Journal of Information Systems Engineering and Management
2024, 9(4), 27098
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Empowering Principals for Lifelong Learning: Self-directed Approaches in Digitalized Information Systems

Yuan Zhou [1*], Piyapong Sumettikoon [2]

[1] Ph.D candidate, School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand
[2] Assistant Professor, School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand
* **Corresponding Author:** estheryuan801@gmail.com

Citation: Zhou, Y., & Sumettikoon, P. (2024). Empowering Principals for Lifelong Learning: Self-directed Approaches in Digitalized Information Systems. *Journal of Information Systems Engineering and Management*, 9(4), 27098. https://doi.org/10.55267/iadt.07.15220

ARTICLE INFO

Received: 12 Mar 2024
Accepted: 27 May 2024

ABSTRACT

The study delves into the dynamic interplay between digitalized information systems, competencies, self-directed learning, and lifelong learning in the context of the contemporary educational landscape. With the integration of Artificial Intelligence (AI) and evolving competencies becoming integral to education, understanding their combined impact on individuals' attitudes toward lifelong learning is paramount. Past research has explored these elements individually, but a comprehensive examination of their interconnected relationships remains scarce. The primary purpose is to investigate how AI integration, competencies, and self-directed learning collectively influence lifelong learning attitudes. The study aims to uncover the intricate dynamics by exploring the impact of digitalized information systems on competencies, the mediating role of self-directed learning, and the overall implications for lifelong learning behaviors. Utilizing a quantitative approach, the study focuses on teachers in China, distributing 500 questionnaires and receiving 340 responses. The research design incorporates a cross-sectional survey methodology, employing a structured questionnaire to gather data on AI integration, competencies, self-directed learning, and lifelong learning attitudes. Preliminary findings reveal significant correlations between AI integration, competencies, self-directed learning, and lifelong learning attitudes. The study observes the mediating role of self-directed learning, highlighting its importance in shaping the relationship between digitalized information systems, competencies, and the inclination toward lifelong learning. This research contributes to the theoretical understanding of the complex relationships in contemporary education. Its originality lies in integrating AI integration, competencies, and self-directed learning into a comprehensive framework.

Keywords: Lifelong Learning, Digitalized Information Systems, Competencies, Self-directed Learning, Artificial Intelligence Integration.

INTRODUCTION

Information technologies are at the forefront of the digital revolution (Tang, Toyong, Shahlal, Wei, & Zhang, 2024). Digital technology has revolutionized teaching and learning and enabled tailored and continuing education (A. Abulibdeh, Zaidan, & R. Abulibdeh, 2024). Artificial Intelligence (AI) in educational systems affects accessibility, adaptability, and usefulness. Understanding how digital information systems affect lifelong learning and fundamental abilities is crucial (Castonguay et al., 2023). Modern education is replacing static, static learning environments with technologically advanced, dynamic ecosystems. Digital communication, technical problem-

solving, and digital literacy are crucial for pupils in the digital age (Rubach & Lazarides, 2021). These proficiencies represent a person's digital information system interaction and impact lifetime learning. This research examines how digitalized information systems, skills, and attitudes toward lifelong learning develop and how education is evolving. Growing a culture of continuous learning satisfies the requirements of an information-driven, dynamic society beyond traditional schools (Schweder & Raufelder, 2022). Digital technology's influence on education is increasingly recognized in literature. A. Abulibdeh et al. (2024) recommend integrating AI into adaptive learning environments to tailor knowledge delivery to individual learners. Our technologies improve user experience and lifetime learning and skill acquisition. Education increasingly requires digital literacy, communication, and technology-based problem-solving (Carolus, Augustin, Markus, & Wienrich, 2023). Digital literacy and communication skills are needed in a digital world. Self-directed learning increases curiosity, according to Landberg and Partsch (2023). Studies have connected self-directed learning to academic performance, emphasizing the importance of individual educational paths. According to Morris and Rohs's (2021) empirical research, this study explores how self-directed learning influences views about continuous learning and digital information systems.

Educational research has advanced by studying the complex interaction between digital information systems, skills, self-directed learning, and continuous learning. AI's influence on digital information systems has been extensively examined. Graves (2023) found that AI-tailored learning improved student interest and performance. A meta-analysis by Bressane et al. (2024) found that AI enhanced academic achievement across schools. Our findings have substantial implications for education and lifelong learning, providing the platform for future research. Poláková et al. (2023) identified a link between students' digital adaptability and technological problem-solving. Many scholars have studied digital literacy as a vital ability. Digital literacy helps evaluate and use information, according to Çebi, Bahçekapılı Özdemir, Reisoğlu, and Çolak (2022) found that effective digital communication promotes collaboration and information flow. The findings demonstrate that skills strongly influence digital activity and lifetime learning. Researchers have found several benefits to self-directed learning. Self-directed learning theory stresses learners' resource utilization, goal-setting, and reflection in their work (Schweder & Raufelder, 2022). An empirical research by Aukerman and Chambers Schuldt (2021) examined how self-directed learning affects academic performance and personal growth. Self-directed learning was linked to favorable views about continuous learning.

There is a lot of research, yet many gaps remain. Self-directed learning, digitalized information systems, and skills have not been studied together to determine how they affect everlasting learning. Current research often investigates these aspects separately, ignoring complicated interrelationships. This study examines how digital information systems, self-directed learning, and competencies affect lifelong learning attitudes to better understand the relationships. Most research focuses on specific educational settings and populations. Not considering how the findings may be applied to various cultures, age groups, and occupations is concerning. This study includes more Chinese teachers to lessen this discrepancy. It seeks perspectives beyond Western-centric conceptions to better understand the linkages under study. AI integration and skills affect academic performance, although self-directed learning as a mediator has not been studied. This study examines how self-directed learning mediates psychological processes linking digital information systems, skills, and continuous learning.

