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Bridging the Digital and Innovation Divide: A Mixed-Methods Study on Technology-Enhanced Learning for Entrepreneurial Education in Thailand

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ABSTRACT

Developing nations increasingly look to entrepreneurship as a catalyst for economic growth, yet fostering high-quality, innovation-driven ventures remains a formidable challenge. This study investigates the "entrepreneurial paradox" in Thailand—a nation with high rates of early-stage entrepreneurial activity but lagging innovation. It explores the potential of Technology-Enhanced Learning (TEL) to bridge this gap by transforming entrepreneurial education. Employing a sequential explanatory mixed-methods design, this research first conducts a thematic analysis of interviews with university students and lecturers to uncover the contextual factors shaping TEL adoption. Subsequently, it develops and tests a theoretical model using Partial Least Squares Structural Equation Modeling (PLS-SEM) on a sample of 458 university students. The quantitative model, an extension of the Unified Theory of Acceptance and Use of Technology (UTAUT), examines the determinants of students' intention to use TEL for entrepreneurial learning and its subsequent impact on entrepreneurial self-efficacy, entrepreneurial intention, and innovation orientation. Qualitative findings reveal that while TEL offers unprecedented access to resources, its efficacy is constrained by infrastructural inconsistencies and a pedagogical gap. The quantitative results confirm the model's robustness, highlighting Performance Expectancy and Facilitating Conditions as the most significant predictors of behavioral intention and use. The integrated findings suggest that the digital divide acts as a fundamental barrier to the deep learning required to cultivate an innovation mindset. This study provides critical, evidence-based implications for socio-economic planning, advocating for a policy shift from merely providing technology to fostering digital equity and pedagogical innovation in emerging economies.

KEYWORDS: Entrepreneurial Education; Technology-Enhanced Learning (TEL); Digital Divide; UTAUT; Entrepreneurial Intention; Innovation Orientation

INTRODUCTION: THE ENTREPRENEURIAL PARADOX IN A DIGITIZING ECONOMY

1.1. The Global Imperative for Entrepreneurship in Developing Economies

In the contemporary global economy, entrepreneurship is widely recognized as a primary engine for sustainable economic development, innovation, and social mobility (Uvarova et al., 2021). For developing countries, fostering a vibrant entrepreneurial ecosystem is not merely an economic strategy but a critical tool for addressing pressing socio-economic challenges, including high rates of youth unemployment and the need for economic diversification. Entrepreneurship facilitates job creation, stimulates competition, and accelerates the diffusion of new technologies and business models, thereby enhancing national productivity and competitiveness (Ebrahimi et al., 2023). Consequently, governments and international development agencies have increasingly prioritized the promotion of entrepreneurship through policy initiatives and educational reform (Hofer & Baur, 2018).

Central to this effort is the role of entrepreneurship education (EE), which has been globally identified as a key mechanism for equipping individuals with the necessary knowledge, skills, and mindset to identify opportunities, manage risks, and create value (Aboobaker et al., 2023). By moving beyond traditional business

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administration curricula, effective EE cultivates crucial competencies such as creativity, proactiveness, and resilience, fostering an entrepreneurial culture that can drive economic transformation from the ground up (Rahmi & Darmansyah, 2025). As nations strive to build knowledge-based economies, the capacity to nurture a generation of innovators and entrepreneurs through education has become a cornerstone of national development strategy (Stanchev, 2018).

1.2. Thailand's Socio-Economic Context: A Nation of Entrepreneurs?

Thailand presents a particularly compelling and paradoxical case study within this global context, making its problem unique and of significant interest for public sector decision-making (Damnet et al., 2024). The nation exhibits a powerful entrepreneurial spirit, evidenced by its Total early-stage Entrepreneurial Activity (TEA) rate, which soared to 23.4% post-pandemic—a 20% increase from previous levels and one of the highest in the world. This figure suggests that a substantial portion of the adult population is actively engaged in starting or running new businesses, reflecting a dynamic and enterprising culture. Furthermore, Small and Medium Enterprises (SMEs) are the backbone of the Thai economy, contributing approximately 35% of the national GDP and employing over 70% of the workforce (Sangnak, 2025).

However, this high level of entrepreneurial activity masks a deeper, more persistent challenge: a significant deficit in innovation (Moghavvemi et al., 2012). Despite the proliferation of new ventures, Thai start-ups consistently lag behind regional and global competitors in terms of research and development (R&D), technological sophistication, and international competitiveness. The majority of entrepreneurial activity appears to be concentrated in necessity-driven or low-innovation sectors, rather than the high-growth, knowledge-intensive fields that are crucial for long-term economic advancement. This disconnect between the quantity of entrepreneurship and its innovative quality constitutes Thailand's "entrepreneurial paradox." This paradox suggests a systemic issue where the prevailing economic and educational structures are successful at encouraging business creation but are failing to cultivate the innovative capabilities required to elevate these businesses beyond local markets and traditional models. The existence of a dual economy—a high-tech, innovation-centric urban core, particularly in Bangkok, coexisting with a vast, lower-tech rural and informal sector—likely underpins this phenomenon. The high TEA rate may be primarily driven by the latter, which does not align with national goals for an innovation-led economy.

1.3. Technology-Enhanced Learning (TEL) as a Potential Catalyst

Technology-Enhanced Learning (TEL), which refers to the integration of information and communication technologies (ICT) into educational processes, emerges as a powerful potential catalyst to address this paradox. In theory, TEL can dismantle traditional barriers to high-quality education by overcoming geographical constraints, reducing costs, and democratizing access to world-class knowledge and resources (Mahmud et al., 2023). For entrepreneurial education, TEL offers transformative possibilities. It can provide students with immersive learning experiences through business simulations, connect them with global mentors and venture capitalists through online platforms, facilitate collaborative, project-based learning across disciplines, and expose them to the latest market trends and technological innovations (Astriyani et al., 2024). By fostering 21st-century skills such as digital literacy, critical thinking, and cross-cultural collaboration, TEL holds the promise of shifting the focus of EE from rote memorization of business principles to the active cultivation of an innovative and adaptive entrepreneurial mindset (Chow & To, 2025).

1.4. The Complicating Factor: The Digital Divide

The potential of TEL to act as a socio-economic lever is severely constrained by a significant complicating factor in the Thai context: a pervasive and multi-faceted digital divide (Barra et al., 2024). This divide manifests as a stark disparity in digital access, literacy, and infrastructure between the hyper-connected, technologically advanced metropolitan area of Bangkok and the nation's vast rural regions. While Bangkok flourishes as a regional tech hub, many rural communities grapple with inconsistent internet connectivity, lower smartphone and computer ownership, and limited digital skills. This is not merely an infrastructural issue; it is a fundamental barrier to social and economic inclusion. The COVID-19 pandemic starkly illustrated this reality, as individuals in rural areas with poor connectivity and low digital literacy were unable to access

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online learning resources or government economic relief schemes delivered through digital platforms (Aljanazrah et al., 2022).

The digital divide in Thailand also has precise demographic dimensions, disproportionately affecting older populations, individuals with lower levels of education, and those in lower-income brackets (Tamnanwan & Sangnak, 2025). A 2020 household survey revealed significant gaps in digital skills, particularly among older adults and young adults without tertiary education, hindering their ability to participate fully in the digital economy. This complex web of geographic and demographic disparities means that any initiative reliant on digital technology, including TEL, risks exacerbating existing inequalities rather than alleviating them. The promise of TEL as a democratizing force can only be realized if the foundational issue of the digital divide is addressed (Barra et al., 2024).

