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Digital Literacy and Lifelong Learning Disposition as Drivers of Innovative Work Behavior and Higher Education Performance: A Mediated Moderation Framework"

Shahid Mehmood*

School of Business Management, University utara Malaysia, Malaysia

Abstract

Cyber entrepreneurship, facilitated by advancements in information technology, represents a transformative form of entrepreneurship. Despite the pivotal role of innovative work behavior and higher education performance in driving the success of IT entrepreneurs, there is limited research on the connection between digital literacy and the innovative capacity of employees. Addressing this gap, this study examines the influence of lifelong learning dispositions on digital literacy and its outcomes. Drawing on the social exchange theory (SET), the research employs a partial least squares algorithm to analyze data collected from 245 IT entrepreneurs working at Malaysia Cyberjaya IT Park. The findings reveal that digital literacy significantly enhances innovative work behavior and higher education performance. Furthermore, lifelong learning disposition mediates the relationship between digital literacy and these outcomes. Additionally, creative thinking and resistance to change moderate the impact of lifelong learning disposition on innovative work behavior and higher education performance. The study discusses how these insights contribute to understanding innovative work behavior and performance, providing actionable strategies for organizations to address these critical factors in workforce development.

Keywords

Resistance to Change, Creative Thinking, Digital Literacy, Innovative Work Behavior, Higher Education Performance, Social Exchange Theory.

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1. Introduction

To make meaningful contributions to society, higher education institutions must maintain and elevate their performance levels (Iqbal et al., 2023). National and international university rankings offer insights into organizational effectiveness, highlighting institutions that excel in growth and adaptation over time (Muslim et al., 2024). As digital education gains global momentum, higher education must embrace digital advancement to remain relevant. Digital integration in education, involving the use of technology across various educational functions, has become vital for organizational management and enhancing performance (Iglesias-Pradas et al., 2021). Creative work behavior, encompassing behaviors driven by organizational creativity, promotes more innovative practices (Ferdinan & Lindawati, 2021). Innovative work behavior is characterized by exploring new opportunities, generating ideas, and developing products or methods that foster change or improve current approaches (El Said, 2021). This behavior can be further divided into stages, such as idea generation and implementation (Pilonato & Monfardini, 2020; Strelan et al., 2020), or into three stages—idea generation, promotion, and realization (Gonzalez et al., 2020). Educational practices, shaped by institutional philosophies, affect classroom activities, teaching methods, assessment tools, and classroom organization (Ben Ghrbeia & Alzubi, 2024). Digital literacy in higher education, especially through critical thinking and adaptive learning styles, accelerates academic success (Marín & Castaneda, 2023). Additionally, higher education plays a key role in fostering innovation and creativity, which are crucial for universities' ability to develop new approaches to teaching and learning (Erdem et al., 2023). As universities implement digital innovations to enhance educational

*Corresponding author: e-mail addresses: shahid_mehmood@oyagsb.uum.edu.my (S. Mehmood)

quality, they also incorporate big data analytic capabilities, significantly influencing overall performance (Peng & Yu, 2022; Tinmaz et al., 2022). Given the dynamic nature of the educational landscape, continuous adaptation and change have become essential to sustaining progress (Kesici, 2022). However, many organizations struggle to implement change effectively due to procedural complexities and employee resistance (Doeze Jager et al., 2022; Malhotra et al., 2021; Rehman et al., 2021).

In the 21st century, critical and creative thinking are essential skills in education (Pinkow, 2023). Critical thinking encourages individuals to act intentionally, evaluate, analyze, and discuss various perspectives, relying on logic and reasoning to interpret and judge information (Copeland, 2023; Kiraga, 2023). (Mursid et al., 2022) further describe critical thinking as a self-regulatory process that emphasizes interpretation, analysis, and evaluation based on clear conceptual and methodological considerations. Creativity, meanwhile, enhances adaptability and enables individuals to develop unique, practical solutions to challenges, ultimately supporting meaningful progress (Kesici, 2022); (Chen et al., 2022). Lifelong learning is another crucial element in this context, defined as knowledge that permeates all aspects of life and spans an individual's entire lifespan (Rawas, 2024). Lifelong learning enables networks to continuously learn from sequential tasks and incorporate new knowledge into an existing base without replacing prior knowledge (Çetin & Demirtaş, 2022; Kesici, 2022). Given the growing need for a knowledge-based economy, the lifelong learning approach has become increasingly essential in education (Eynon & Malmberg, 2021). This study explores the influence of digital literacy on lifelong learning disposition, innovative work behavior, and higher education performance. The following research questions arise from this study's objectives:

How does digital literacy impact lifelong learning disposition?
How does lifelong learning disposition mediate the relationship between digital literacy and innovative work behavior?
How does lifelong learning disposition mediate the relationship between digital literacy and higher education performance?
How does resistance to change moderate the relationship between lifelong learning disposition and innovative work behavior?
How does resistance to change moderate the relationship between lifelong learning disposition and higher education performance?
How does creative thinking moderate the relationship between lifelong learning disposition and innovative work behavior?
How does creative thinking moderate the relationship between lifelong learning disposition and higher education performance?

The theoretical framework of this study is grounded in Social Exchange Theory (SET), a sociological and psychological model that explains human relationships through cost-benefit analysis. Developed by (Cropanzano et al., 2017), SET posits that individuals weigh the advantages of social interactions, such as support and companionship, against potential drawbacks, like time and energy. SET emphasizes minimizing negative impacts while maximizing positive ones, with the likelihood of maintaining relationships when benefits outweigh costs. Key concepts in SET include the "comparison level," based on previous experiences, and the "comparison level for alternatives," which assesses potential alternatives' advantages. This study examines digital literacy, innovative work behavior, higher education performance, lifelong learning disposition, resistance to change, and creative thinking, utilizing data from 245 IT entrepreneurs at Cyberjaya IT Park, Malaysia. The data is analyzed using structural equation modeling (SEM) to determine digital literacy's direct impact on lifelong learning disposition, along with the moderating effects of resistance to change and creative thinking. This research offers valuable insights into how digital literacy, innovative behavior, and lifelong learning dispositions influence the adaptability and performance of IT entrepreneurs, contributing to entrepreneurial ecosystems that value adaptability, innovation, and lifelong learning.