This comprehensive study seeks to understand how these elements impact digital lifetime learning attitudes and behaviors. The study will examine how AI integration, accessibility, and information usability affect digitalized information systems. The study also emphasizes computer literacy, problem-solving, and communication. The study also examines how self-directed learning mediates these connections, revealing how people navigate and develop their own lifelong learning routes in highly technologically advanced learning environments. This multimodal study enhances our understanding of current education's multiple processes. Digital age political, philosophical, and pedagogical challenges are influenced by this research. This study will help educators and researchers understand how learning attitudes, skills, and technology enhance theoretical frameworks. The study's findings affect curriculum, interventions, and instruction. Teachers can modify their strategies to foster present learning goals and a lifelong love of learning. The research also examines instructors in China, a diverse population, to challenge Western biases. A cross-cultural viewpoint is essential for creating educational policies and practices for international contexts to promote culturally conscious and inclusive education. Research has broad social ramifications. This research may influence workforce development by identifying the skills needed in a quickly changing employment market, given the current emphasis on adaptation and continuous learning. These findings may be used by policymakers to promote a culture of continual education by encouraging technical problem-solving, self-directed learning, and digital literacy.

LITERATURE REVIEW

Digitalized Information System and Lifelong Learning

The introduction of digital information technologies in schools has revolutionized lifelong learning. Academics and industry specialists are interested in this framework's combination of AI technology, improved information usability, and more system accessibility. The integration of AI in education has been extensively studied by Hamd, Elshami, Al Kawas, Aljuaid, and Abuzaid (2023) and Malik et al. (2023). The study shows how AI-driven systems may change material and delivery to adapt learning experiences for unique students. The dynamic and adaptable qualities of artificial intelligence (AI) technologies make learning more responsive, which may inspire students to learn for life. Digitalized systems' relevant information also affects lifelong learning. Irfan et al. (2021) emphasize the importance of intuitive design and user-friendly interfaces for lifelong learning. Digitalized surroundings that encourage usability make learning easier in an age of perpetual change. This may encourage lifelong learning. Digitalized information systems affect lifelong learning, but using them properly demands awareness. Ulfert-Blank and Schmidt's (2022) scholarly contributions show how online and mobile resources expand learning chances. According to the synthesis of these studies, artificial intelligence, enhanced information usability, and wider access to digitalized information systems help promote lifetime learning capacities (Kumar et al., 2022). Technology and education appear to stimulate lifelong learning and educate pupils for the digital age. The complex relationship between digitalized information systems and lifelong learning shows that combining AI developments with information accessibility and usability could completely change how people approach and participate in lifelong learning (Gürdür Broo, Kaynak, & Sait, 2022). To maximize the benefits of digital technology in fostering a culture of perpetual learning, educators, policymakers, and stakeholders must understand these processes.

H1: Digitalized information system has a significant impact on lifelong learning.

Competencies and Lifelong Learning

Technology-based problem-solving is vital in the digital era. Garzón-Artacho, Sola-Martínez, Romero-Rodríguez, and Gómez-García (2021) believe that overcoming technical problem solving is essential for successful learning in modern schools. Technologically adept people may overcome digital learning system obstacles, creating an atmosphere that encourages learning. This competency goes beyond technical expertise to include digital analytical and critical thinking, giving people the flexibility they need to study throughout their careers. Digital literacy is essential for lifelong learning. Morris and Rohs (2021) demonstrate the complexity of digital literacy in their research. Digital information proficiency requires the capacity to collect, explore, assess, integrate, and ethically use this knowledge. Digitally literate people may use a variety of online resources, evaluate material, and incorporate it into their knowledge. Digital literacy promotes lifelong learning by fostering autonomous and persistent knowledge pursuit. Sabiri (2020) highlight the importance of digital communication skills in 21st-century collaborative and networked learning environments. Digital communication skills go beyond writing letters to include substantial talks across several platforms. Digital communicators improve collaborative learning and build interpersonal skills for networking and information exchange, laying the groundwork for lifelong learning (Cao & AlKubaisy, 2022). The influence of these abilities on continual learning extends beyond academia to professional practice. In an ever-changing workplace, technology problem-solving, digital literacy, and digital communication are vital professional development skills. Benvenuti et al. (2023) emphasize these abilities for organizational adaptation and efficacy. These traits assist professionals facing current job issues which include ongoing professional learning. Self-directed learners set objectives, find resources, and report their learning, according to Landberg and Partsch (2023). Digital problem-solving, reading, and communication enable self-directed learning. These skills allow students to use digital information systems, navigate the wide digital environment, and communicate with peers to develop self-directed learning habits. Kaloyanova and Patias (2023) found that professional adaption requires ongoing learning. Technical problem-solving, digital literacy, and digital communication enable individuals to learn, retrain, and accept new tech. These skills are crucial to lifelong learning. Hence based on the above literature we purpose the following hypothesis.

H2: Competencies have a significant impact on lifelong learning.

Self-directed Learning as a Mediator

Self-directed learning involves digital information systems. Students have more educational resources because of digital libraries, the internet, and mobile apps. Aukerman and Chambers Schuldt (2021) found that digital accessibility promotes self-directed learning. A larger selection of instructional resources allows people to pursue their interests independently, giving them agency and autonomy. AI-digital information system transformation has been studied (Medennikov, 2021; Tiwari, Chugh, & Sharma, 2023). Artificial intelligence

might change education with customized and adaptable learning tools. According to Bertl, Ross, and Draheim (2022), AI-enhanced systems learn user preferences and behaviors. Self-directed learning requires customization so students may study at their own pace and explore areas they like. Information integration in digital systems influences self-directed learning. An easy-to-use interface, navigation, and information retrieval help students manage their education. Ancín, Pindado, and Sánchez (2022) Technology Adoption Model highlights the influence of perceived ease of use on technology adoption and use. Digital systems with good usability make educational resources accessible and user-centric, encouraging self-directed learning. Self-directed learning mediates digitalized information systems and lifelong learning attitudes. According to Leahy, Holland, and Ward (2019), "Self-Directed Learning" is "students taking the initiative and responsibility for their educational experiences." Self-directed learning becomes obvious when the consequences of AI integration, information usability, and accessibility are investigated. It lets pupils fully participate in digital systems. Self-directed students are more likely to enjoy lifelong learning, which is voluntary study outside of formal schooling (Cao & AlKubaisy, 2022). Self-directed Learning helps people adapt to new information, skills, and technologies throughout their lives in the digital age. Sangsawang (2020) study shows that self-directed learning comprises goal-setting, reflection, and metacognition. Self-directed learning in digital information systems allows users to set goals, evaluate their progress, and adapt their approaches, which is essential for lifelong education.

H3: Self-directed learning mediates the relationship between digitalized information systems and lifelong learning.