1.5. Research Gap and Objectives

The Thai government has recognized the importance of both digital transformation and entrepreneurship, launching parallel policy initiatives (Sangnak, 2025). The 20-Year Digital Economy and Society Development Plan aims to build a high-capacity digital infrastructure and cultivate a digitally skilled populace. At the same time, the Ministry of Education's "Anywhere Anytime" project seeks to equip students with digital devices. Concurrently, agencies like the Office of Small and Medium Enterprises Promotion (OSMEP) have formulated plans to stimulate entrepreneurship among students. Despite these efforts, a critical research gap exists at the intersection of these policy domains. There is a lack of empirical understanding of how TEL is being accepted and utilized for entrepreneurial education within the unique Thai context, and whether it is effectively contributing to the development of an innovation-oriented mindset (Braun, 2021). The underlying factors that drive students' adoption of these technologies, and the subsequent impact on their entrepreneurial ambitions, remain under-researched, particularly when considering the moderating effect of the digital divide.

This study aims to fill this gap by employing a mixed-methods approach to provide a holistic and nuanced understanding of this complex issue. The following objectives guide the research:

- To qualitatively explore the lived experiences, perceived benefits, and challenges of using TEL for entrepreneurial education among Thai university students and lecturers, thereby uncovering the contextual nuances that quantitative models may miss.
- To develop and quantitatively test a theoretical model, based on the Unified Theory of Acceptance and Use of Technology (UTAUT), that identifies the key determinants of students' intention to use TEL for EE and its subsequent influence on their entrepreneurial self-efficacy, entrepreneurial intention, and innovation orientation.
- To integrate the qualitative and quantitative findings to provide evidence-based, actionable recommendations for policymakers, socio-economic planners, and higher education institutions aimed at leveraging TEL to resolve the entrepreneurial paradox and foster sustainable, innovation-driven economic growth.

CONCEPTUAL FOUNDATIONS AND HYPOTHESIS DEVELOPMENT

2.1. The Promise and Peril of TEL in Developing Nations

The literature on Technology-Enhanced Learning (TEL) in developing countries is characterized by a pronounced dichotomy between its immense theoretical potential and the challenging realities of its implementation (Mahmud et al., 2023). On one hand, TEL is heralded as a transformative force capable of addressing long-standing issues of educational inequity. Proponents argue that digital technologies, particularly the internet, can overcome geographical and economic barriers, providing learners in remote or underserved areas with access to educational opportunities that were previously unattainable. By facilitating open and distance learning, TEL can reduce the cost of education delivery, reach larger populations, and offer flexible learning pathways that cater to diverse needs. The array of available tools—from learning management systems and video conferencing to collaborative online platforms—can support a variety of pedagogical approaches and learning modes, including face-to-face, blended, and fully online environments (Aljanazrah et al., 2022).

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On the other hand, a substantial body of research highlights the significant perils and obstacles that hinder the realization of this promise. The primary challenge is the lack of adequate infrastructure, including reliable electricity and affordable, high-speed internet, which remains a significant barrier in many developing regions (Mahmud et al., 2023). Beyond infrastructure, socio-economic factors such as poverty limit students' ability to afford necessary devices and data plans. Furthermore, cultural and institutional factors can impede progress; in some contexts, distance education is still perceived as a "second-best" alternative to traditional face-to-face instruction. The successful implementation of TEL is not merely a matter of providing technology; it requires a supportive ecosystem that includes trained educators, relevant digital content, and a culture that values and promotes digital literacy (Rumreich et al., 2024). The gap between the optimistic rhetoric surrounding e-learning and the complex reality on the ground remains a central theme in the literature.

2.2. Entrepreneurial Education (EE) and the Cultivation of an Innovation Mindset

Entrepreneurial Education (EE) is defined as the process of providing individuals with the concepts, skills, and mindset to recognize opportunities and create economic or social value. Its importance has grown in parallel with the recognition of entrepreneurship as a driver of economic prosperity. Modern EE extends beyond the functional aspects of business creation (e.g., finance, marketing) to focus on developing a set of psycho-cognitive attributes that are essential for success in a dynamic and uncertain global economy (Aboobaker et al., 2023). Research has identified three key categories of impact from EE: the development of entrepreneurial skills (such as creativity, proactiveness, and opportunity identification), the cultivation of a positive perception and attitude towards entrepreneurship (including tolerance for risk and ambiguity), and the strengthening of entrepreneurial intention, which is a strong predictor of actual start-up behavior (Asghar et al., 2019).

A robust theoretical link exists between education, human capital, and economic development. Human capital theory posits that investments in education enhance individuals' knowledge and skills, thereby increasing their productivity and innovative capacity (Aboobaker et al., 2023). This, in turn, contributes to aggregate economic growth. In the context of entrepreneurship, EE is a specialized form of human capital investment that directly fosters the capabilities needed to launch and grow new ventures. By integrating practical, experiential learning opportunities—such as working on real-world projects with start-ups—EE can significantly enhance students' self-efficacy and their ability to translate ideas into action. The ultimate goal of contemporary EE is not just to produce more business owners, but to cultivate an innovation mindset that can drive technological advancement and societal progress.

2.3. Theoretical Framework: The Unified Theory of Acceptance and Use of Technology (UTAUT)

To investigate the factors influencing students' adoption of TEL for entrepreneurial education, this study employs the Unified Theory of Acceptance and Use of Technology (UTAUT) as its foundational theoretical framework. The UTAUT model, developed by Venkatesh et al. (2003), represents a significant advancement in technology acceptance research by synthesizing eight prominent earlier models, including the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and the Innovation Diffusion Theory (Xue et al., 2024). While precursor models like TAM focused primarily on the core constructs of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), UTAUT provides a more comprehensive framework by incorporating a wider range of determinants (Varma, 2018). The choice of UTAUT is justified by its superior explanatory power—it has been shown to account for up to 70% of the variance in users' behavioral intention—and its inclusion of social and contextual factors, which are particularly salient in this study's context (Hakimi et al., 2024). Research in developing countries has shown that cultural and environmental variables can significantly moderate technology acceptance, making UTAUT a more appropriate model than simpler, cognitively focused frameworks.

The four core constructs of the UTAUT model are defined for this study as follows (Zhou & Johar, 2024):

- **Performance Expectancy (PE):** The degree to which a student believes that using TEL will help them attain gains in their entrepreneurial learning and improve their future business performance. This is analogous to perceived usefulness.

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- **Effort Expectancy (EE):** The degree of ease associated with the use of TEL platforms and tools for entrepreneurial education activities.
- **Social Influence (SI):** The degree to which a student perceives that important others (such as lecturers, peers, and family) believe they should use TEL for their entrepreneurial studies.
- **Facilitating Conditions (FC):** A student's perception of the availability and adequacy of the organizational and technical infrastructure to support the use of TEL. This includes access to hardware, software, reliable internet, and technical support.

In the UTAUT model, the first three constructs (PE, EE, SI) are direct determinants of Behavioral Intention (BI) to use a technology, while Facilitating Conditions and Behavioral Intention are direct determinants of the actual Use Behavior (Xue et al., 2024).

2.4. Model Extension and Hypothesis Development

While the core UTAUT model provides a robust foundation, it is necessary to extend it to address the specific research questions related to entrepreneurial and innovation outcomes (Abushakra & Nikbin, 2019). The standard UTAUT model may not fully capture the nuances of an educational context in a developing country, where the ultimate goal is not just technology use, but the development of specific capabilities (Handoko, 2020). The relationships between UTAUT constructs have been shown to vary across different cultural and economic contexts, suggesting the need for contextual adaptation (Bervell & Umar, 2017). Therefore, this study proposes an extended model that integrates key constructs from the entrepreneurship literature. The development of the corresponding hypotheses depicts the proposed research model.

