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CAN ENTREPRENEURIAL EDUCATION PROMOTE ENTREPRENEURIAL SUCCESS? THE MEDIATING ROLE OF DIGITAL LITERACY

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Abstract:

Small and Medium Enterprises (SMEs) play a crucial role in economic growth, especially in developing countries. Yet, many SMEs face challenges early on, resulting in high failure rates. Despite thorough studies on factors affecting SME success, the influence of entrepreneurial education is still unclear. This thesis explores how entrepreneurial education affects success by looking at the roles of digital literacy. It aims to discover how digital literacy, developed through education, improves entrepreneurial success and suggests ways to enhance entrepreneurial education to better support small and medium-sized enterprises. Based on theories like the theory of Human Capital, Human Value, and Autonomous Learning, this study examines how entrepreneurial education affects success through digital literacy, addressing critical gaps in understanding educational mechanisms that enhance entrepreneurial outcomes. A survey was conducted among 410 entrepreneurs in Shandong, China, to assess their views on how entrepreneurial education has influenced their success. Data was gathered from university graduates who participated in such programs. Mediation analysis was used to see if digital literacy connected entrepreneurial education and entrepreneurial success. The finding shows that entrepreneurial education boosts entrepreneurial success, with digital literacy playing a partial mediating role. Digital literacy partially mediates this effect, meaning that people with strong digital skills—whether learned through

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education or self-directed learning—are more likely to succeed. This study significantly contributes to entrepreneurial behavior and autonomous learning theories, providing valuable insights for educators, policymakers, and entrepreneurs. The findings advocate for curriculum reforms integrating applied digital competencies in entrepreneurship programs and policy initiatives supporting continuous digital upskilling to support small business growth and boost economic development. However, its reliance on quantitative data might overlook the full complexity of technological factors affecting entrepreneurial success. Future research should use qualitative methods to better understand these influences.

Keywords:

Entrepreneurial Education, Entrepreneurial Success, Digital Literacy, Self-Directed Learning, Autonomous Learning

Introduction

Digital technologies are driving the future economy, with increasing demand for technology jobs and positions that require digital skills. Digital literacy is recognized as a crucial component of contemporary educational settings (Khan, 2022; Polizzi, 2020a) and a prerequisite for enhanced personal efficacy (Abdul Jalil Toha, 2021). This proficiency offers significant advantages to both individuals and broader societal structures. It facilitates the evolution of educational institutions into learning organizations and fosters environments conducive to dialogue, collaboration, and reflective practices within professional communities (Caena & Redecker, 2019).

Besides, digital literacy and proficiency in language are essential for candidates to achieve success (Dvorakova & Polents, 2021). Similarly, Harris (2021) asserts that digital literacy is crucial for the success of adults across various domains, including life, academia, and employment (Harris & Adetunji, 2021).

Many literatures have identified the predictors and indicators that influence entrepreneurial success. These factors include personal and contextual/environmental elements. Entrepreneurial education, as a contextual factor, attained increasing attention. However, little research takes entrepreneurs as a sample to explore their perception about the impact of entrepreneurial education on their entrepreneurial success or achievement.

Chandra identified that Entrepreneurship Education and Digital Literacy significantly contribute to the development of Entrepreneurial Competence in individuals (Chandra & Hendayana, 2024). Entrepreneurship education is believed to help individuals develop managerial skills needed to manage business effectively, such as strategic planning, decision-making, and leadership while digital literacy allows individuals to manage business operations efficiently through the use of information and information systems. The main objective is to identify the influence of entrepreneurial education on entrepreneurial success through the mediation of digital literacy because in the era of globalization and rapid technological advancement, aspiring entrepreneurs must possess a profound comprehension of integrating entrepreneurial capabilities with digital literacy to enhance their entrepreneurial achievement.

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By harmonizing these elements, it is anticipated that entrepreneurs will effectively navigate complex business challenges, maximize digital opportunities, and foster innovation within their enterprises.

The following part explained the definition and importance of Entrepreneurial Education, the definition, measurement, the role of Digital Literacy, the definition, different measurements and factors influencing Entrepreneurial Success.

Literature Review

This part explores the current research on the definition and importance of Entrepreneurial Education, the definition and role of Digital Literacy, predictors and indicators for Entrepreneurial Success.