These findings are relevant to educational institutions, policymakers, and organizations aiming to nurture an environment supportive of continuous learning and innovation. The paper is structured as follows: first, SET and digital literacy are integrated into the theoretical framework. Next, the proposed research model and hypotheses are discussed. Following the results, the paper discusses findings and implications, concluding with a summary and future directions.

2. Literature Review

2.1. Social Exchange Theory

Social Exchange Theory (SET) posits that employees are inclined to reciprocate the resources and benefits offered by their organization, directly influencing engagement and motivation levels (Arsawan et al., 2020). SET suggests that employees are motivated to engage when the organization provides financial and psychological support. In contrast, when organizations fail to meet these expectations by limiting training, job security, or promotional opportunities, employee disengagement can increase (Cropanzano et al., 2017). SET thus provides a useful lens to explore how digital literacy influences lifelong learning disposition and, in turn, innovative work behavior and academic performance in higher education. This framework helps in understanding how digital literacy directly impacts lifelong learning, the mediating role of lifelong learning between digital literacy and innovative work behavior, and the moderating effects of resistance to change and creative thinking. Digital literacy supports lifelong learning disposition by equipping individuals to continuously engage in new learning opportunities that nurture growth and adaptability. By maintaining digital literacy as a priority, organizations can retain skilled employees, addressing challenges such as workforce retention. Social Exchange Theory further indicates that employees may adhere to established routines when faced with high job demands unless reassured of organizational reciprocity and fair reward (Cook et al., 2013). This mutual commitment supports a psychological contract where employees anticipate future rewards, and the organization acknowledges its obligations. Many studies have explored organizational policies through this theoretical framework, underscoring the importance of career development, job security, and employee engagement strategies (Arsawan et al., 2020; Cook et al., 2013; Cropanzano et al., 2017).

2.2. Digital Literacy for Innovative Work Behavior

Digital literacy encompasses not only the effective use of digital technologies but also an understanding of associated ethical, legal, and security risks. Lifelong learning through digital literacy brings various social and personal benefits (Kesici, 2022). Innovative work behavior (IWB) is an individual characteristic likely to emerge in work environments that foster an innovation-oriented culture (Afsar & Umrani, 2020). IWB is crucial to achieving organizational sustainability and competitive advantage (Khan et al., 2020). In competitive industries, organizations require employees to engage in IWB to meet customer needs and maintain market relevance, beyond research and development alone (Ferdinan & Lindawati, 2021; Kwon & Kim, 2020). This is in addition to research and development. Given that businesses depend on a variety of actors to promote creative work practices, (Grošelj et al., 2020). IWB involves organizational skills, openness to innovation, and resilience in implementing new ideas. For example, IWB consists of four interconnected actions: problem recognition, idea generation, idea promotion, and idea realization (Arsawan et al., 2020).

The first steps, problem recognition and idea generation, initiate the innovation process. The latter steps, idea promotion and realization, allow the practical application of innovative concepts. Research suggests that employees who engage in IWB contribute to their organizations beyond regular job expectations (Montani et al., 2020). (Ferdinan & Lindawati, 2021) note that IWB positively correlates with task performance. Learning environments that encourage creative thinking and problem-solving are essential for adapting to students' varied abilities (Akram et al., 2020; Santoso et al., 2019). Instructors should foster environments where students can cultivate these skills. This finding aligns

with the assertion that developing critical thinking skills is essential for modern educational settings (Ahmad et al., 2022). Critical thinking skills equip learners to address the complexities of today's dynamic world (Pinkow, 2023), especially within science and engineering fields (Afsar & Umrani, 2020; Santoso et al., 2019). While digital tools provide a valuable virtual environment, challenges arise, such as cyberbullying, cyberattacks, and digital addiction (Arsawan et al., 2020). Users must also navigate copyright, plagiarism, and ethical considerations in using digital resources (Marín & Castaneda, 2023). Digital literacy thus requires understanding and adherence to these parameters.

2.3. Digital Literacy for Higher Educational Performance

In the modern era, digital literacy is a foundational skill. It enables individuals to gather, evaluate, and apply digital information effectively, transforming it into meaningful insights (Muslim et al., 2024). A digitally literate individual can utilize technology to create and organize information. it is difficult to guarantee that graduates of higher education institutions are digitally literate (Marín & Castaneda, 2023). Many organizations argue that higher education does not adequately prepare graduates with sufficient digital literacy (Erdem et al., 2023). (Ferdinan & Lindawati, 2021) define digital literacy as an array of competencies for effectively using digital tools to access, assess, and synthesize information. Digital literacy encompasses the capacity to use information and communication technologies (ICT) for understanding and conveying digital information. Few studies have yet analyzed the factors influencing digital literacy, leaving room for exploration (Oh et al., 2021; Tinmaz et al., 2022). Digital literacy also supports students' effective engagement with online learning platforms, now integral to higher education. Many institutions rely on digital tools such as online forums, quizzes, and virtual classrooms, which require a foundational level of digital proficiency. Students with strong digital literacy can maximize these resources, enhancing their interaction with peers and instructors and deepening their understanding of course content (Kesici, 2022). This flexibility enriches the learning experience, allowing students to engage with material outside traditional classroom settings. Educational success is significantly influenced by digital literacy, which promotes learning autonomy, adaptability, and engagement. Digital literacy education is essential in addressing modern digital challenges. Effective educational design is necessary to enhance students' digital literacy; without it, learners may struggle to attain the required competencies (Alanoglu et al., 2022). As technology evolves, learning systems must adapt to meet changing needs (Reddy et al., 2020). (Liu et al., 2020) propose that achieving digital literacy requires flexibility, engagement, and familiarity with cloud-based and location-based learning platforms. Such digital capabilities enable learners to benefit from digital literacy, expanding their opportunities for social and professional growth, innovation, and creativity.