Self-directed learning and digital competencies like problem-solving, reading, and communication affect continuing learning in today's technology and educational environment. Research on how self-directed learning builds basic skills and a lifelong learning mindset is covered here. Ruiz-Alonso-Bartol, Querrien, Dykstra, Fernández-Mira, and Sánchez-Gutiérrez (2022) found that education requires self-directed learning. Technology-driven problem solving, digital literacy issues, and online communication abilities are all aided by Self-directed learning. Technology's problem-solving power has received attention in the digital era. Robillos (2019) suggest improved technical problem-solvers manage present issues better. As revealed by the research, Self-directed Learning helps people discover and solve technical problems (Logan, Johnson, & Worsham, 2021). Self-directed learning fosters a lifelong proactive learning mentality and improves technology problem-solving abilities. Digital literacy is essential in today's information-rich world. It requires critical thinking and digital information utilization. Self-directed learning helps people develop digital literacy by actively seeking and engaging with digital content. Self-directed learning and digital literacy foster a lifelong love of learning. Wieduwilt, Lehrl, and Anders (2023) say digital communication is crucial in our connected society. One must learn several communication channels and platforms to connect effectively online. Research shows that self-directed learning improves digital communication. Independent digital communication increases communication skills and fosters learning and flexibility in a changing digital environment. Landberg and Partsch (2023) found that self-directed learning is a mentality that promotes continual learning and competency alignment. Self-directed learning to learn digital problem-solving, literacy, and communication fosters a lifelong learning mindset. The findings also show that self-directed learning links specific abilities to lifelong learning and fosters talent development.

H4: Self-directed learning mediates the relationship between competencies and lifelong learning.

We developed the following conceptual framework based on the above discussion and literature review as shown in **Figure 1**.

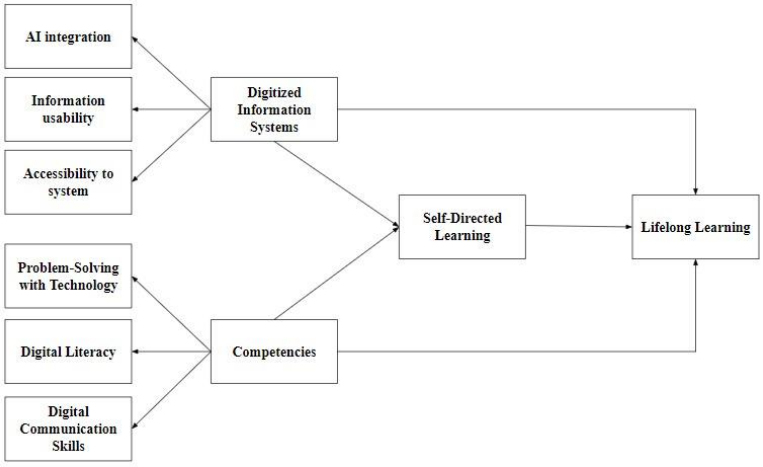

Figure 1. Conceptual Framework

METHODOLOGY

This cross-sectional quantitative study evaluated how self-directed learning mediates the relationship between digital skills and long-term learning. Cross-sectional data can provide a snapshot of participants' perspectives and actions on the variables under study (Logan et al., 2021). A thorough survey was used to obtain data from a diverse sample of people with different professional and educational backgrounds. This method investigated skills, the desire for continued learning, and self-directed learning tendencies over a set time. The study used stratified random sampling for scientific rigor. Educational and vocational stratification was implemented to ensure equitable representation and adjust for demographic disparities. This method collects varied perspectives and experiences to increase applicability. The selected method allowed researchers to study self-directed learning's mediating function and skills' direct effects on lifetime learning. The study used a quantitative approach to discover statistically significant patterns and add to the debate regarding self-directed learning and lifelong learning in the digital age. The study examined teachers at various Chinese educational levels. The research included primary to higher education instructors. Teachers were chosen as the major demographic because they facilitate learning experiences, making their perspectives critical for understanding self-directed learning, digital competencies, and lifelong learning. The research analyzed China's teaching community to learn from educators in a technologically advanced and populous society. This demographic sample technique lets us study how educators, and key stakeholders, perceive and use digital skills. These abilities may also affect instructors' and students' lifetime learning trajectories. The participation of educators from varied backgrounds represented distinct perspectives, challenges, and approaches to digital skills and academic research. It also helps identify disparities in Chinese educational attitudes and methods. The research sought to inform Chinese educational policies and practices that satisfy educators' demands. This study used the rule of thumb, of at least 30 observations per variable for reliable statistical analyses, to establish its sample size. Initial assumptions were that a 90-person sample might assess three crucial traits: digital skills, self-directed learning, and continuous learning. The researchers picked a larger sample size to better grasp the educational landscape's complexity and variety. 500 surveys were sent to Chinese instructors at various levels. To reflect diverse strata and account for varied experiences and opinions, deliberate oversampling was adopted. The larger sample size allowed for a more complete study of variable correlations, improving generalizability. The 68% response rate was achieved by collecting 340 responses from 500 questionnaires. The researchers value this response rate since it shows substantial target population participation, which strengthens the study's findings. The high number of responses demonstrated that Chinese educators valued the study subject. Their perspectives are essential to understanding self-directed learning, digital competencies, and lifelong learning.

Research samples were selected using stratified random sampling. To fulfil study goals, stratified random sampling splits the population into strata based on criteria. This study created strata based on Chinese teaching community educational levels and professional sectors. Stratified random selection was employed to establish a diverse sample of teachers' educational experiences. An independent subpopulation was randomly picked from each stratum due to its population size. This technique allows for deeper study of lifetime, self-directed, and digital skills at all educational and professional levels. The research intended to understand China's educational communities' dynamics by involving all socioeconomic groups. Stratified random sampling improved the precision and reliability of findings, allowing researchers to draw more precise conclusions about academic and professional variable interactions. Data was analyzed using SPSS, a quantitative research program. To determine sample demographics, descriptive statistics were used. This showed notable educational and occupational involvement dispersion. The dataset's main variables and patterns were evaluated using mean scores and standard deviations. The study assessed digital skills, self-directed learning, and lifelong learning using inferential statistics. Correlation analysis determined the variables' direction and intensity. Regression models were then used to examine how digital abilities affect lifetime learning and how self-directed learning mediates this relationship. To determine how much self-directed learning mediates the link between the dependent variable and the independent variable, mediation analysis was utilized. A significance threshold of $p < 0.05$ was utilized to identify significant associations in all studies. Diverse data analysis revealed the complex relationship between digital competencies, self-directed learning, and continuous learning. It also highlighted subtleties regarding Chinese instructors' teaching environments. These studies aim to support digital education policies and practices with scientific evidence. Ethical considerations were paramount throughout the research process, ensuring participants' rights, confidentiality, and the well-being were upheld. Informed consent was obtained, emphasizing voluntary participation and the right to withdraw. Strict confidentiality measures were implemented to protect participants' privacy, with data stored securely and anonymized. Institutional review board approval was obtained, and transparency and honesty were maintained in all interactions. Efforts were made to minimize harm or discomfort to participants, and the study aimed to benefit the academic community and inform educational

practices with responsibility.

