Impact of AI-Based Digital Tools on the Performance of Women Entrepreneurs in Developing Economies: The Mediating Role of Entrepreneurial Self-Efficacy and Operational Efficiency and the Moderating Role of Digital Literacy

Bushra Sadiq
bushrasadiq@gmail.com
PhD Scholar, Leadership and Management Deptt, National Defence University Islamabad, Pakistan

Dr. Muhammad Ismail Ramay
drismailramay@ndu.edu.pk
Professor, Leadership and Management Deptt, National Defence University Islamabad, Pakistan

Corresponding Author: * Bushra Sadiq bushrasadiq@gmail.com

ABSTRACT

The rapid advancement of artificial intelligence (AI) technologies has significantly transformed the entrepreneurial ecosystem, creating new opportunities for small and medium enterprises (SMEs) worldwide. In developing economies, AI-based digital tools provide women entrepreneurs with innovative solutions to overcome traditional barriers such as limited market access, resource constraints, and operational inefficiencies. Despite the growing adoption of digital technologies, limited research has explored the mechanisms through which AI-based tools influence the performance of women entrepreneurs. This paper examines how AI-powered digital tools can enhance the performance of women entrepreneurs in developing economies and the role of entrepreneurial self-efficacy and operational efficiency that mediate the relationship between them and the moderator role of digital literacy. The survey was a quantitative research design that included the survey of women who run SMEs. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to analyze the data. The results show that AI-based digital tools have a strong effect in improving the performance of women entrepreneurs because of their effects on decision making, productivity in operations and market reach. More so, the findings show that entrepreneurial self-efficacy and operational efficiency partly mediate the association between AI-based digital tools and entrepreneurial performance. It is also shown that the digital literacy influences this relationship significantly and enhances the positive effect of AI technologies on business performance. The results can be added to the existing literature on digital entrepreneurship and economic empowerment of women with a combination of technological, psychological, and operational approaches. The research also gives practical implications to policymakers, entrepreneurship support agencies, and technology providers who are interested in promoting the adoption of digital and enhancing the abilities of women entrepreneurs in third world economies.

Keywords: AI-based digital tools, Women entrepreneurship, Entrepreneurial self-efficacy, Operational efficiency, Digital literacy, Developing economies, Business performance

INTRODUCTION

Entrepreneurship among women has become a major economic growth, innovation, and job creator in the global economy, especially in the developing ones. Women enterprises are also known to play a big role in diversifying the economy, alleviating poverty and empowering the society. Women entrepreneurs are rapidly venturing into the business arena in most developing nations and setting up small and medium sized enterprises (SMEs) which help in the local and national economic development. Regardless of these efforts,

women entrepreneurs are still confronted with a lot of challenges including, lack of access to financial resources, lack of access to business networks, discrimination based on gender, and absence of access to technological infrastructure. Such obstacles tend to reduce the potential and sustainability of the women-led businesses in the developing economies [1].

Rapid technological changes during recent years have changed the world entrepreneurial environment. The advent of digital technologies, especially artificial intelligence (AI), has opened new possibilities to entrepreneurs to optimize business processes and operational work, expand into new markets, and optimize decision-making processes. Digital products powered by AI, such as data analytics platforms, automated marketing systems, recommendation engines, chatbots, and digital payment technologies, can help companies make workflow more effective and efficient. Such tools can greatly boost the performance of the entrepreneurs, through innovation, increased productivity, and lowered cost of operations [2].

The digitalization of technologies is particularly significant to those women entrepreneurs in the developing economies, where more pronounced are the traditional business barriers. Through the digital platforms, the women entrepreneurs can access online marketplaces, connect with customers around the globe, and do business activities at the comfort of their locations. Digital tools will help women entrepreneurs to fight the geographical barrier and social restraints that traditionally confine female involvement in the economic process. The past research has illustrated that digital technologies and information communication technologies (ICT) are important in empowering women entrepreneurs by increasing access to information, expanding market connectivity, and building entrepreneurial capacities [3].

Although digital technologies have great opportunities, their influence on the business performance is, in many ways, determined by the extent to which the entrepreneurs embrace and use digital technologies. There are a number of psychological and organizational factors that shape the relationship between the technological adoption and the entrepreneurial success. Entrepreneurial self-efficacy is one of the most significant in this consideration. Entrepreneurial self-efficacy is the attitude in which a person feels that they can effectively accomplish entrepreneurial activities including identification of an opportunity, mobilization of resources, risk management, and innovation. High self-efficacy entrepreneurs believe that they can easily embrace new technologies, experiment with new strategies and address business challenges [4].

As per the social cognitive theory, self-efficacy plays a major role in determining human behavior, motivation and performance outcomes. High self-efficacy entrepreneurs are more resilient, creative and persistent in uncertain and challenging business environments. Self-efficacy, in the case of digital entrepreneurship, might have an impact on how much entrepreneurs are prepared to test some more sophisticated technologies like artificial intelligence and data analytics. It has been shown that digital technologies can boost entrepreneurial self-efficacy by equipping entrepreneurs with instruments and resources that boost entrepreneur-management of business functioning and critical decision-making processes [5].

Along with psychological aspects, there are technological factors that may also affect the performance of business through making it more operational. Operational efficiency can be defined as the capacity of a business to make the best use out of its resources so as to generate the highest output at the lowest cost. Digital tools supported by AI can be of great benefit to the operations through automation of repetitive systems, supply chains optimization, better inventory management systems and customer relationship management. The AIs technologies enable entrepreneurs to deal with strategic tasks (innovation of products, market development, customer interactions, etc.) by automation of routine tasks and simplification of operational processes [6].