Entrepreneurial Education

Definition and Scope

Entrepreneurial education focuses on equipping individuals with essential skills and mindset to spot, assess, and pursue business ventures. It involves programs that enhance innovation, creativity, risk-taking, self-control, independence, and problem-solving through structured courses and trainings, aiming to nurture future entrepreneurs' abilities.

Importance in Fostering Entrepreneurial Skills and Mindsets

According to Morris et al. (2013), a set of thirteen essential skills is vital for entrepreneurial success. These skills include identifying opportunities, innovative thinking, risk management, determination, resourcefulness, out-of-the-box strategies, value creation, resilience, and networking. Entrepreneurship education significantly contributes to the development of these competencies.

Entrepreneurial success depends on two main categories: environmental factors like financial resources, government aid, social connections, training, and infrastructure (Gupta & Mirchandani, 2018; Ramadani et al., 2015), and personal traits like mindset, education, determination, and dedication (Shen & Huang, 2023). These qualities, including those developed through educational programs, significantly impact an entrepreneur's success.

Research conducted by Liñán et al. (2009) and Fayolle et al. (2014) has demonstrated that entrepreneurial education (EE) cultivates a favorable entrepreneurial mindset, enhances self-efficacy, and heightens the inclination to embark on entrepreneurial endeavors (Liñán, 2009; Fayolle, 2014). Numerous empirical studies have highlighted the positive impact of online entrepreneurial education on cultivating an entrepreneurial mindset. For example, Munawar et al. (2023) examined how online entrepreneurship education, coupled with favorable attitudes and cognitive frameworks, enhances professionals' growth, innovation, and success in Pakistan. Moreover, Munawar also pointed that entrepreneurial attitude showed some influences on the entrepreneurial mindset, which enhances professional growth. And professional growth creates innovation for entrepreneurial success (Munawar et al., 2023). Furthermore, according to Autio et al. (1997) and Krueger and Brazeal (1994), cultivating an entrepreneurial mindset is highly effective in developing the necessary skills for starting a business (Shen & Huang, 2023).

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In conclusion, the entrepreneurship program, as a significant environmental factor, has played a crucial role in fostering students' entrepreneurial skills, mindset, and attitude throughout their entrepreneurial journey.

Digital Literacy

Definition and Dimensions

The definition of digital literacy remains ambiguous, with various terms frequently used interchangeably within the literature to convey the same concept (Falloon, 2020; Parker et al., 2023; Stopar & Bartol, 2019). These include 'information literacy' (Tewell, 2015; Zurkowski), 'computer literacy' (Epperson, 2010; Tsai & Hebert, 2002), 'internet literacy' (Bauer & Mohseni Ahooei, 2018; Harrison & Alvermann, 2018), and 'media literacy' (Christ & Potter, 2006).

According to Law et al. (2018), digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy" (Law et al., 2018). For the purpose of this research, we focus on the definition provided by Cabero (2011). Since the cultivation and enhancement of digital competencies should be integral to lifelong learning (Cabero, 2011), digital literacy involves the capacity to use tech for social change, think critically about its role, and skillfully employ it for learning content creation, and communication (Cabero, 2011). It's often synonymous with digital competence.

The Role of Digital Literacy in Modern Business Environment

According to a quantitative survey including 373 students and 441 practitioners, digital literacy is identified as an essential element for fostering social entrepreneurial intentions and behaviors (Ip, 2024). That means businesses must integrate digital tools for increased efficiency, product innovation, and digital connectivity in order to stay competitive. Consequently, job seekers are expected to develop IT skills and digital know-how. Tatiana (2022) noted that over half of companies struggle with finding adequately skilled personnel, with nearly 40% of hires lacking necessary qualifications due to skill gaps. New graduates and entrepreneurs often lack the required job skills and entrepreneurial competencies (Tatiana, 2022). Besides, the advent of Industry 4.0 has heightened the employer's requirement for specialized technical competencies, particularly in scientific, technological, engineering, and mathematical domains. This requires a fundamental level of digital literacy, which should be cultivated through both primary and continuous education, to enable individuals to effectively utilize emerging technologies and demonstrate flexibility across diverse job roles and economic sectors (Menshikova, et al., 2020; Dvorakova & Polents, 2021).

Entrepreneurial Success

Different Measures of Entrepreneurial Success

Entrepreneurial success is the outcome of entrepreneurial behavior toward achieving set goals (Wang et al., 2022) and it is primarily about reaching established goals, often measured economically. It involves running a registered business and staying in the market.

