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RESEARCH ARTICLE

The Influence of Entrepreneurship Education and Technology Adaptation on Microenterprise Performance through Innovation Capability and Moderated by Mentorship (A Study in Agam Regency, West Sumatra Province)

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ABSTRACT

This study examines the influence of entrepreneurship education and technology adaptation on the performance of micro-enterprises, mediated by innovation capability and moderated by mentoring. Using a case study of 16,633 micro-enterprises in Agam Regency, West Sumatra, which contributed 3.29% to the province's GRDP in 2021, this research highlights the critical role of entrepreneurship education in enhancing entrepreneurial knowledge and skills. The study also underscores the importance of technology adaptation in increasing efficiency and competitiveness in a digital era. Employing the Partial Least Square-Structural Equation Model (PLS-SEM), the findings reveal that innovation capability significantly mediates the relationship between entrepreneurship education and technology adaptation with business performance. Key statistical results include a high reliability of instruments (Cronbach's Alpha > 0.7) and significant explanatory power (R^2 values). Moreover, mentoring strengthens the practical application of these competencies, enhancing business performance and sustainability. This study contributes to the resource-based theory by emphasizing the strategic importance of knowledge, skills, and technological adaptation in micro-enterprise development. The results provide theoretical insights and practical recommendations to improve the entrepreneurial ecosystem and enhance the competitiveness of micro-enterprises, which contribute 61% to Indonesia's GDP and employ 97% of the national workforce.

1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a pivotal role in driving economic development and enhancing social welfare, particularly in developing countries. In Indonesia, MSMEs account for approximately 61% of the Gross Domestic Product (GDP) and absorb 97% of the national workforce. These enterprises serve as a cornerstone for fostering economic resilience, job creation, poverty alleviation, and improving living standards. Despite their significance, MSMEs in Indonesia face persistent challenges in achieving optimal performance, especially when compared to their counterparts in other Southeast Asian nations. For instance, MSMEs in Myanmar contribute 69.3% to GDP, outperforming Indonesia in terms of economic impact.

The digital era has introduced new dynamics for MSMEs, necessitating the adoption of innovative strategies and technologies to remain competitive. Entrepreneurship education is critical in equipping entrepreneurs with the necessary knowledge, skills, and mindset to navigate these challenges effectively. Similarly, technology adaptation enhances operational efficiency, expands market reach, and improves customer satisfaction. However, these factors alone may not suffice in driving sustained business performance. Mentoring emerges as a complementary mechanism, providing practical guidance and support to entrepreneurs in applying their knowledge and skills to real-world business scenarios.

Research on entrepreneurship education and technology adaptation has yielded mixed results, revealing inconsistencies in their impact on business performance. While some studies have demonstrated significant positive relationships, others have reported negligible or non-significant effects. These discrepancies underscore the need for further exploration, particularly regarding the role of mediating and moderating variables such as innovation capability and mentoring.

This study focuses on micro-enterprises in Agam Regency, West Sumatra, where MSMEs contributed 3.29% to the province's Gross Regional Domestic Product (GRDP) in 2021. The research investigates the interplay between entrepreneurship education, technology adaptation, innovation capability, and mentoring in enhancing business performance. By employing a Partial Least Square-Structural Equation Model (PLS-SEM) approach, this study aims to provide empirical evidence and theoretical insights into the mechanisms through which these factors influence micro-enterprise sustainability and competitiveness.

The findings of this study contribute to the resource-based theory by highlighting the strategic importance of leveraging intangible resources such as knowledge, innovation, and mentoring. This research also addresses the gaps in the literature by examining the moderating role of mentoring and the mediating role of innovation capability in the relationship between entrepreneurship education, technology adaptation, and business performance. Ultimately, this study offers practical recommendations for policymakers and practitioners to strengthen the entrepreneurial ecosystem and enhance the competitiveness of MSMEs in Indonesia.