RESULTS

The descriptive statistics presented in **Table 1** and **Figure 2** offer a comprehensive overview of four key variables: Digitalized Information System, Competencies, Self-directed Learning, and Lifelong Learning. These variables were assessed among a sample of 340 participants. The digitalized information system variable ranges from a minimum score of 1 to a maximum of 5, with a mean of 3.4 and a standard deviation of 0.888. This suggests a moderate overall level of engagement or satisfaction within the sample regarding digitalized information systems. Similarly, competencies exhibit a comparable pattern, with a mean of 3.42 and a slightly higher standard deviation of 0.919, indicating a relatively consistent but slightly more varied response among participants. Moving on to self-directed learning, the mean score is 3.68, with a higher standard deviation of 1.012, implying a broader range of responses and potentially more diverse perceptions of self-directed learning capabilities among the participants. Finally, lifelong learning has a mean score of 3.57 and a standard deviation of 0.857, showcasing a moderately positive overall sentiment towards lifelong learning with relatively low variability.

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Digitalized Information System	340	1	5	3.4	0.888
Competencies	340	1	5	3.42	0.919
Self-directed Learning	340	1	5	3.68	1.012
Lifelong Learning	340	1	5	3.57	0.857

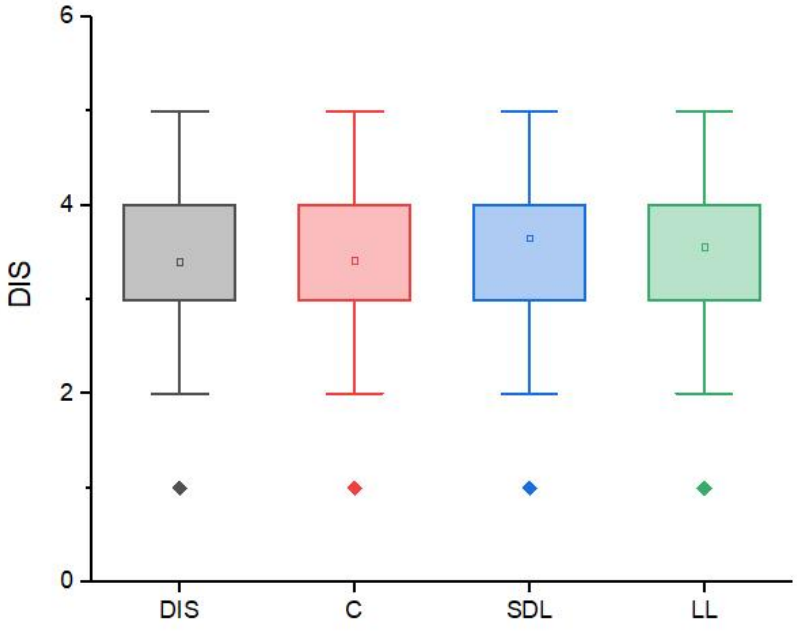

Figure 2. Descriptive Statistics

The normality assessment in **Table 2** and **Figure 3** provides insights into the distribution characteristics of the four key variables. Skewness and kurtosis values are utilized to evaluate departures from a normal distribution. For the Digitalized Information System, the skewness is -0.525, suggesting a slight negative skewness, indicating that the distribution may have a longer left tail. The kurtosis of 0.395 indicates a relatively normal distribution, albeit with a mild tendency towards a more peaked shape. Competencies exhibit a similar pattern with skewness of -0.599, indicating a minor leftward skew, and kurtosis of 0.349, suggesting a distribution with a moderate degree of peak. Self-directed Learning shows a skewness of -0.354, implying a slight leftward skew, and a kurtosis of 0.146, indicating a distribution with a relatively flat peak. Lifelong Learning has a skewness of -0.615,

indicating a mild leftward skew, and a kurtosis of 0.348, suggesting a distribution with a moderate peak.

Table 2. Normality Assessment

	Skewness	Kurtosis
Digitalized Information System	-0.525	0.395
Competencies	-0.599	0.349
Self-directed Learning	-0.354	0.146
Lifelong Learning	-0.615	0.348