The three primary determinants of intention in the original UTAUT model are Performance Expectancy, Effort Expectancy, and Social Influence (Varma, 2018). Performance Expectancy, or the perceived usefulness of the technology, is consistently found to be the strongest predictor of intention (Jeon et al., 2020). Effort Expectancy, or perceived ease of use, is also a significant factor, particularly in the early stages of technology adoption. Social Influence captures the impact of the social environment on an individual's decision-making.

- **H1:** Performance Expectancy will have a positive influence on Behavioral Intention to use TEL for entrepreneurial education.
- **H2:** Effort Expectancy will have a positive influence on Behavioral Intention to use TEL for entrepreneurial education.
- **H3:** Social Influence will have a positive influence on Behavioral Intention to use TEL for entrepreneurial education.

The UTAUT model posits that both intention and the presence of a supportive environment determine actual use (Xue et al., 2024). Facilitating Conditions refer to the tangible resources and support systems that enable technology use. Behavioral Intention represents the motivational factor that drives an individual to act.

- **H4:** Facilitating Conditions will have a positive influence on the Use Behavior of TEL.
- **H5:** Behavioral Intention will have a positive influence on the Use Behavior of TEL.

To connect technology adoption with entrepreneurial outcomes, the model is extended with three critical constructs. Entrepreneurial Self-Efficacy (ESE) is an individual's belief in their own capability to successfully perform the tasks and roles of an entrepreneur (Aboobaker et al., 2023). The active use of TEL for learning and practicing entrepreneurial skills is expected to build this confidence.

- **H6:** Use of TEL will have a positive influence on Entrepreneurial Self-Efficacy.

Entrepreneurial Intention (EI) is the cognitive state that precedes the decision to start a new business and is a focal point of entrepreneurship research (Asghar et al., 2019). ESE is one of its most powerful antecedents; individuals are more likely to intend to pursue a course of action if they believe they are capable of succeeding.

- **H7:** Entrepreneurial Self-Efficacy will have a positive influence on Entrepreneurial Intention.

Finally, to address the innovation aspect of the research problem, Innovation Orientation (IO) is introduced. This construct reflects an individual's propensity towards innovativeness, proactiveness, and risk-taking—key

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dimensions of an entrepreneurial orientation. It is hypothesized that engaging with diverse ideas and tools through TEL can foster a more innovative mindset. Furthermore, those who intend to become entrepreneurs are more likely to embrace innovation as a competitive strategy.

- **H8:** Use of TEL will have a positive influence on Innovation Orientation.
- **H9:** Entrepreneurial Intention will be positively associated with Innovation Orientation.

PHASE 1: VOICES FROM THE FIELD - A THEMATIC EXPLORATION OF TEL IN THAI ENTREPRENEURIAL EDUCATION

3.1. Research Paradigm and Rationale

This study adopts a pragmatist research paradigm. Pragmatism eschews the traditional dichotomy between positivist and interpretivist philosophies, focusing instead on the research problem itself and advocating for the use of multiple methods to gain the most comprehensive understanding (Creswell & Plano Clark, 2018). This "what works" approach is particularly well-suited to mixed-methods research, as it integrates quantitative data (which provides objective findings) and qualitative data (which offers rich, contextual understanding) to address complex, real-world issues. The research employs a sequential explanatory mixed-methods design, denoted as QUAL → QUAN (Creswell & Plano Clark, 2018). This design involves collecting and analyzing qualitative data first, and then using the results to inform the development of the second, quantitative phase. The rationale for this sequence is twofold. First, the phenomenon of TEL adoption for EE in the specific context of Thailand is complex and under-researched. An initial qualitative exploration is necessary to identify the salient, context-specific factors, themes, and language used by participants. Second, these rich qualitative insights can then be used to develop a more valid and contextually relevant quantitative instrument (i.e., the survey), ensuring that the subsequent model testing is grounded in the lived experiences of the target population.

3.2. Participant Selection and Data Collection

To capture a diverse range of perspectives, a purposive sampling strategy was employed for the qualitative phase. Participants were selected based on their direct involvement in entrepreneurial education programs at Thai universities. The sample comprised 22 undergraduate students and 6 lecturers. To ensure representation across the urban-rural spectrum, participants were recruited from two distinct institutional settings: a large, prestigious public university located in the Bangkok metropolitan area and two regional public universities in the North and Northeast of Thailand. This sampling strategy was designed to capture potential variations in experiences related to infrastructure, resources, and pedagogical approaches.

Data were collected through semi-structured interviews, each lasting approximately 45-60 minutes. Due to geographic dispersion and participant preferences, interviews were conducted both in person and via video conferencing platforms. A semi-structured interview protocol (see Appendix A) was used to guide the conversations, ensuring that key topics were covered while allowing the flexibility to probe emergent themes. The protocol was developed based on the existing literature and covered areas such as the specific digital technologies used in their courses (e.g., Learning Management Systems, social media like LINE, collaborative tools like Padlet), the perceived benefits of these tools for developing entrepreneurial skills, the primary challenges and barriers encountered, and the perceived role of the university, lecturers, and peers in supporting their technology-enabled learning journey. All interviews were conducted in Thai, audio-recorded with consent, and professionally transcribed and translated into English for analysis.

3.3. Data Analysis: Thematic Analysis

The qualitative data were analyzed using the six-phase thematic analysis approach outlined by Braun and Clarke (2006), a rigorous and widely accepted method for identifying, analyzing, and reporting patterns (themes) within qualitative data (Braun & Clarke, 2006). The process was as follows: (1) **Familiarization:** The research team repeatedly read the transcripts while listening to the audio recordings to immerse themselves in the data. (2) **Initial Coding:** The transcripts were systematically coded line-by-line to identify interesting features of the data relevant to the research questions. (3) **Searching for Themes:** The initial codes

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were collated into potential themes, and all relevant coded data extracts were gathered within each identified theme. (4) **Reviewing Themes:** The potential themes were reviewed at two levels. First, the collated extracts for each theme were checked for coherence. Second, the entire thematic map was considered alongside the dataset to ensure it accurately reflected the participants' narratives. (5) **Defining and Naming Themes:** Once the thematic map was finalized, the specifics of each theme were refined, and clear, concise names were generated for each. (6) **Producing the Report:** The final phase involved writing the narrative analysis, weaving together the analytic narrative with compelling, illustrative quotations to present the findings.

3.4. Qualitative Findings: Emergent Themes

The thematic analysis revealed three overarching themes that encapsulate the complex experiences of students and lecturers with TEL for entrepreneurial education in Thailand. These themes highlight a tension between the opportunities presented by digital tools and the persistent structural and pedagogical challenges that limit their impact. Table 1 provides demographic details of the participants, and Table 2 presents the final thematic structure with illustrative quotations.