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Measuring entrepreneurial success is a complex topic with diverse perspectives. Researchers use different methods, such as counting new hires post-launch (Caliendo et al., 2023), focusing on goal attainment and business growth (Rauch & Frese, 2000), and considering both objective measures like financial success and subjective aspects like personal satisfaction (Fisher et al., 2014).

Specifically, Loderer and Peyer (2002) suggest performance metrics such as industry-standard scales, total income, and return on initial investment (Loderer, 2002). Fisher (2014) defines entrepreneurial success as maintaining business operations and market position, emphasizing the significance of non-financial measures (Fisher, 2014). Fried and Tauer's successful index includes expenses, owner time, revenue, and growth (Fried, 2015).

Many literatures agree that success is viewed both objectively and subjectively, with emphasis on personal criteria like satisfaction with business progress and work-life balance (Fisher et al., 2014; Staniewski & Awruk, 2019). According to Wach et al. (2016), entrepreneurial success should consider individual perspectives beyond just wealth (Wach, 2016), and includes factors such as market reception, financial rewards, and autonomy (Orser, 2009; Wach, 2016).

In summary, evaluating entrepreneur success requires considering multiple dimensions due to the complex nature of their ventures. Research by Gorgievski et al (2011). highlights ten criteria, categorizing them into people- and business-related aspects (Gorgievski, 2011). Besides, success is often viewed through organizational and personal lenses, emphasizing its multifaceted nature. Furthermore, Wach et al. (2016) created the Subjective Entrepreneurial Success scales (SES-IS and SES-AS) to gauge success via firm performance, interpersonal relationships, personal contentment, societal contribution, and financial gains (Wach, 2016). These scales were validated in Germany and Poland. Additionally, Angel et al. (2018) recognized personal fulfillment, customer satisfaction, community impact, and business expansion as key elements of entrepreneurial success (Angel, 2018).

Factors Influencing Entrepreneurial Success

The endurance, expansion, and flourishing of entrepreneurial ventures are deeply rooted in understanding entrepreneurial success (Elsafty et al., 2020). Amidst the statistic that only 10% of small enterprises endure beyond their first three years of operation (Vesper, 1990), the attainment of long-term stability, marked by a minimum three-year establishment (Ismail et al., 2015; Taormina, 2007; Vesper, 1990; Watson et al., 1998), represents a significant hurdle. Therefore, academic research in entrepreneurship requires a thorough examination of the factors that drive the sustainable growth of such enterprises.

Entrepreneurial success is determined by a multifaceted array of elements, encompassing self-efficacy, educational background, gender, age, and social environment (Krueger, 2008; Shahab et al., 2018), each contributing significantly (Rohanaraj, 2023). While various scholarly works identify key components such as gender, motivational disposition, practical experience, specialized knowledge, skills, cultural predispositions towards entrepreneurship, a clearly defined concept, meticulous planning, precise target market identification, familial support, strategic location, competitive acumen, effective work-life management, innovation, and formalized business documentation, there remains a divergence of opinion among experts on the primary determinants (Yeoh & Popovič, 2016; Zakaria, 2021).

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The factors influencing entrepreneurial success are often divided into three main types: individual traits, social connections, and broader societal conditions. Some scholars classify them as internal (like personal qualities and organization) and external (finances, society, and environment). Others distinguish between environmental aspects like resources and support, and personal characteristics such as mindset, education, drive, and involvement (Baron, 2007; Gupta & Mirchandani, 2018; Ramadani et al., 2015; Zakaria, 2021). Regardless of how one classifies the influencing factors, entrepreneurial education is increasingly attracting significant attention, which is also the focus of this research.

The Mediating Role of Digital Literacy

The following part explains the mediating role of digital literacy between entrepreneurial education and entrepreneurial success. To be specific, the theoretical basis of digital literacy as a mediator is mentioned and then the existing research on digital literacy's influence on entrepreneurial success is discussed.

Theoretical Basis for Digital Literacy as a Mediator

According to Lifelong Learning Theory, learning should happen across a lifetime and technology is essential for learning today. Without essential skills, adult learners will be left behind (Laal, 2011). Furthermore, Alvin Toffler (1970) argued that illiteracy now transcending traditional literacy skills, demands a lifelong capacity for lifelong learning, unlearning, and reacquisition. This necessitates an expanded understanding of education that incorporates formal, non-formal, and informal learning modalities across various settings (Gewirtz, 2019).

