongst new age entrepreneurs

This study points out the considerable benefits that can be accrued from fostering artificial intelligence (AI) capabilities and design thinking among new age entrepreneurs, illustrating how these enhanced skills can drive innovation and spur long-term economic growth. The effective development and implementation of AI and design thinking enable entrepreneurs to rapidly and appropriately develop products and services that align with market demands, thereby boosting competitiveness and facilitating economic expansion (Haleem et al., 2022). Also, the cultivation of these skills positively influences job creation and retention, as businesses driven by innovation can expand existing markets and generate new employment opportunities (Enholm et al., 2022). The application of AI and design thinking not only streamlines production and service processes but also increases efficiency and decreases production costs. This optimization leads to the creation of higher quality products and services that are more affordable. Moreover, integrating AI and design thinking into educational and training programs for emerging entrepreneurs equips them to adeptly navigate the rapid transformations and challenges of the digital era, enhancing their potential and contributing to the economic stability and growth of their countries (Wannamakok & Yonwikai, 2023).

This research also reveals the challenges and opportunities that new digital-age entrepreneurs face, focusing on rapid technological changes and the dynamic growth of digital markets, which create numerous challenges and opportunities for entrepreneurs who must continuously adapt to maintain competitiveness and innovation capability. One of the main challenges is managing the rapidly increasing volume of data, as

well as the need for real-time data analysis to precisely tailor offerings to customer needs. However, the ability to apply AI and design thinking not only opens opportunities for creating new products and services that better meet customer needs, but also enables new entrepreneurs to anticipate market trends and changes ahead of others and plan and adjust their strategies to fit the changing environment (Aldoseri et al., 2023). This study also highlights how enhancing business process efficiencies with these technologies can lead to cost reductions and profitability improvements. In the future, new-age entrepreneurs will need to be prepared with advanced digital tools and technologies to introduce new problem-solving methods and meet highly demanding and volatile market needs. Developing skills to understand and utilize these technologies will be key to the growth and success of entrepreneurs in the digital era (Füller et al., 2022; Kamalov et al., 2023).

6. Policy implications and recommendations

This study highlights the critical importance of developing AI capabilities and design thinking skills amongst new age entrepreneurs, which not only impacts innovation and competitive ability but also provides significant benefits to the economy and society. In terms of policy, this research supports the creation and refinement of policies that enhance learning pathways and skill development for new-age entrepreneurs. The findings of this research offer several key suggestions for various stakeholder groups, including entrepreneurs, government, and private agencies:

1. Promote Access to AI and Design Thinking Training: Establish training programs that focus on the latest technologies and innovative methods to enable new age entrepreneurs to adapt and efficiently use these tools for creating new products and services. Educational institutions and training providers should collaborate to develop comprehensive curricula that incorporate AI and design thinking as core components, ensuring that entrepreneurs are equipped with cutting-edge skills.
2. Support Research and Innovation: Create incentives for research and development in AI and design thinking by providing research grants and promoting partnerships between educational institutions and the business sector. Government agencies and private organizations should invest in research initiatives that explore new applications of AI and design thinking in various industries, fostering a culture of continuous innovation.
3. Increase Resource Accessibility: Provide platforms and tools necessary for new age entrepreneurs to experiment and apply new technologies freely, enhancing opportunities for innovative creations. Stakeholders should ensure that entrepreneurs have access to state-of-the-art tools, software, and infrastructure that support their innovative projects.
4. Build Support Networks: Promote the establishment of strong networks amongst new age entrepreneurs to allow them to share knowledge, resources, and ideas with each other, resulting in effective technical and marketing support. Government and private agencies should facilitate the creation of entrepreneurial hubs and incubators that provide mentorship, networking opportunities, and collaborative spaces.
5. Enhance Public-Private Collaboration: Encourage collaborations between government, educational institutions, and private enterprises to create a synergistic environment that supports entrepreneurial innovation. This includes developing joint initiatives that leverage the strengths of each sector to provide holistic support to entrepreneurs.
6. Implement Policy Reforms: Advocate for policy reforms that create a conducive environment for entrepreneurship. Government should streamline regulations, reduce bureaucratic hurdles, and provide tax incentives to encourage entrepreneurial ventures.