- **Theme 1: The Double-Edged Sword of Accessibility: Bridging and Widening Divides.** This theme captures the contradictory nature of TEL's impact on access. On the one hand, participants universally praised the flexibility and the vast array of resources that TEL provides. Students from regional universities, in particular, felt that online platforms leveled the playing field, giving them access to international guest speakers, global case studies, and learning materials that were previously confined to top-tier institutions in Bangkok. However, this enhanced access was frequently undermined by the practical realities of the digital divide. Students, especially those living in dormitories or off-campus in rural areas, reported significant frustration with unreliable and slow internet connectivity, which disrupted their participation in synchronous classes and their ability to download large files. The cost of mobile data and the lack of personal laptops (with many relying solely on smartphones) were also cited as significant barriers, effectively creating a new form of inequality based on socio-economic status.
- **Theme 2: From Passive Consumption to Active Creation: A Pedagogical Chasm.** This theme highlights a critical gap between how technology is often used and how it *could* be used to foster entrepreneurial skills. The dominant experience for many students was the use of TEL for passive information consumption—watching recorded lectures on an LMS, downloading PDFs, and submitting assignments. While convenient, this approach was seen as a simple digitization of traditional, teacher-centered pedagogy. In contrast, the most valued learning experiences occurred when technology was used for active, collaborative creation. Examples included using platforms like Padlet or Miro for virtual brainstorming, developing business model canvases in shared documents, or using social media to conduct market validation and build a customer base for a class project. Lecturers acknowledged this gap, expressing a desire to implement more project-based, technologically immersive learning. However, they cited constraints such as large class sizes, a lack of institutional support for specialized software, and their own need for further training in digital pedagogy.
- **Theme 3: Navigating the "Shadow" Learning Ecosystem: The Primacy of Informal Networks.** This theme reveals the decisive role of informal, student-driven digital networks that operate primarily outside the formal curriculum. While formal Social Influence from lecturers was mentioned, the more potent influence came from peers within social media platforms, particularly LINE and Facebook. Students created their own LINE groups for each course to collaborate, share resources, and support one another, often finding this peer-to-peer interaction more valuable than the formal course structure. Furthermore, these platforms served as nascent entrepreneurial ecosystems. Students used Facebook Marketplace and Instagram to test product ideas, build followings, and conduct social commerce, gaining practical, real-world entrepreneurial experience. This "shadow" learning ecosystem was seen as highly effective but was rarely acknowledged or integrated into the formal EE curriculum. This suggests that the actual social dynamics of learning and entrepreneurship in this context are happening in informal digital spaces.

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3.5. Trustworthiness and Rigor

To ensure the trustworthiness of the qualitative findings, several established techniques were employed (Creswell & Plano Clark, 2018). **Credibility** was enhanced through prolonged engagement with the topic and member checking, where a summary of the findings was shared with a subset of participants to verify that their perspectives were accurately represented. **Transferability** was addressed through "thick description"—providing rich, detailed accounts of the participants and their context (as seen in Table 1 and the theme descriptions) to allow readers to assess the applicability of the findings to other settings. **Dependability** and **confirmability** were established by maintaining a clear audit trail, which includes verbatim transcripts, coding frameworks, and detailed analytic memos documenting the research process from data collection to theme generation.

Table 1: Demographics of Qualitative Study Participants

Participant ID	Role	University Type	Field of Study	Gender
S01	Student	Urban	Business Administration	Female
S02	Student	Urban	Engineering	Male
S03	Student	Regional	Marketing	Female
S04	Student	Regional	Agribusiness	Male
S22	Student	Urban	Information Technology	Male
L01	Lecturer	Urban	Entrepreneurship Center	Male
L02	Lecturer	Regional	Business Management	Female
L06	Lecturer	Urban	Innovation Management	Female

Table 2: Final Thematic Structure with Illustrative Quotations

Main Theme	Sub-theme	Illustrative Quotation (Translated from Thai)
1. The Double-Edged Sword of Accessibility	1.1. Democratization of Knowledge	"Before, we would only hear about speakers from Silicon Valley. Now, with Zoom, our professor can invite them to talk to our class directly. It feels like we are not so far away from the center of things anymore." (S15, Regional, Marketing)"
	1.2. The 'Last Mile' Problem	"The university Wi-Fi is fine, but at my dorm, it is terrible. I missed half the online lecture because the connection kept dropping. I cannot afford a better mobile data plan, so I have to hope the recording is clear." (S08, Regional, Agribusiness)"
	1.3. The Device Gap	"Trying to create a full business plan on a smartphone is a nightmare. Some of my friends have MacBooks and can use all the cool design software. I have to go to the university computer lab, but it is often full." (S11, Urban, Business Administration)"
2. From Passive Consumption to Active Creation	2.1. Digitized Traditionalism	"For most classes, 'online learning' means they upload the PowerPoint slides to the LMS. It is not really different from a normal lecture, just more convenient. We do not do anything with the technology." (S05, Urban, Engineering)"
	2.2. Technology as an Entrepreneurial Sandbox	The best project was when we used a simulation game to run a virtual company. We had to make decisions on pricing, marketing... it felt real. That is where I actually learned about cash flow, not from the textbook." (L03, Regional, Business Management)"

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Main Theme	Sub-theme	Illustrative Quotation (Translated from Thai)
	2.3. The Need for Pedagogical Support	"I want to use more interactive tools, like virtual whiteboards for brainstorming, but it takes much time to set up and manage with 100 students in a class. The university does not provide training for these advanced tools." (L05, Urban, Innovation Management)"
3. Navigating the "Shadow" Learning Ecosystem	3.1. The Essential Role of LINE	"The first thing we do for any class is create a LINE group. We share notes, ask questions... honestly, I learn more from my friends in the LINE group than from the official course page. It is faster and more direct." (S18, Urban, Information Technology)"
	3.2. Social Media as a Prototyping Lab	"My friends and I started selling custom t-shirts on Instagram for a class project. We learned about targeting ads, talking to customers, and managing payments. It was a real business, even if it was small. We did not learn that in the lecture." (S01, Urban, Business Administration)"
	3.3. Formal vs. Informal Influence	The lecturer tells us to be innovative, but our friends are the ones who show us the new apps or the new ways to sell things online. We see them doing it, making real money, and that is what really motivates us." (S12, Regional, Marketing)"

PHASE 2: A PREDICTIVE MODEL OF TECHNOLOGY-DRIVEN ENTREPRENEURIAL INNOVATION

4.1. Bridging Qualitative Findings to Quantitative Instrument Design

The critical integration point in the sequential explanatory design is the use of qualitative findings to inform the quantitative phase (Creswell & Plano Clark, 2018). The rich, contextual insights from the interviews were instrumental in refining the survey instrument to ensure its relevance and validity within the Thai higher education context. Standard scales for the UTAUT constructs were adapted, and new items were developed to capture nuances identified in the thematic analysis. For instance, the theme of "The Double-Edged Sword of Accessibility" directly informed the operationalization of the **Facilitating Conditions (FC)** construct. Standard FC scales often focus on workplace IT support. To better reflect the student experience, specific items were added regarding the perceived reliability of internet access in their primary study location (home/dormitory), the affordability of mobile data plans, and personal access to a functional laptop computer capable of running necessary software.

Similarly, the theme "Navigating the 'Shadow' Learning Ecosystem" highlighted the inadequacy of measuring only formal sources of influence. Consequently, the **Social Influence (SI)** construct was bifurcated with items that separately measured the perceived influence of formal sources (lecturers and university communications) and informal sources (peers, student clubs, and activity on social media platforms like LINE). This allowed for a more granular analysis of which social channels are more potent in shaping students' intentions. Finally, insights from "From Passive Consumption to Active Creation" helped refine the items for Performance Expectancy (PE) to include not only academic performance but also the perceived usefulness of TEL for developing practical, hands-on entrepreneurial skills, such as prototyping and market testing.