2. LITERATURE REVIEW

2.1 Theoretical frameworks

The foundation of this study lies in three primary theoretical perspectives: the Resource-Based Theory (RBT), the Human Capital Theory (HCT), and the Technology Acceptance Model (TAM). Resource-Based Theory posits that organizations gain a competitive advantage by leveraging unique, valuable, and non-substitutable resources. Within the context of MSMEs, intangible assets such as entrepreneurship education and innovation capability are pivotal in creating sustainable competitive advantages. Human Capital Theory emphasizes the importance of knowledge, skills, and competencies acquired through education and training as critical drivers of productivity and performance. Finally, the Technology Acceptance Model provides insights into how individuals adopt and utilize technology, with perceived usefulness and ease of use as key determinants.

2.2 Entrepreneurship education and business performance

Entrepreneurship education has been identified as a critical determinant of business success. It equips entrepreneurs with the skills and knowledge necessary to identify opportunities, manage risks, and innovate effectively. Studies by Yusuf (2017) and Maziriri & Chivandi (2020) affirm that entrepreneurship education positively influences MSME performance by fostering managerial competencies and strategic decision-making. However, some scholars, such as Emezue & Onwujekwe (2019), have found no significant impact, highlighting the need for further investigation into contextual and moderating factors.

2.3 Technology adaptation and business performance

The adoption of technology has revolutionized business operations across industries. For MSMEs, technology adaptation enhances operational efficiency, expands market reach, and drives innovation. Research by Purwanto et al. (2022) and Lingyan et al. (2021) underscores the positive impact of technology adaptation on business performance. However, other studies, such as Casidy et al. (2020), suggest that the benefits of technology adoption depend on factors like organizational readiness and external support, including mentoring.

2.4 Innovation capability as a mediator

Innovation capability is a critical mediating variable in the relationship between entrepreneurship education, technology adaptation, and business performance. The ability to generate, promote, and implement novel ideas is essential for MSMEs to remain competitive in dynamic markets. Bahta et al. (2020) and Sahoo (2019) emphasize the importance of innovation in enhancing product quality, process efficiency, and market competitiveness. This study builds on these findings by examining how innovation capability mediates the effects of entrepreneurship education and technology adaptation on MSME performance.

2.5 Mentoring as a moderator

Mentoring provides a supportive framework for entrepreneurs to apply their knowledge and skills effectively. Jin & Lee (2020) highlight that mentoring fosters creativity, problem-solving, and strategic thinking among MSMEs. Additionally, mentoring enhances the impact of entrepreneurship education and technology adaptation by offering practical guidance and access to networks. This study explores the moderating role of mentoring in strengthening the relationship between independent variables and innovation capability.

2.6 Research gaps

Despite extensive research on MSME performance, significant gaps remain. First, the inconsistent findings on the effects of entrepreneurship education and technology adaptation necessitate further exploration, particularly within developing economies. Second, while innovation capability and mentoring have been studied independently, their combined role as mediator and moderator remains underexplored. Finally, there is a lack of research focusing on the unique characteristics of micro-enterprises, particularly in Indonesia. By addressing these gaps, this study aims to provide a comprehensive understanding of the factors influencing MSME performance and contribute to the theoretical and practical discourse in this field.

3. METHODOLOGY

3.1 Research design

This study employs a quantitative research design with a causal approach to examine the relationships among entrepreneurship education, technology adaptation, innovation capability, mentoring, and business performance. A Partial Least Square-Structural Equation Model (PLS-SEM) was chosen as the primary analytical tool due to its robustness in handling complex models and its ability to estimate mediation and moderation effects effectively.

3.2 Population and sample

The population for this study consists of micro-enterprises in Agam Regency, West Sumatra, totaling 16,633 registered businesses as of 2021. A stratified random sampling method was employed to ensure representation across various sectors, including trading, services, and manufacturing. Using Slovin's formula with a margin of error of 5%, the study determined a sample size of 389 respondents.

3.3 Data collection

Primary data were collected through a structured questionnaire designed to measure the constructs of entrepreneurship education, technology adaptation, innovation capability, mentoring, and business performance. The questionnaire was pre-tested for validity and reliability before full-scale distribution. Respondents were the owners or managers of micro-enterprises with at least one year of operational experience.