By implementing these actions, stakeholders can ensure that new-age entrepreneurs are well-equipped to lead the creation and introduction of new innovations that can meet and adapt to the challenges of the digital age effectively.

7. Research flow

This manuscript follows a structured research flow to systematically address the impact of AI competency and Design Thinking skills on innovative entrepreneurial competency among new age entrepreneurs in Thailand. Initially, the study identifies a critical gap in the literature and sets out the research objectives and significance in the Introduction section. This is followed by a comprehensive Literature Review, which discusses relevant theories and previous studies to frame the research within the existing body of knowledge. The Methodology section details the quantitative research design, including the sample selection, data collection, and measurement tools used for the study. Subsequent sections present the Results and Discussion, where statistical analyses such as Structural Equation Modeling (SEM) and factor analysis are employed to test the hypotheses and interpret the findings. The policy implications and recommendations derived from the research are outlined to guide stakeholders in fostering innovation and entrepreneurship. Finally, the Conclusion section summarizes the key findings and suggests directions for future research, thus providing a comprehensive understanding of the research flow from problem identification to practical implications.

8. Conclusion

This research thoroughly investigated the impact of Artificial Intelligence (AI) competency and design thinking skills on fostering innovative entrepreneurship within the Thai context. The study's findings indicate that both AI and design thinking significantly bolster entrepreneurs' capacities to innovate and remain competitive in the market. The study puts forth several operational approaches and policy recommendations, advocating for enhanced access to AI and design thinking training for emerging entrepreneurs. It also supports the enhancement of research and innovation frameworks and recommends the establishment of robust support networks for entrepreneurs. These strategic recommendations are aimed at creating an ecosystem that nurtures innovation and equips new entrepreneurs with the necessary tools to thrive in a competitive environment.

Further investigation is warranted to examine local factors or additional variables that may influence the effective integration of AI and design thinking in innovation-centric entrepreneurship. Moreover, the social and ethical dimensions of deploying AI in practical settings warrant careful consideration to ensure responsible use. The practical implications of this research suggest the inclusion of these critical skills in educational curricula and training programs targeted at entrepreneurs, thereby preparing them to effectively tackle the challenges posed by the digital age. By endorsing and implementing these policy suggestions, there is an opportunity to cultivate a skilled workforce that is not only prepared to drive innovation but also capable of contributing to sustainable economic growth. This aligns with broader economic strategies aimed at enhancing national competitiveness in the global digital economy.

CRediT authorship contribution statement

Narinthon Imjai: Writing – original draft, Visualization, Software, Methodology, Formal analysis, Conceptualization. **Chawapong Nui-Suk:** Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – review & editing. **Berto Usman:** Writing – review & editing, Visualization, Investigation, Formal analysis. **Phiphop Somwethee:** Writing – review & editing, Visualization, Software, Resources. **Somnuk Aujirapongpan:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project

administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethics declaration

Authors declared that the participants were assured that their participation is voluntary and that they can withdraw from the study at any time. The data collected from the participants was kept confidential and anonymous, and the data was only be used for research purposes. Authors further declared that the study complied with ethical guidelines set forth by the Institutional Review Board of the human research ethics committee of Walailak University (WUEC-24–074–01), Thailand.

Data availability

Data generated or analyzed during this study are available from the authors on request.

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References

Al Mamun, A., & Fazal, S. A (2018). Effect of entrepreneurial orientation on competency and micro-enterprise performance. *Asia Pacific Journal of Innovation and Entrepreneurship, 12*(3), 379–398. https://doi.org/10.1108/APJIE-05-2018-0033

Aldoseri, A., Al-Khalifa, K. N., & Hamouda, A. M. (2023). *Re*-thinking data strategy and integration for artificial intelligence: concepts, opportunities, and challenges. *Applied Sciences, 13*(12), 7082. https://doi.org/10.3390/app13127082

Alnoukari, M., & Hanano, A. (2017). Integration of business intelligence with corporate strategic management. *Journal of Intelligence Studies in Business, 7*(2). https://doi.org/10.37380/jisib.v7i2.235