Enhancing efficiency in operations is also a central concern to women entrepreneurs who, in most cases, have small and resource-deficient businesses. By utilizing the uses of AI-based digital tools, women entrepreneurs will be able to enhance the productivity, minimize the expenses of operations, and increase the overall performance of their companies. Nevertheless, even with the possible advantages of AI technologies, a number of entrepreneurs are unable to successfully incorporate digital technologies into their business work because of the lack of digital abilities as well as the absence of digital training [7].

Digital literacy is another significant issue that determines the usefulness of digital technologies in the entrepreneurship domain. Digital literacy is defined as the proficiency to access and comprehend, to review and apply digital technology to its full potential. Within the framework of entrepreneurship, digital literacy allows entrepreneurs to apply digital tools in running businesses, marketing online, and financial transactions and data analysis. The more digitally literate entrepreneurs would be more likely to become innovative with the use of new technologies and use the digital platform to enhance business performance [8].

The issue of digital literacy is even more decisive in the developing economies, where the technological infrastructure and digital skills are not evenly distributed. A lot of women in the developing countries who are entrepreneurs do not have adequate knowledge of digital and technical skills to effectively apply the advanced digital technologies effectively. This digital skills gap has already become a key obstacle that prevents the enjoyment of the digital transformation by women entrepreneurs. Empirical research has revealed that digital literacy plays an important role in the adoption of digital innovations, as well as, in performance of women-owned businesses as it increases their ability to utilize digital tools and online platforms [9].

Besides, with the advent of digital entrepreneurship, the presence of technology in business operations has been enhanced even more. Digital entrepreneurship can be described as entrepreneurial activities in which value is created through heavy use of digital technologies and online platforms to access the market and engage customers. Digital tools powered by AI are slowly becoming a key part of any digital entrepreneurship as it allows entrepreneurs to process large amounts of data, automate marketing operations, make customer experiences more personal, and enhance business decision-making. These technologies are changing the competitive environment of the entrepreneurship and developing new opportunities of women business owners to grow their businesses [10].

Although the role of AI technologies in business is increasingly important, there is a paucity of studies that investigate how digital technologies that use AI can affect the performance of female entrepreneurs in developing countries. The current literature is mostly concentrated on the direct correlation between the digital technology and business performance, whereas the psychological and working mechanisms behind these are still under investigation. Specifically, the mediating effects of entrepreneurial self-efficacy and operational efficiency have lacked the proper research in the framework of the AI-based digital tools and entrepreneurship among women.

Moreover, the mediating aspect of digital literacy in changing the relationship between AI-based digital tools and entrepreneurial performance was not a focus of much attention within the current literature. Since the use of digital technologies is becoming more common in the contemporary business world, the role of digital literacy in facilitating the usefulness of AI-based tools should be addressed to facilitate sustainable entrepreneurial development.

To fill these research gaps, the current study explores how AI-based digital tools affect the performance of the women entrepreneurs in the developing economies, with the entrepreneurial self-efficacy and operational efficiency as the two mediating variables and a moderating variable being the digital literacy.

This paper combines the insights of both the Resource-Based View (RBV) and Social Cognitive Theory to come up with a holistic model of how technological, psychological and capability-related factors interact to determine entrepreneurial performance.

This research is likely to be useful to the body of scholarship about digital entrepreneurship and women economic empowerment in a number of ways. To begin with, the research gives information regarding the effectiveness of the use of the AI-based digital tools by the women-run enterprises. Second, it emphasizes the values of entrepreneurial self-efficacy and operational efficiency as the most appropriate processes that mediate the linkage between digital technologies and the business performance. Third, the paper focuses on the importance of digital literacy to help entrepreneurs to properly use digital technologies. Lastly, the study has both practical implications to policymakers, entrepreneurship support organizations and development agencies to encourage women entrepreneurship and digital inclusion in developing economies.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

AI-Based Digital Tools and Performance in Entrepreneurship.

Artificial intelligence (AI) technologies have evolved at a fast pace and are changing the world of business dramatically. Digital applications based on artificial intelligence assist companies in automating their various routine operations, handling huge amounts of data, and supporting the process of decision-making and better operational performance. These technologies are machine learning algorithms, automated marketing systems, predictive analytics tools, chatbots, and intelligent customer relationship management systems. These technologies allow entrepreneurs to make business processes more efficient, make their operations less expensive, and build more personalized customer experiences [11].

Over the past years, AI-initiated online applications have become more readily available to small and medium enterprises (SMEs), such as businesses with women entrepreneurs. Due to the inclusion of AI technologies, entrepreneurs will be able to optimize their resource allocation, increase supply chain management, and enhance strategies to engage customers. Strategic decision-making is another area where AI tools are used to assist in making informed decisions based on the data given on the trends of the market, consumer behavior and performance of the business [12].

In the case of women entrepreneurs in the developing economies, AI technologies offer old possibilities to address the conventional limitations of access to the market, limited mobility, and managerial support. Women entrepreneurs have an opportunity to grow their business with the help of digital platforms and AI-based tools and enter the world market and communicate with customers. Furthermore, the AI technologies help to conduct business remotely, which is especially useful when women are limited by socio-cultural factors that do not allow them to move freely in the course of business-related tasks [13].