3. Research Model and Hypothesis

Technology, particularly digital technology, plays an increasingly vital role in educational settings, with digital literacy emerging as a key factor in facilitating adaptability to scientific and technical advancements (Liu et al., 2020). Educational goals increasingly focus on developing individuals capable of adapting to change and fostering innovation, necessitating educators with strong digital literacy skills. Digital literacy has gained substantial attention as a crucial twenty-first-century competency, crucial for navigating electronic technologies used in both social and educational domains (Alanoglu et al., 2022; Kesici, 2022). It encompasses the skills to gather, synthesize, and communicate accurate information effectively, as well as the responsible use of technology within the teaching and learning process (Peng & Yu, 2022). Digital literacy is defined as a combination of abilities including creativity, collaboration, communication, critical thinking, problem-solving, decision-making, and a comprehensive understanding of technological concepts (Tinmaz et al., 2022). In a digital age where instructors are expected to exhibit high levels of digital literacy, they play a key role in equipping students with the necessary skills for the twenty-first century (Erdem et al., 2023). This digital competency is directly linked to lifelong learning processes, enabling individuals to identify their learning needs, recognize opportunities, and address challenges to achieve success in

continuous learning (Marín & Castaneda, 2023). The competences of lifelong learning encompass 21st century abilities, as can be shown by looking at these competencies (Mursid et al., 2022). The relationship between lifelong learning and essential twenty-first-century skills is foundational, including problem-solving, critical thinking, decision-making, communication, information literacy, adaptability, and global competencies (Eynon & Malmberg, 2021). Lifelong learning demands individuals who can adapt to change, apply information to solve arising challenges, and continually acquire new knowledge (Sumarni & Kadarwati, 2020). Effective learning activities serve as the core of lifelong learning competencies, utilizing various learning approaches: surface, deep, and strategic (Bilgiç et al., 2021). Surface learning emphasizes memorization for immediate application, strategic learning focuses on goal achievement, and deep learning fosters enduring knowledge through meaningful connections (Cropley & Knapper, 2021; El Said, 2021; Eynon & Malmberg, 2021; Karatas et al., 2021).

H1: Digital literacy positively influences lifelong learning disposition

Lifelong learning is a concept encompassing learning across all age groups and at every stage of life, beginning from the moment an individual enters the educational process (Liu et al., 2020). While society often associates lifelong learning with adult education, this understanding only partially reflects its true scope. Students acquire foundational competencies during formal education, enabling them to assimilate new knowledge effectively in the future (Eynon & Malmberg, 2021). In contemporary education, knowledge and skills evolve rapidly, necessitating continual learning. Studies emphasize the importance of identifying individuals' lifelong learning levels and tendencies (Eynon & Malmberg, 2021; Karatas et al., 2021). Lifelong learning intersects with several critical factors. For instance, (Cropley & Knapper, 2021) identify a positive association between lifelong learning and innovative behavior, while (Karatas et al., 2021) explore its relationship with occupational self-efficacy. (Matsumoto-Royo et al., 2021) examine its connection to self-efficacy in 21st-century skills and digital education standards. Additionally, communication satisfaction and information literacy have been linked to lifelong learning (Huang, 2015). Findings consistently reveal favorable correlations between lifelong learning and various factors such as innovation, self-efficacy, and digital literacy. Structuring curricula to provide knowledge and skills that foster lifelong learning is essential at all educational levels (Rawas, 2024). Regarding the usage of digital tools, digital literacy is an approach that seeks to put people in a position where they can utilize technologies efficiently and employ new techniques to use tools to address problems (Oh et al., 2021). The increasing digitization of industries has elevated the importance of digital literacy, defined as the ability to utilize digital tools efficiently and develop innovative solutions. This competency extends beyond basic technical skills to include problem-solving and critical application of knowledge (Marín & Castaneda, 2023). Digital literacy also encompasses locating, assessing, synthesizing, and generating information using technology (Alanoglu et al., 2022). It equips individuals to evaluate the reliability of information and share insights effectively (Reddy et al., 2020). Furthermore, digital literacy incorporates higher-order thinking skills such as analysis, synthesis, evaluation, and creative problem-solving (Santoso et al., 2019).

Innovative work behavior encompasses activities that extend beyond the creation of new products within research and development, applying to the organization as a whole. Innovation involves changes and the development or application of ideas that are novel at the organizational, national, global, and industry levels (Afsar & Umrani, 2020). Creativity serves as the foundation for new ideas, partially influenced by organizational management, though individual contributions often result in unique designs (Akram et al., 2020). Globalization has introduced challenges and opportunities arising from diverse cultures, requiring contemporary organizations to address these complexities effectively. Innovative work behavior is considered vital for organizations seeking to excel in competitive global markets (Afsar et al., 2021). Developing new knowledge, skills, and technologies depends on fostering innovative thinking and creating environments that encourage such behaviors (Arsawan et al., 2020).

The capacity for generating novel solutions is influenced by individuals' knowledge, experience, and their ability to apply both in addressing new challenges (Grošelj et al., 2020).

Innovative work behavior involves the intentional initiation and implementation of new ideas, processes, and procedures across individual roles, groups, and organizations (Khan et al., 2020). This behavior comprises concept creation, concept marketing, and idea realization. The initial phase involves developing fresh, practical, and beneficial ideas, followed by marketing these ideas to gain support and resources. Building coalitions is an essential component, enabling individuals to find partners with the necessary skills and assets to advance the ideas. Finally, a prototype or model is developed, allowing individuals or organizational units to integrate the concept into routine activities (Kwon & Kim, 2020). In higher education, the concept of organizational performance is multifaceted, with scholars divided on its assessment. Financial metrics are often highlighted, but other non-financial dimensions, such as innovation, research, operational efficiency, service delivery, internationalization, and governance, are equally emphasized (Afsar et al., 2021; Ahmad et al., 2022); (Ferdinan & Lindawati, 2021; Pinkow, 2023). Globally, teaching, research, and service have been identified as key indicators of university organizational success (Arsawan et al., 2020). Educational performance, particularly in higher education, is measured by outcomes related to teaching and learning objectives (Kwon & Kim, 2020; Montani et al., 2020; Muslim et al., 2024).

H2: Lifelong learning disposition mediates the relationship between digital literacy and innovative work behavior.
H3: Lifelong learning disposition mediates the relationship between digital literacy and higher education performance.