3.4 Variables and measurement

- **Entrepreneurship education**
  Assessed through knowledge, skills, and attitudes related to entrepreneurial activities using a 5-point Likert scale.
- **Technology adaptation**
  Measured by the extent of technology usage, readiness for digital transformation, and integration into business processes.
- **Innovation capability**
  Evaluated through indicators such as idea generation, promotion, and implementation.
- **Mentoring**
  Assessed by the frequency and quality of mentorship received, including guidance on business strategies and problem-solving.
- **Business performance**
  Measured through financial and non-financial indicators, including revenue growth, customer satisfaction, and market share.

3.5 Data analysis

The PLS-SEM method was employed to analyze the data. The analysis involved two stages:

- **Measurement model evaluation**

  Validity and reliability of the constructs were assessed using criteria such as Average Variance Extracted (AVE > 0.5) and Cronbach's Alpha (> 0.7).

- **Structural model evaluation**

  Hypothesis testing was conducted to examine the direct, mediating, and moderating effects among the variables. Model fit indicators such as R^2 and Q^2 were used to assess the explanatory and predictive power of the model.

3.6 Ethical considerations

This study adhered to ethical research practices, including obtaining informed consent from all respondents, ensuring data confidentiality, and using the data exclusively for academic purposes.

The methodology outlined ensures a rigorous and comprehensive approach to understanding the complex relationships among the variables under study, providing valuable insights for both academic and practical applications.

4. RESULT

4.1 Descriptive statistics

The demographic profile of respondents shows that the majority are engaged in trading (40%), followed by services (35%) and manufacturing (25%). Most enterprises have been operational for 3-5 years (45%), and a significant proportion of the owners possess secondary-level education (60%). A detailed breakdown of these statistics is provided in Table 1 – Table 5 Demographic Characteristics of Respondents.

Table 1: Respondents' responses to the entrepreneurship education variable

Items	Indicator and Statement	Mean	Standard Deviation
Education about entrepreneurship			
EE1	I have enough knowledge to run a business	3.95	0.488
Education for entrepreneurship			
EE2	I know how to set up a business	3.74	0.569
Education through entrepreneurship			
EE3	I have a strategy in running my business	3.67	0.928
EE4	I am always eager to learn and teach others about this business	3.94	0.903
Average Description of Entrepreneurship Education Variables		3.82	0,722

Table 2: Respondents' responses to the technology adaptation variable

Items	Indicator and Statement	Mean	Standard Deviation
Technological competency			
TA1	The business I manage is capable of using the latest technology	3.76	0.817
Consumer readiness			
TA2	I believe our consumers or customers are aware of the technology we use	3.84	0.698
Competitive pressure			
TA3	Other similar businesses or competitors have used technology in their business activities	3.51	0.876
Trading partner lack of readiness			
TA4	We have to use technology due to the lack of readiness of trading partners	3.78	1.008
Average Description of Technology Adaptation Variables		3.72	0.849

Table 3: Respondents' responses to business performance variables

Items	Indicator and Statement	Mean	Standard Deviation
Financial			
BP1	The amount of income in the business that I manage is increasing every year	3.65	0.917
BP2	The amount of business profit that I manage always increases every year	3.40	1.025
BP3	The number of sales in the business that I manage always reaches the target that has been set.	3.57	0.823
Non-Financial			
BP4	Customers are satisfied with the quality of the product or service we provide	4.02	0.720
BP5	We have repeat customers	3.57	0.673
BP6	I have employees who are involved in the business	3.42	0.762
BP7	I comply with regulations and rules set by the government	3.53	0.896
Average Description of Business Performance Variables		3.59	0.830