The concept of lifelong learning aligns with the notion that education should transcend conventional boundaries and be actively promoted throughout one's lifetime. Besides, lifelong learning must inherently integrate the acquisition and augmentation of digital competencies (Santos & Gomes, 2024). Meanwhile, digital competence combines technological know-how, skills, and abilities with advanced thinking for ongoing learning (Arango et al., 2020). Moreover, 'Digital Lifelong Learning' highlights the importance of ongoing education In today's fast-changing digital landscape (Europeans, 2019).

Therefore, lifelong digital learning is crucial for fulfilling this need, empowering people to navigate tech, comprehend new tech, and adjust to digital changes. The increasing significance of digital transformation in society and institutions highlights the necessity to enhance digital skills for all age groups (Santos & Gomes, 2024) and companies seeking to compete and innovate in an increasingly digitalized business environment (Magaz-González et al., 2024).

Existing Research on Digital Literacy's Impact on Entrepreneurial Success

Small and medium businesses need digital literacy to boost their operations and sales. Being digitally literate enhances technical, managerial, social, and entrepreneurial skills (Sariwulan et al., 2020). Sariwulan's (2020) finding showed that digital literacy had the greatest influence on the performance of SME entrepreneurs, both directly and indirectly (Sariwulan et al., 2020). Similarly, Hiranya Dissanayake (2023) revealed a positive relationship between Digital Financial Literacy and entrepreneurial performance (Dissanayake et al., 2023). Besides, Shiyu Ji (2023) also identified that digital literacy has a significant positive impact on the entrepreneurial performance of rural households (Ji & Zhuang, 2023). Furthermore, R. Meutia Fransiska (2024) reviewed that SEM can unlock their potential,boosting entrepreneurial

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success and contributing to sustainable economic growth globally by improving digital literacy (R. Meutia Fransiska, 2024).

Theoretical Framework and Hypothesis Development

This part explains the conceptual model and how the hypotheses are proposed.

Conceptual Model

The following model shows the relationships between entrepreneurial education, digital literacy, and entrepreneurial success and there are four hypotheses in this research (shown in Figure 1).

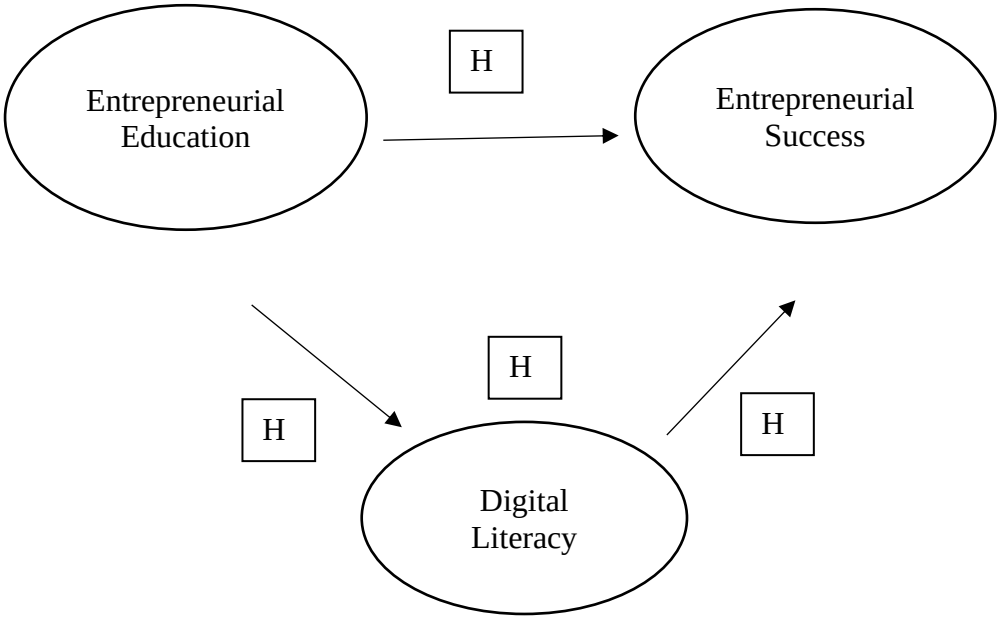

Figure 1: Hypothesized Model

Hypotheses Formulation

In order to identify the direct/indirect relationship between Entrepreneurial education, digital literacy and entrepreneurial success, and verify the mediating role of digital literacy, this research proposes four hypotheses.