Change represents the distinction between old and new ways of thinking (Doeze Jager et al., 2022). Resistance to change reflects actions by employees aimed at maintaining the status quo and avoiding adjustments to new processes or systems (Cropanzano et al., 2017; White et al., 2020). In IT organizations, resistance to transitioning from older systems to innovative ones is often attributed to employees' preferences for comfort zones (Turgut & Neuhaus, 2020). New and creative systems frequently face opposition due to their perceived disruption of familiar patterns (Arsawan et al., 2020). To mitigate resistance, organizations need to focus on employee education, skill enhancement, and motivational strategies, enabling smoother transitions to innovative systems (Warrick, 2023). Addressing resistance to change is essential for fostering positive behavioral intentions and promoting the adoption of advanced technologies. Evidence indicates that resistance to change adversely affects the integration of innovative technologies, undermining organizational competitiveness and growth (Huang, 2015). The development of knowledge, skills, and abilities required for lifelong learning is a fundamental capability in the 21st century, driven by rapid societal and technological transformations (Srivastava & Agrawal, 2020). Lifelong learning is characterized as a continuous process of acquiring and applying knowledge, skills, and values across various roles and contexts (White et al., 2020). This concept encompasses not only the assimilation of new information but also the retention and application of prior learning (Malhotra et al., 2021). Resistance to change has long been a central issue in organizational research, particularly due to its potential impact on long-term competitive advantages (Alanoglu et al., 2022; Doeze Jager et al., 2022; Malhotra et al., 2021; Rehman et al., 2021). While resistance is generally viewed as a challenge to efficiency and effectiveness, some perspectives suggest that it may occasionally act as a trigger for constructive discussions and improvements. Nonetheless, mainstream assumptions emphasize its disruptive effects on organizational processes. Resistance to change is often described as an almost universal response to required modifications, reflecting inherent tendencies and personality traits (Turgut & Neuhaus, 2020). One of the primary barriers to adopting new IT systems in organizations has been identified as resistance to change, underscoring its influence on technological innovation and overall operational success (Huang, 2015).

Personality traits play a significant role in the adoption of innovative systems. Extraversion has been observed to moderate the impact of computer-assisted communication on team decision-making

performance, while openness to experience strongly correlates with the acceptance of new IT systems (Srivastava & Agrawal, 2020). Lifelong learning encompasses ongoing educational activities aimed at enhancing knowledge, skills, and competencies across personal, social, and professional contexts. The rapidly changing demands of the twenty-first century, shaped by scientific and technological advancements, necessitate a shift in educational approaches and teaching methodologies (Kroth et al., 2022; Tabancali & Öngel, 2022). Educators and pre-service teachers who exhibit a propensity for lifelong learning and self-improvement are more adept at adjusting to change, thus promoting adaptability and acceptance of innovation (Çetin & Demirtaş, 2022; Kesici, 2022). Digital literacy is foundational for success in high-technology industries such as telecommunications and IT, serving as the primary tool for daily operations. It encompasses skills such as synthesizing digital resources, building knowledge, producing media, and facilitating communication, all of which are essential for enabling constructive social action (Liu et al., 2020). Technological innovation significantly influences a company's competitiveness, acting as a driver for organizational survival and growth. Innovation is particularly critical for businesses in technology-driven sectors where the ability to integrate advanced tools and processes determines market success (Huang, 2015; Reddy et al., 2020). Research output of higher education performance" is implied by research performance. (Oh et al., 2021), Performance is the information that is gained during study and shared with others (Gonzalez et al., 2020). Organizational performance, particularly in research output, is closely tied to the effective application of human capital and capabilities. Weak research productivity in organizations is often attributed to factors such as a lack of quality standards, inadequate research skills, and an unbalanced emphasis on teaching versus research (Pilonato & Monfardini, 2020; Strelan et al., 2020). Performance within educational institutions extends beyond academic achievements to include their societal contributions. This third-mission performance captures the benefits provided by higher education to broader communities, although its implementation faces challenges due to the complex interplay of stakeholders (El Said, 2021; Ferdinan & Lindawati, 2021; Iglesias-Pradas et al., 2021; Iqbal et al., 2023).

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H4: Resistance to change moderates the relationship between lifelong learning disposition and innovative work behavior.

H5: Resistance to change moderates the relationship between lifelong learning disposition and higher education performance.

Producing innovative and impactful outcomes requires creative thought, often referred to as "creative thinking" due to its focus on identifying issues and devising multiple, applicable solutions (Pinkow, 2023). Creative thinking can be characterized as a set of cognitive processes employed in response to specific objects, situations, or problems. This encompasses the ability to approach challenges and scenarios using various methods that align with individual capabilities. Creative thinking, as defined, involves generating novel ideas that are both unexpected and beneficial in diverse contexts (Akpur, 2020). It is intrinsically tied to creativity—the ability to generate imaginative concepts, apply innovative developmental approaches, create new entities, or transform existing ones into novel products. (Sumarni & Kadarwati, 2020) describe it as a distinctive mode of self-expression. Markers of innovative thinking have been extensively studied. (Kesici, 2022) identifies five critical dimensions: fluency, flexibility, originality, elaboration, and metaphorical thinking. Fluency denotes the ability to rapidly produce ideas, approaches, solutions, and questions. Flexibility involves generating alternative perspectives by modifying strategies or thought patterns. Originality reflects the capacity to propose unique strategies or concepts that combine elements in unconventional ways. Elaboration pertains to enhancing, refining, or specifying ideas to make them more compelling or applicable (Suyundikova et al., 2021). Finally, metaphorical thinking facilitates forming new connections through analogies or comparisons. Lifelong learning emphasizes personal growth and open-mindedness, essential for living a meaningful life and building sustainable futures. Rooted in humanistic principles, lifelong learning aims to nurture positive attitudes toward continuous development. Individuals can effectively utilize lifelong learning by understanding diverse learning styles and mechanisms that enable acquiring, transforming, and validating knowledge while fostering

adaptability and new behavioral patterns (Bilgiç et al., 2021). Lifelong learners demonstrate openness to change, which enhances their learning capacity, allows them to exceed their potential, and fulfills their educational needs. Curiosity drives lifelong learners, equipping them with the knowledge to exhibit more effective behaviors and habits (Copeland, 2023). The advantages of lifelong learning extend to employability, social participation, and community engagement. Awareness of democratic rights and responsibilities enables individuals to take initiative and adapt to societal changes, preventing social alienation. Lifelong learning also supports self-realization through personal development in areas of interest (Oh et al., 2021; Reddy et al., 2020). The goal is to develop key competencies such as digital skills, entrepreneurship, science and technology proficiency, problem-solving, and critical thinking (Liu et al., 2020). These competencies empower individuals to contribute meaningfully to society and succeed in the business sector (Tinmaz et al., 2022).

Basic skills like learning how to learn, literacy, technological competency, and calculus form the foundation of lifelong learning. Higher-order skills such as self-regulation, critical thinking, and problem-solving further enhance this process (Matsumoto-Royo et al., 2021). However, cognitive skills alone are insufficient for lifelong learning. Affective traits, referred to as dispositions, are equally critical. Lifelong learning disposition reflects an innate inclination to pursue continuous learning and improvement (Bilgiç et al., 2021; Cropley & Knapper, 2021).