Empirical evidence has demonstrated that adoption of digital technologies has a positive influence on the performance of the entrepreneurial activity, as it increases productivity, innovation, and competitiveness. Companies that successfully incorporate digital tools in their business tend to have greater chances of attaining greater efficiency and profitability than those that make use of conventional business operations only. In turn, the digital tools based on AI are gaining recognition as a strategic asset that can help entrepreneurs to develop competitive advantage and enhance the general level of business performance [14].

According to the Resource-Based View (RBV), technological resources like AI tools may become effective organizational assets that can be used to increase performance and capabilities of firms. This view states

that companies that are able to effectively exploit the power of technology are in a position to perform at a higher level because they have the ability to employ distinctive competencies that their rivals would find it difficult to follow. Thus, digital technologies based on AI are predicted to be instrumental in enhancing the performance of female entrepreneurs by allowing them to allocate technological resources more efficiently [15].

According to the discussion, the hypothesis below will be proposed:

H1: AI-based digital tools can significantly positively influence the performance of women businesspeople in developing economies.

Mediating Role of Entrepreneurial Self-Efficacy

Entrepreneurial self-efficacy is the belief of an individual in his ability to effectively execute entrepreneurial activities and reach the business objectives. It is a psychological fabrication based on Social Cognitive Theory, which puts great importance on individual beliefs and confidence in determining the outcome of behavior and performance [16]. High self-efficacy of entrepreneurs leads to high levels of motivation and persistence as well as innovation amidst challenges in business settings.

Self-efficacy is significant in the determination of entrepreneurial behaviour especially in technology adoption. The entrepreneur who trusts in themselves would tend to explore novel technology, use new strategy and risk calculatedly that would lead to growth of the business. On the other hand, low self-efficacy entrepreneurs might be afraid to embrace new advanced technologies because of the fear of failure or they are not convinced that they can effectively utilize them [17].

The integration of AI-based computerized tools can greatly increase the entrepreneurial self-efficacy through offering businesspeople with instruments to help them in demanding business tasks and better decision-making. As an example, the AI-based analytics systems enable the entrepreneur to evaluate the market trends and the preferences of customers without having to possess sophisticated technical skills. In the same manner, automated marketing tools allow the entrepreneurs to gain control over online marketing campaigns in a more efficient way, which may guide them to be more confident in controlling the actions of the business process [18].

It has been proposed that entrepreneurial self-efficacy can be reinforced through the availability of digital technologies and technological resources, which will make individuals more confident in their capacity to cope with business operations. In the event that businesspeople can effectively apply digital tools to enhance business processes, they are more confident in their potential that will also affect their entrepreneurial activities. Through this, self-efficacy becomes a key psychological process that technological adoption can use to determine the business performance [19].

Self-efficacy is specifically significant in the context of women entrepreneurship since the female gender is usually subject to social and institutional pressures, leading to the loss of belief in entrepreneurial practices. Digital technologies that involve AI can be used to overcome these barriers and make women entrepreneurs accessible resources, training platforms, and automated business solutions that can streamline complicated business operations. As a result, the implementation of AI-based systems has the potential to enhance the performance of women in business and increase their entrepreneurial self-efficacy [20].

According to this argument, the entrepreneurial self-efficacy should mediate the association between AI-based digital tools and entrepreneurial performance.

Hence, the hypotheses are the following:

H2: AI based digital tools positively influence entrepreneurial self-efficacy in women entrepreneurs.

H3: Entrepreneurial self-efficacy positively influences the performance of women entrepreneur.

H4: AI-based digital tools are associated with the performance of women entrepreneurs through entrepreneurial self-efficacy.

Intermediary Effect of Operational Efficiency

Operational efficiency is the capacity of an organization to use its resources in an effective manner to meet the highest levels of productivity at the least cost and wastages. Efficient operations can make businesses more effective in provision of products and services, enhance customer satisfaction and raise profitability. The efficiency in the operations is especially critical in the business of an entrepreneur since small businesses frequently have limited financial and human resources [21].

AI-driven digital solutions are also relevant in the enhancement of the efficiency of the operations through the automation of repetitive procedures, the optimization of the working processes, and the more efficient management of the available resources. As an illustration, AI-based inventory management systems can assist companies in monitoring the level of stock and predicting demand, whereas customer relationship management systems can enhance communication with customers and also improve service delivery. In the same manner, accounting and financial management systems are automated, which cuts the time and effort that may be used in handling the financial records and transactions [22].

The introduction of AI technologies into the business processes can help the entrepreneurs to minimize the operational expenses and to maximize the productivity. Entrepreneurs will be able to invest more time and resources in strategic work like innovation, marketing, and product development since repetitive processes will be replaced by automatization, and the efficiency of processes increased. Consequently, there is a high likelihood of businesses using AI-based digital tools enjoying high operational performance and competitiveness [23].

In the case of female entrepreneurs, the efficiency of operations is of crucial importance since most female-owned enterprises are used on a small scale and are not usually provided with financial and managerial resources. Digital tools that require AI to operate can be used to overcome these issues as they can streamline the business process and make the entrepreneurs manage their businesses better. By increasing their operational efficiency, women entrepreneurs are able to increase the productivity, minimize the risks of the business as well as enhance the overall performance of their businesses [24].