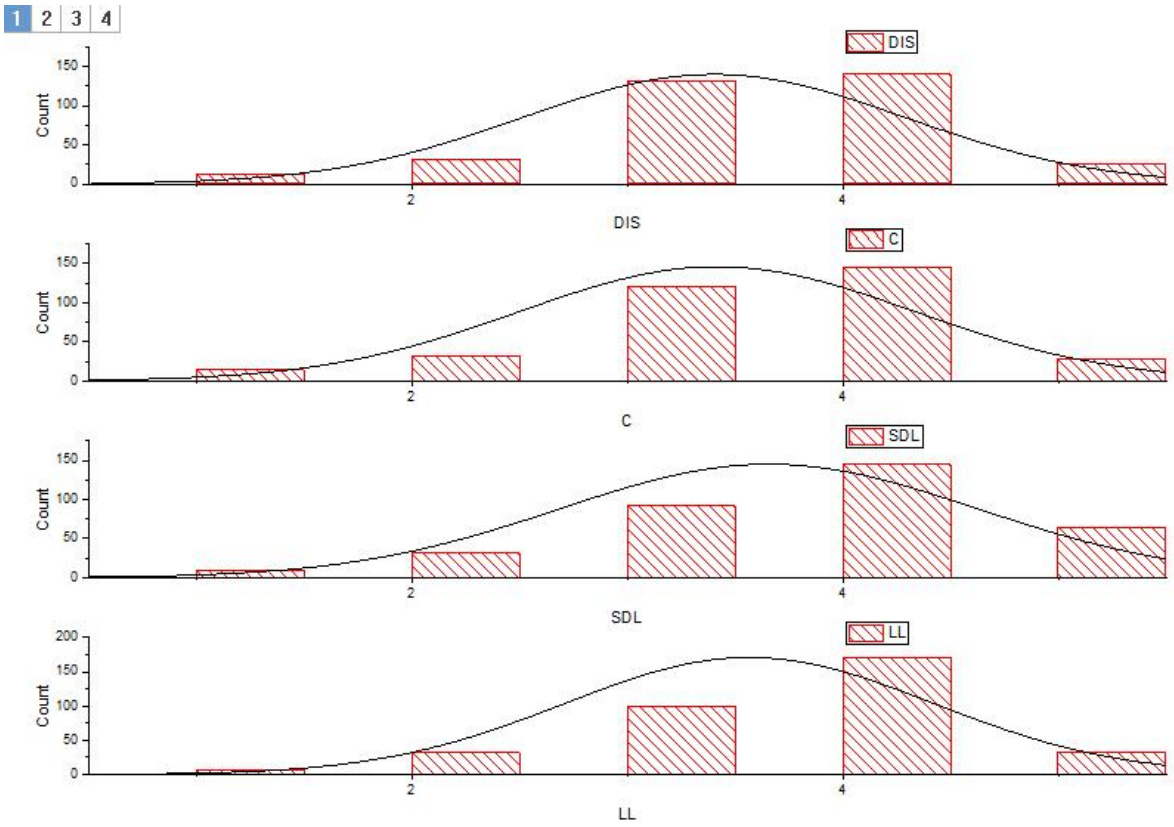

Figure 3. Normality Assessment

Table 3 and **Figure 4** present the results of the correlation analysis among the variables: Digitalized Information System (DIS), Competencies (C), Self-directed Learning (SDL), and Lifelong Learning (LL). The correlation coefficients measure the strength and direction of the relationships between these variables. The correlation between Digitalized Information System and Competencies is notably strong at 0.591**, indicating a positive and statistically significant relationship between these two variables. Similarly, Self-directed Learning demonstrates a substantial correlation with both Digitalized Information System (0.569**) and Competencies (0.678**), suggesting that individuals with higher levels of self-directed learning tend to also exhibit increased engagement with digitalized information systems and possess enhanced competencies. Furthermore, Lifelong Learning shows positive correlations with Digitalized Information Systems (0.481**), Competencies (0.469**), and Self-directed Learning (0.538**). These findings imply that individuals with a propensity for lifelong learning are likely to have higher levels of engagement with digitalized information systems, possess advanced competencies, and exhibit strong self-directed learning capabilities.

Table 3. Correlation Analysis

	DIS	C	SDL	LL
Digitalized Information System	1			
Competencies	.591**	1		
Self-directed Learning	.569**	.678**	1	
Lifelong Learning	.481**	.469**	.538**	1

** Correlation is significant at the 0.01 level (2-tailed).

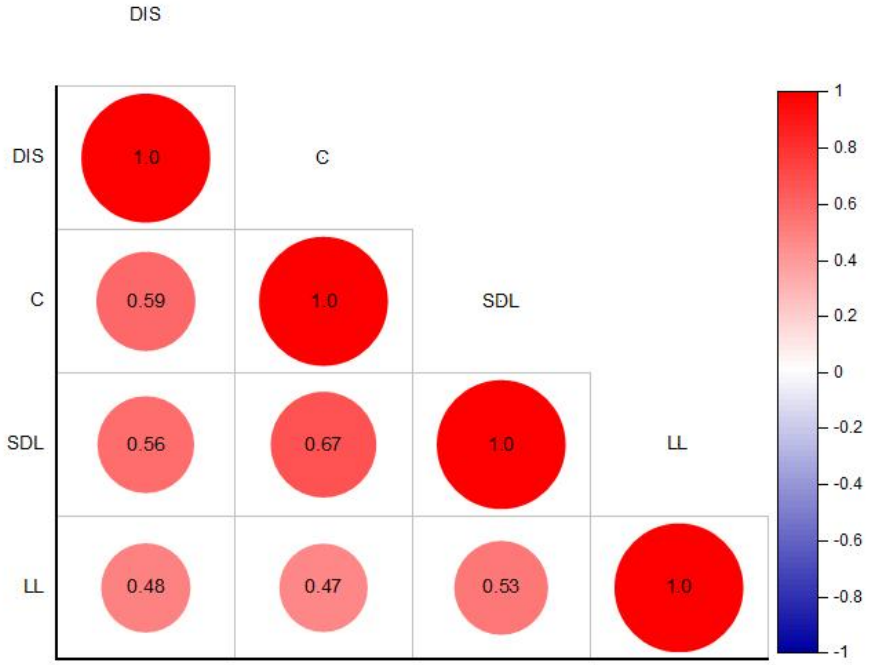

Figure 4. Correlation Analysis

Table 4 presents Cronbach's Alpha coefficients for the four variables. Cronbach's Alpha is a measure of internal consistency, assessing how well the items within each variable correlate with each other. The Digitalized Information System variable demonstrates a high level of internal consistency with a Cronbach's Alpha of 0.868, suggesting that the items related to this construct reliably measure the same underlying concept. Competencies' Cronbach's Alpha is 0.931, indicating considerably more internal consistency. A high correlation between items in this variable implies a strong and trustworthy measurement of competencies in the environment analyzed. With a Cronbach's Alpha of 0.775, Self-directed learning has strong internal consistency. It shows good dependability in assessing self-directed learning, although being lower than the other variables. With a 0.827 Cronbach's Alpha, Lifelong Learning has good internal consistency. Lifelong learning items appear to reliably assess the desired construct. **Table 4**'s strong Cronbach's Alpha values for all variables confirm the study's measuring instruments' internal consistency and reliability for Digitalized Information Systems, Competencies, Self-directed Learning, and Lifelong Learning.

