THE INFLUENCE FACTORS OF DIGITAL TRANSFORMATION MANAGEMENT IN EDUCATIONAL PLATFORMS WITH THE PERSPECTIVE OF PROMOTING LIFELONG LEARNING OPPORTUNITIES UNDER SUSTAINABLE DEVELOPMENT GOALS

Wenzhong Lu [1] and Anan Pongtornkulpanich [2*]

[1,2] Chakrabongse Bhuvanarth International Institute for Interdisciplinary Studies (CBIS),
Rajamangala University of Technology Tawan-OK, Thailand.
Email: [1]wenzhong.lu@rmutto.ac.th, [2]anan_po@rmutto.ac.th (*Corresponding Author)

Abstract

In order to keep pace with the global rapid changes in educational market needs and achieve Sustainable Development Goal 4 (SDGs), which emphasizes the quality of education through various learner skills. This research aims to analyze the factors influencing digital transformation management of education platforms from the perspective of promoting lifelong learning opportunities under the SDGs and construct a causal model for digital transformation management within this context. Collecting 521 valid data via online survey among the students enrolled in higher educational institutions in western China, including Sichuan, Chongqing, Yunnan, Guizhou, Gansu, Shanxi, Qinghai, Xinjiang, and Tibet, and this research employs the structural equation modeling (SEM) to determine the correlation among relevant variables. The results indicate that technology innovation significantly enhances perceived ease of use and perceived usefulness, which in turn foster positive attitudes towards lifelong learning. Digital human capital also positively influences perceived ease of use, perceived usefulness, and attitudes towards lifelong learning. Moreover, digital leadership impacts perceived ease of use, perceived usefulness, and attitudes, although its influence on lifelong learning intentions is more direct. The mediating effects of perceived ease of use and perceived usefulness are significant, demonstrating that these variables facilitate the impact of technology innovation, digital human capital, and digital leadership on attitudes towards lifelong learning. Additionally, attitudes towards lifelong learning mediate the relationship between these factors and the intention to promote lifelong learning opportunities. These findings highlight these critical roles in shaping perceptions and attitudes towards digital learning, ultimately enhancing the intention to engage in lifelong learning.

Keywords: Digital Transformation Management, Lifelong Learning, Sustainable Development Goals, The Stimulus-Organism-Response Theory, Structural Equation Modeling.

1. INTRODUCTION

In an era characterized by rapid technological advancements and significant global economic shifts, the importance of lifelong education has become increasingly evident. Lifelong education encompasses continuous learning opportunities that extend beyond traditional schooling, providing individuals with the necessary skills and knowledge to adapt to evolving job markets, technological innovations, and societal needs (Abulibdeh et al., 2024; Chukwuedo et al., 2021). The digitalization of educational platforms has emerged as a pivotal development, offering new avenues for delivering lifelong education through flexible and accessible learning experiences (Mohamed Hashim et al., 2022). However, these advancements also present challenges that need to be addressed to ensure the effectiveness of lifelong education initiatives (Mhlanga, 2022). One pressing issue in China is the increasing knowledge unemployment among college graduates, despite the rise in higher education participation rates (Jiang & Ke, 2021). Many Chinese college graduates are finding it difficult to secure suitable employment, a problem exacerbated by the Degree Law enacted in 2024, which highlights a significant gap in practical skills among Chinese

college students (Zeng et al., 2021). Employers have observed a mismatch between the skills required for modern jobs and the education provided, indicating a need for more practical, adaptable learning opportunities (Ng et al., 2021). Furthermore, there is a lack of awareness and motivation for lifelong learning among Chinese college students, influenced by the distractions of games and entertainment media, which divert attention from continued education and self-improvement (Liang, 2023). Additionally, the digitalization of educational platforms has often failed to effectively engage students, as traditional classroom experiences have been mechanically transferred to digital formats without sufficient innovation (Cui et al., 2023). This lack of engaging content leads to a decline in learning outcomes, as students become disengaged from the learning process.

The current research landscape in lifelong education and digital transformation has significantly progressed, particularly in leveraging digital platforms to facilitate continuous learning (Gürbüz, 2021). Numerous studies underscore the benefits of digitalization in education, such as increased accessibility, flexibility, and personalized learning experiences (Mohamed Hashim et al., 2022). However, there is a notable deficiency in research exploring lifelong education within the Chinese context, often neglecting the unique socio-economic and cultural dynamics that shape lifelong learning in China (Wu et al., 2024). Additionally, while discussions on the digitalization of education are extensive (Stavroulakis et al., 2022), there is limited research connecting these developments with lifelong learning principles, and quantitative research on lifelong education is scarce, limiting the ability to systematically measure the impacts and outcomes of lifelong learning initiatives. Furthermore, comprehensive studies addressing the management of digital transformation processes in the educational sector are needed, ensuring these transitions support educational objectives and enhance learning experiences. This study aims to address these gaps by examining the current state of digital transformation management of educational platforms in promoting lifelong learning under the Sustainable Development Goals (SDGs). It seeks to analyze the factors influencing digital transformation management of education platforms from the perspective of promoting lifelong learning opportunities under the SDGs and construct a causal model for digital transformation management within this context.