Besides, operational efficiency can serve as a primary driver by which AI-driven digital tools can affect the performance of the entrepreneur. In the context of entrepreneurs embracing AI tech, the companies are in a position to optimize business processes, optimize resource management, and minimize inefficiencies. All of these eventually lead to the eventual increase in the performance of the business and the operational efficiency is a key mediator in how AI uptake and entrepreneurial performance correlate.

On the basis of this discussion the following hypotheses can be put forward:

H5: AI-based digital tools positively affect the efficiency of operations.

H 6: Operational efficiency positively influences the performance of the women entrepreneurship.

H7: Operational efficiency mediates the connection between AI based digital tools and performance of women entrepreneurs.

Moderating Impact of Digital Literacy

Digital literacy can be defined as a skill of successfully acquiring, interpreting, assessing, and using digital technologies to communicate, process information, and do business. Digital literacy can be highly instrumental in the context of entrepreneurship, through which entrepreneurial innovators are able to use digital technologies to innovate, market, manage finances, and make strategic decisions [25].

Stongly digitally literate entrepreneurs have a greater capacity to embrace and employ emerging and established technologies like artificial intelligence, cloud computing and data analytics. These are the skills that can help an entrepreneur to comprehend digital information, navigate online platforms, and incorporate digital tools into their businesses. Consequently, the digital literacy contributes greatly to the capacity of the entrepreneur to capitalize on the digital transformation [26].

Digital literacy is a significant problem in the lives of most entrepreneurs especially women in the developing economies. Women are often curtailed by the lack of access to digital education, training in technology tools and internet access to develop digital skills. This digital skills gap has the potential to diminish the efficacy of AI-based computerized instruments since entrepreneurs might fail to apply the technologies to the fullest in business development [27].

Past research indicates that digital literacy may enhance the correlation between adoption of technology and performance of an entrepreneur. The more the entrepreneurial is digital-literate, the better chance he/she has to implement digital technologies and turn them into better business results. Thus, AI-based digital tools have the potential to positively affect the results of entrepreneurship, which can be reinforced by digital literacy [28].

Digital literacy will be moderating in the context of women entrepreneurship, as it seeks to establish the effectiveness of AI-based digital tools. Female entrepreneurs who are more digitally literate can better apply AI technologies, and it makes the tools more effective in improving business results. On the other hand, women entrepreneurs who have lower digital literacy can have challenges adopting and using AI tools, thus limiting their effects on business performance.

Due to the arguments outlined above, the following hypothesis is put across:

H8: An intermediate variable is the digital literacy, which mediates the relationship between AI-based digital tools and the performance of women entrepreneurs in the sense that the stronger the digital literacy the stronger the relationship.

CONCEPTUAL FRAMEWORK

According to the Resource-Based View (RBV) and the Social Cognitive Theory, this paper will put forward a conceptual framework that explains the impact of AI-based digital tools on the performance of female entrepreneurs in developing economies. According to the framework, AI-driven digital tools are strategic technological resources that can enhance entrepreneurial performance by a direct and indirect process involving psychological and operational processes.

The Resource-Based View holds that an organization gains a competitive advantage when it manages to employ valuable and rare resources that enhance organizational capabilities [15]. Digital technologies and

artificial intelligence tools could be valuable technological resources in the context of entrepreneurship that can be important to increase business competencies and achieve operational efficiency. AI-based digital tools help entrepreneurs to robotize business processes, structure market data, and optimize the customer engagement strategy, which, in turn, increases firm performance.

Nevertheless, the technological resources are not enough to guarantee better business performance. Psychological aspects, including entrepreneurial self-efficacy, determine the capability of entrepreneurs to make good use of these technologies. According to social Cognitive Theory, beliefs in capabilities determine the motivation of individuals, their behavior and performance outcomes [16]. The entrepreneurial self-efficacy is much more successful in embracing new technologies and trying new business strategies to enhance business performance.

Besides psychological processes, AI-based digital tools can also be used to affect entrepreneurial performance by enhancing operational efficiency. With the help of AI, entrepreneurs can lower the costs of operations and enhance productivity by automation of repetitive processes, optimization of business processes, and better utilization of resources. Enhanced operational effectiveness will provide the businesses with capacity to provide products and services in a more effective manner, hence leading to improved organizational performance.

Also, the connection between the AI-based digital tools and the entrepreneurial performance might be determined by the degree of digital literacy of the entrepreneurs. Digital literacy allows business owners to become cognizant, critical and capable of applying digital technologies in running the business [25]. More digital literate women entrepreneurs can use AI-based tools to market themselves, interact with their customers, financial management and decision making.

Thus, it is presumed that digital literacy will reinforce the connection between AI-based online tools and the entrepreneurial performance. The entrepreneurs with good digital skills are capable of taking maximum advantage of digital technologies, whereas those with poor digital skills might have problems incorporating the digital tools to their advantage.

According to these theoretical views, the proposed study is that entrepreneurial self-efficacy and operational efficiency mediate the relationship between AI-based digital tools and entrepreneurial performance, and digital literacy moderates the relationship between AI-based digital tools and entrepreneurial performance.

METHODOLOGY

Research Design

This paper takes the quantitative research method to analyze the variables of AI-based digital tools, entrepreneurial self-efficacy, operational efficiency, digital literacy, and the performance of women entrepreneurs. The research design is a cross-sectional survey study that will be used to gather primary data concerning women entrepreneurs who run small to medium-sized businesses (SMEs) in developing economies.