4.2. Sampling and Data Collection

The target population for the quantitative phase was undergraduate students enrolled in Thai higher education institutions. To ensure a representative sample that captured the regional variations highlighted by the digital divide, a multi-stage stratified sampling strategy was employed. First, universities were stratified by region (Bangkok Metropolitan, Central, North, Northeast, and South). Within each region, universities were

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randomly selected. Finally, faculty deans and program heads at the selected universities were contacted to request the distribution of the online survey link to their undergraduate students. This approach aimed to gather responses from a diverse range of academic disciplines and institutional contexts.

Data were collected over three months using a web-based questionnaire hosted on Google Forms. The questionnaire was bilingual (Thai and English) and consisted of two main sections. The first section collected demographic information (gender, age, university region, field of study, year of study, and self-reported digital literacy). The second section contained the measurement items for the nine latent constructs in the research model: Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Behavioral Intention, Use Behavior, Entrepreneurial Self-Efficacy, Entrepreneurial Intention, and Innovation Orientation. All measurement items were adapted from validated scales in prior literature and were measured on a 7-point Likert scale, ranging from 1 (Strongly Disagree) to 7 (Strongly Agree) (Asghar et al., 2019). A total of 458 complete and usable responses were obtained for the final analysis.

4.3. Data Analysis: Partial Least Squares Structural Equation Modeling (PLS-SEM)

The collected data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with the SmartPLS 4 software (Sarstedt & Richter, 2024). PLS-SEM was chosen over covariance-based SEM (CB-SEM) for several reasons. First, the primary objective of this study is prediction—to identify the key drivers of behavioral intention and entrepreneurial outcomes. PLS-SEM is a prediction-oriented methodology that is well-suited for this purpose (Hair et al., 2017). Second, the research model is complex, involving multiple constructs and paths. PLS-SEM is robust in handling such complex models. Third, PLS-SEM does not require the stringent assumption of normal data distribution, which is often violated in social science survey data.

The analysis followed the recommended two-step procedure (Hair et al., 2017). The first step involved assessing **the measurement model** to establish its reliability and validity. This included examining indicator loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) for convergent validity, as well as the Fornell-Larcker criterion and Heterotrait-Monotrait (HTMT) ratio for discriminant validity. The second step was the **assessment of the structural model**, where the path coefficients (β), t-values, and p-values were calculated using a bootstrapping procedure (5,000 resamples) to test the hypothesized relationships. The model's explanatory power was assessed using the coefficient of determination (R^2), and its predictive relevance was evaluated using Stone-Geisser's Q^2 value.

4.4. Quantitative Results

The results of the PLS-SEM analysis are presented systematically, starting with the sample demographics and followed by the assessment of the measurement and structural models.

- **Descriptive Statistics** The demographic profile of the 458 survey respondents is summarized in Table 3. The sample was reasonably balanced in terms of gender (58.1% female, 41.9% male). The majority of respondents were from the Bangkok Metropolitan region (35.8%), followed by the Northeast (22.9%) and North (18.1%), providing a reasonable basis for capturing regional diversity. Students from Business/Economics (31.2%) and Social Sciences/Humanities (28.4%) were the most represented fields of study.
- **Measurement Model Assessment** The results of the measurement model assessment confirmed the reliability and validity of the constructs. As shown in Table 4, all indicator loadings were above the recommended threshold of 0.7. Cronbach's alpha values for all constructs were above 0.7, and composite reliability (CR) values were all above 0.8, indicating high internal consistency. The average variance extracted (AVE) for each construct was greater than 0.5, confirming convergent validity. Discriminant validity was established using both the Fornell-Larcker criterion and HTMT ratios, as presented in Table 5. The Fornell-Larcker criterion was met, as the square root of the AVE for each construct (the diagonal values) was greater than its correlation with any other construct. Additionally, all HTMT ratio values were below the conservative threshold of 0.85, providing strong evidence for discriminant validity.

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- **Structural Model Assessment** The results of the structural model analysis, which tested the nine hypotheses, are presented in Table 6. The model demonstrated substantial explanatory and predictive power. It explained 61.2% of the variance in Behavioral Intention ($R^2 = 0.612$), 54.8% in Use Behavior ($R^2 = 0.548$), 45.3% in Entrepreneurial Self-Efficacy ($R^2 = 0.453$), 58.1% in Entrepreneurial Intention ($R^2 = 0.581$), and 49.7% in Innovation Orientation ($R^2 = 0.497$). All endogenous constructs also showed medium to considerable predictive relevance, with Q^2 values well above zero.

The hypothesis testing results revealed that eight of the nine hypotheses were supported. **Performance Expectancy** ($\beta = 0.452$, $p < 0.001$) was the strongest predictor of **Behavioral Intention (BI)**, strongly supporting H1. **Effort Expectancy** ($\beta = 0.218$, $p < 0.001$) also had a significant positive influence on BI, supporting H2. **Social Influence** ($\beta = 0.115$, $p = 0.014$) had a significant but comparatively weak positive effect on BI, supporting H3. **Facilitating Conditions** ($\beta = 0.388$, $p < 0.001$) and Behavioral Intention ($\beta = 0.411$, $p < 0.001$) were both strong, significant predictors of **Use Behavior**, supporting H4 and H5. The extended part of the model was also strongly supported. **Use Behavior** had a significant positive impact on both **Entrepreneurial Self-Efficacy (ESE)** ($\beta = 0.673$, $p < 0.001$) and **Innovation Orientation (IO)** ($\beta = 0.356$, $p < 0.001$), supporting H6 and H8. **ESE** was a powerful predictor of **Entrepreneurial Intention (EI)** ($\beta = 0.762$, $p < 0.001$), supporting H7. Finally, **EI** was positively associated with **IO** ($\beta = 0.421$, $p < 0.001$), supporting H9.

Table 3: Demographics of Survey Respondents (N=458)

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	192	41.9
	Female	266	58.1
Age	18-20	245	53.5
	21-22	189	41.3
	23+	24	5.2
University Region	Bangkok Metropolitan	164	35.8
	Central	51	11.1
	North	83	18.1
	Northeast	105	22.9
	South	55	12
Field of Study	Business/Economics	143	31.2
	Social Sciences/Humanities	130	28.4
	Science/Technology/Engineering	111	24.2
	Health Sciences	45	9.8
	Other	29	6.3
Self-reported Digital Literacy	Novice	31	6.8
	Intermediate	201	43.9
	Advanced	226	49.3

Table 4: Measurement Model Assessment: Reliability and Convergent Validity

Construct	Item	Loading	Cronbach's α	CR	AVE
Performance Expectancy (PE)	PE1	0.851	0.902	0.93	0.729
	PE2	0.866			
	PE3	0.879			
	PE4	0.824			
Effort Expectancy (EE)	EE1	0.88	0.915	0.94	0.795
	EE2	0.901			
	EE3	0.892			

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Construct	Item	Loading	Cronbach's α	CR	AVE
Social Influence (SI)	SI1	0.845	0.887	0.92	0.742
	SI2	0.877			
	SI3	0.859			
Facilitating Conditions (FC)	FC1	0.821	0.899	0.928	0.721
	FC2	0.884			
	FC3	0.862			
	FC4	0.83			
Behavioral Intention (BI)	BI1	0.912	0.921	0.949	0.824
	BI2	0.903			
	BI3	0.908			
Use Behavior (USE)	USE1	0.899	0.909	0.936	0.785
	USE2	0.875			
	USE3	0.891			
Entrepreneurial Self-Efficacy (ESE)	ESE1	0.855	0.925	0.945	0.776
	ESE2	0.889			
	ESE3	0.892			
	ESE4	0.87			
Entrepreneurial Intention (EI)	EI1	0.925	0.94	0.958	0.852
	EI2	0.931			
	EI3	0.909			
Innovation Orientation (IO)	IO1	0.863	0.911	0.937	0.748
	IO2	0.881			
	IO3	0.85			
	IO4	0.874			

Note: CR = Composite Reliability; AVE = Average Variance Extracted.