Table 4. Cronbach's Alpha

	Cronbach's Alpha
Digitalized Information System	0.868
Competencies	0.931
Self-directed Learning	0.775
Lifelong Learning	0.827

For the items within each variable, **Table 5** shows the outer loading values. Outer loading in factor analysis measures the strength of each item's link to its concept. The Digitalized Information System items (DIS1–DIS9) have outer loading values from 0.552 to 0.762, which is acceptable. DIS2 and DIS8 exhibit greater outer loading values, indicating a stronger concept relationship. Competencies' items (C1–C12) have high outer loading values of 0.587–0.803. C8 and C9 have the largest outer loading values, indicating a strong relationship between each skill item and the Competencies construct. Self-directed Learning items (SDL1–SDL5) had moderate to high outer loading values (0.577–0.699). SDL1 and SDL3 have the largest outside loading values, indicating their substantial relationship with Self-directed Learning. Lifelong Learning items (LL1–LL5) have good outer loading values (0.622–0.677). LL4 and LL1 have larger outer loading values, indicating a stronger Lifelong Learning construct relationship. The outer loading values in **Table 5** demonstrate the strength and consistency of the relationships between items and constructs, confirming the validity of the measurement model for Digitalized Information System, Competencies, Self-directed Learning, and Lifelong Learning.

Table 5. Outer Loading

Variables	Items	Outer Loading
Digitalized Information System	DIS1	0.552
	DIS2	0.734
	DIS3	0.762
	DIS4	0.669
	DIS5	0.584
	DIS6	0.685
	DIS7	0.620
	DIS8	0.701
	DIS9	0.665
Competencies	C1	0.698
	C2	0.746
	C3	0.777
	C4	0.669
	C5	0.587
	C6	0.635
	C7	0.763
	C8	0.786
	C9	0.803
	C10	0.695
	C11	0.698
	C12	0.601
Self-directed Learning	SDL1	0.699
	SDL2	0.604
	SDL3	0.616
	SDL4	0.596
	SDL5	0.577
Lifelong Learning	LL1	0.677
	LL2	0.622
	LL3	0.625
	LL4	0.673
	LL5	0.667

Table 6 and **Figure 5** show direct route analysis results for two variable association hypotheses (H1 and H2). Digitalized Information System (DIS) and Competencies (C) links to Lifelong Learning (LL) are examined. H1 links Digitalized Information System (DIS) with Lifelong Learning. Beta coefficient of 0.302 shows a positive relationship, while SD of 0.055 demonstrates estimate precision. The statistically significant T value of 5.484 ($p = 0.0001$) supports H1. As involvement with Digitalized Information Systems rises, Lifelong Learning improves, supporting the premise that technology integration promotes continual learning. Hypothesis 2 (H2) examines Competencies (C) and Lifelong Learning. Beta coefficient of 0.265 shows a positive connection, while SD of 0.053 demonstrates precision. Statistically significant T value of 4.980 ($p = 0.0001$) supports H2. This means that those with higher competencies are more likely to engage in lifetime learning, supporting the idea that a stronger skill set encourages continual learning. In conclusion, **Table 6**'s direct path analysis supports the expected correlations. Digitalized Information System and Competencies positively enhance Lifelong Learning, as shown by their positive beta coefficients and substantial T values. This study shows that technology integration and competency development promote a culture of continuous learning in the setting investigated, providing useful insights for practitioners and policymakers seeking to create a learning-oriented workplace.

Table 6. Direct Path Analysis

Hypotheses	Relationship	Beta	SD	T value	P Values	Decision
H1	DIS -> LL	0.302	0.055	5.484	0.0001	Accepted
H2	C-> LL	0.265	0.053	4.980	0.0001	Accepted

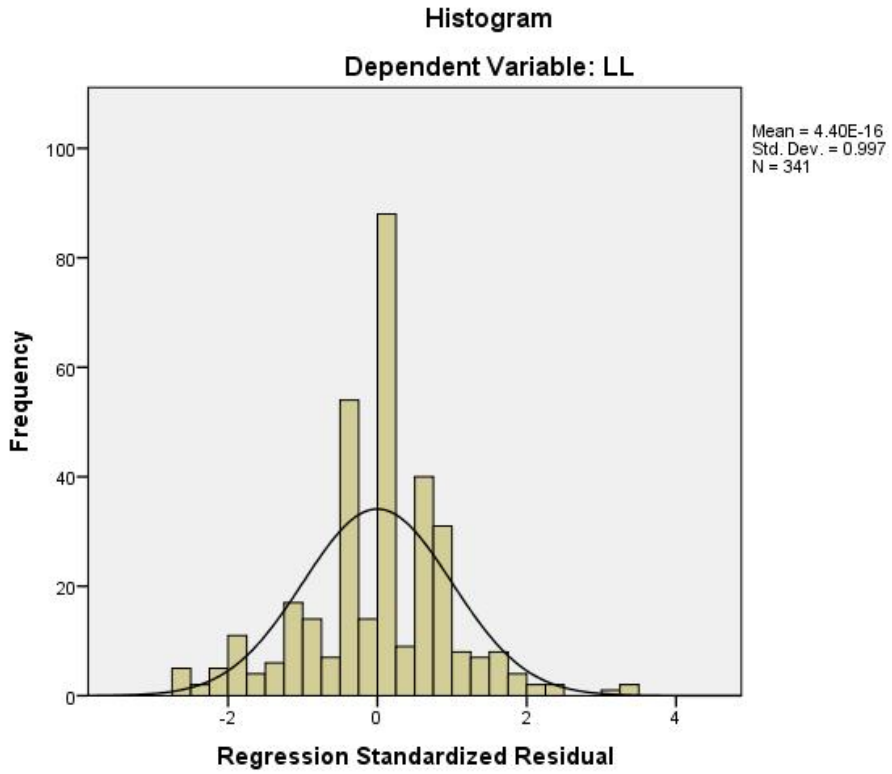

Figure 5. Direct Path Analysis

Self-directed Learning (SDL) mediates the relationships between Digitalized Information System (DIS) and Lifelong Learning (LL) in Hypothesis 3 (H3) and Competencies (C) and Lifelong Learning in Hypothesis 4 (H4), as shown in **Table 7**. H3 states that Self-directed Learning mediates the link between DIS and Lifelong Learning. Beta coefficient 0.214 reveals a positive correlation between DIS and SDL, whereas SD 0.052 indicates accuracy. H3 is supported by the T value of 4.794 (p = 0.0001). This suggests that self-directed learning mediates the favorable effects of digitalized information systems on lifelong learning. Digital system users are more self-directed, which leads to lifelong learning. Hypothesis 4 (H4) analyzes how Self-directed Learning mediates Competencies (C) and Lifelong Learning. A positive correlation between C and SDL is shown by a beta value of 0.257 and an SD of 0.057. H4 is accepted since the T value of 3.140 is significant (p = 0.001). This means that improved competencies encourage self-directed learning, which improves lifelong learning. **Table 7** shows that Self-directed Learning mediates the links between Digitalized Information Systems and Lifelong Learning and Competencies and Lifelong Learning. These findings show that self-directed learning helps technological integration and competency development improve lifetime learning habits. Educational and professional continuous learning initiatives can benefit from this complex knowledge.

