



Exploring Factors Affecting High-School Student Entrepreneurship Competency

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Entrepreneurial competencies are increasingly recognized as essential skills for students in today's dynamic and competitive world. This study aims to identify and validate the crucial entrepreneurial competencies of Thai high school students using a 2nd-order confirmatory factor analysis (CFA). A questionnaire was developed to assess these competencies, administered to a sample of high school technology teachers selected using multi-stage random sampling. The results indicated that technology teachers perceive the development of entrepreneurial competencies as crucial for their students. Specifically, the analysis revealed that entrepreneurial skills, leadership skills, and innovative adaptability were most important. These findings suggest that enhancing these competencies can significantly contribute to students' overall entrepreneurial potential. The research contributes to the understanding of entrepreneurial competencies among high school students and provides a validated framework for assessing these competencies. The study's novelty lies in its validation of essential entrepreneurial competencies specifically tailored for Thai high school students, offering a framework for assessing and nurturing these competencies in an educational context.

Keywords: entrepreneurial competency, high school students, innovative adaptability, leadership skills, Thailand

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INTRODUCTION

We find ourselves in the early beginnings of the fourth industrial revolution, a term first introduced in Germany in 2011, spurred on by the digital revolution (Marku, 2024). A distinctive feature of this revolution is the exponential increase in internet prevalence and mobility (International Telecommunication Union, 2023; World Economic Forum, 2023). Devices are shrinking in size yet ever-growing in computational and processing power, while also becoming more affordable. The complex nature of digital technology, coupled with its integration across multiple sectors, has precipitated rapid and widespread societal and economic transformations (Frost & Sullivan, 2019). Artificial intelligence and machine learning have bolstered computational capabilities, further fueled by the vast reservoirs of data now at our disposal (McAfee & Brynjolfsson, 2021). As a result, emerging businesses are capitalizing on this digital landscape, birthing a vast number of "information products" (Schwab, 2017).

This seismic shift impacts all facets of a country's development, including education (Frost & Sullivan, 2019). In the midst of this transformative tide, adapting to the evolving global landscape becomes imperative for fostering safe and prosperous societies. Particularly, the youth, navigating through the labyrinth of societal evolution, must equip themselves with pertinent skills to navigate these changes (Lohmann & Smith, 2023). Education serves as a linchpin in fostering such skill development (Andrin et al., 2024). However, Thailand's digital industry lags in progress (Khalid & Naumova, 2021). The dearth of advanced digital skills, coupled with regulatory hurdles, impedes the country's ability to harness its technological potential and attract investment. Consequently, Thailand misses out on leveraging big data from digital transactions to craft products and services attuned to user needs and behaviors (National Economic and Social Development Council [NESDC], 2023).

Acknowledging the pivotal role of entrepreneurship in national development, Thailand's National Strategy 2018-2037 emphasizes the cultivation of a new generation of entrepreneurs equipped with the requisite skills and spirit to thrive in the modern marketplace. This entails fortifying fundamental business knowledge, particularly in digital literacy, finance, and contemporary marketing. Moreover, emphasis is placed on fostering a culture of innovation and sustainability (Sumarno et al., 2023), alongside bolstering community economies and instilling self-awareness and digital competencies in basic education.

Understanding the imperative nature of entrepreneurial competencies in this evolving milieu, this research endeavors to delineate and analyze these competencies. It seeks to furnish learners with the acumen to harness innovation, technology, and interdisciplinary knowledge to forge careers, generate income, and embark on lifelong learning journeys. By delving into relevant literature and conducting second-order confirmatory component analysis, this study aims to equip high school students with the requisite skills for the 21st century, thereby fostering social value and fortifying community economies in the face of rapid technological change.

Statement of the Problem

Identifying and teaching entrepreneurial competencies to high school students has become a critical factor in ensuring the viability of many developing economies (Nweke & Nweke, 2020). For Thailand, very recent data from UNICEF (2023) suggests that this might even be a matter of national survival as 68% of all out-of-school or unemployed Thai youth lack any motivation to develop skills or seek work. These Not in Employed, Education or Training (NEET) is a rising statistic (15%) that has serious consequences for the security of the Kingdom. The problem is not just isolated to Thailand as studies from around the world report on youth unemployment and the lack of youth education and training in entrepreneurial endeavors (Nweke & Nweke, 2020). In 2023, the ILO (International Labour Organization) reported that in poorer nations, 20.5% of the workforce was seeking employment (ILO, 2023). This statistic is also consistent with the Statista Research Department (2024) which projects 2024's global youth NEET at 21.78%. NEETs represent a category at risk for social exclusion and may show poor non-cognitive skills (Ripamonti, 2023). However, the youth globally are recognized as an essential and critical part of every society's population dynamism and strength are critical for economic and industrial development.

Despite the increasing recognition of the importance of entrepreneurship education, there remains a gap in understanding which specific competencies are most essential for high school students, particularly in the context of rapidly evolving digital economies like Thailand. Furthermore, while there is a wealth of literature discussing the significance of entrepreneurship education, there is limited empirical research validating the effectiveness of existing educational approaches in nurturing these competencies. Therefore, this study aims to identify, validate, and prioritize the essential entrepreneurial competencies for high school students in Thailand and evaluate the adequacy of current educational approaches in addressing these competencies.

Research Hypothesis

This study hypothesizes that specific entrepreneurial competencies such as entrepreneurial skills, leadership skills, and innovative adaptability are critical for high school students and that current educational approaches may need to be restructured to better develop these competencies in the context of Thailand's digital economy.