Hypothesis 1: Entrepreneurial education is positively related to entrepreneurial success.
Hypothesis 2: Entrepreneurial education is positively related to digital literacy.
Hypothesis 2: Digital literacy is positively related to entrepreneurial success.
Hypothesis 3: Digital literacy mediates the relationship between entrepreneurial education and entrepreneurial success.

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Methodology

Research Design

This study utilized a retrospective research methodology and a retrospective study investigates outcomes specified at the beginning of a study by looking backward at data collected from previous patients which is usually used in the medical area (Powell & Sweeting, 2015). This research aimed to request participants (entrepreneurs) to reflect on their learnings from entrepreneurial education and reassess the critical factors contributing to the success of their entrepreneurial endeavors (success).

Quantitative survey methodology and structural equation modeling were also employed. SPSS 26.0 (Statistical Package for the Social Sciences) was used to key in each respondent's response for a pilot study analysis and Smartpls 4.0 was used for formal data analysis.

Data Collection

Sample and Population

The research employed online surveys through Wenjuanxing for efficient data collection, the sample proportion for this study should be at least 383 entrepreneurs with the assistance of one free online sample size calculator which is based on the Morris Hamburg (1985)'s method (Hamburg, 1985). The survey respondents selected for this study were university graduates who already owned/started a company and were between 23-37 years old. Since there are 17 cities in Shandong Province, more than 23 people needed to be surveyed in each city. Random sampling was used based on the accessibility of the target population. The study population was drawn from various sources, encompassing business directories such as the Yellow Pages and exclusive private networks. Besides, this research sought the help of faculty members from the university's admissions and placement department to distribute questionnaires to their graduates who owned a company. Snowball sampling can also be used which proved effective in analyzing distinctive or select demographics, such as entrepreneurs (Christie et al., 2000).

Data Collection Methods

Furthermore, the data were gathered from June 2024 to August 2024. Since the original draft of the questionnaire was in English, the English version of the scales was translated into Chinese by a bilingual researcher and translated back again by an independent researcher. This questionnaire was tested by the experts and peers of the project members and modified before the first pilot test. Considering the Podsakoff, MacKenzie (2003)'s approach to reduce the possibility of common method bias (CMB), the participation of the entrepreneurs was voluntary, and confidentially of their responses were assured.

Measures and Instruments

This research uses reliable and valid maturity scales from various sources to ensure accurate results. It adopts scales related to entrepreneurship education, digital literacy, and entrepreneurial success to suit university graduates and alumna entrepreneurs, creating a tailored research scale. Alumni entrepreneurs then rate the items based on their actual experiences. This study's measurements involve a questionnaire divided into four parts. Section one collects demographic information like age, gender, major, and business tenure. Section two evaluates entrepreneurial education based on learning, inspiration, and access to

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resources through a 5-point Likert scale. Section three assesses digital literacy with 26 items on a 5-point scale. Lastly, Section Four measures entrepreneurial success from personal and organizational viewpoints on a 5-point scale.

The Measurement for Entrepreneurial Education (EE)

This section identified the benefits of entrepreneurship education, using a 22-item scale from Johannisson (1991) and Souitaris et al. (2007), identified by Tariq Ahmed (2015) (Johannisson, 1991; Ahmed, 2015; Souitaris, 2007). The Cronbach's alpha coefficient of this scale was 0.911(shown in Table 1), indicating that the scale has good reliability.

Table 1: Cronbach's Alpha of Variables

Variables	Cronbach's Alpha	N of Items
	.968	72
Entrepreneurial Education	.911	22
Entrepreneurial Success	.897	24
Digital Literacy	.888	26

Source: SPSS 26.0

The study assesses entrepreneurship education's impact through three subsections, namely, learning, inspiration and access to incubation resources. First, according to Johannisson (1991), the first subsection-learning can be categorized into five levels: values and motivation, abilities and skills, social skills and networks, experience, and intuition (Johannisson, 1991), which evaluates if educational learning enhances entrepreneurial skills via the five aspects-values, motivation, skills, networks, and experience-rated on a 5-point scale (1=not at all, 5=to a large extent). The second subsection, "Entrepreneurship Education Inspiration Benefits," includes six items to evaluate how program events inspire graduates to pursue entrepreneurship. This is measured through Yes/No responses and a 5-point Likert scale to assess the impact on career aspirations. Inspiration, which drives creativity and motivation toward new goals (Branzei & Zietsma, 2003; Isabella, 1990), is a key element of entrepreneurship education. To measure this, Souitaris et al. (2007) developed a scale asking students to identify program events that influenced their entrepreneurial ambitions. Participants respond using a 5-point Likert scale (1=not at all to 5=more than ten times) to gauge how these experiences shaped their career decisions.