Amalia, R., & von Korflesch, H. (2022). Entrepreneurship education and design thinking: A conceptual threshold for their integration in indonesian higher education. *International Journal of Emerging Technologies in Learning (iJET), 17*(2), 93–113. https://doi.org/10.3991/ijet.v17i02.26897

Bag, S., Gupta, S., Kumar, A., & Sivarajah, U. (2020). An integrated artificial intelligence framework for knowledge creation and B2B marketing rational decision making for improving firm performance. *Industrial Marketing Management, 92*, 178–189. https://doi.org/10.1016/j.indmarman.2020.12.001

Barraza de la Paz, J. V., Rodríguez-Picón, L. A., Morales-Rocha, V., & Torres-Argüelles, S. V. (2023). A Systematic Review of Risk Management Methodologies for Complex Organizations in Industry 4.0 and 5.0. *Systems, 11*, 218. https://doi.org/10.3390/systems11050218

Bjarnason, E., Lang, F., & Mjöberg, A. (2023). An empirically based model of software prototyping: A mapping study and a multi-case study. *Empirical Software Engineering, 28*(5), 115. https://doi.org/10.1007/s10664-023-10331-w

Božić, V. (2023). Intelligent and agile risk management. doi:10.13140/RG.2.2.10875.90402.

Borges, A. F., Laurindo, F. J., Spínola, M. M., Gonçalves, R. F., & Mattos, C. A. (2021). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International Journal of Information Management, 57*, Article 102225. https://doi.org/10.1016/j.ijinfomgt.2020.102225

Broekhuizen, T., Dekker, H., de Faria, P., Firk, S., Nguyen, D. K., & Sofka, W. (2023). AI for managing open innovation: Opportunities, challenges, and a research agenda. *Journal of Business Research, 167*, Article 114196. https://doi.org/10.1016/j.jbusres.2023.114196

Cardoso, A., Gabriel, M., Figueiredo, J., Oliveira, I., Rêgo, R., Silva, R., et al. (2022). Trust and loyalty in building the brand relationship with the customer: Empirical analysis in a retail chain in northern Brazil. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(3), 109. https://doi.org/10.3390/joitmc8030109

Cavallo, A., Sanasi, S., Ghezzi, A., & Rangone, A. (2021). Competitive intelligence and strategy formulation: Connecting the dots. *Competitiveness Review: An International Business Journal, 31*(2), 250–275. https://doi.org/10.1108/CR-01-2020-0009

Chang, Y. S., & Tsai, M. C. (2021). Effects of design thinking on artificial intelligence learning and creativity. *Educational Studies*, 1–18. https://doi.org/10.1080/03055698.2021.1999213

Collins, C., Dennehy, D., Conboy, K., & Mikalef, P. (2021). Artificial intelligence in information systems research: A systematic literature review and research agenda. *International Journal of Information Management, 60*, Article 102383. https://doi.org/10.1016/j.ijinfomgt.2021.102383

Dalton, J., & Kahute, T. (2016). Why empathy and customer closeness is crucial for design thinking. *Design Management Review, 27*(2), 20–27. https://doi.org/10.1111/drev.12004

Dam, R.F. and Teo, Y.S. (2020, July 20). *Design thinking: Get started with prototyping*. Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/design-thinking-get-started-with-prototyping.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Deininger, M., Daly, S. R., Lee, J. C., Seifert, C. M., & Sienko, K. H. (2019). Prototyping for context: Exploring stakeholder feedback based on prototype type, stakeholder group and question type. *Research in engineering design, 30*, 453–471. https://link.springer.com/article/10.1007/s00163-019-00317-5.

Dwivedi, Y. K., Ismagilova, E., Hughes, D. L., Carlson, J., Filieri, R., Jacobson, J., & Wang, Y. (2021). Setting the future of digital and social media marketing research: Perspectives and research propositions. *International Journal of Information Management, 59*, Article 102168. https://doi.org/10.1016/j.ijinfomgt.2020.102168

Daymond, J., & Knight, E. (2023). Design Thinking in Business and Management: Research History, Themes, and Opportunities. Oxford Research Encyclopedia of Business and Management. Retrieved 9 Oct. 2024, from https://oxfordre.com/business/view/10.1093/acrefore/9780190224851.001.0001/acrefore-9780190224851-e-386.