Research Questions

1. How do high school technology teachers perceive the essential entrepreneurial competencies of Thai students, and what are their opinions regarding the effectiveness of current educational approaches in fostering these competencies?
2. What are the specific entrepreneurial competencies deemed most critical for Thai high school students, and how do these competencies align with the demands of the modern marketplace and evolving socio-economic landscape?
3. How can a validated framework of essential entrepreneurial competencies, derived through 2nd-order confirmatory factor analysis, inform educational policy and curriculum development to better prepare high school students for success in the digital economy and entrepreneurial ventures?

Entrepreneurial Competency (Entrecomp)

Entrepreneurship has been reported as a key competency necessary for a knowledge-based economy and society (Bacigalupo et al., 2016a). The Entrepreneurship Competence Framework (EntreComp) presents entrepreneurial competency as a multidimensional proficiency applicable across various life domains, including personal growth, societal engagement, employment, and entrepreneurial pursuits (Bacigalupo et al., 2016b). This model, comprising three core competency areas and 15 distinct competencies, serves as a robust reference for curriculum design in formal education and training settings, as well as for initiatives in nonformal learning contexts (Seikkula-Leino et al., 2021). It emphasizes the alignment between educational endeavors and the demands of entrepreneurship, bridging the realms of education and work (Bian & Lee, 2020). The framework depicts entrepreneurship as a holistic competence, encompassing idea generation, resource utilization, and action-taking, underscoring the interrelatedness and interconnectedness of the 15 competencies constituting entrepreneurship proficiency (Figure 1).

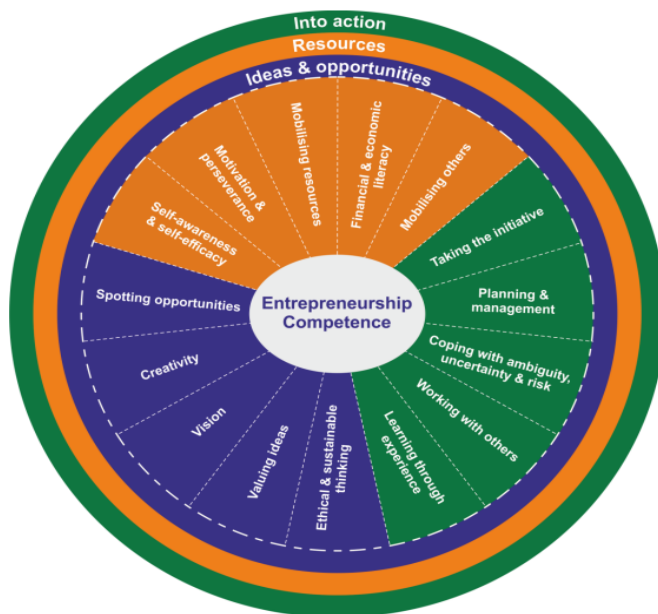


Figure 1
The EntreComp framework
Sources: (Bacigalupo et al., 2016a, 2016b)

Entrepreneurial Skills (EntreSkills)

Developing entrepreneurial skills is critical for both individual self-discovery and broader societal participation. Gold and Rodriguez (2018) emphasize the importance of nurturing an entrepreneurial mindset among youth, highlighting traits such as initiative-

taking, critical thinking, and effective communication as indispensable for navigating future career landscapes. They identify key components of the entrepreneurial mindset, including future orientation, comfort with risk, opportunity recognition, flexibility and adaptability, initiative and self-reliance, creativity and innovation, critical thinking and problem-solving, and communication and collaboration.

Building on this, Draksler and Širec (2018) highlight a research gap pertaining to the impact of entrepreneurship education on entrepreneurial competencies and intentions. They propose a novel research model aimed at comprehensively studying these dynamics. Ferreras-Garcia et al. (2021) present a structural model examining the nexus between generic, specific, and entrepreneurial competencies, shedding light on students' competency acquisition. Similarly, Wathanakom et al. (2021) delve into youth entrepreneurial competencies, unveiling developmental needs and offering insights into effective entrepreneurial education design. Conversely, Demirbilek and Çetin (2021) offer a qualitative exploration of entrepreneurship competencies among school principals, delineating competencies across individual, organizational, relational, and commitment domains.

In more recent studies, Ilyas et al. (2023) address the challenges faced by social entrepreneurs in balancing social and commercial purposes. They propose a curriculum matrix based on the Identity Capital Model to aid students in achieving social entrepreneurship objectives while incorporating principles of innovation and sustainability. Their research, based on data from semi-structured interviews with successful youth social entrepreneurs, emphasizes the need for education that equips students with the necessary knowledge and skills to manage social ventures effectively.

Virasa et al. (2022) investigate entrepreneurial intentions (EI) in six ASEAN countries (Vietnam, the Philippines, Indonesia, Thailand, Malaysia, and Singapore) using the theory of planned behavior (TPB). Their study identifies key predictors of EI across different stages of economic development, with attitudes toward behavior, subjective norms, and perceived behavioral control playing significant roles. Their findings suggest tailored policy management strategies for new business creation in each respective nation, based on the specific economic context.

These recent studies underscore the evolving landscape of entrepreneurial education and highlight the importance of equipping students with a diverse set of competencies to thrive in the modern marketplace. By integrating insights from these contemporary sources, this research aims to provide a comprehensive understanding of entrepreneurial skills necessary for high school students in the 21st century.