The final subsection, 'Access to Incubator Resources' draws upon the reflections of graduates on their resource experiences, which lists eleven benefits. Respondents were requested to rate their familiarity with the eleven resources provided during such programs on a five-point scale (from 1=never to 5=frequently, more than ten times)

The Measurement for Entrepreneurial Success (ES)

This research adopted the Subjective Entrepreneurial Success Scale, originally developed by Dej (2010), Gorgievski (2009), Augustin&Wegge (2009), to assess entrepreneurial success. This scale evaluated the significance of various entrepreneurial success criteria and the extent to which these criteria have been achieved, taking a psychological perspective. Besides, the scale has been extensively used in prior research to evaluate both the importance and the

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achievement of entrepreneurial success (Wach et al., 2016; Wach et al., 2020). A total of 24 items are employed, using a 5-point Likert scale.

In the measurement, participants indicate their success over the past year in achieving the criteria across five facets: company performance (5 items), workplace relationships (6 items), community impact (3 items), personal financial rewards (2 items), and personal fulfillment/balance (8 items). Responses for the importance of success criteria range from 1=not important at all to 5=very important, with an example item being, "I think innovation is important for a company." For achievement, respondents assess their success on a scale from 1=not achieved at all to 5=very well achieved, exemplified by the item, "In the past year, I achieved work-life balance." The results showed that the overall Cronbach's α coefficient of the Entrepreneurial Success scale is 0.897 (shown in Table 1), and the scale has good reliability.

The Measurement for Digital Literacy (DL)

Numerous efforts have been made to create digital literacy frameworks, including the European Commission's DigComp 2.0 by Van den Brande et al. (2016) and UNESCO (2018)'s Digital Literacy Global Framework (DLGF) by Law et al. (2018) and so on (Hammoda & Foli, 2024).

This research adopted Profile of Digital Competence by Ambar Arango (2020) with 26 items in total to measure digital literacy. There are 6 dimensions for Digital Competence, such as digital knowledge, information management, individual digital communication, collective digital communication, networked collaborative learning, and network leadership. The digital competencies framework encompasses questions related to utilizing technology for task execution, problem-solving, communication, and information management. Additionally, it addresses ethical behavior, collaborative efforts, the creation and sharing of digital content, and engagement in social networking platforms (Arango et al., 2020). A 6-point Likert scale was used, in which participants responded according to the degree of agreement in the statement, in which 1=totally disagree and 6=totally agree. The whole measurement has a 0.882 reliability.

Data Analysis Techniques

Data analysis was conducted using Structural Equation Modeling (PLS-SEM 4.0) software and SPSS 26.0. Since this is a quantitative study, statistical programs were utilized. The data were examined using descriptive statistics, exploratory factor analyses, confirmatory factor analyses, internal consistency reliability, indicator loadings, convergent validity and discriminant validity. Among them, descriptive statistics and exploratory factor analyses were analyzed by SPSS 26.0 because SmartPLS don't have detailed descriptive statistics reporting and does not perform EFA, and the other data were verified by SmartPLS 4.0.

Specifically, descriptive statistics were initially conducted on the demographic data of the respondents and the assertions within their respective latent variables. Subsequently, factor analysis, Cronbach's Alpha (CA), Composite Reliability (CR), convergent validity (AVE), and discriminant validity (HTMT) for the measurement model were evaluated. Finally, to assess the structural equation model, the coefficient of determination (R^2), effect size (F^2), and path coefficients were calculated using SmartPLS 4.0.