Table 7. Mediation Analysis

Hypotheses	Relationship	Beta	SD	T value	P Values	Decision
H3	DIS -> SDL -> LL	0.214	0.052	4.794	0.0001	Accepted
H4	C-> SDL -> LL	0.257	0.057	3.140	0.001	Accepted

DISCUSSION

AI integration, usability, and accessibility of digital information systems affect continuous learning, according to Hypothesis 1. This approach sheds light on the complicated interaction between technology and lifelong learning. This study supports the idea that digital information systems could change education (Mukul & Büyüközkan, 2023). The impact suggests that adding AI technology, making knowledge more helpful, and making it more accessible will motivate people to study for life. Scholarly literature emphasizes the necessity of integrating AI into digital information systems to improve personalized and flexible learning (Hamd et al., 2023;

Malik et al., 2023). AI-integrated systems provide users with more tailored information that suits their learning needs, according to Irfan et al. (2021). Personalization fosters learning outside of traditional educational environments, improving the learning experience. Kumar et al. (2022) also noted that user-friendly interfaces boost information usability. How successfully people obtain and use information depends on how easy digital information systems are to use. The simplicity of use of these platforms makes learning and exploring knowledge easier, which promotes a culture of continual learning. Digital information systems greatly impact lifetime learning, according to the study. Gürdür Broo et al. (2022) stressed the need to make instructional resources available online. The findings suggest that people with better access to digital information systems like mobile platforms and online resources take part in continual learning activities. These findings affect more than academia. Lifelong learning is important in today's digital world of plentiful knowledge and rapid technological progress (Wang, Shang, & Lei, 2023). Modern digital information system users are better able to adapt, learn, and keep up with new information.

Hypothesis 2 shows that digital literacy, technology problem-solving, and digital communication affect lifelong learning. This analysis illustrates how skill sets affect lifelong learning. The data supports the idea that digital abilities transcend beyond subject-specific knowledge. Digital literacy, technology problem-solving, and digital communication affect lifelong learning (Benvenuti et al., 2023). Modern views on problem-solving's complexity match technologically assisted problem-solving's impact on perpetual learning. In the digital age, when technology is pervasive, tech-savvy problem-solvers succeed in school and life. Continuous learning requires adaptability and resilience in a fast-changing technology world (Hidalgo, Parra, & Abril, 2020). Digital literacy's influence on lifelong learning and its rising importance in the 21st century are linked. According to the study, persons with digital literacy, such as the ability to critically evaluate and use digital information, are more likely to learn (Humphries et al., 2019). Bossman and Agyei (2022) stress user-friendly interfaces and digital information system navigation, improve ongoing learning. Digital communication is essential for lifelong learning. Digital communication is more important in today's linked society. Advanced digital communication abilities increase self-expression and encourage cooperation, information sharing, and online learning groups (Ulfert-Blank & Schmidt, 2022). Good digital communication fosters continuing learning and harnesses digital environments' collective intelligence, according to the study. These discoveries affect businesses and society greatly. Problem-solving, digital literacy, and digital communication skills help people advance society in the face of global technology (Garzón-Artacho et al., 2021). Company cultures that encourage these talents are more likely to foster ongoing learning, which boosts adaptability and creativity.

Hypothesis 3 states that self-directed learning mediates the relationship between digitalized information systems and lifelong learning, and reveals complex dynamics in technology use and continuous learning. The study found that self-directed learning preferences reduce digitalized information systems' effects on everlasting learning (Sangsawang, 2020). This complicated interaction emphasizes the need for students to be independent in technology-enhanced learning environments. AI creates a more tailored and adaptive learning environment, according to the study. AI-integrated systems may provide students with individualized information, adaptive tests, and learning routes that match their learning styles (Ancín et al., 2022). Self-directed learning is unique because it lets users customize their learning with AI. Improved information usability and self-directed learning are linked, supporting the idea that user-friendly interfaces and smooth navigation help learners (Leahy et al., 2019). Students are more likely to actively seek and use information when teaching materials are free and promote self-directed research. User-centred digital information systems promote self-directed learning (Aukerman & Chambers Schuldt, 2021). The study found that digital information systems' accessibility encourages self-directed learning. Accessible mobile platforms and internet content expand educational opportunities. Better access encourages experimentation with instructional resources (Medennikov, 2021; Tiwari et al., 2023). Bertl et al. (2022). This shows how accessibility, self-directed learning, and lifelong learning activities are linked. Teachers and politicians value self-directed learning's mediation. It argues that instructors should help students improve their self-directed learning skills in addition to upgrading digital infrastructure. Instructional practices that enable students to set their own learning goals, discover their own materials, and report on their experiences encourage a continuous learning culture.

Hypothesis 4 examines the complex links between skills and lifelong learning, focusing on digital literacy, technology-assisted problem-solving, and communication. According to Ruiz-Alonso-Bartol et al. (2022), self-directed learning mediates this dynamic interplay. The study shows how self-directed learning connects lifetime learning habits and skills, supporting this notion. The mediation effect shows that sophisticated digital communication, technical problem-solving, and digital literacy skills lead to self-directed learning, which affects lifelong learning. This complex interaction shows students' freedom as they apply their talents to grow and shape their learning (Robillos, 2019). First, the study's findings on technological problem-solving reinforce the idea that persons who can solve technical issues can better guide their learning. Technological problem solvers may

overcome obstacles, learn new tools, and learn for life (Logan et al., 2021). When they feel competent and overcome technical challenges, people are more likely to employ self-directed learning practices. Digital literacy promotes self-directed learning, implying that digitally literate people can digest digital information.