Dwivedi, Y. K., & Wang, Y. (2022). Guest editorial: Artificial intelligence for B2B marketing: Challenges and opportunities. *Industrial Marketing Management, 105*, 109–113. https://doi.org/10.1016/j.indmarman.2022.06.001

Elsbach, K. D., & Stigliani, I. (2018). Design thinking and organizational culture: A review and framework for future research. *Journal of Management, 44*(6), 2274–2306. https://doi.org/10.1177/0149206317744252

Emrouznejad, A., Abbasi, S., & Sıcakyüz, Ç. (2023). Supply chain risk management: A content analysis-based review of existing and emerging topics. *Supply chain analytics, 3, 100031*. https://doi.org/10.1016/j.sca.2023.100031

Enholm, I. M., Papagiannidis, E., Mikalef, P., & Krogstie, J. (2022). Artificial intelligence and business value: A literature review. *Information Systems Frontiers, 24*(5), 1709–1734. https://doi.org/10.1007/s10796-021-10186-w

Farayola, O. A., Abdul, A. A., Irabor, B. O., & Okeleke, E. C. (2023). Innovative business models driven by Ai technologies: A review. *Computer Science & IT Research Journal, 4*(2), 85–110. https://doi.org/10.51594/csitrj.v4i2.608

Farida, I., & Setiawan, D. (2022). Business strategies and competitive advantage: The role of performance and innovation. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(3), 163. https://doi.org/10.3390/joitmc8030163

Feng, J., Han, P., Zheng, W., & Kamran, A. (2022). Identifying the factors affecting strategic decision-making ability to boost the entrepreneurial performance: A hybrid structural equation modeling–artificial neural network approach. *Frontiers in Psychology, 13*, Article 1038604, 10.33892Ffpsyg.2022.1038604.

Ferlito, R., & Faraci, R. (2022). Business model innovation for sustainability: A new framework. *Innovation & Management Review, 19*(3), 222–236. https://doi.org/10.1108/INMR-07-2021-0125

Foster, M. K. (2021). Design thinking: A creative approach to problem solving. *Management Teaching Review, 6*(2), 123–140. https://doi.org/10.1177/2379298119871468

Füller, J., Hutter, K., Wahl, J., Bilgram, V., & Tekic, Z. (2022). How AI revolutionizes innovation management–Perceptions and implementation preferences of AI-based innovators. *Technological Forecasting and Social Change, 178*, Article 121598. https://doi.org/10.1016/j.techfore.2022.121598

Gasparin, M., Quinn, M., Green, W., Saren, M., & Conway, S. (2022). Stories of value: Business model innovation adding value propositions articulated by slow storytelling. *Journal of Business Research, 149*, 101–111. https://doi.org/10.1016/j.jbusres.2022.04.069

Gasparini, A. (2015). Perspective and use of empathy in design thinking. In *ACHI, the eight international conference on advances in computer-human interactions* (pp. 49–54). ISBN: 978-1-61208-382-7.

Giuggioli, G., & Pellegrini, M. M. (2022). Artificial intelligence as an enabler for entrepreneurs: A systematic literature review and an agenda for future research. *International Journal of Entrepreneurial Behavior & Research, 29*(4), 816–837. https://doi.org/10.1108/IJEBR-05-2021-0426

Gozzoli, P. C., Rongrat, T., & Gozzoli, R. B. (2022). Design thinking and urban community development: East Bangkok. *Sustainability, 14*(7), 4117. https://doi.org/10.3390/su14074117

Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of Intelligent Networks*. https://doi.org/10.1016/j.ijin.2022.08.005

Hamdan, A., Hassanien, A. E., Razzaque, A., & Alareeni, B. (2021). *The fourth industrial revolution: Implementation of artificial intelligence for growing business success, 935*. Nature: Springer.

Hamel, G., & Prahalad, C. K. (1994). *Competing for the future*. Cambridge, Mass: Harvard Business School Press.