The quantitative form of research is common in the studies of entrepreneurship and adoption of technologies since this type of studies enables the researcher to test the relationship between theoretical variables using statistical tests [11]. Structural Equation Modeling (SEM) is applied in this study to test the conceptual framework and research hypotheses.

In particular, the research incorporates the Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS. PLS-SEM is applicable to research models that have a variety of mediating and moderating relationships. It is also suitable to exploratory research and models that have latent constructs that are measured using a number of indicators [19].

Population and Sample

The study target population is comprised of small and medium enterprises (SME) women entrepreneurs in developing economies but those who utilize digital technologies or online platforms in their business activities.

SMEs that belong to women constitute a fast-developing sector of the entrepreneurial ecosystem, especially in developing economies when digital technologies open new opportunities to engage in the economy. Nevertheless, the issue of utilizing and implementing modern technologies, including artificial intelligence, continues to be a problem to many women entrepreneurs.

Respondents will be selected through purposive sampling method who will fit the following criteria:

1. The interviewee should be a female entrepreneur.

2. The respondent has to own or operate a small or medium-sized enterprise.

3. The business should be using digital tools or web platforms in conducting business.

The research is designed to get about 300-400 responses that are thought to be adequate in analyzing PLS-SEM. Based on the previous researches, a sample size of 200 and above is considered to be sufficient to conduct a structural equation modeling and achieve good statistical findings [25].

Data Collection

A structured questionnaire survey will be used to obtain primary data. The questionnaire will be spread online via sites like:

• Google Forms

• Email surveys

• Groups of social media entrepreneurs.

Women Entrepreneur Associations

In the questionnaire, there will be two sections:

The first section is the demographic information, which will be acquired through the questionnaire.

Section A: Demographic Information

The first part will be the demographic information, and this will be obtained using the questionnaire.

In this section, the background information about the respondents will be gathered, which includes:

- Age

- Education level

- Business sector

- Business age

- Number of employees

- Entrepreneurial experience

Section B: Measuring Research Variables

This part will contain measurement items of major constructs to be applied in the study.

Measurement of Variables

All constructs in this study will be measured using previously validated scales from the literature. Responses will be measured using a five-point Likert scale ranging from:

  1 = Strongly Disagree

  5 = Strongly Agree

AI-Based Digital Tools

AI-based digital tools refer to the use of artificial intelligence technologies such as automated marketing systems, chatbots, data analytics tools, and AI-powered business platforms.

Sample items include:

- My business uses AI-based tools to analyze customer data.

- AI tools help improve business decision-making.

- AI technologies improve the efficiency of my business operations.

These items are adapted from studies on digital technology adoption in entrepreneurship [12].

Entrepreneurial Self-Efficacy

Entrepreneurial self-efficacy refers to the entrepreneur's confidence in their ability to successfully manage and grow their business.

Sample items include:

- I am confident in my ability to manage my business successfully.

- I can identify new business opportunities.

- I can overcome challenges in my business.

These items are adapted from the entrepreneurial self-efficacy scale [17].

Operational Efficiency

Operational efficiency refers to the ability of businesses to utilize resources effectively to maximize productivity and minimize costs.

Sample items include:

- Digital tools help streamline my business processes.

- My business operations have become more efficient due to digital technologies.

- Technology helps reduce operational costs in my business.

These items are adapted from operations management studies [21].

Digital Literacy

Digital literacy refers to the entrepreneur's ability to effectively use digital technologies and online platforms.

Sample items include:

- I am comfortable using digital tools for business activities.

- I can easily learn new digital technologies.

- I regularly use online platforms for managing my business.

These items are adapted from digital literacy studies [25].

Performance of Women Entrepreneurs

Entrepreneurial performance refers to the overall success and growth of the business.

Sample items include:

- My business profitability has improved in recent years.

- My business has experienced growth in sales.

- My business performance is better than competitors.

These items are adapted from entrepreneurship performance studies [24].

Data Analysis Techniques

The collected data will be analyzed using SmartPLS 4 software following the PLS-SEM approach. The analysis will be conducted in two stages.

Measurement Model Evaluation

The measurement model will be evaluated to assess the reliability and validity of the constructs.

The following criteria will be examined:

- Cronbach's Alpha (> 0.70)

- Composite Reliability (> 0.70)

- Average Variance Extracted (AVE > 0.50)

- Factor Loadings (> 0.70)

These criteria ensure that the measurement scales used in the study are reliable and valid [19].

Structural Model Evaluation

The structural model will be used to test the proposed hypotheses. The following indicators will be evaluated:

- Path coefficients

- t-values

- p-values

- R^2 values

- Effect size (f^2)

- Predictive relevance (Q^2)

Bootstrapping with 5000 resamples will be used to determine the significance of the relationships between variables.

Mediation and Moderation Analysis

Indirect effect analysis will be undertaken by the use of the bootstrapping method to test the mediating effects of the entrepreneurial self-efficacy and operational efficiency.

The mediation of the digital literacy will be tested by incorporating an interaction term between AI-based digital tools and digital literacy in the PLS-SEM model.

DATA ANALYSIS AND RESULTS

Demographic Profile of the respondents

Questionnaires were issued to 350 women who were entrepreneurs with small and medium enterprises (SMEs) business. Following the elimination of incomplete responses, 312 valid responses were then analysed as final data, giving a response rate of 89%.