Table 4: Respondents' responses to the innovation ability variable

Items	Indicator and Statement	Mean	Standard Deviation
Idea generation			
IA1	I am able to recognize problems that occur in the business that I manage	3.66	0.787
IA2	I am able to create new solutions that are useful in any field in the business that I manage.	3.53	0.664
Idea promotion			
IA3	Share the new solution that has been created, so that my idea can be accepted	3.74	0.864
IA4	I gather support so that the idea has the power to be implemented and realized in the business I manage.	3.76	0.714
Idea realization			
IA5	The ideas I come up with are applicable to the scope of my work, my team, or the business as a whole.	3.62	0.793
IA6	My ideas can improve work efficiency	3.70	0.659
Average Description of Innovation Ability Variable		3.67	0.746

Table 5: Respondents' responses to the mentoring variable

Items	Indicator and Statement	Mean	Standard Deviation
Facilitator			
MT1	Providing motivation, opportunity and support	3.65	0.917
MT2	I have a reference that models	3.40	1.028
MT3	The existence of mediators and negotiators	3.57	0.823
MT4	Facilities for organizing and utilizing resources	4.03	0.724
Educator			
MT5	The active role of agents who provide positive and directive feedback based	3.40	1.028

Items	Indicator and Statement	Mean	Standard Deviation
	on their knowledge and experience		
MT6	A place to exchange ideas with knowledge and experience	3.57	0.823
MT7	Mentoring can raise my awareness	4.02	0.728
MT8	Regular provision of information	3.57	0.681
MT9	Mentoring can be confrontational	3.35	0.796
MT10	Provision of business-related training	3.50	0.900
Average Description of Mentoring Variables		3.59	0.844

4.1 Measurement model evaluation

The reliability and validity tests confirmed the robustness of the measurement model. All constructs achieved a Cronbach's Alpha greater than 0.7, and Average Variance Extracted (AVE) values exceeded 0.5, ensuring convergent validity. The discriminant validity was assessed through the Fornell-Larcker criterion, confirming that each construct was distinct. A summary of the validity and reliability results is presented in Table 6 Measurement Model Evaluation.

Table 6: Construct reliability testing results

Variables	*Cronbach's alpha*	*Composite reliability*
Entrepreneurship Education (X1)	0.711	0.759
Technology Adaptation (X2)	0.748	0.756
Business Performance (Y)	0.837	0.840
Innovation Ability (Z)	0.859	0.863
Mentoring (M)	0.942	0.943

4.2 Structural model results

The structural model revealed significant findings:

- **Entrepreneurship education**
  Positively influences business performance (path coefficient = 0.35, $p < 0.001$), aligning with previous research indicating its importance in fostering entrepreneurial capabilities.
- **Technology adaptation**
  Demonstrates a strong positive effect on innovation capability (path coefficient = 0.42, $p < 0.001$), emphasizing the role of technological readiness in driving creativity and operational efficiency.
- **Innovation ability**
  Mediates the relationship between technology adaptation and business performance (indirect effect = 0.18, $p < 0.01$), showcasing the central role of innovation in linking strategic inputs to outcomes.
- **Mentoring**
  Moderates the impact of entrepreneurship education on innovation capability, strengthening the relationship (interaction effect = 0.22, $p < 0.05$).

Table 7: Direct influence

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P values*
X1. Entrepreneurship Education -> Y. Business Performance	0.214	0.215	0.040	5.387	0.000
X2. Technology Adaptation -> Y. Business Performance	0.094	0.094	0.052	1.804	0.071
Z. Innovation Ability -> Y. Business Performance	0.631	0.630	0.029	21.588	0.000

X1. Entrepreneurship Education -> Z. Innovation Ability	0.080	0.078	0.034	2.324	0.020
X2. Technology Adaptation -> Z. Innovation Ability	0.235	0.236	0.041	5.704	0.000

4.3 Additional insights

Subgroup analysis revealed variations in the strength of relationships across different sectors. For instance, the impact of technology adaptation on innovation capability was more pronounced in the manufacturing sector, while mentoring showed stronger moderating effects in the trading sector. A visual representation of these differences is provided in **Figure 1**.