Leadership Skills (LeadSkills)

The EntreComp framework emphasizes the multidimensional nature of entrepreneurial competency, which extends to domains beyond traditional entrepreneurship (Bacigalupo et al., 2016a, 2016b). It has also been stated that entrepreneurial leadership is additionally a distinct field of study within the domain of leadership (Harrison et al., 2023). In one study out of Nigeria, entrepreneurial leadership was reported to include four distinct skills conceptual, technical/business, interpersonal, and entrepreneurial (Harrison et al., 2018).

Thus, entrepreneurial leadership skills are an integral component of the EntreComp Framework, reflecting the ability to mobilize resources, inspire others, and navigate complex challenges. Gold and Rodriguez (2018) also underscore the importance of nurturing an entrepreneurial mindset among youth, which includes traits like initiative-taking and effective communication—attributes closely linked to leadership. Their Entrepreneurial Mindset Index (EMI) points out that the traditional entrepreneur is motivated by profit and offers six knowledge domains in their EMI (Figure 2) (Gold & Rodriguez, 2018).

Additionally, Ferreras-Garcia et al. (2021) and Wathanakom et al. (2021) delve into competency acquisition among students, shedding light on the development of leadership skills alongside entrepreneurial competencies. Therefore, understanding and fostering leadership skills among high school students align with the holistic perspective of entrepreneurship presented in the EntreComp framework.

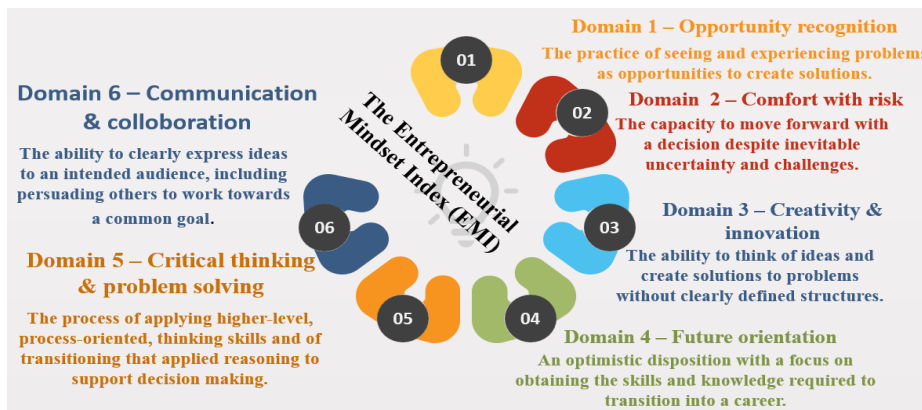


Figure 2

The entrepreneurial mindset index

Source: (Gold & Rodriguez, 2018).

Creation: The authors.

Innovative Adaptability (InnAdapt)

Innovative adaptability is a key facet of entrepreneurial competency (Bacigalupo et al., 2016a, 2016b). InnAdapt is also a quality that can be shaped by education, not only at the individual level but even at societal levels (Przyborowska & Błajet, 2014).

The EntreComp framework underscores the importance of adaptability in navigating dynamic environments and seizing opportunities—a notion echoed by Demirbilek and Çetin (2021) in their exploration of entrepreneurship competencies among school principals. Moreover, Drakslar and Širec (2018) identify a research gap regarding the impact of entrepreneurship education on entrepreneurial competencies and intentions, suggesting the need to understand how educational interventions can foster InnAdapt. By examining the nexus between generic, specific, and entrepreneurial competencies, students can acquire skills, including InnAdapt. Therefore, investigating and nurturing

innovative adaptability among high school students is essential for preparing them to thrive in an ever-changing entrepreneurial landscape, as emphasized by both theoretical frameworks and empirical research (Ferreras-Garcia et al., 2021).

In summary, these studies collectively contribute to our understanding of entrepreneurial competency, spanning education, youth empowerment, organizational leadership, and the broader societal landscape (Table 1). They underscore the importance of holistic skill development, the integration of entrepreneurial mindset in educational curricula, and the imperative for ongoing research to inform effective pedagogical practices and leadership structures.

Table 1

Selected results of the literature review synthesis of entrepreneurial competency components for use in the questionnaire’s creation.

Entrepreneurial Competencies	Bacigalupo et al. (2016)	Gold & Rodriguez (2018)	Goswami et al. (2017)	Zarefard & Beri (2017)	Gerber (2009)	Gillespie-Brown (2008)	Teerathanachaiyakun (2019)
1. Self-confidence	✓	✓					✓
2. Effort and determination	✓	✓				✓	
3. Enthusiasm and diligence		✓	✓	✓	✓	✓	
9. Versatility: product, market, technology	✓	✓					✓
46. Competitiveness					✓		
44. Financial and economic knowledge	✓						✓
5. Risk taker	✓	✓	✓				
41. Honest and moral		✓				✓	✓
22. Responsibility		✓					
21. Ability to make quick decisions		✓					
23. Foresight, vision	✓	✓	✓	✓		✓	
31. Courage: Dare to face risks.		✓	✓				
26. Profit focus, value creation	✓	✓					
10. Creativity and innovation	✓	✓	✓	✓	✓		
13. Initiative	✓	✓	✓				
49. Imagination + thinking outside the box		✓					

Note. Blue represents innovative adaptability, red indicates leadership, and green is entrepreneurial.

METHOD

Population and Sample

The population under study comprised 2,360 technology-related teachers at the upper secondary level schools operating under the supervision of Thailand’s Office of the Basic Education Commission’s (OBEC) Secondary Education Area Offices (SEAOs)

during the academic year 2023 (Individual Student Data Collection System, 2023). To ensure the sample's representativeness and homogeneity, a stratified random sampling technique was employed, followed by simple random sampling within each stratum. The strata were defined based on the regions and SEAOs, ensuring that each subgroup was proportionately represented in the sample. Sample size selection criteria were drawn from multiple sources, including Sarstedt et al. (2021), who recommend sample sizes for confirmatory factor analyses (CFAs) and structural equation modeling (SEMs) to be between 200 and 400 participants, depending on the model's complexity and the number of variables.