The demographic profile of the respondents consists of the age, level of education, and business experience, and the industry. Knowledge of the demographic distribution is significant as it gives one idea about the background of the entrepreneurial participants and puts the research results into perspective.

Table 1. Demographic Profile of Respondents (n = 312)

Variable	Category	Frequency	Percentage
Age	20–30	96	30.8%
	31–40	128	41.0%
	41–50	64	20.5%
	Above 50	24	7.7%
Education	Bachelor	142	45.5%
	Master	110	35.3%
	Diploma	42	13.5%
	PhD/Other	18	5.7%
Business Age	1–3 years	104	33.3%
	4–6 years	98	31.4%
	7–10 years	70	22.4%
	Above 10 years	40	12.8%
Sector	Retail	110	35.3%
	Services	126	40.4%
	Manufacturing	44	14.1%
	Online business	32	10.2%

According to the demographic findings, most of the people who replied to the questionnaires are in the 31-40 age gap with evidence of active entrepreneurship among middle-aged women. The majority of the

respondents are also well-educated, which proves that education may also affect the use of digital technologies.

Assessment of the Measurement model

The measurement model was tested to determine the reliability and validity of the constructs with the help of PLS-SEM techniques. In other past researches, measurement model evaluation incorporates factor loading analysis, Cronbach alpha, composite reliability (CR), and average variance extracted (AVE) analysis [19][25].

Table 2. Reliability and Convergent Validity

Construct	Items	Factor Loading	Cronbach Alpha	Composite Reliability	AVE
AI-Based Digital Tools	AIDT1	0.81	0.88	0.91	0.67
	AIDT2	0.85			
	AIDT3	0.82			
Entrepreneurial Self-Efficacy	ESE1	0.84	0.87	0.90	0.65
	ESE2	0.80			
	ESE3	0.82			
Operational Efficiency	OE1	0.83	0.86	0.90	0.66
	OE2	0.81			
	OE3	0.79			
Digital Literacy	DL1	0.85	0.89	0.92	0.69
	DL2	0.82			
	DL3	0.84			
Entrepreneurial Performance	EP1	0.86	0.90	0.93	0.71
	EP2	0.88			
	EP3	0.83			

The results show that the item reliability is confirmed by all the factor loadings that are more than 0.70. The values of Cronbach alpha and composite reliability exceed the suggested value of 0.70, indicating a

high level of internal consistency. Moreover, the values of AVE are more than 0.50, which shows sufficient convergent validity.

Discriminant Validity

The FornellLarcker criterion was used to determine discriminant validity where the square root of AVE of each construct is expected to be higher than the correlation with other constructs [25].

Table 3. Fornell-Larcker Discriminant Validity

Construct	AIDT	ESE	OE	DL	EP
AI-Based Digital Tools	0.81				
Entrepreneurial Self-Efficacy	0.56	0.80			
Operational Efficiency	0.53	0.59	0.81		
Digital Literacy	0.48	0.46	0.51	0.83	
Entrepreneurial Performance	0.61	0.65	0.63	0.58	0.84

The results confirm that the square root of AVE for each construct is higher than its correlation with other constructs, indicating adequate discriminant validity.

Structural Model Assessment

After establishing reliability and validity, the structural model was evaluated to test the proposed hypotheses. The significance of relationships was assessed using bootstrapping with 5000 resamples.

Table 4

Hypothesis Testing Results

Hypothesis	Relationship	Path Coefficient	t-value	p-value	Result
H1	AIDT → EP	0.28	4.91	0.000	Supported
H2	AIDT → ESE	0.52	8.63	0.000	Supported
H3	ESE → EP	0.31	5.74	0.000	Supported
H5	AIDT → OE	0.49	7.98	0.000	Supported
H6	OE → EP	0.29	5.10	0.000	Supported

The results indicate that AI-based digital tools significantly influence entrepreneurial performance, entrepreneurial self-efficacy, and operational efficiency. These findings support hypotheses H1, H2, H3, H5, and H6.

Mediation Analysis

The mediating effects of entrepreneurial self-efficacy and operational efficiency were examined using bootstrapping procedures.

Table 5

Mediation Analysis

Relationship	Indirect Effect	t-value	p-value	Result
AIDT → ESE → EP	0.16	4.11	0.000	Supported
AIDT → OE → EP	0.14	3.85	0.000	Supported

The results confirm that both entrepreneurial self-efficacy and operational efficiency significantly mediate the relationship between AI-based digital tools and entrepreneurial performance, supporting hypotheses H4 and H7.

Moderation Analysis

The moderating effect of digital literacy on the relationship between AI-based digital tools and entrepreneurial performance was also examined.

Table 6

Moderation Analysis

Hypothesis	Interaction Effect	Path Coefficient	t-value	p-value	Result
H8	AIDT × DL → EP	0.18	3.42	0.001	Supported

The results indicate that digital literacy significantly moderates the relationship between AI-based digital tools and entrepreneurial performance. This suggests that the positive impact of AI technologies on business performance becomes stronger when entrepreneurs possess higher levels of digital literacy.

Model Predictive Power

The coefficient of determination (R^2) was used to assess the predictive power of the model.

Table 7

R² Values

Endogenous Variable	R²
Entrepreneurial Self-Efficacy	0.27
Operational Efficiency	0.24
Entrepreneurial Performance	0.46

The R² value of 0.46 for entrepreneurial performance indicates that the model explains approximately 46% of the variance in women entrepreneurs' performance, which is considered moderate explanatory power in social science research.