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H6: Creative thinking moderates the relationship between lifelong learning disposition and innovative work behavior.

H7: Creative thinking moderates the relationship between lifelong learning disposition and higher education performance.

Figure 1 illustrates the conceptual framework, showcasing the suggested evolution of SET (Social Exchange Theory) and the relationships between lifelong learning disposition, creative thinking, innovative work behavior, and higher education performance.

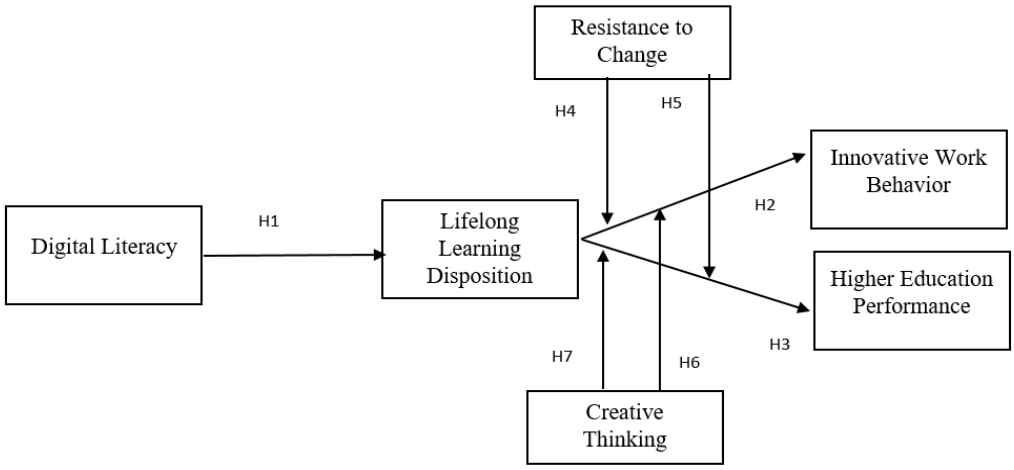

Figure 1: Research model and corresponding hypothesis

4. Methodology

4.1. Data Collection

The data for this study were collected from IT entrepreneurs operating in Cyberjaya IT Park, Malaysia, to test the proposed hypotheses. This location was selected based on its relevance to current

global discussions in academia and industry regarding digital literacy and innovative work behavior. The data collection occurred between July and September 2024, a few months after obtaining the necessary authorization. Online questionnaires were distributed to participants, employing a survey-based approach. This method was chosen due to its effectiveness in examining the relationships between digital literacy, innovative work behavior, and higher education performance, as well as its ability to generate generalizable insights (Muslim et al., 2024; Rawas, 2024). Such an approach is commonly used in management studies exploring behavioral patterns in decision-making contexts (Ben Ghrbeia & Alzubi, 2024; Warrick, 2023). A total of 300 questionnaires were distributed, with 245 fully completed and returned, resulting in a response rate of over 81%. Some questionnaires were not returned, while others were discarded due to incomplete responses. The target population consisted of IT entrepreneurs based in Cyberjaya IT Park, Malaysia, and the study employed a cross-sectional design using primary data collection. Due to challenges in accessing a complete list of IT entrepreneurs in this location, a convenience sampling technique was employed, selecting respondents who agreed to participate. The sample size was calculated using the G*Power 3 software, which determines adequate sample sizes for statistical analyses (Faul et al., 2007). Based on an assumed effect size of 0.40 and an error probability of 5%, the suggested sample size was 158 participants per region. Data were ultimately collected from 245 respondents, exceeding this minimum threshold. Demographic data revealed that 44.8% of respondents were male, 42.4% were female, and 12.6% preferred not to disclose their gender. Respondents aged 20–28 years comprised 31.4%, those aged 28–33 years accounted for 27.3%, 33–41 years made up 18.7%, and those above 41 years represented 22.4%. In terms of education, 10.6% had less than a high school diploma, 31.0% held a high school diploma, 40.4% had a bachelor's degree, 2.0% had a PhD, and 11.8% reported other educational qualifications

Table 1: Descriptive statistics of the sample

Variable	Description	Distribution	%
Gender	Male	110	44.8
	Female	104	42.4
	Prefer not to say	31	12.6
	Total	245	100.0
Age	20-28 Years	77	31.4
	28-33 Years	67	27.3
	33-41 Years	46	18.7
	Above 41	55	22.4
	Total	245	100.0
Education	Less than high school	26	10.6
	High school diploma	76	31.0
	Bachelor's Degree	99	40.4
	PhD	15	2.0
	Others	29	11.8
	Total	245	100.0

4.2. Data Analysis

The collected data were analyzed using partial least squares structural equation modeling (PLS-SEM). This method is suitable for estimating complex relationships between latent variables and is widely used in information systems (IS) and management research (Hair et al., 2024). A two-stage process was followed to evaluate the measurement and structural models. The measurement model's quality was assessed through internal consistency, convergent validity, discriminant validity, and item reliability. Item reliability was evaluated using item loadings, retaining items with loadings above 0.7.

Internal consistency reliability was assessed using Cronbach's alpha (α) and composite reliability (CR), with acceptable values ranging from 0.6 to 0.95. Convergent validity was determined using the Average Variance Extracted (AVE), accepting values of 0.5 or higher as indicative of adequate construct validity. Discriminant validity was evaluated using the Fornell-Larcker criterion. The structural model was assessed by examining path coefficients, standardized root mean squared residual (SRMR) for model fit, R^2 values for endogenous variables, and collinearity diagnostics. Variance inflation factors (VIFs) were calculated to detect multicollinearity, with values below 5 indicating acceptable levels. The significance of path coefficients was determined using p-values, with values below 0.05 considered statistically significant. Predictive accuracy was verified using cross-validated redundancy (Q^2), with values above zero confirming the model's accuracy. SmartPLS 3.0 software was used for all measurement and structural model evaluations.

5. Results

5.1. Measurement Model Assessment Results

The validity and reliability of the constructs were evaluated through an assessment of the reflective measurement model. The analysis focused on four key dimensions as outlined by prior studies (Hair et al., 2024).