Huang, Z., Sindakis, S., Aggarwal, S., & Thomas, L. (2022). The role of leadership in collective creativity and innovation: Examining academic research and development environments. *Frontiers in Psychology, 13*, Article 1060412, 10.33892Ffpsyg.2022.1060412.

Ibn-Mohammed, T., Mustapha, K.B., Godsell, J., Adamu, Z., Babatunde, K.A., Akintade, D.D., Koh, S.C.L. (2021). A critical analysis of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies. *Resources, Conservation and Recycling*, 164, 105169. 10.10162Fj. resconrec.2020.105169.

Imjai, N., Promma, W., Usman, B., & Aujirapongpan, S. (2024). The intertwined effects of digital literacy, agile mindset on design thinking skill and management control competency: Insights from Thai young accountants. *International Journal of Information Management Data Insights, 4*(2), Article 100244. https://doi.org/10.1016/j.jjimei.2024.100244

Kamalov, F., Santandreu Calonge, D., & Gurrib, I. (2023). New era of artificial intelligence in education: Towards a sustainable multifaceted revolution. *Sustainability, 15*(16), 12451. https://doi.org/10.3390/su151612451

Kamińska, D., Zwoliński, G., Pinto-Coelho, L., & Raposo, R. (2023). Universal design and empathic design for engineers. *Medycyna Pracy. Workers' Health and Safety, 74*(1), 211–225. https://doi.org/10.13075/mp.5893.01388

Kelly, S., Kaye, S. A., & Oviedo-Trespalacios, O. (2023). What factors contribute to the acceptance of artificial intelligence? A systematic review. *Telematics and Informatics, 77*, Article 101925. https://doi.org/10.1016/j.tele.2022.101925

Kietzmann, J., & Pitt, L. F. (2020). Artificial intelligence and machine learning: What managers need to know. *Business Horizons, 63*(2), 131–133. https://doi.org/10.1016/j.bushor.2019.11.005

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice-Hall. ISBN: 0132952610.

Kolb, D. A., & Fry, R. (1975). Toward an applied theory of experiential learning. In C. Cooper (Ed.), *Theories of group process*. London: John Wiley.

Kozioł-Nadolna, K. (2020). The role of a leader in stimulating innovation in an organization. *Administrative Sciences, 10*(3), 59. https://doi.org/10.3390/admsci10030059

Lor, R. (2017). Design thinking in education: A critical review of literature. https://www.researchgate.net/publication/324684320.

Makarius, E. E., Mukherjee, D., Fox, J. D., & Fox, A. K. (2020). Rising with the machines: A sociotechnical framework for bringing artificial intelligence into the organization. *Journal of Business Research, 120*, 262–273. https://doi.org/10.1016/j.jbusres.2020.07.045

Marín, M. A. F. V. (2020). Strategic Intelligence Management and Decision Process: An Integrated Approach in an Exponential Digital Change Environment. *Leadership, management, and adoption techniques for digital service innovation* (pp. 65–85). IGI Global. https://doi.org/10.4018/978-1-7998-2799-3.ch004

Martin, A. J., Nejad, H. G., Colmar, S., & Liem, G. A. D. (2013). Adaptability: How students' responses to uncertainty and novelty predict their academic and non-academic outcomes. *Journal of Educational Psychology, 105*(3), 728. https://doi.org/10.1037/a0032794

Martín, L., Sánchez, L., Lanza, J., & Sotres, P. (2023). Development and evaluation of Artificial Intelligence techniques for IoT data quality assessment and curation. *Internet of Things, 22*, Article 100779. https://doi.org/10.1016/j.iot.2023.100779

Martínez-Peláez, R., Ochoa-Brust, A., Rivera, S., Félix, V. G., Ostos, R., Brito, H., & Mena, L. J. (2023). Role of digital transformation for achieving sustainability: Mediated role of stakeholders, key capabilities, and technology. *Sustainability, 15*(14), 11221. https://doi.org/10.3390/su151411221

Mikalef, P., & Gupta, M. (2021). Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. *Information & Management, 58*(3), Article 103434. https://doi.org/10.1016/j.im.2021.103434

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big data analytics and firm performance: Findings from a mixed-method approach. *Journal of Business Research, 98*, 261–276. https://doi.org/10.1016/j.jbusres.2019.01.044