Structural Model Diagram

Conceptually, the tested model is represented as:
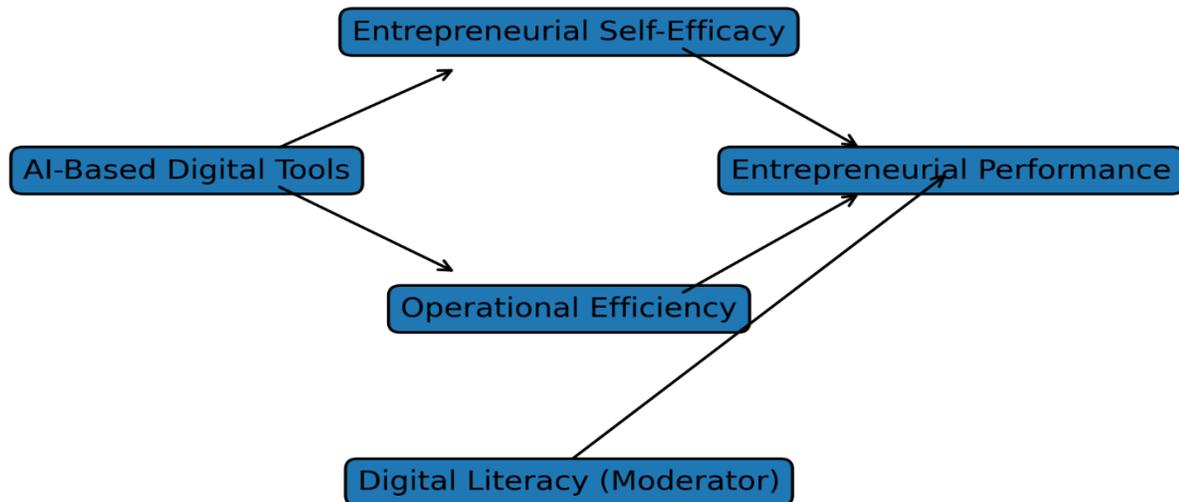
DISCUSSION

The main goal of the research was to look at how AI-based digital tools were affecting the performance of women entrepreneurs in developing economies and also exploring the mediating factors of entrepreneurial self-efficacy and operational efficiency and the moderating factor of digital literacy. The results of analysis render a number of valuable suggestions regarding the interaction of technological, psychological, and capability-related factors to determine the success of the entrepreneurship.

To begin with, the findings prove the positive effect of AI-based digital tools on the performance of women entrepreneurs in a high degree, which proves Hypothesis 1. This observation suggests that the

implementation of AI-based systems including e-marketing systems, robotic customer management systems, and data analysis tools can help entrepreneurs enhance business efficiency, increase market penetration, and improve decision-making. The findings can be explained by the fact that past studies have implied that digital technologies are strategic resources, which increase organizational capabilities and competitive advantage [12][14]. Traditional barriers to business are being overcome by using AI-based tools and enabled women entrepreneurs to act more efficiently in the more competitive market.

Second, the research establishes that AI-based digital tools have a great impact on entrepreneurial self-efficacy, which proves Hypothesis 2. The observation indicates that entrepreneurs who embrace digital technologies have more confidence in their capacity to run and expand their business. The AI-driven tools make complex business processes easier, offer data-driven information, and simplify the decision-making process, which leads to better perceived ability of entrepreneurs to conduct entrepreneurial activities effectively. The outcome can be attributed to the concepts of the Social Cognitive Theory, which attributes the impact of self-beliefs in determining the outcomes of individual behavior and performance [16]. Those entrepreneurs who possess confidence in their capabilities will be more inclined to do new activities, use new technologies and seek growth opportunities.

In addition, the findings also show that the entrepreneurial self-efficacy has a positive impact on the entrepreneurial performance, and this assumption is in line with Hypothesis 3. This observation shows the significance of psychological aspects of entrepreneurial success. Women business people who are more self-efficacious are more likely to exhibit motivation, resilience and persistence to business challenges. They are also less conservative in trying new strategies and technology and this helps in enhancing business results. The result is in line with other previous research works, which highlight the importance of self-efficacy in influencing entrepreneurial behavior and firm performance [17][19].

The mediation test also shows that entrepreneurial self-efficacy somewhat mediates the connection between AI-based digital tools and entrepreneurial performance to confirm Hypothesis 4. This finding indicates that AI technologies have a beneficial direct effect on the performance of businesses, as well as on the confidence of entrepreneurs in the opportunity to successfully handle business processes. The more entrepreneurial gain confidence in their skills and abilities, the more they are interested in trying new business opportunities and applying new strategies, which will eventually enhance the work of the business.

Besides psychological processes, the operational efficiency of the relationship between AI-based digital tools and entrepreneurial performance is also an important issue in the study. The findings suggest that the operational efficiency is enhanced by using AI-based digital tools significantly, which confirms Hypothesis 5. This result indicates that AI technologies can assist entrepreneurs in making business operations smoother, automaticizing routine operations, and/or making better use of resources. Operational efficiency can help the businesses to minimize costs, enhance productivity and overall organizational performance. These results are in line with past research that emphasizes the importance of digital technologies in enhancing operations and efficiency in business [21][23].