1. **Outer Loadings:** Item loadings above 0.7 indicate sufficient reliability.
2. **Variance Inflation Factor (VIF**): VIF values below 5 confirm the absence of multicollinearity issues.
3. **Internal Consistency Reliability**: Assessed using Cronbach's alpha (α), rho_A, and composite reliability (CR), with acceptable thresholds starting at 0.7.
4. **Convergent Validity:** Evaluated through the Average Variance Extracted (AVE), with a minimum threshold of 0.5.

The evaluation results of the measurement model are presented in Table 2. The findings indicate that the majority of the measurement model satisfies the required evaluation criteria. All outer loadings exceed 0.7, demonstrating sufficient item reliability. AVE values surpass the threshold of 0.5, confirming convergent validity. Internal consistency and reliability are established across all constructs, with Cronbach's alpha and composite reliability values ranging between 0.6 and 0.95.

Table 2: Assessment results of measurement Model

Construct definitions, measurement scales, and reliability & validity assessment results	**Items Loading**	**VIF**
Creative Thinking (Mursid et al., 2022): the discovery of unique Ideas. α=0.863; CR=0.898; AVE=0.596		
Self-Discipline	0.726	1.719
Flexibility	0.778	2.134
Innovation search	0.807	2.460
Inquisitive	0.828	2.393
Courage	0.775	1.937
Uniqueness	0.709	1.819
Digital Literacy: the ability to use technologies to find, evaluate, create and communicate information. α=0.849; CR=0.889; AVE=0.578		
I share research findings or news that are currently viral.	0.734	1.646
When I suddenly want to know something for academic purposes, I immediately find out by searching the internet	0.828	2.767
I refer to online materials to support the threefold missions of higher education	0.873	3.214
I am an expert in surfing the internet in order to support	0.766	1.925

academic purposes		
In order to find out specific terminology in searching for a specific database, I searched through the internet and other digital media	0.800	2.058
I share information digitally only that is proven valid (eg; research results).	0.502	1.233
Higher Education Performance (Ning & Downing, 2012**):** the effectiveness and outcomes of goals. α=0.888; CR=0.911; AVE=0.578		
My college is increasing funding sources beyond the main funding	0.768	2.556
My university has made changes to the existing financial regulation system in each work unit for the better	0.831	2.686
My college increases financial transparency and accountability	0.802	2.853
My college improves financial services to stakeholders	0.730	2.206
Student complaints against this college institution continue to decrease	0.690	1.794
My college is increasing the number of new student applicants	0.783	2.443
My university increases cooperation with international stakeholders	0.663	1.712
My college is increasing the number of new product and service innovations	0.723	1.971
Innovative Work Behavior (Santoso et al., 2019**):** the action to promote new products with organization. α=0.912; CR=0.931; AVE=0.693		
Exploration of ideas	0.771	2.049
Valid Generation of ideas	0.857	3.754
Valid Promote ideas	0.879	3.714
Valid Implementation of ideas	0.814	3.856
Vision of innovation	0.835	4.057
Opportunity oriented	0.835	3.034
Lifelong Learning Dispositions (Bilgiç et al., 2021): attitudes and behaviours throughout a person's life. α=0.913; CR=0.930; AVE=0.623		
I set learning goals according to my own abilities.	0.797	2.397
I prepare the necessary resources for learning in advance	0.804	2.541
Using learning strategies appropriate to the learning subject	0.761	2.008
I believe in the necessity	0.795	2.376
I make a study plan to make good use of my time during the learning process.	0.801	2.664
I am confident that I can learn when I encounter new information.	0.819	2.805
I prefer to motivate myself during the learning process.	0.822	2.674
Trying to learn even if the learning topics are difficult	0.711	1.757
Resistance to Change (Huang, 2015): oppositions of individuals or groups to adopt new process with in organizations. α=0.789; CR=0.864; AVE=0.615		
I am not interested in new mobile learning technological developments.	0.826	1.854
I feel uncomfortable in changing my current learning methods and using mobile technology to learn English.	0.687	1.534
I am not interested to use mobile technology to learn English.	0.783	1.806
I am not used to using mobile technology to learn English.	0.831	1.863

The Fornell-Larcker criterion was applied to confirm discriminant validity. This criterion compares

the square root of each construct's AVE with the correlations among the constructs. Discriminant validity is established when the square root of the AVE for a construct exceeds its correlations with other constructs (refer to Table 3) (Fornell & Larcker, 1981). In the context of Malaysia's Cyber Jaya IT Park, the Fornell-Larcker criterion was validated with statistically significant results, ensuring that the constructs are empirically distinct from one another. Assessing discriminant validity is a critical step in PLS-SEM (partial least squares structural equation modeling), complementing the evaluation of convergent validity to ensure the robustness of the measurement model.

Table 3: Discriminant Validity test using Fornell-Larcker criterion.

	1	2	3	4	5	6
Creative Thinking (1)	0.772					
Digital Literacy (2)	0.681	0.760				
Higher Education Performance (3)	0.728	0.754	0.751			
Innovative Work Behavior (4)	0.664	0.671	0.815	0.833		
Lifelong Learning Disposition (5)	0.596	0.638	0.710	0.775	0.790	
Resistance to Change (6)	0.619	0.715	0.651	0.548	0.479	0.784

5.2. Structural Model Assessment Results

The structural model assessment indicates no significant collinearity issues, as all VIF values remain below the threshold of 5 (refer to Table 2). The path coefficients (β) and their significance levels (p-values) at a 95% confidence level are presented in Table 5. These results were derived using a bootstrapping procedure with 10,000 subsamples to ensure accuracy and reliability. In the African context, hypotheses H1, H2, H3, H4, H5, H6, and H7 yielded p-values greater than 0.05, indicating that the corresponding path coefficients were not statistically significant. For hypotheses to be supported, p-values below 0.05 or t-values exceeding the critical value of 1.96 were required, following established guidelines for structural equation modeling (Hair et al., 2024).

Table 4: Path Coefficients and their Significance

	Hypothesis	Path Coefficients
H1	Digital Literacy -> Lifelong Learning Disposition	-0.638

The structural model results, including path coefficients and the model's explanatory power, are illustrated in Figure 2. The model accounts for 40.7% of the variance in lifelong learning dispositions, as indicated by the R^2 values. Additionally, it explains 68.7% of the variance in higher education performance and 67.3% in innovative work behavior. The model's standardized root mean square residual (SRMR) value, measured at 0.087 in Malaysia's Cyber Jaya IT Park, indicates an acceptable model fit, as it falls below the 0.08 threshold recommended for models with more than 100 observations (Hair et al., 2024). The predictive relevance of the model was further supported by Q^2 values for endogenous constructs, with Q^2 predict values of 0.287 for innovative work behavior and 0.541 for higher education performance, confirming the model's predictive significance.