Table 5: Discriminant Validity Assessment (HTMT Ratios)

	BI	EE	EI	ESE	FC	IO	PE	SI	USE
BI									
EE	0.481								
EI	0.602	0.41							
ESE	0.559	0.433	0.815						
FC	0.623	0.515	0.501	0.528					
IO	0.588	0.405	0.698	0.65	0.531				
PE	0.715	0.59	0.582	0.577	0.68	0.611			
SI	0.395	0.421	0.35	0.389	0.499	0.375	0.465		
USE	0.689	0.499	0.589	0.612	0.695	0.599	0.701	0.488	

Note: All values are below the threshold of 0.85, establishing discriminant validity.

Table 6: Structural Model Results for Hypothesis Testing

Hypothesis	Path	Path Coefficient (β)	t-value	p-value	Decision
H1	PE → BI	0.452	9.812	<0.001	Supported
H2	EE → BI	0.218	5.13	<0.001	Supported
H3	SI → BI	0.115	2.451	0.014	Supported
H4	FC → USE	0.388	8.115	<0.001	Supported
H5	BI → USE	0.411	8.943	<0.001	Supported
H6	USE → ESE	0.673	19.542	<0.001	Supported
H7	ESE → EI	0.762	28.91	<0.001	Supported

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Hypothesis	Path	Path Coefficient (β)	t-value	p-value	Decision
H8	USE → IO	0.356	7.025	<0.001	Supported
H9	EI → IO	0.421	8.359	<0.001	Supported
R^2 Values	*BI = 0.612; USE = 0.548; ESE = 0.453; EI = 0.581; IO = 0.497*				
Q^2 Values	*BI = 0.489; USE = 0.415; ESE = 0.341; EI = 0.485; IO = 0.360*				

SYNTHESIS AND DISCUSSION: INTEGRATING QUALITATIVE INSIGHTS WITH QUANTITATIVE EVIDENCE

5.1. A Nuanced Interpretation of the Findings

This study's mixed-methods design allows for a richer interpretation of the quantitative results by illuminating them with the contextual depth from the qualitative phase (Creswell & Plano Clark, 2018). The integration of both datasets moves beyond simply identifying *what* factors predict technology adoption and entrepreneurial intention to explaining *why* and *how* these factors operate within the specific socio-economic landscape of Thailand.

The quantitative model strongly supported H1, identifying **Performance Expectancy** as the most potent determinant of students' behavioral intention to use TEL (β = 0.452). This statistical finding is given texture by the qualitative data. The interviews revealed that students' perception of "performance" is not limited to achieving better grades. Instead, it is deeply connected to the practical, tangible benefits that TEL offers for their entrepreneurial aspirations. As one student noted, the most valued experiences were not passive lectures but active simulations that felt "real" (S05, L03). This aligns with the qualitative theme "From Passive Consumption to Active Creation," suggesting that students are highly motivated to use technologies that they believe will directly equip them with the skills to build a business, validate an idea, or connect with industry mentors (Rahmi & Darmansyah, 2025). The strength of this path implies that for TEL to be adopted enthusiastically, its value proposition for real-world entrepreneurial capability development must be explicit and central to the pedagogical design.

Facilitating Conditions emerged as another critical factor, showing a strong, direct influence on actual Use Behavior (β = 0.388), as per H4. The quantitative significance of this construct is powerfully explained by the qualitative theme "The Double-Edged Sword of Accessibility." The statistical relationship is not an abstract concept but a reflection of the lived reality for many students, particularly those outside of Bangkok. The interview data, filled with accounts of dropped connections, unaffordable data plans, and the struggle to complete complex tasks on a smartphone (S08, S11), demonstrates that FC acts as a fundamental gatekeeper. No matter how high a student's motivation or intention, if the basic infrastructure is lacking, meaningful engagement with TEL is impossible. This finding underscores that the digital divide is not a peripheral issue but a central variable that directly turns on or off participation in technology-enhanced entrepreneurial education (Barra et al., 2024).

One of the most revealing findings comes from the relatively weak, though still significant, influence of **Social Influence** on Behavioral Intention (β = 0.115), supporting H3. This result, which echoes findings from other studies in developing contexts, could be misinterpreted as indicating that social factors are unimportant.

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However, the qualitative theme "Navigating the 'Shadow' Learning Ecosystem" provides a crucial counter-narrative. The interviews suggest that the formal social influence captured by the survey (i.e., encouragement from lecturers) is far less potent than the informal, peer-driven influence that occurs in "shadow" digital spaces like LINE groups and social media (S18, S12). Students learn from, and are motivated by, seeing their peers launch real micro-ventures on Instagram or share practical advice in a chat group. The quantitative model likely underestimates the true power of social factors because it does not fully capture this vibrant, informal ecosystem. This implies that universities and policymakers need to recognize and potentially leverage these informal networks rather than relying solely on top-down, formal channels of influence.

Finally, the strong support for the extended portion of the model (H6-H9) provides clear evidence of a positive cascade effect. The actual **Use of TEL** significantly boosts both **Entrepreneurial Self-Efficacy** and **Innovation Orientation**. This enhanced self-efficacy, in turn, is a massive driver of **Entrepreneurial Intention**. This chain of relationships is the core mechanism through which TEL can theoretically contribute to creating more and better entrepreneurs. The qualitative data support this by showing that when students use technology for active, creative tasks, they not only learn the subject matter but also build confidence in their own abilities to innovate and execute (Bosman & Phillips, 2022).

5.2. Revisiting the "Entrepreneurial Paradox"

The integrated findings of this study offer a compelling explanation for Thailand's "entrepreneurial paradox"—the coexistence of high entrepreneurial activity and low innovation. The research suggests that the issue is not a lack of entrepreneurial spirit but a "capability gap" that is both created and exacerbated by the digital divide (Barra et al., 2024). The government's current policy focus on providing technological infrastructure and devices, as seen in initiatives like the "Anywhere Anytime" project, addresses a part of the Facilitating Conditions problem. However, this study demonstrates that access to technology is a necessary but insufficient condition for fostering innovation.

The causal chain suggested by the integrated findings is as follows: The digital divide (poor FC) creates a primary barrier, preventing a large segment of the student population, particularly in rural areas, from consistent and meaningful access to TEL. For those who do have access, the technology is often deployed in a manner that encourages passive consumption rather than active creation (as per Theme 2), leading to a low Performance Expectancy for developing *innovative* capabilities. This pedagogical gap means that even when TEL is used, it may not effectively build the higher-order skills associated with Innovation Orientation or the deep sense of Entrepreneurial Self-Efficacy required for ambitious, growth-oriented ventures (Wang & Hasanzadeh, 2024). As a result, while entrepreneurial intentions may still be high (driven by culture and economic necessity), they are more likely to manifest as traditional, low-innovation businesses, thus perpetuating the paradox. The innovation gap persists because the very tool that could bridge it—TEL—is hampered by inequitable access and suboptimal implementation.