Data Collection

Data were collected through a well-structured and validated questionnaire, ensuring high reliability and validity. The table below details the stratified random sampling and simple random sampling process from each region and SEAO.

Table 2
Sampling breakdown by regions, SEAOs, and teachers

Survey Region	Population		Sample Groups			
			Number Targeted		Actual Sample	
	SEAOs	Teachers	SEAOs	Teachers	Teachers	%
Northern	15	456	8	77	71	92
Central and Eastern	21	637	11	108	103	95
Northeast	17	933	9	158	150	95
Southern	9	334	5	57	55	97
Totals	62	2,360	33	400	379	95

Ensuring Homogeneity and Agreement Levels

To ensure the homogeneity of the sample, stratified random sampling was used to proportionately represent all regions and SEAOs. This method reduces the risk of sampling bias and ensures that the sample accurately reflects the population's diversity (Sarstedt et al., 2021). Within each stratum, simple random sampling was performed to maintain randomness and objectivity. The level of agreement among the sampled teachers was assessed using statistical measures such as Cronbach's alpha and inter-rater reliability coefficients (Pimdee, 2021). These measures confirmed a high level of consistency and agreement in the responses, ensuring the data's reliability and validity.

The Questionnaire's Design

The entrepreneurial competency questionnaire comprised two sections. Section 1 encompassed a set of five items designed to gauge personal characteristics. Conversely, Section 2 featured nine items written to encapsulate the study's focal constructs: entrepreneurial skills, leadership skills, and innovative adaptability, all contributing to entrepreneurial competency (Sumarno et al., 2023). To quantify responses in Section 2, a Likert-type agreement opinion scale was employed. This scale ranged from '1' to '5', with '5' (4.50 – 5.00) representing the highest level of agreement and '1' (1.00 – 1.49) indicating the least.

Research Instrument Validity and Reliability

Ensuring the questionnaire's validity was undertaken by seven experts, each holding a Ph.D. with expertise in areas such as innovation research, measurement, evaluation, and learning management. Using the index of item-objective congruency (IOC) as the measurement tool, items scoring $\leq .50$ underwent revision or removal. IOC values ranged from 0.57 to 1.00, affirming strong construct validity, with a discriminatory power value between 0.61 and 0.78.

Pilot Study

To assess the reliability and usability of the questionnaire, a pilot test involving 62 participants was conducted. These questionnaires were administered to technology teachers at the high school level during the academic year 2023, representing each area under the OBEC's SEAOs. This comprehensive approach aimed to ensure broad coverage and accuracy.

The pilot study's findings provided valuable insights into each questionnaire item's clarity and relevance. The discriminatory power of the items ranged between 0.84 and 0.87, while the overall reliability value stood at a strong 0.91. Internal consistency was evaluated using Cronbach's α , yielding values ranging from 0.68 to 0.87 for the three constructs and nine indicators, indicating commendable reliability.

Main Study

The results of the pilot study informed the final version of the questionnaire used in the main study. The final survey involved 379 technology-related teachers from upper-secondary-level schools under the OBEC's SEAOs. The authors' process of content validity assessment, pilot testing, and reliability analysis underpinned the strength of the research instrument, ensuring its suitability for the main study.

FINDINGS

Technology Teacher Personal Characteristics (n = 379)

From the technology teachers' responses to the items in Section 1, it was determined that a significant majority were women (62.80%), with 45.91% being 30-39 years old. Interestingly, the teaching experience was very similar in three time increments: 6-10 years (29.29%), more than 15 years (29.02%), and 11-15 years (26.65%). Given the senior level of most educators, it was not surprising to find that many had pursued post-graduate degrees (55.67%). When asked which grade each teacher was responsible for, 27.18% indicated Grade 11 while another 25.33% indicated Grade 10.

Descriptive Statistics Analysis

Table 3 presents the results of the research latent and observed variables descriptive statistics analysis in descending order of importance. The opinions of technology teachers regarding high school students' entrepreneurial competencies are summarized, showcasing an overall consensus at the highest level. When examining each component and indicator individually, it is evident that all aspects are rated at the highest level of agreement.

Table 3
Results of the mean and SD of the research variables

Element/Indicator	Mean	SD	Opinion level
Belief in one's self to do business (Ent1).	4.90	0.40	MA
Entrepreneurial Skills (EntreSkills)	4.56	0.37	MA
Having the ability to make decisions (Lead2).	4.48	0.55	SA
Having an entrepreneurial vision (Ent4).	4.48	0.56	SA
Leadership Skills (LeadSkills)	4.46	0.40	SA
Having responsibility towards consumers (Lead1).	4.46	0.56	SA
Having the ability to analyze markets and trends (Ent3).	4.44	0.56	SA
Having an entrepreneurial personality (Lead3).	4.44	0.57	SA
Creativity (Adap2).	4.43	0.55	SA
Innovative Adaptability (InnAdapt)	4.43	0.42	SA
Knowing how to create a competitive business advantage (Ent2).	4.42	0.58	SA
Has the ability to adapt (Adap1).	4.42	0.52	SA
Averages	4.50	0.31	MA

Note. MA - most agreement, SA-significant agreement

Significance of the Data

The correlation coefficients (r) measure how strongly two variables are related to each other (Table 4), with higher r indicating a stronger positive relationship between the variables. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value of 0.81 verifies the adequacy for conducting factor analysis on the sample. Bartlett's Test of Sphericity, with an approximate Chi-Square value of 603.946, a df = 36, and a statistical significance <0.001, confirms that the variables in the dataset are related.