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Results

Descriptive Statistics

This research targeted Chinese university graduates who have completed entrepreneurship programs and had owned their own businesses. Since there are around 70 colleges in Shandong, including 45 public and 21 private ones, along with 84 vocational schools, the study surveyed 413 student entrepreneurs, receiving 410 valid responses (99.3% response rate). The demographics were evenly split between 54.6% male and 45.4% female participants (Table 2). Most respondents were aged 24-36 (65.6%), with 33.9% under 23. Respondents varied in academic level, with undergraduates and those below accounting for 31.7% and 47.3%, while master's and doctoral students made up 13.7% and 7.3%. The majority (34.1%) were from humanities and social sciences, followed by natural sciences at 22.4%.

Table 2: Demographic Information

Demographic Constructs	Option	Frequency (n=410)	Percentage (%)
Gender	Male	224	54.60%
	Female	186	45.40%
	Other (third gender)	0	0.00%
Age	Under 23 years old	139	33.90%
	24-36 years old	269	65.60%
	Over 37 years old	2	0.50%
Highest education level	Below Undergraduate	130	31.70%
	Bachelor's degree	194	47.30%
	Master's degree	56	13.70%
	Doctorate	30	7.30%
College major	Natural sciences	92	22.40%
	Humanities and Social Sciences	140	34.10%
	Agricultural Sciences	43	10.50%
	Medical Sciences	51	12.40%
	Engineering and Technology	84	20.50%

Hypothesis Testing

To examine the mediating role of digital literacy between entrepreneurial education and success, this study initially outlined the direct and indirect effects. Subsequently, structural equation modeling (SEM) was employed to assess the mediating effect. Finally, bootstrapping was utilized to determine the significance of the mediation (p-value). The hypotheses of this research were assessed by examining the path coefficients (β), t-value, p-value through structural equation modelling using the PLS algorithm.

The first section of the hypotheses (shown in Table 3) reported the analyses being conducted on the direct relationship between entrepreneurial education, digital literacy and entrepreneurial success. The second section of the hypotheses testing (shown in Table 4)

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reported the analyses on the indirect relationship between entrepreneurial education and entrepreneurial success by digital literacy.

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Table 3: Hypothesis Testing Direct Effects

Hypotheses	Relationship	Std.Beta	STDEV	T values	P values	PCI LL 5%	PCI UL 95%	F^2	Results
H1	EE -> ES	0.299	0.043	6.899	0.000	0.227	0.369	0.106	supported
H2	EE -> DL	0.594	0.037	16.222	0.000	0.532	0.652	0.544	supported
H3	DL -> ES	0.390	0.043	9.027	0.000	0.319	0.461	0.197	supported

Note: This research uses 95% confidence interval and one-tailed type with a bootstrapping of 5,000. The study's research hypotheses were tested based on the values of the t-stats as prescribed by Hair et al.(2013). They suggest that t-stat values must be>1.645 and p-values<0.05(Hair, 2013).

Table 4: Hypothesis Testing Indirect Effects

Hypotheses	Relationship	Std.Beta (>0.05)	Standard deviation (STDEV)	T values	P values	PCI LL 5%	PCI UL 95%	V^2	Results
H4	EE -> DL -> ES	0.232	0.033	7.048	0.000	0.180	0.287	0.054	supported

Note: This research uses 95% confidence interval and one-tailed type with a bootstrapping of 5,000.The study's research hypotheses were tested based on the values of the t-stats as prescribed by Hair et al.(2013). They suggest that t-stat values must be>1.645 and p-values < 0.05(Hair, 2013)

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Discussion

Interpretation of Results

This research has identified the direct relationship (shown in Table 3) between Entrepreneurial Education and Digital Literacy (β=0.594, t=16.222, p=0.000), Digital Literacy and Entrepreneurial Success (β=0.390, t=9.027, p=0.000), which showed that Entrepreneurial Education (EE) is positively related to Digital Literacy (DL) and Digital Literacy is positively related to Entrepreneurial Success. The relationship between EE and DL is in line with the previous research which pointed out that 72.73% of responses regarded teachers as the most influential element in helping them gain digital literacy skills (Snyder, 2024) and Digital literacy obtained through educational institutions at various levels, as part of foundational education and further honed in continuous vocational training, empowers individuals to effectively utilize emerging technologies and transition between diverse job roles and economic sectors (Dvorakova, 2021).

The relationship between DL and ES is supported by previous studies that digital literacy is essential for adults' success in all areas of life, and ICT competencies (digital literacy) are critical skills that help achieve specific objectives, contributing to the success of entrepreneurship (Chou & Lin, 2024; Dvorakova & Polents, 2021; Ip, 2024; Harris & Adetunji, 2021; Jim et al., 2024).