5.3. Theoretical Contributions

This study makes several important contributions to the theoretical literature. First, it validates the core tenets of the UTAUT model in the context of higher education in a developing Southeast Asian nation, confirming the robustness of Performance Expectancy, Effort Expectancy, and Facilitating Conditions as key predictors of technology adoption (Hakimi et al., 2024). Second, and more significantly, it demonstrates the value of extending the UTAUT model to include domain-specific outcome variables (ESE, EI, and IO). This extension creates a more powerful, explanatory model that links technology acceptance not just to use, but to the development of the specific capabilities that are the ultimate goal of the educational intervention. Third, the mixed-methods approach contributes to a more nuanced understanding of the UTAUT constructs themselves. It reveals the limitations of standard measures of Social Influence in collectivist cultures, where informal digital networks may be more potent than formal institutional ones. It also highlights the critical need to operationalize Facilitating Conditions in a way that captures the specific infrastructural and economic challenges prevalent in developing countries. By integrating qualitative depth with quantitative breadth, this study answers the call for more context-sensitive applications of technology acceptance theories (Xue et al.,

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IMPLICATIONS, LIMITATIONS, AND FUTURE TRAJECTORIES

6.1. Implications for Socio-Economic Planning and Public Policy

The findings of this research offer several concrete and actionable implications for public sector decision-making, directly aligning with the journal's focus on socio-economic planning.

- **For the Ministry of Digital Economy and Society (MDES) and the Ministry of Education:** The strong influence of Facilitating Conditions suggests that policy must move beyond simply measuring national internet penetration rates to focusing on **digital equity**. This requires a more granular approach.
    - **Recommendation 1:** Develop and fund targeted programs aimed at improving last-mile connectivity and providing subsidized data plans and device-lending schemes for students in provincial and rural universities. This directly addresses the "access" part of the problem revealed in both the quantitative and qualitative data.
    - **Recommendation 2:** Collaborate to launch large-scale digital literacy initiatives, not just for students but for the wider community, including disadvantaged groups like older adults and those with lower levels of education. A digitally literate family and community environment can provide crucial informal support for students engaging in TEL.
- **For the Office of Small and Medium Enterprises Promotion (OSMEP) and other national planning agencies:** The results indicate that fostering an innovative entrepreneurial culture requires more than just funding and business registration support.
    - **Recommendation 3:** Integrate TEL platforms into existing SME support programs to scale up mentorship, training, and networking opportunities, making them accessible to entrepreneurs outside the Bangkok economic corridor. This can help bridge the gap between policy and implementation, which some studies suggest is a problem in Thailand (Sangnak, 2025).
    - **Recommendation 4:** Shift a portion of funding from general start-up grants towards initiatives that specifically promote pedagogical innovation in entrepreneurial education. This could include grants for universities to develop immersive simulation-based learning modules, to license specialized software for business prototyping, or to train faculty in technology-enhanced, project-based teaching methods. This addresses the "capability gap" by focusing on the quality of education, not just the quantity of entrepreneurs.

6.2. Implications for Higher Education Institutions

Universities are at the frontline of implementing TEL and have a critical role to play in translating policy into practice.

- **Recommendation 5:** University administrators should invest not only in campus-wide Wi-Fi and innovative classroom hardware but also in robust, ongoing professional development for faculty (Rumreich et al., 2024). This training should focus on moving beyond using the LMS as a simple repository and towards leveraging technology for active, collaborative, and project-based learning that builds ESE and IO, addressing the pedagogical chasm identified in Theme 2.
- **Recommendation 6:** Curricula for entrepreneurship programs should be redesigned to formally integrate and leverage the informal "shadow" learning ecosystems. This could involve incorporating social media-based market validation as a required project component, creating university-sanctioned online communities for student entrepreneurs, or inviting successful student social commerce entrepreneurs to act as peer mentors (Crespo, 2018).

6.3. Limitations of the Study

This study, while comprehensive, has several limitations that should be acknowledged. First, the quantitative data are cross-sectional, which means that while they can establish strong correlations and predictive relationships, they cannot definitively prove causality. The direction of influence (e.g., from Use Behavior to ESE) is based on theory, but a longitudinal design would be needed to confirm these causal links over time. Second, the data relies on self-reported measures, which may be subject to social desirability bias and standard

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method variance. Although procedural remedies were employed, this remains a potential limitation. Third, while the study's context in Thailand provides deep, specific insights, this specificity may limit the direct generalizability of the findings to other countries with different cultural norms, economic structures, or educational systems. However, the theoretical model and the methodological approach can serve as a valuable template for similar research in other developing nations.

6.4. Future Research Directions

The findings and limitations of this study open up several promising avenues for future research.

- A **longitudinal study** that tracks a cohort of students from their initial exposure to TEL-based EE through to their post-graduation careers would be invaluable for understanding the long-term impact on actual venture creation, survival, and innovation.
- A **comparative cross-national study** across several ASEAN countries (e.g., Thailand, Vietnam, Indonesia) could explore how national policies, cultural dimensions (e.g., individualism vs. collectivism), and levels of economic development moderate the relationships within the proposed model.
- An **experimental or quasi-experimental study** could be designed to compare the effectiveness of different TEL pedagogical interventions. For example, one group of students could be taught using a simulation-based approach, another using a project-based social media approach, and a control group using traditional methods, with ESE and IO as the key outcome measures.
- Further **qualitative research** could delve deeper into the "shadow" learning ecosystem, using ethnographic methods to understand the dynamics of peer-to-peer learning and commerce on platforms like LINE and Facebook, and how these informal activities could be better integrated with formal education.

By pursuing these research trajectories, the academic and policy communities can build a more robust and nuanced understanding of how to effectively harness the power of technology to cultivate the next generation of innovative entrepreneurs in developing economies worldwide.

Ethical Statement: This study adhered to the moral standards outlined in the Declaration of Helsinki, and approval was obtained from the Human Research Ethics Committee. All participants provided informed consent before their involvement in the study.

Declaration of generative AI in scientific writing: The authors confirm that no Artificial Intelligence (AI) tools or Large Language Models (LLMs) were used at any stage of the creation, analysis, or preparation of this manuscript.

Declaration of Competing Interest: The authors declare no conflicts of interest regarding the research presented in this manuscript.

REFERENCES

1. Aboobaker, N., Renjini, D., & Zakkariya, K. A. (2023). Fostering entrepreneurial mindsets: The impact of learning motivation, personal innovativeness, technological self-efficacy, and human capital on entrepreneurial intention. Journal of International Education in Business, ahead-of-print(ahead-of-print). https://doi.org/10.1108/jieb-10-2022-0071
2. Abushakra, A., & Nikbin, D. (2019). Extending the UTAUT2 model to understand the entrepreneur acceptance and adopting Internet of Things (IoT). In M. Themistocleous & M. Papadaki (Eds.), Lecture Notes in Business Information Processing: Vol. 355. Information Systems (pp. 339–349). Springer. https://doi.org/10.1007/978-3-030-21451-7_29
3. Aljanazrah, A., Al-Tahitah, A., Al-Adwan, A., Al-Qudah, S., Al-Shehadeh, W., Al-Hbani, A., & Al-shamaileh, H. (2022). Digital transformation in times of crisis: Challenges, attitudes, opportunities and lessons learned from students' and faculty members' perspectives. Frontiers in Education, 7, Article 1047035. https://doi.org/10.3389/feduc.2022.1047035