Interpretation of Correlation Coefficients

The correlation analysis provides valuable insights into the relationships among different aspects of high school students' entrepreneurial competencies (Table 4). These findings support the initial agreement and justify further analysis, such as factor analysis, to explore the underlying structures of entrepreneurial competencies.

Table 4
Correlation coefficients of the observed variables

Variables	Ent1	Ent2	Ent3	Ent6	Lead1	Lead2	Lead4	Adap3	Adap5
Ent1	1								
Ent2	.48**	1							
Ent3	.40**	.30**	1						
Ent6	.43**	.24**	.20**	1					
Lead1	.40**	.18**	.25**	.24**	1				
Lead2	.32**	.15**	.12*	.20**	.30**	1			
Lead4	.46**	.32**	.17**	.16**	.31**	.23**	1		
Adap3	.24**	.13**	.18**	.14**	.14**	.14**	.24**	1	
Adap5	.36**	.24**	.28**	.15**	.25**	.23**	.18**	.25**	1

Note. ** Sig.<.01

Reliability and Significance of Observed Variables

Table 5 provides important insights into the reliability and significance of the observed variables within each component of the study: Entrepreneurial Skills (EntreSkills), Leadership Skills (LeadSkills), and Innovative Adaptability (InnAdapt). The table presents alpha (α) values, element weights (β), standard errors (SE), t-values (t), and R² values, offering a comprehensive understanding of the strength and reliability of the components and their constituent indicators.

Table 5

Confidence values, element weights, reliability of observable variables, and component score coefficients

Element/Indicator	(α)	β (SE)	(t)	(R ²)
Entrepreneurial Skills (EntreSkills)	0.84	0.82(0.07)	11.34**	0.67
Belief in one’s self to do business (Ent1).		0.93	-	0.86
Knowing how to create a competitive business advantage (Ent2).		0.51(0.06)	8.10**	0.26
Having the ability to analyze markets and trends (Ent3).		0.61(0.07)	8.32**	0.37
Having an entrepreneurial vision (Ent4).		0.47(0.06)	7.47**	0.22
Leadership Skills (LeadSkills)	0.68	0.82(0.10)	8.49**	0.67
Having responsibility towards consumers (Lead1).		0.63	-	0.39
Having the ability to make decisions (Lead2).		0.51(0.08)	6.44**	0.26
Having an entrepreneurial personality (Lead3).		0.48(0.08)	6.19**	0.23
Innovative Adaptability (InnAdapt)	0.87	0.79(0.15)	5.20**	0.62
Has the ability to adapt (Adap1).		0.40	-	0.16
Creativity (Adap2).		0.63(0.13)	4.93**	0.39

Note. **Sig. < .01

2nd – Order CFA Results

The 2nd-order CFA results are shown in Figure 3.

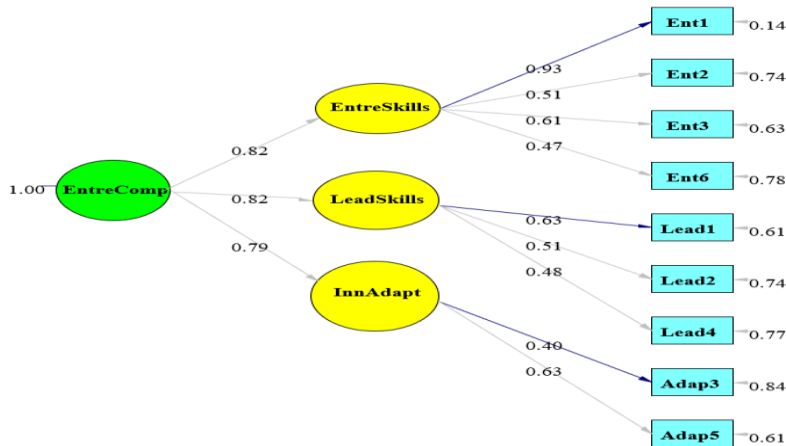


Figure 3

2nd-order CFA testing results for entrepreneurial competency

Note. Chi-Square=8.89, df=18, p-value=0.96, RMSEA=0.000

DISCUSSION

Entrepreneurial Skills (EntreSkills)

The calculated alpha value (α) of 0.84 underscores a notable level of internal consistency and reliability among the observed variables comprising the EntreSkills component. This implies a strong coherence among the various aspects of entrepreneurial skills assessed in the study. The substantial element weight (β) of 0.82 signifies a robust positive relationship between the observed variables and the construct of EntreSkills. This suggests that the variables within this component contribute significantly to the overall understanding of EntreSkills. The statistically significant t-value (11.34**) further reinforces the importance of EntreSkills in the context of the study. This indicates that the observed variables within this component have a meaningful impact on the overall model. Additionally, the R^2 value of 0.67 reveals that approximately 67% of the variance in EntreSkills is accounted for by its observed variables.

These findings align with prior research indicating the pivotal role of attitudes toward risk in predicting an entrepreneur's success or failure (Bacigalupo et al., 2016a, 2016b; Goswami et al., 2017; Zarefard & Beri, 2017). Moreover, in the rapidly evolving landscape of the modern world, nurturing entrepreneurial creativity and innovation is increasingly recognized as a fundamental objective of education (Przyborowska & Błajet, 2014). This underscores the relevance and significance of entrepreneurial skills in adapting to future challenges and opportunities.