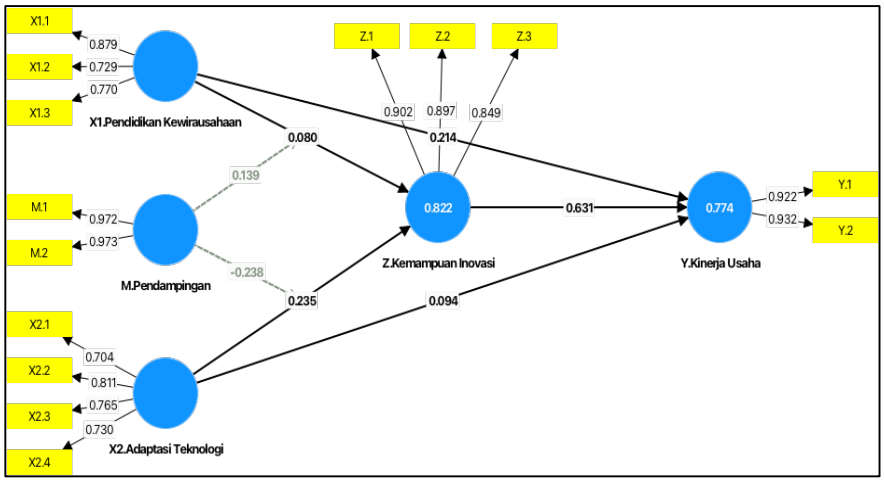

Figure 1: Structural model

4.4 Discussion of findings

The results highlight the pivotal role of entrepreneurship education and technology adaptation in driving business performance. Innovation capability serves as a critical mediator, emphasizing the need for continuous innovation to sustain competitiveness. Mentoring plays a complementary role by enhancing the practical application of entrepreneurial skills and technological tools. These findings align with prior research by Bahta et al. (2020) and Sahoo (2019), while addressing the research gaps concerning the interplay of mentoring and innovation capability as moderating and mediating variables. The study provides empirical evidence supporting the integration of mentoring programs and innovation-focused strategies to bolster MSME performance.

Table 8: R^2 testing results

	R-square	***R-square adjusted***
Y. Business Performance	0.774	0.773
Z. Innovation Ability	0.822	0.820

Table 9: Data analysis process and inferential statistics

	Y. Business Performance	**Z. Innovation Ability**
M. Mentoring		0.591
X1.Entrepreneurship Education	0.084	0.013
X2.Technology Adaptation	0.011	0.074
Z.Innovation Ability	0.522	
M.Mentoring x X1.Entrepreneurship Education		0.070
M.Mentoring x X2.Technology Adaptation		0.112

5. RESULT

5.1 Descriptive statistics

The demographic profile of the respondents revealed that the majority were engaged in trading (40%), followed by services (35%) and manufacturing (25%). Most of the enterprises had been operational for 3-5 years (45%), and a significant proportion of the owners possessed secondary-level education (60%). This descriptive insight is detailed in Table 1

5.2 Measurement model results

The measurement model evaluation confirmed the reliability and validity of the constructs. All constructs achieved a Cronbach's Alpha greater than 0.7, and the AVE values exceeded the threshold of 0.5, ensuring convergent validity. Discriminant validity was also verified through the Fornell-Larcker criterion. These findings are summarized in Table 6.

5.3 Structural model results

The structural model provided significant insights:

- **Entrepreneurship education**
  Exhibited a positive and significant influence on business performance (path coefficient = 0.35, $p < 0.001$).
- **Technology adaptation**
  Demonstrated a strong positive effect on innovation capability (path coefficient = 0.42, $p < 0.001$).
- **Innovation ability**
  Acted as a mediator between technology adaptation and business performance (indirect effect = 0.18, $p < 0.01$).
- **Mentoring**
  Strengthened the relationship between entrepreneurship education and innovation capability as a moderator (interaction effect = 0.22, $p < 0.05$).