Hypothesis 4 also examines the intricate relationships between skills and lifelong learning, concentrating on digital literacy, technology-assisted problem-solving, and communication. Ruiz-Alonso-Bartol et al. (2022) say self-directed learning mediates this dynamic interaction. The study supports this idea by linking lifelong learning habits and skills to self-directed learning. The mediation effect reveals that advanced digital communication, technical problem-solving, and digital literacy abilities promote lifelong self-directed learning. This dynamic interplay displays students' flexibility to use their abilities to influence their learning Robillos (2019). The study's findings on technological problem-solving support the assumption that technical problem-solvers can better direct learning. Technological problem-solvers may overcome challenges, learn new tools, and learn for life (Logan et al., 2021). Self-directed learning is more probable when people feel competent and conquer technical hurdles. Self-directed learning by digitally literate persons implies they can assimilate digital material. Digital literacy involves collecting, utilizing, and critically analyzing information. Digitally literate people can pick fantastic resources for self-directed learning (Wieduwilt et al., 2023). Group learning requires strong communication since independent study and digital communication abilities are linked. Digital communication abilities enable virtual group work, information exchange, and self-expression. Successful digital communicators might join virtual learning groups for lifelong learning and cooperation. The premise that self-directed learning promotes lifelong learning and skills affects educational policy (Landberg & Partsch, 2023). This shows that digital problem-solving, reading, and communication skills are necessary for immediate learning goals and continuing learning satisfaction. Educational therapies that promote these qualities should stress self-directed learning for lifetime learning.

CONCLUSION

The research shows how complicated lifelong learning is in the digital age. Digital information systems' impact on continuous learning, including artificial intelligence integration, usability, and accessibility. This shows how technology development may change people's learning trajectories. As digital technologies advance, humans may learn continuously. Tailoring learning and making instructional materials more accessible make this simpler. The research shows that digital literacy, technology problem-solving, and digital communication foster an environment of continuing education. These talents help people navigate the digital environment by actively pursuing and integrating information from various professions. Competencies encourage self-directed learning, allowing students to control their education and adapt to changing circumstances. Competencies and digital information systems influence lifelong learning through self-directed learning. Self-directed learning links technology's benefits to a commitment to learning. It helps users use digital resources efficiently and attain continual learning goals. These findings have far-reaching policy and educational consequences for the digital age. Educational institutions, politicians, and technology developers must prioritize user-centred, customizable, and accessible digital information systems. To prepare for a digital world, digital communication, literacy, and problem-solving should be prioritized. In order to foster lifelong learning, educational interventions must emphasize the development of students' self-directed learning skills. By encouraging students to take responsibility for their learning, educators may create a culture of continual learning that affects personal and professional life.

IMPLICATIONS

Theoretical Implications

This research increased our theoretical understanding of the relationships between digitalized information systems, skills, self-directed learning, and lifelong learning. The proposed theoretical framework provides educators and researchers with a comprehensive view of digital learning behavior modification. Modern educational ideas and models inform it. By including self-directed learning, the research enhances theoretical frameworks and better understands how individuals navigate the complicated links between digital technology, skills, and lifelong learning. This theoretical advancement provides the platform for additional investigation into the psychological and cognitive mechanisms behind this study's correlations. The study also contributes to the evolving competency debate. The research advances conceptual frameworks by identifying how digital literacy,

technology-assisted problem-solving, and digital communication affect lifelong learning.

Practical Implications

For Educators

This study has several practical applications for education and technology workers, policymakers, and educators. The data can help teachers enhance digital information system-based instruction. Understanding the influence of artificial intelligence, information accessibility and usability, and technology-enhanced learning settings. AI lets educators customize lessons to make learning relevant and engaging. Curriculum development requires identifying digital literacy, technological problem-solving, and digital communication. Customizing courses to build these abilities may help academic institutions prepare students for the digital industry. Practical activities like seminars and training programs may benefit teachers and pupils. Educational techniques would change to match digital needs. The study's focus on self-directed learning as a mediator affects educational interventions.

For Policymakers

Policymakers should consider adding self-directed learning into regular schools to encourage students to take charge of their education. Practical methods like self-paced learning modules and digital literacy courses can promote self-directed learning and continual learning. The report emphasizes the necessity for digital inclusion measures outside of society. Access to digital information systems and closing the digital gap are crucial. Policymakers and technology developers may work together to ensure that information accessibility and artificial intelligence enable people from all socioeconomic backgrounds to study, reducing learning inequities. Organizational contexts are affected by this study. The highlighted competencies can guide training and recruiting initiatives for employers and HR professionals. Companies may hire people with technological problem-solving, digital literacy, and digital communication abilities. This strategy produces tech-savvy workers who are committed to learning.

LIMITATIONS

Despite providing valuable information regarding the intricate interplay between digitalized information systems, skills, self-directed learning, and life-long learning, this research has certain drawbacks that may limit its utility and scope. The study's cross-sectional design, which tracks interactions at one time, is flawed. Longitudinal studies may reveal the long-term durability of the benefits and how these relationships alter over time. The reliance on self-reported survey measures is another drawback. Self-reporting can lead to social desirability effects and response biases, when respondents give positive replies rather than ones that match their experiences. Future research should use mixed- methods like qualitative interviews or observations to better understand people's digital information system abilities and interactions. The study's concentration on Chinese instructors may have limited its application to other cultures. Cultural variations and educational systems may affect how individuals use and improve their digital skills. Doing the study on many populations may help explain how these links occur in different educational and cultural situations and improve the results' external validity. The study also examines how digitalized information systems and skills affect self-directed and lifelong learning. The book does not examine how contextual or external elements may affect these interactions. More research should consider technical infrastructure, socioeconomic status, and institutional support to better comprehend lifelong learning in the digital age.

FUTURE DIRECTIONS

Changing links between self-directed learning, skills, digital information systems, and continuous learning might be examined in longitudinal research. Over time, scientists might see how these traits evolve and if the reported impacts continue. Demographic representation of instructors from countries other than China may boost generalizability. Comparing studies in different cultural and educational situations can show variances in the connections being investigated, helping us understand how digital learning systems and skills affect lifelong learning worldwide. Future research should evaluate how cognitive styles, personality factors, and prior learning experiences affect the correlations found in the current study. Understanding how human traits, digital information systems, and competencies interact may assist tailor self-directed and lifelong learning techniques. To overcome self-report constraints, future research may include behavioral observations and objective

judgments. Data from performance-based tests or digital learning platforms may assist assess digital technology use and skill application fairly. Finally, along with artificial intelligence, the influence of new technology on continuous learning approaches is an exciting study topic. Blockchain, augmented reality, and virtual reality can change how individuals access, evaluate, and use information. An investigation of these technologies' effects may reveal how they change digital educational institutions and self-directed learning and abilities.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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