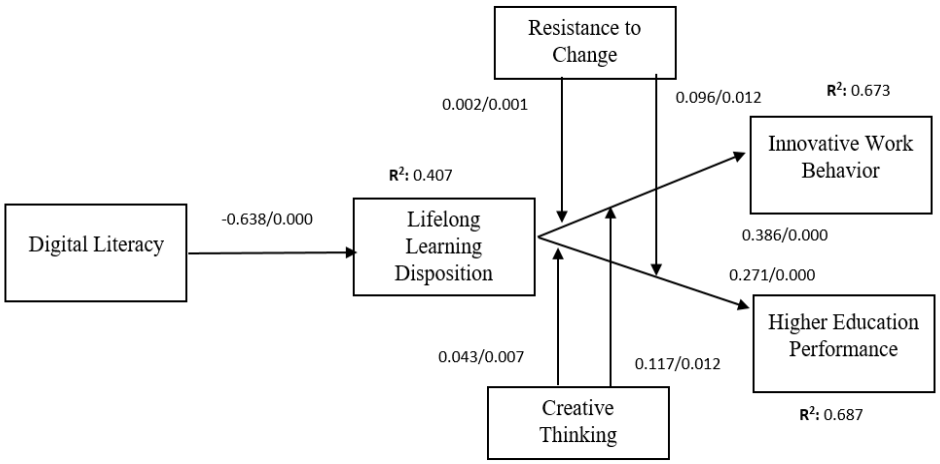

Figure 3: Structural Model Results

The mediation analysis results (see Table 5) reveal that digital literacy has a significant indirect effect on lifelong learning dispositions through innovative work behavior and higher education performance.

Table 5: Mediation Effect Results

	Mediation Relationships	Path Coefficients
H2	Digital Literacy -> Lifelong Learning Disposition -> Innovative Work Behavior	0.386
H3	Digital Literacy -> Lifelong Learning Disposition -> Higher Education Performance	0.271

The moderation analysis results (see Table 6) indicate that resistance to change significantly impacts the indirect effect of lifelong learning dispositions via innovative work behavior and higher education performance. Additionally, creative thinking significantly influences the indirect effect on lifelong learning dispositions through the same pathways.

Table 6: Moderation Effect Results

	Moderation Relationships	Path Coefficients
H4	Lifelong Learning Disposition * Resistance to Change-> Innovative Work Behavior	0.002
H5	Lifelong Learning Disposition * Resistance to Change-> Higher Education Performance	0.096
H6	Lifelong Learning Disposition * Creative Thinking-> Innovative Work Behavior	0.117
H7	Lifelong Learning Disposition * Creative Thinking -> Higher Education Performance	0.043

6. Discussion

The study aimed to provide empirical insights for managers regarding the impact of digital literacy, lifelong learning dispositions, and innovative work behavior on higher education performance. These insights are critical, particularly in addressing challenges such as employee turnover and workplace innovation in the context of phenomena like the Great Resignation. This research draws on social exchange theory (SET) and digital literacy acceptance frameworks to establish the relationships

between these constructs. The findings suggest that innovative workplace behaviors and higher education performance are influenced by digital literacy and lifelong learning dispositions. The study employed PLS algorithms on data from 245 IT enterprises in Malaysia's Cyber Jaya IT Park to test the proposed hypotheses. In the context of Malaysia's Cyber Jaya IT Park, digital literacy was found to be significantly influenced by lifelong learning dispositions. Digital literacy encompasses various competencies, including media, technology-related skills, problem-solving, and information access. This study also investigated the distinction between technical knowledge and cultural literacy, examining their roles in shaping digital citizenship. Recent studies, such as those by (Marín & Castaneda, 2023), indicate that pre-service teachers exhibit higher digital literacy levels. Similarly, (Kesici, 2022) emphasized that educators' integration of digital tools into teaching processes is shaped by their perceptions of these technologies' importance. However, unlike earlier findings, this study suggests that educators' educational philosophies do not directly influence students' digital literacy.

Mediation analysis indicates that lifelong learning dispositions positively influence innovative work behavior and higher education performance. This finding underscores the importance of technologically proficient organizations and the ongoing progress of digitalization in the education sector. Addressing these demands requires standardized digital literacy development programs and robust IT infrastructures. Research by (Peng & Yu, 2022) highlights that digital literacy significantly impacts academic achievement, particularly when integrated into routine campus activities. Furthermore, digital literacy facilitates learning, as noted by (Tinmaz et al., 2022), who identified a connection between higher academic achievement in postsecondary institutions and the possession of digital literacy skills. (Reddy et al., 2020) emphasized that combining digital literacy with operational skills, critical thinking abilities, a dependent learning style, and digital information-gathering skills can accelerate higher education outcomes. Similarly, (Bilgiç et al., 2021) described digital competency as the ability to evaluate, select, and utilize information and data effectively, leveraging technology to address challenges. Enhancing digital literacy and competency requires cultivating problem-solving skills, information management, and the application of innovative work behaviors to achieve higher educational performance. Lifelong learning involves continuous learning aimed at enhancing quality of life, both personally and professionally. It is essential for individuals to embrace lifelong learning to stay ahead in a rapidly evolving and innovation-driven society. Modern society's role as both a producer and consumer of diverse innovations emphasizes the need for individuals to integrate into lifelong learning processes. Digital tools play a vital role in education by serving as effective learning resources in today's information-rich environment. The findings of this study are consistent with literature demonstrating that digital storytelling—linked to digital literacy (Erdem et al., 2023; Marín & Castaneda, 2023; Tinmaz et al., 2022), innovative behavior (Afsar et al., 2021; Kwon & Kim, 2020; Montani et al., 2020), and educational performance (El Said, 2021; Gonzalez et al., 2020; Iqbal et al., 2023)—contributes to the development of creative thinking. (Alanoglu et al., 2022) further emphasized that problem-based learning environments enhance creativity, thereby improving digital literacy.