Based on Table 4, the mediation analysis was conducted to assess the mediating role of digital literacy on the relationship between entrepreneurial education and entrepreneurial success. The total effect of entrepreneurial education on entrepreneurial success was statistically significant (β=0.299, t=6.899, p=0.000). Upon incorporating digital literacy as the mediating variable (β=0.232, t=7.048, p=0.000), the impact of entrepreneurial education on entrepreneurial success remained significant. Furthermore, the indirect effect of entrepreneurial education on entrepreneurial success through digital literacy was also found to be significant (β>0.1, t>1.86, p<0.05).

To assess the strength of the mediation, the variance accounted for (VAF) was calculated in accordance with the guidelines provided by Hair (2013). The VAF is determined using the formula: (indirect effect / total effect)*100. As per Hair et al. (2013), VAF values can be interpreted as follows: VAF greater than 80% signifies full mediation, VAF between 20% and 80% indicates partial mediation, and VAF less than 20% suggests no mediation. As shown in Table 5, the VAF=0.232/0.531*100=43.69, which means a partial mediation.

Therefore, based on the data provided in Table 3, Table 4 and Table 5, it concluded that digital literacy (DL) appeared to be a mediator and had a partial mediation effect between entrepreneurial education (EE) and entrepreneurial success (ES).

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Table 5: Meditation Role of Digital Literacy

Total effect		Direct effect			Indirect effect			
EE-ES		EE-ES			EE-DL-ES			
β	P-value	β	T-value	P-value	β	SD	T-value	P-value
0.531	0.000	0.299	6.899	0.000	0.232	0.033	7.048	0.000

Variance accounted for(VAF)	43.69% Partial Mediation
VAF=0.232/0.531*100=43.69	VAF=43.69%(partial mediation effect)

Note: EE: Entrepreneurial Education ; ES: Entrepreneurial Success ; DL: Digital Literacy

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Implications for Theory and Practice

Contributions to the Fields of Entrepreneurship, Education, and Digital Literacy

This research has theoretical, practical contributions and methodological implications to entrepreneurship and entrepreneurial education, offering new insights into entrepreneurs' behavior, and success.

Theoretically, this study demonstrates how digital literacy, beyond technical skills, contributes to critical thinking, adaptability, and success in entrepreneurial contexts, thereby enriching the human value theory with a modern lens that emphasizes the value of digital competence.

Practically, this research identified that Digital Literacy is a key factor that directly impacts entrepreneurial success. The strong direct effect of Digital Literacy (β=0.390) emphasizes the critical role of digital skills in entrepreneurial success. In today's digital world, entrepreneurs need to be adept at using technology for marketing, communication, financial management, and developing their businesses. Methodologically, this research highlighted the need for future studies to consider how digital education and technology integration within entrepreneurial education impact success, possibly requiring updated tools to measure digital competencies.

Practical Recommendations for Educators, Policymakers, and Entrepreneurs

This research recommended that it would be beneficial to integrate digital literacy into entrepreneurial education. Given its significant impact, educational programs should emphasize digital literacy as a core component. Courses on digital marketing, e-commerce, data analysis, and technology adoption can be valuable for aspiring entrepreneurs.

Limitations and Future Research

Primarily, the geographical limitation of the study, confined to Shandong Province, China, may restrict the applicability of the findings to other regions or nations. Secondly, the retrospective methodology introduces recall bias, as entrepreneurs were required to reflect on past educational experiences, possibly idealizing or undervaluing them based on their present success. Additionally, the swift advancement of digital literacy implies that the skills recalled by participants could already be obsolete, highlighting the need for further investigation into how contemporary educational programs are adapting to technological advancements.

Conclusion

Entrepreneurial Education (EE) has a direct effect on Entrepreneurial Success (0.299), as well as an indirect effect through Learner Autonomy (0.089) and Digital Literacy (0.232). Digital Literacy (DL) is a complete and pronounced mediator between EE and ES. In other words, if one individual has a high digital literacy cultivated by entrepreneurial education or by self-directed learning, one will be more likely to achieve entrepreneurial success. Therefore, higher institutions and all kinds of universities are supposed to strengthen the outcome of entrepreneurial education and upgrade new skills and knowledge such as digital literacy for students.

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