Leadership Skills (LeadSkills)

Similarly, the LeadSkills component demonstrates high internal consistency with an alpha value of 0.68. The element weight (β) of 0.82 indicates a strong association between the observed variables and LeadSkills. The significant t-value (8.49**) suggests that the component is statistically significant, with an R^2 value of 0.67 indicating a substantial proportion of variance explained by its observed variables.

These findings resonate with existing literature emphasizing the critical role of leadership skills in entrepreneurial success. Effective leadership, characterized by decision-making abilities, responsibility towards stakeholders, and a clear entrepreneurial vision, is essential for navigating the complexities of modern business environments (Neck & Corbett, 2018). This aligns with the high agreement levels reported by technology teachers in our study.

Innovative Adaptability (InnAdapt)

The Innovative Adaptability component also exhibits high internal consistency with an alpha value of 0.87. The element weight (β) of 0.79 suggests a robust relationship between the observed variables and innovative adaptability. Despite a slightly lower t-value (5.20**), the component remains statistically significant, with an R^2 value of 0.62 indicating a considerable amount of variance explained by its observed variables.

Innovative adaptability is crucial in the current digital age, where rapid technological advancements and market dynamics require constant innovation and flexibility

(Kuratko, 2016). The strong agreement on the importance of creativity and adaptability among high school students highlights the necessity for educational programs to foster these skills, ensuring students are well-prepared for the future.

Comparative Analysis

Comparing these findings with other studies in the field reveals consistent themes. For instance, Sukardi et al. (2022) identified significant support for competencies such as organizational skills, strategic skills, commitment, and conceptual skills in Indonesia, emphasizing the role of experiential learning in enhancing entrepreneurial education. Similarly, our study's emphasis on entrepreneurial skills, leadership, and innovative adaptability aligns with these findings, reinforcing the universal importance of these competencies.

Moreover, the importance of digital literacy and citizenship skills in entrepreneurial endeavors, as noted by other researchers, parallels our focus on innovative adaptability (Ferreras-Garcia et al., 2021). This highlights the need for a holistic approach to entrepreneurship education, integrating both traditional entrepreneurial competencies and modern digital skills.

CONCLUSION

The findings of this study contribute significantly to our understanding of the factors shaping entrepreneurial readiness among high school students. By employing a comprehensive 2nd-order CFA, the authors identified and validated three essential components of entrepreneurial competency. These were entrepreneurial skills, leadership skills, and innovative adaptability.

Furthermore, key findings revealed that entrepreneurial skills had a high internal consistency and reliability. These skills, encompassing self-belief, competitive advantage creation, market analysis, and entrepreneurial vision, are essential for students to thrive in entrepreneurial endeavors. The significant positive relationship between these variables and the construct of entrepreneurial skills indicates that fostering these attributes can lead to more competent young entrepreneurs.

Leadership skills also demonstrated strong internal consistency and reliability. Key attributes such as decision-making abilities, responsibility towards stakeholders, and entrepreneurial personality were found to be critical. The high agreement levels reported by technology teachers emphasize the necessity of integrating leadership training into entrepreneurship education.

Innovative adaptability showed the need for students to be adaptable and creative in the face of rapid technological advancements. The high reliability and significant association of this component suggest that educational programs should prioritize innovative adaptability to prepare students for future challenges.

Moreover, these results have implications for education and policy, as educators and policymakers can use these validated components to develop targeted interventions and curricula. By focusing on entrepreneurial skills, leadership, and innovative adaptability, educational programs can better prepare students for entrepreneurial success. The study

also reinforces the need for a holistic approach to entrepreneurship education, integrating both traditional entrepreneurial competencies and modern digital skills. This approach can ensure that students are well-equipped to navigate the complexities of the modern business environment. Finally, this study addressed a specific gap in the literature by providing a validated framework for assessing entrepreneurial competencies tailored to high school students, particularly in the Thai educational context. Future research can build on this foundation to further explore and refine strategies for entrepreneurship education.

In conclusion, this study provides a strong framework for understanding and fostering entrepreneurial competencies among high school students. The validation of the key components—entrepreneurial skills, leadership skills, and innovative adaptability—offers a valuable tool for educators and policymakers. By leveraging these insights, we can develop more effective educational programs that empower the next generation of entrepreneurs to meet future challenges and opportunities with confidence and competence.

LIMITATIONS

Despite the robust findings, this study has several limitations. First, the sample was limited to technology-related teachers in Thailand, which may not be representative of all high school teachers or students in different regions or subjects. Future research should consider a more diverse sample to enhance generalizability. Second, the cross-sectional design of the study limits the ability to draw causal inferences. Longitudinal studies are recommended to examine the development of entrepreneurial competencies over time. Lastly, the study relied on self-reported data, which may be subject to social desirability bias. Employing multiple data sources, such as peer or supervisor evaluations, could provide a more comprehensive assessment of entrepreneurial competencies.

SUGGESTIONS

To build on the findings of this study and address the identified research gap, future research should explore the following areas:

1. **Diverse Populations:** Investigate entrepreneurial competencies across different demographics, including students from various academic disciplines and geographic regions, to enhance the generalizability of the findings.
2. **Longitudinal Studies:** Conduct longitudinal studies to track the development of entrepreneurial competencies over time and assess the long-term impact of educational interventions.
3. **Intervention Effectiveness:** Evaluate the effectiveness of specific educational programs and curricula designed to enhance entrepreneurial competencies in high school students. Experimental designs could provide causal evidence of the impact of these interventions.
4. **Integration of Technology:** Examine the role of digital tools and online platforms in developing entrepreneurial skills among students, especially in the context of increasing digitalization in education.