Moderation analysis revealed that creative thinking significantly influences innovative work behavior and higher education performance. Employees resistant to change may demonstrate lower engagement in lifelong learning if they do not perceive innovative behavior and academic achievement as reflective of their identity. Social exchange theory posits that employees engage in creative work behaviors as a self-enhancement strategy when motivated to regain digital proficiency during organizational transitions. This is particularly evident when employees feel a strong sense of belonging to their organizations. The existing literature highlights conceptual ambiguities in interpreting creative thinking processes, as well as an overemphasis on outcomes while neglecting the mechanisms of engagement in creative processes (Kesici, 2022; Mursid et al., 2022). Creative thinking supports digital literacy by fostering deliberate and analytical use of information and communication technologies. Digital literacy extends beyond competence and usage to encompass digital transformation, which includes innovation and creativity (Akpur, 2020; Sumarni & Kadarwati, 2020). Similarly, innovative work behavior positively correlates with higher education performance and

lifelong learning dispositions. Individuals practicing creativity demonstrate curiosity and adaptability, qualities critical to lifelong learning. This mindset enables them to integrate new information effectively and apply it innovatively, reinforcing their commitment to continuous personal and professional development. Creative thinking also drives novel work practices by encouraging alternative problem-solving approaches, which contribute to cycles of innovation and growth (Ferdinan & Lindawati, 2021; Grošelj et al., 2020). Organizations can enhance employees' lifelong learning and innovative work behavior by cultivating environments that promote creativity. This approach supports overall success and advancement. The relationship between creative thinking and academic achievement highlights its critical role in fostering a proactive approach to learning. Creative thinkers are more likely to engage deeply with academic content, demonstrating flexibility, problem-solving skills, and innovative approaches to complex issues. These attributes are particularly valuable in higher education, where critical and innovative thinking are essential for research and collaborative projects (Kwon & Kim, 2020; Montani et al., 2020). Promoting creative thinking in academic environments can significantly enhance lifelong learning behaviors and improve educational outcomes.

6.1. Implications for Research

This study provides empirical support for the importance of innovative work behaviors in enhancing digital literacy. It expands the existing literature on innovative work behavior, which has been largely confined to literacy, by demonstrating that digital literacy negatively influences dispositions toward lifelong learning (Çetin & Demirtaş, 2022; Kesici, 2022). Additionally, the study shows that evaluating creative thinking offers deeper insights into performance, especially in examining the effects of lifelong learning dispositions on innovative work behavior and higher education performance. It also highlights the importance of assessing resistance to change, which provides valuable insights into performance and the indirect effects of lifelong learning dispositions on innovative work behavior and academic outcomes. These findings suggest areas for future research to explore and emphasize the importance of focusing on these constructs, which have not been widely studied in relation to digital literacy. This could be particularly useful for research in organizations struggling to track and assess employee performance (Liu et al., 2020).

6.2. Implications for Practice

This study offers concrete evidence that promoting digital literacy is essential for fostering innovative work practices and improving academic achievement. it current work trends showing that IT entrepreneurs prioritize positions where digital literacy is emphasized, offering freedom and skill advancement, it is crucial for companies to encourage such behaviors by providing flexible working hours, demonstrating trust, and nurturing a sense of community among staff. Since digital literacy is central to recognizing diverse patterns of information (Bilgiç et al., 2021), it is vital for successful learning and performance in postsecondary education. Based on these findings, organizations should prioritize innovative work behaviors among employees, as digital literacy plays a key role in knowledge-based industries and high-tech companies. Given the fast-paced nature of today's business environment, it is important to emphasize change management as a key corporate goal. To effectively implement change, organizations must prepare employees for transitions. Practically speaking, the importance of digital literacy in enhancing work practices and educational outcomes emphasizes the need for IT entrepreneurs to continually develop their digital skills. Customized training programs and continuous professional development are essential, enabling IT entrepreneurs to enhance creativity and academic success. This dual focus on digital literacy and lifelong learning supports a culture of ongoing improvement and innovation.

6.3. Limitations

Despite adhering to rigorous methodological procedures, the study's use of cross-sectional data presents a limitation. The results reflect only the current situation, which could be a drawback. However, given that the research was conducted shortly after the crisis and the onset of the Great Resignation phenomenon, a longitudinal approach was not deemed relevant at the time. Future studies could benefit from incorporating a longitudinal perspective to further validate the findings. Secondly, the use of convenience sampling in this study may limit the generalizability of the results, as it may not accurately represent the broader population of IT entrepreneurs in Cyber Jaya or beyond. The findings may not be applicable to other sectors or regions with different technological, cultural, or economic conditions. To improve the generalizability of future research, a more diverse and representative sampling strategy should be considered. Including participants from various sectors and industries could provide a broader understanding of digital literacy's impact. Additionally, future studies should replicate this research in other global contexts to compare and contrast the unique characteristics of different regions. Exploring whether the type of IT entrepreneurs who engage in digital work practices mediates the relationship between digital literacy and lifelong learning dispositions would also be a valuable direction for future research. Lastly, while this study utilized quantitative methods, combining these with qualitative approaches could yield a deeper understanding of how innovative work behavior and higher education performance are influenced by digital literacy. Conducting focus groups or interviews could provide more comprehensive insights into the variables driving these relationships.

7. Conclusion

In conclusion, this study highlights the significant impact of digital literacy on innovative work behavior and higher education performance. It also emphasizes the mediating role of lifelong learning dispositions and the moderating roles of resistance to change and creative thinking. First, the study adopts social exchange theory to manage and assess performance, offering IT entrepreneurs an effective control mechanism. It helps management teams secure IT investments and allows employees to achieve higher education performance while maintaining their digital literacy and lifelong learning attitudes. Second, the continuous learning of digital literacy among employees depends on the support of IT entrepreneurs. Lifelong learning dispositions serve as a mediator in this process. For IT entrepreneurs, the moderating effects of resistance to change and creative thinking facilitate the development of lifelong learning dispositions, innovative work behaviors, and higher educational performance. These findings provide empirical support for new approaches that can assist decision-makers in formulating strategies to educate and prepare IT entrepreneurs in the realm of digital literacy through creative work practices. While other studies have focused on business owners who started their ventures using IT or the internet—often referred to as "e-, social-, and techno- entrepreneurs"—this research opens new opportunities for exploring emerging research gaps. These gaps can guide future investigations, offering insights for IT entrepreneurs and organizations to address challenges related to digital literacy and continuous innovation.

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