Besides, the findings show that operational efficiency has a positive impact on the performance of an entrepreneur, which validates Hypothesis 6. Other benefits of quality business practices are that the entrepreneurs will be able to offer products and services at a better rate and customer satisfaction will be enhanced and profitability improved. Operational efficiency is of special relevance to women entrepreneurs since most of the businesses that are owned by them have limited financial and human resources. Digital products created with the assistance of AI allow addressing these limitations, allowing business owners to run their business in a more effective and strategic way.

The mediation analysis proves that the connection between AI-based digital tools and entrepreneurial performance is mediated by the operational efficiency, which validates Hypothesis 7. This conclusion implies that AI technologies are added to the enhanced entrepreneurial performance through the effectiveness of the business operation. By implementing AI-based technologies, entrepreneurs will be able to simplify their work processes, manage inventories, and manage customer relations, and, as a result, achieve higher business results.

The other notable study result is the modifying effect of digital literacy. The findings have shown that digital literacy plays an important role in enhancing the correlation between AI-based digital tools and entrepreneurial performance, which confirms Hypothesis 8. The finding emphasizes the role of digital skills in empowering entrepreneurs to use sophisticated technologies. Women entrepreneurs with a high level of digital literacy can use AI-based tools to market their services, manage their finances, and make strategic decisions more effectively. Thus, the advantage of AI technologies is enhanced in cases when entrepreneurs have good digital skills.

The digital skills gap is also illustrated in the discovery that there are numerous developing economies with a digital skills gap. Although the opportunities of AI-based digital tools to the business growth are immense, the entrepreneur. who is not digital literate, might not be able to maximize the benefits of the technology. Thus, enhancing digital literacy of women in business is necessary in order to maximize the positive effects of digital transformation.

All in all, the results of the research can be added to the existing body of knowledge on digital entrepreneurship and female economic empowerment. The findings indicate that technological assets, psychological ability, and digital abilities have a combined impact on the achievement of women entrepreneurs in emerging economies. The study can give a detailed explanation of the impacts of AI technologies on entrepreneurial performance by combining the insights of the Resource-Based View and the Social Cognitive Theory by using several mechanisms.

CONCLUSION

This paper analyzed how AI-based digital applications have influenced the performance of women entrepreneurs in developing countries considering the mediating variables of entrepreneurial self-efficacy and operational efficiency and the moderating variable of digital literacy. The results demonstrate that AI-based digital tools greatly boost the performance of women entrepreneurs by influencing the productivity of the business, allowing them to make decisions based on data, and increase their market opportunities.

Another important finding of the results is that entrepreneurial self-efficacy and operational efficiency are valuable mediating factors using which AI technologies affect the performance of business. The digital applications powered by AI can boost confidence among entrepreneurs in their capacity to handle business operations at the same time increasing the effectiveness of business processes. All these mechanisms result into enhanced entrepreneurial performances.

Additionally, the research shows that digital literacy contributes to enhancing the connection between the digital tools powered by AI and the performance of entrepreneurs. Women entrepreneurs who possess high digital skills are in a better position to use the advanced technologies to their advantage, which increases the beneficial effects of AI technologies to business performance.

All in all, the evidence shows that the adoption of digital technology, entrepreneurial self-efficacy, operational efficiency, and digital literacy strengthening are critical measures that can give more women

entrepreneurs the power to succeed and enable the development of the developing economy in a sustainable manner.

THEORETICAL IMPLICATIONS

The present research has a number of contributions to literature. To start with, it builds upon the Resource-Based View (RBV) by illustrating that AI-based digital tools may be used as strategic technological resources that can increase the entrepreneurial abilities and firms performance.

Second, the paper incorporates the Social Cognitive Theory in the digital entrepreneurship setting by emphasizing the importance of entrepreneurial self-efficacy as a psychological process by which the adoption of technology has an impact on business performance.

Third, the study has added to the body of the literature examining women entrepreneurship by establishing that operational efficiency and digital literacy have been the main factors that affect the usefulness of digital technologies in enhancing business performance.

PRACTICAL IMPLICATIONS

This research provides a number of implications to the policymaker, organization providing support to entrepreneurs and technology providers, which are practical.

To start with, the governments and development agencies must encourage the use of the AI-based digital tools by women entrepreneurs through financial support, training opportunities, and support of digital infrastructure.

Second, entrepreneurship training should aim at strengthening entrepreneurial self-efficacy through mentoring, skills development workshops as well as practical business training programs.

Third, policymakers are advised to invest in digital literacy initiatives so that the women entrepreneurs have the skills to use the digital technologies efficiently.

Lastly, AI tools that are user-friendly and specifically target small businesses and women owners should be created by technology firms and made affordable and accessible.

LIMITATIONS AND FUTURE STUDIES

This study has a number of limitations regardless of its contributions. To begin with, the research design used to conduct the study was a cross-sectional meaning that it could not serve to cause-and-effect links between the variables. The longitudinal research design can be applied in the future to investigate how AI technologies have affected the entrepreneurial performance in the long term.

Second, the research concentrated more on women entrepreneurs in emerging economies. Future researchers can use comparative research of developed and developing nations in order to explore the differences in adoption of digital technologies and entrepreneurial performance.

Third, only two mediating and one moderating variables were considered in the study. The other factors that future research can investigate include innovation capability, entrepreneurial orientation, and access to financial resources.

Lastly, the qualitative or mixed-method research can be employed in the future to learn more about the experiences of women business owners when using AI technologies.

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