5. Cross-Cultural Comparisons: Conduct cross-cultural studies to compare entrepreneurial competencies among students from different countries, providing insights into how cultural factors influence entrepreneurship education.

By addressing these limitations and pursuing the suggested research directions, future studies can further contribute to the field of entrepreneurship education, ultimately fostering a generation of students equipped with the skills and mindset necessary for entrepreneurial success.

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REFERENCES

- Andrin, G., Kilag, O. K., Abella, J., Tañiza, F. N., Groenewald, E., & Cordova Jr, N. (2024). Leadership in literacy: The role of instructional leadership in fostering student reading achievement. *Excellencia: International Multi-disciplinary Journal of Education*, 2(1), 100-109. <https://doi.org/10.5281/>
- Anh N. T. (2013). One Village One Product (OVOP) in Japan to One Tambon One Product (OTOP) in Thailand: Lessons for grass root development in developing countries. *Journal of Social and Development Sciences*, 4, 529–537. <http://tinyurl.com/h9bbdew>
- Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016a). EntreComp: The entrepreneurship competence framework. *Luxembourg: Publication Office of the European Union*, 10, 593884. <https://core.ac.uk/download/pdf/38632642.pdf>
- Bacigalupo, M., Kampylis, P., McCallum, E., & Punie, Y. (2016b). Promoting the entrepreneurship competence of young adults in Europe: Towards a self-assessment tool. In *ICERI2016 Proceedings* (pp. 611-621). IATED. <https://doi.org/10.21125/iceri.2016.1150>
- Bian, J. Y., & Lee, J. H. (2020). Entrepreneurship competency-based education research: EntreComp (Entrepreneurship Competence) frame for the advancement of university startup education. *Asia-Pacific Journal of Business Venturing and Entrepreneurship*, 15(6), 189-207. <http://tinyurl.com/cwebupbc>
- Bureekhampun, S., & Maneepun, C. (2021). Eco-Friendly and community sustainable textile fabric dyeing methods from Thai buffalo manure: From pasture to fashion designer. *SAGE Open*, 11(4), 21582440211058201. <https://doi.org/10.1177/21582440211058201>
- Changsorn P. (2015, March 28). 3 categories seen as rising stars for Otop exports. *The Nation*. <http://tinyurl.com/zmwmfw>
- Demirbilek, M., & Çetin, M. (2021). Entrepreneurship competencies of school principals: A scale development study. *International Journal of Contemporary Educational Research*, 8(3), 55-80. <http://dx.doi.org/10.33200/ijcer.847110>

- Draksler, T. Z., & Širec, K. (2018). Conceptual research model for studying students' entrepreneurial competencies. *Naše gospodarstvo/Our economy*, 64(4), 23-33. <https://doi.org/10.2478/ngoe-2018-0020>
- Ferreras-Garcia, R., Sales-Zaguirre, J. and Serradell-López, E. (2021). Developing entrepreneurial competencies in higher education: a structural model approach. *Education + Training*, 63(5), 720-743. <https://doi.org/10.1108/ET-09-2020-0257>
- Fritsch, M. (2013). New business formation and regional development: A survey and assessment of the evidence. *Foundations and Trends in Entrepreneurship*, 9(3), 249–364. <https://doi.org/10.1561/03000 00043>
- Frost & Sullivan. (2019). *Thailand Digital Technology Foresight 2035*. <http://tinyurl.com/bdf4ttwr>
- Gerber, M. (2009). *The E-myte Enterprise*. Harper Collins Publishers.
- Gillespie-Brown, J. (2008). *So you want to be an entrepreneur?: How to decide if starting a business is really for you*. Wiley.
- Gold, T., & Rodriguez, S. (2018). Measuring entrepreneurial mindset in youth: Learnings from NFTE's entrepreneurial mindset index. *Network for Teaching Entrepreneurship*. <https://www.nfte.com/entrepreneurial-mindset/>
- Goswami, K., Hazarika, B., & Handique, K. (2017). Determinants of financial risk attitude among the handloom micro-entrepreneurs in North East India. *Asia Pacific Management Review*, 22(4), 168-175.
- Harrison, C., Omeihe, I., Simba, A., & Omeihe, K. (2023). Leading the way: The entrepreneur or the leader? *Journal of Small Business & Entrepreneurship*, 35(6), 890-906. <https://doi.org/10.1080/08276331.2020.1840853>
- Harrison, C., Burnard, K., & Paul, S. (2018). Entrepreneurial leadership in a developing economy: a skill-based analysis. *Journal of Small Business and Enterprise Development*, 25(3), 521-548. <https://doi.org/10.1108/JSBED-05-2017-0160>
- ILO. (2024, January 10). Global unemployment to increase in 2024, warns ILO report. International Labour Organization. <https://news.un.org/en/story/2024/01/1145377>
- Individual student data collection system. (2023) Data Management Center. (Thailand). <http://tinyurl.com/3vwexuf>
- International Telecommunication Union. (2023). Measuring digital development: Facts and figures 2023. <https://tinyurl.com/yp3p5ph3>
- Khalid, B., & Naumova, E. (2021). Digital transformation SCM in view of COVID-19 from Thailand SMEs perspective. In de la Poza, E., & Barykin, S. E. (Eds.), *Global Challenges of Digital Transformation of Markets* (pp. 49-66). Nova Science Publishers. <http://tinyurl.com/y32kd6j8>
- Kuratko, D. F. (2016). *Entrepreneurship: Theory, Process, Practice*. Cengage Learning.