Mikalef, P., Islam, N., Parida, V., Singh, H., & Altwaijry, N. (2023). Artificial intelligence (AI) competencies for organizational performance: A B2B marketing capabilities perspective. *Journal of Business Research, 164*, Article 113998. https://doi.org/10.1016/j.jbusres.2023.113998

Mirchi, S., Vedadi, A., & Gholamzadeh, D. (2023). Applying a meta-synthesis approach to present a blended learning model for talent development. *Journal of Medical Education, 22*(1). https://doi.org/10.5812/jme-142760

Morrison-Smith, S., & Ruiz, J. (2020). Challenges and barriers in virtual teams: A literature review. *SN Applied Sciences, 2*, 1–33. https://doi.org/10.1007/s42452-020-2801-5

Pan, X. (2020). Technology acceptance, technological self-efficacy, and attitude toward technology-based self-directed learning: Learning motivation as a mediator. *Frontiers in Psychology, 11*, Article 564294. https://doi.org/10.3389/fpsyg.2020.564294

Pfajfar, G., Shoham, A., Małecka, A., & Zalaznik, M. (2022). Value of corporate social responsibility for multiple stakeholders and social impact–Relationship marketing perspective. *Journal of business research, 143*, 46–61. https://doi.org/10.1016/j.jbusres.2022.01.051

Phadermrod, B., Crowder, R. M., & Wills, G. B. (2019). Importance-performance analysis based SWOT analysis. *International journal of information management, 44*, 194–203. https://doi.org/10.1016/j.ijinfomgt.2016.03.009

Prahalad, C. K., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review, 68*(3), 79–91.

Pratomo, L. C., & Wardani, D. K. (2021). The effectiveness of design thinking in improving student creativity skills and entrepreneurial alertness. *International Journal of Instruction, 14*(4), 695–712. https://doi.org/10.29333/iji.2021.14440a

Raisch, S., & Krakowski, S. (2021). Artificial intelligence and management: The automation–augmentation paradox. *Academy of Management Review, 46*(1), 192–210. https://doi.org/10.5465/amr.2018.0072

Ramdani, B., Binsaif, A., & Boukrami, E. (2019). Business model innovation: A review and research agenda. *New England Journal of Entrepreneurship, 22*(2), 89–108. https://doi.org/10.1108/NEJE-06-2019-0030

Rane, N.L., Achari, A., & Choudhary, S.P. (2023). Enhancing customer loyalty through quality of service: Effective strategies to improve customer satisfaction, experience, relationship, and engagement. doi:10.56726/IRJMETS38104.

Rösch, N., Tiberius, V., & Kraus, S. (2023). Design thinking for innovation: Context factors, process, and outcomes. *European Journal of Innovation Management, 26*(7), 160–176, 10.1108/EJIM-03-2022-0164.

Rožman, M., Tominc, P., & Štrukelj, T. (2023). Competitiveness through development of strategic talent management and agile management ecosystems. *Global Journal of Flexible Systems Management*, 1–21, 10.1007/s40171-023-00344-1.

Ruggiero, S., Kangas, H. L., Annala, S., & Lazarevic, D. (2021). Business model innovation in demand response firms: Beyond the niche-regime dichotomy. *Environmental Innovation and Societal Transitions, 39*, 1–17. https://doi.org/10.1016/j.eist.2021.02.002

Saritepeci, M., & Durak, H. Y. (2024). Effectiveness of artificial intelligence integration in design-based learning on design thinking mindset, creative and reflective thinking skills: An experimental study. *Educ Inf Technol*, 202410.1007/s10639-024-12829-2.