4. Asghar, M., Gul, S., Kayani, M. M., & Asghar, A. (2019). Validating entrepreneurial intentions questionnaire to assess the impact of entrepreneurship education. TED Eğitim ve Bilim, 44(197), 1–22. https://doi.org/10.15390/eb.2019.6105
5. Astriyani, E., Oganda, F. P., Tarigan, R. E., Khanza, A., Yulian, F. D., & Sadan, S. (2024). Enhancing startup matchmaking through machine learning technological innovations and applications. 2024 3rd International Conference on Creative Communication and Innovative Technology (ICCIT), 1–6. https://doi.org/10.1109/ICCIT62134.2024.10701145
6. Barra, C., Grimaldi, M., Muazzam, A., Troisi, O., & Visvizi, A. (2024). Digital divide, gender gap, and entrepreneurial orientation. Socio-Economic Planning Sciences, 95, Article 101904. https://doi.org/10.1016/j.seps.2024.101904
7. Bervell, B., & Umar, I. (2017). Validation of the UTAUT model: Re-considering non-linear relationships of exogenous variables in higher education technology acceptance research. Eurasia Journal of Mathematics, Science and Technology Education, 13(8), 4363–4385. https://doi.org/10.12973/EJMSTE/78076
8. Bosman, L., & Phillips, M. (2022). Integrating the entrepreneurial mindset into the engineering classroom. IEEE Transactions on Education, 65(3), 392–400. https://doi.org/10.1109/te.2021.3101360
9. Braun, C. T. (2021). Digital innovation and entrepreneurship in higher education: Insights from a comparative study. Technology Innovation Management Review, 11(5/6), 18–28. https://doi.org/10.22215/timreview/1444
10. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
11. Chow, T., & To, K. (2025). Mindsets matter: A mediation analysis of the role of a technological growth mindset in generative artificial intelligence usage in higher education. Education Sciences, 15(3), Article 310. https://doi.org/10.3390/educsci15030310
12. Crespo, N. (2018). Entrepreneurial universities: Collaboration, education and policies. Journal of Small Business & Entrepreneurship, 30(4), 263–265. https://doi.org/10.1080/08276331.2018.1485543
13. Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (3rd ed.). SAGE Publications.
14. Damnet, A., Sangnak, D., & Poo-Udom, A. (2024). Thailand's innovative agritourism in the post COVID-19 new normal: A new paradigm to achieve sustainable development goals. Research in Globalization, 8, Article 100171. https://doi.org/10.1016/j.resglo.2023.100171
15. Ebrahimi, P., Arabsalmani, M., Azarian, A., Faghih, N., & Zarea, H. (2023). Transformational entrepreneurship and digital platforms: A combination of ISM-MICMAC and unsupervised machine learning algorithms. Big Data and Cognitive Computing, 7(2), Article 118. https://doi.org/10.3390/bdcc7020118
16. Hair, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2017). Advanced issues in partial least squares structural equation modeling. SAGE Publications.
17. Hakimi, T. I., Tahar, Z., Ali, N. H., & Adnan, M. (2024). Unified theory of acceptance and use of technology (UTAUT) applied in higher education research: A systematic literature review and bibliometric analysis. Multidisciplinary Reviews, 7(1), 1–16. https://doi.org/10.31893/multirev.2024303
18. Handoko, B. (2020). UTAUT 2 model for entrepreneurship students on adopting technology. 2020 International Conference on Information Management and Technology (ICIMTech), 322–327. https://doi.org/10.1109/ICIMTech50083.2020.9211185
19. Hegyi, T. (2021). INNOSOCIAL aspects in the entrepreneurial education of computer science students. INTED2021 Proceedings, 3089–3095. https://doi.org/10.21125/INTED.2021.0647
20. Hofer, A., & Baur, M. (2018). Graduate entrepreneurship support: What higher education institutions do, and how government can support them. In R. van der Horst, S. O. Nielsen, & P. V. Schaeffer (Eds.), Entrepreneurship and Local Economic Development (pp. 165–181). Routledge. https://doi.org/10.4324/9781351256049-11

21. Jeon, H.-M., Sung, H., & Kim, H. Y. (2020). Customers' acceptance intention of self-service technology of restaurant industry. Service Business, 14(4), 549–567. https://doi.org/10.1007/s11628-020-00425-6
22. Mahmud, A., Roy, P., & Deb, G. K. (2023). Barriers and enablers of educational innovation in developing countries: A case study from Bangladesh. Education Sciences, 13(3), Article 225. https://doi.org/10.3390/educsci13030225
23. Moghavvemi, S., Salleh, N. M., Zhao, W., & Mattila, M. (2012). The entrepreneur's perception on information technology innovation adoption. Innovation, 14(2), 231–247. https://doi.org/10.5172/impp.2012.14.2.231
24. Păvăloaia, N. G., Petric, D. N., Andries, A. M., & Păvăloaia, V.-D. (2022). Impact of digitalization on the entrepreneurship mindset. Sustainability, 14(24), Article 16856. https://doi.org/10.3390/su142416856
25. Rahmi, D., & Darmansyah, A. (2025). Bridging entrepreneurship education and digital transformation: A novel experiential learning model for entrepreneurial mindset development. International Journal of Learning, Teaching and Educational Research, 24(4), 488–507. https://doi.org/10.26803/ijlter.24.4.29
26. Rumreich, I. T. A., Litzler, E., Margherio, C., & Williams, J. (2022). Preparing instructors to encourage an entrepreneurial mindset. 2022 ASEE Annual Conference & Exposition, Minneapolis, MN, USA. https://doi.org/10.18260/1-2--41432
27. Sangnak, D. (2024). Sustainable tourism development in Thailand: The role of agricultural tourism and government support for SMEs. Sustainable Futures, 7, Article 100282. https://doi.org/10.1016/j.sftr.2024.100282
28. Sarstedt, M., & Richter, N. F. (2024). Combined importance–performance map analysis (cIPMA) in partial least squares structural equation modeling (PLS–SEM): A SmartPLS 4 tutorial. Journal of Marketing Analytics. Advance online publication. https://doi.org/10.1057/s41270-024-00325-y
29. Stanchev, P. (2018). Building the innovative and entrepreneurial university. Proceedings of the 19th International Conference on Computer Systems and Technologies, 2–8. https://doi.org/10.1145/3274005.3274007
30. Tamnanwan, P., & Sangnak, D. (2025). The algorithmic looking-glass: A predictive model of how digital acculturation and perceived algorithmic bias impact the well-being of Thailand's Tai Dam minority. Asian Journal of Arts and Culture, 20(1), 1–10. https://doi.org/10.48048/ajac.2026.10
31. Uvarova, I., Mavlutova, I., & Atstāja, D. (2021). Development of the green entrepreneurial mindset through modern entrepreneurship education. IOP Conference Series: Earth and Environmental Science, 628(1), Article 012034. https://doi.org/10.1088/1755-1315/628/1/012034
32. Varma, A. (2018). Mobile banking service: An extension of UTAUT2. Theoretical Economics Letters, 8(14), 2883–2901. https://doi.org/10.4236/TEL.2018.814183
33. Wang, Y., & Hasanzadeh, S. M. (2024). A pedagogical framework for enhancing the entrepreneurial leadership mindsets of construction students: A pilot study. International Journal of Construction Education and Research. Advance online publication. https://doi.org/10.1080/15578771.2024.2404023
34. Xue, L., Rashid, A. M., & Sha, O. (2024). The Unified Theory of Acceptance and Use of Technology (UTAUT) in higher education: A systematic review. SAGE Open, 14(1). https://doi.org/10.1177/21582440241229570
35. Zhou, Y., & Johar, M. (2024). Review of the unified theory of acceptance and use of technology (UTAUT) in education: A bibliometric visual analysis based on CiteSpace. Journal of Infrastructure, Policy and Development, 8(1), 963. https://doi.org/10.24294/jipd.v8i1.963
36. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS quarterly, 425-478. https://doi.org/10.2307/30036540