- Lohmann, R. C., & Smith, A. C. (2023). *15-Minute Focus: Digital Citizenship: Supporting Youth Navigating Technology in a Rapidly Changing World*. National Center for Youth Issues. <http://tinyurl.com/3fzfer4v>
- Marku, M. (2024). Navigating the Future of Work: Human Capital in the Age of Industry 4.0. *Interdisciplinary Journal of Research and Development*, 11(1), 190-190. <https://doi.org/10.56345/ijrdv11n127>
- McAfee, A., & Brynjolfsson, E. (2021). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W. W. Norton & Company.
- National Economic and Social Development Council (2023). *The 13th National Economic and Social Development Plan (2023-2027)*. Office of the Prime Minister Bangkok, Thailand. <http://tinyurl.com/46e6kvsn>
- Neck, H. M., & Corbett, A. C. (2018). The scholarship of teaching and learning entrepreneurship. *Entrepreneurship Education and Pedagogy*, 1(1), 8-41.
- Nweke, A. C., & Nweke, C. L. (2020). Nurturing youths entrepreneurial mindset and national development: A critical analysis. *Global Journal of Arts, Humanities and Social Sciences*, 8(10), 111-121. <http://tinyurl.com/yvdu9pj8>
- OECD. (2001). *Putting the Young in Business: Policy challenges for youth entrepreneurship*. <http://tinyurl.com/222f3r7a>
- Pimdee, P. (2021). An analysis of the causal relationships in sustainable consumption behaviour (SCB) of Thai student science teachers. *International Journal of Instruction*, 14(1), 999-1018. <https://doi.org/10.29333/iji.2021.14159a>
- Przyborowska, B., & Błajet, P. (2014). Innovative competencies in professional and private life. *Edukacja Dorosłych*, 1(70). <http://tinyurl.com/ye5haf2z>
- Ripamonti, E. (2023). Youth NEETs and social exclusion: Non-cognitive skills as a mediating factor. *Journal of Youth Studies*, 26(1), 45-63. <https://doi.org/10.1080/13676261.2023.1878417>
- Sarstedt, M., Ringle, C. M., & Hair, J. F. (2021). Partial least squares structural equation modeling. In *Handbook of market research* (pp. 587-632). Springer.
- Sumarno, Gimin, & Noviana, E. (2023). The comparison analysis of teacher's learning effectiveness in realizing entrepreneurship skills of students. *International Journal of Instruction*, 16(2), 679-702. <https://doi.org/10.29333/iji.2023.16236a>
- Schwab, K. (2017). *The Fourth Industrial Revolution*. Crown Business.
- Seikkula-Leino, J., Salomaa, M., Jónsdóttir, S. R., McCallum, E., & Israel, H. (2021). EU policies driving entrepreneurial competencies—Reflections from the case of EntreComp. *Sustainability*, 13(15), 8178. <https://doi.org/10.3390/su13158178>
- Sitabutr, V., & Pimdee, P. (2017). Thai entrepreneur and community-based enterprises' OTOP branded handicraft export performance: A SEM analysis. *Sage Open*, 7(1), 2158244016684911. <https://doi.org/10.1177/2158244016684911>

- Statista Research Department. (2024, February 13). Youth not in education, employment, or training worldwide 2005-2025. <http://tinyurl.com/3w2pbe82>
- Sukardi, Wildan, & Subhani, A. (2022). Experiential learning in entrepreneurship teaching: An evaluation based on importance-performance analysis. *International Journal of Instruction*, 15(4), 453-472. <https://doi.org/10.29333/iji.2022.15425a>
- Teerathanachaiyakun, K. (2019). *Entrepreneurship and New Venture*. Bangkok: SE-ED Education.
- Thu, N. T. A. (2013). One Village One Product (OVOP) in Japan to One Tambon One Product (OTOP) in Thailand: Lessons for grass root development in developing countries. *Journal of Social and Development Sciences*, 4, 529-537. <http://tinyurl.com/h9bbdew>
- UNICEF. (2023). *In-depth Research on Youth Not in Employment, Education, or Training (NEET) in Thailand*. United Nations Children's Fund & College of Population Studies, Social Research Institute, Chula Unisearch. <http://tinyurl.com/3tuum3je>
- Van Stel, A., Barrientos-Marin, J., Caçador-Rodrigues, L., Millan, A., & Millán, J. M. (2023). Measuring performance differentials across entrepreneurship types. *International Entrepreneurship and Management Journal*, 19(3), 981-1016. <https://doi.org/10.1007/s11365-021-00755-5>
- Virasa, T., Sukavejworakit, K., & Promsiri, T. (2022). Predicting entrepreneurial intention and economic development: A cross-national study of its policy implications for six ASEAN economies. *Heliyon*, 8(5). <https://doi.org/10.1016/j.heliyon.2022.e09435>
- Wathanakom, N., Khlaisang, J., & Songkram, N. (2021). A journey to enhance youth in entrepreneurship: Investigation of entrepreneurial competencies and development needs. *Journal of Education and Innovation*, 23(3), 64-78. <http://tinyurl.com/3psjvtfp>
- World Economic Forum. (2023). *The Global Competitiveness Report 2023*. <https://www.weforum.org/reports/global-competitiveness-report-2023>
- Zarefard, M., & Beri, S. E. C. (2017). Relationship between entrepreneurs' managerial competencies and innovative start-up intentions in university students: an Iranian case. *International Journal of Entrepreneurship*, 21(3), 1-19. <https://tinyurl.com/3xmjar79>