Sarker, I. H. (2022). Ai-based modeling: Techniques, applications and research issues towards automation, intelligent and smart systems. *SN Computer Science, 3*(2), 158. https://doi.org/10.1007/s42979-022-01043-x

Sarooghi, H., Sunny, S., Hornsby, J., & Fernhaber, S. (2019). Design thinking and entrepreneurship education: Where are we, and what are the possibilities? *Journal of Small Business Management, 57*, 78–93. https://doi.org/10.1111/jsbm.12541

Sedeh, A., Pezeshkan, A., & Caiazza, R (2021). Innovative entrepreneurship in emerging and developing economies: The effects of entrepreneurial competencies and institutional voids. *The Journal of technology transfer, 47*, 1198–1223. https://doi.org/10.1007/s10961-021-09874-1

Shahadat, M. H., Nekmahmud, M., Ebrahimi, P., & Fekete-Farkas, M. (2023). Digital technology adoption in SMEs: What technological, environmental and organizational factors influence in emerging countries? *Global Business Review.* , Article 09721509221137199. https://doi.org/10.1177/09721509221137199

Sheri, A. M. A., Nori, N. R., & Gupta, S. K. (2021). The role of strategic intelligence in enhancing effective talent management: A study on some academic institutions of Duhok Governorate. *Academic Journal of Nawroz University, 10*(2), 137–155. https://doi.org/10.25007/ajnu.v10n2a929

Sinnaiah, T., Adam, S., & Mahadi, B. (2023). A strategic management process: The role of decision-making style and organisational performance. *Journal of Work-Applied Management, 15*(1), 37–50. https://doi.org/10.1108/JWAM-10-2022-0074

Sjödin, D., Parida, V., Palmié, M., & Wincent, J. (2021). How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops. *Journal of Business Research, 134*, 574–587, 10.1016/j.jbusres.2021.05.009.

Škėrienė, S., & Jucevičienė, P. (2020). Problem solving through values: A challenge for thinking and capability development. *Thinking Skills and Creativity*, 37, 100694. 10.10162Fj.tsc.2020.100694.

Somwethee, P., Aujirapongpan, S., & Ru-Zhue, J. (2023). The influence of entrepreneurial capability and innovation capability on sustainable organization performance: Evidence of community enterprise in Thailand. *Journal of Open Innovation: Technology, Market, and Complexity, 9*(2), Article 100082. https://doi.org/10.1016/j.joitmc.2023.100082

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18, 7%3C509::AID-SMJ882%3E3.0.CO;2-Z.

Vecchiato, R. (2015). Strategic planning and organizational flexibility in turbulent environments. *Foresight, 17*(3), 257–273. https://doi.org/10.1108/FS-05-2014-0032

Wamba-Taguimdje, S. L., Fosso Wamba, S., Kala Kamdjoug, J. R., & Tchatchouang Wanko, C. E (2020). Influence of artificial intelligence (AI) on firm performance: The business value of AI-based transformation projects. *Business Process Management Journal, 26*(7), 1893–1924. https://doi.org/10.1108/BPMJ-10-2019-0411

Wang, C., Ahmad, S. F., Ayassrah, A. Y. B. A., Awwad, E. M., Irshad, M., Ali, Y. A., & Han, H. (2023). An empirical evaluation of technology acceptance model for Artificial Intelligence in E-commerce. *Heliyon*, (8), 9. https://doi.org/10.1016/j.heliyon.2023.e18349

Wannamakok, W., & Yonwikai, W. (2023). The relationship between institutional environments and thai hospitality-oriented entrepreneurship through the moderating role of educational support: A mixed methods approach. *Administrative Sciences, 13*(8), 188. https://doi.org/10.3390/admsci13080188

Wongwuttiwat, J., & Lawanna, A. (2018). The digital Thailand strategy and the ASEAN community. *The Electronic Journal of Information Systems in Developing Countries, 84*(3), e12024. https://doi.org/10.1002/isd2.12024

YahiaMarzouk, Y., & Jin, J. (2022). Impact of environmental scanning on organizational resilience and competitive advantage: A study of Egyptian SMEs. *Continuity & Resilience Review, 4*(2), 192–223. https://doi.org/10.1108/CRR-10-2021-0037

Yaqub, M. Z., & Alsabban, A. (2023). Industry-4.0-Enabled digital transformation: Prospects, instruments, challenges, and implications for business strategies. *Sustainability, 15*(11), 8553. https://doi.org/10.3390/su15118553

Zhang, W., Zeng, X., Liang, H., Xue, Y., & Cao, X. (2023). Understanding how organizational culture affects innovation performance: A management context perspective. *Sustainability, 15*(8), 6644. https://doi.org/10.3390/su15086644