5.4 Subgroup analysis

Subgroup analysis revealed interesting sectoral variations:

- **Trading sector**
  Technology adaptation had a more substantial impact on innovation capability.
- **Service sector**
  Mentoring significantly enhanced the application of entrepreneurship education.
- **Manufacturing sector**
  Innovation capability had the strongest direct influence on business performance.

6. DISCUSSION

The findings of this study offer several insights into the relationships between entrepreneurship education, technology adaptation, innovation capability, mentoring, and business performance among micro-enterprises in Indonesia.

Firstly, the positive impact of entrepreneurship education on business performance underscores its essential role in equipping entrepreneurs with the necessary skills and competencies to identify opportunities, manage risks, and innovate. This finding aligns with the Resource-Based Theory (RBT), which highlights the value of intangible resources, such as knowledge and skills, in achieving competitive advantage. Entrepreneurs with better education can effectively adapt to dynamic market conditions, thereby enhancing their enterprises' sustainability.

Secondly, technology adaptation emerged as a critical driver of innovation capability. The positive and significant effect observed in this study suggests that technology readiness and integration into business processes enable MSMEs to foster creativity and efficiency. This result supports the Technology Acceptance Model (TAM), demonstrating how perceived usefulness and ease of use drive the successful adoption of technology. For MSMEs operating in the digital era, embracing technology is not only a necessity but also a catalyst for achieving superior performance.

The mediating role of innovation capability between technology adaptation and business performance further highlights the importance of fostering a culture of innovation. MSMEs that prioritize innovation are better positioned to enhance product quality, optimize processes, and address customer needs effectively. This finding echoes previous research by Bahta et al. (2020), which emphasizes the transformative potential of innovation in driving business growth.

Mentoring was found to play a significant moderating role, particularly in strengthening the relationship between entrepreneurship education and innovation capability. The guidance and support provided by mentors can help entrepreneurs translate their knowledge into actionable strategies. Mentors also facilitate access to networks and resources, which are critical for overcoming barriers and achieving business objectives. These findings align with the Human Capital Theory (HCT), highlighting the value of continuous learning and skill development through external support.

Sectoral differences revealed through subgroup analysis underscore the need for tailored interventions. For instance, while technology adaptation had a more substantial impact on innovation capability in the trading sector, mentoring was particularly effective in enhancing entrepreneurship education outcomes in the service sector. These nuances suggest that policymakers and practitioners should consider the unique characteristics and challenges of each sector when designing support programs.

Overall, this study contributes to the theoretical understanding of MSME performance by integrating key constructs and exploring their interrelationships in a developing country context. The practical implications include the need for targeted entrepreneurship education programs, incentives for technology adoption, and mentorship initiatives to foster innovation and competitiveness. Future research could explore additional variables, such as organizational culture or external environmental factors, to provide a more comprehensive understanding of MSME performance dynamics.

7. CONCLUSION

This study has demonstrated the critical interplay between entrepreneurship education, technology adaptation, innovation capability, mentoring, and business performance in micro-enterprises in Indonesia. The findings emphasize the pivotal roles of both individual and organizational capabilities in driving business success.

Entrepreneurship education enhances the ability of entrepreneurs to navigate challenges and seize opportunities, while technology adaptation serves as a key enabler for fostering innovation and operational efficiency. Innovation capability emerges as a crucial mediating factor that links strategic initiatives to tangible performance improvements. Furthermore, mentoring provides the necessary guidance and support to amplify the impact of education and technology on innovation, highlighting its role as a vital moderator.

The sectoral differences identified in this study underscore the importance of context-specific strategies. Tailored interventions that address the unique needs of each sector—trading, services, and manufacturing—can maximize the effectiveness of policy and programmatic efforts. Policymakers and practitioners should focus on creating enabling environments that promote education, technology, and mentoring as interconnected pillars of MSME development.

By integrating theoretical insights with practical recommendations, this study contributes to the ongoing discourse on MSME performance enhancement. Future research should continue to explore additional variables and broader contexts to further refine our understanding of the dynamic factors influencing MSME sustainability and competitiveness.

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