This study is systematically organized. The literature review introduces the theoretical foundation and explains the development of the study's hypotheses. The methodology section details the data collection and analysis processes. The findings section presents the results of the descriptive analysis, reliability and validity analysis, confirmatory factor analysis, and structural equation modeling. The discussion contextualizes these findings within the existing literature, highlighting theoretical and practical contributions. The study concludes with a summary of the findings, contributions, limitations, and future research directions.

2. LITERATURE REVIEW

2.1 Theoretical approach

Digital transformation management (DTM) in education involves integrating technological innovations, digital human capital, and digital leadership to enhance learning outcomes and institutional effectiveness (Razmak & Farhan, 2024). DTM focuses on three main dimensions: technological innovation, which includes

developing digital platforms and virtual classrooms to support accessible and personalized learning (Songkram et al., 2021); digital human capital, which emphasizes the digital literacy and continuous professional development of educators and students (Wei, 2023); and digital leadership, which involves guiding and managing the digital transformation process through strategic planning and fostering a supportive organizational culture (Imran et al., 2021). Although the literature on DTM is limited, studies highlight its importance in higher education strategy, emphasizing comprehensive approaches that address technological, human, and organizational factors (Mohamed Hashim et al., 2022). The theoretical framework of DTM includes key factors such as Technology Innovation, Digital Human Capital, and Digital Leadership, which influence user engagement and acceptance through perceived ease of use and usefulness, ultimately affecting the intention to use digital platforms for lifelong learning (Benitez et al., 2022).

The SOR (Stimulus-Organism-Response) theory is a psychological framework that explains how external stimuli influence individual behavior through internal cognitive and emotional processes (Kurniawan et al., 2022). In education, digital transformation and technological innovations act as stimuli, affecting both learners and educators. The three components are: Stimulus—external inputs like digital learning platforms and new teaching methods (Quinn & Kohl, 2021); Organism—internal cognitive and emotional responses, such as learners' attitudes and motivations towards digital learning, and educators' willingness to adopt new technologies (Mladenović et al., 2023); and Response—the resulting behaviors, including engagement with digital platforms and integration of digital tools into teaching (Li et al., 2022). SOR theory provides insights into how digital transformation impacts educational behavior, helping institutions develop strategies to maximize positive outcomes, enhance learning experiences, and promote effective engagement with new technologies (Rodríguez-Abitia & Bribiesca-Correa, 2021). This framework is essential for designing educational interventions that effectively influence learner responses and support lifelong learning (Gan et al., 2023).

The Technology Acceptance Model (TAM), developed by Fred Davis in 1986, explains how individuals accept and use new technologies (Dah & Hussin, 2021). In education, TAM identifies key variables influencing technology adoption: Perceived Usefulness—the belief that a technology enhances performance (Harrigan et al., 2021), Perceived Ease of Use—how effortless the technology is to use (Gupta et al., 2021), Attitude Toward Using—overall attitude influenced by usefulness and ease of use (Kurniawan et al., 2022), Behavioral Intention to Use—the intention to use the technology (Unal & Uzun, 2021), and Actual System Use—practical engagement over time (Hofer et al., 2021). TAM helps educational institutions develop strategies to overcome adoption barriers, enhance digital engagement, and effectively integrate new technologies into learning and teaching. Motivation Theory explains what drives individuals to act, focusing on intention, which includes behavior expectation and willingness (Ayvat & Gunturkun, 2022). In educational digital transformation under SDGs, behavior expectation involves beliefs about the benefits of digital tools, while behavior willingness reflects readiness to adopt these tools, influenced by resources and support (Han et al., 2023). The Theory of Planned Behavior (TPB) and Self-Determination Theory (SDT) offer insights into how intentions drive behavior. TPB highlights attitudes, norms, and perceived control, while SDT distinguishes between intrinsic and extrinsic motivation, showing that genuine interest and external factors

impact engagement (Salter et al., 2022). These theories help design interventions that promote lifelong learning under SDGs (Uoc, 2023).

Integration of these four theories provides comprehensive insights into effectively managing digital transformation in education. This integrated approach explores how technological stimuli (DTM) interact with internal cognitive and emotional processes (SOR), shaping attitudes and behaviors towards digital tools (TAM) and driving motivation (Motivation Theory). It enables the development of strategies that enhance digital literacy, foster positive attitudes, and promote the adoption of digital platforms, leading to improved learning outcomes and institutional effectiveness. By understanding these dynamics, educational institutions can create environments that support lifelong learning and align with sustainable development goals (SDGs).

2.2 Hypothesis development

The adoption of technology in education enhances accessibility, engagement, and personalized learning, resonating with learners who view education as a continuous journey. Digital platforms mediate this relationship, translating technological advancements into positive attitudes toward lifelong learning. Research by Wu (2024) shows that personalized, interactive digital platforms significantly improve attitudes toward lifelong learning, encouraging ongoing personal and professional development. F. Chen et al. (2023) confirms that digital platforms foster positive attitudes by mediating the relationship between technological innovation and lifelong learning. Consequently, the following hypothesis is proposed:

H1. Technology innovation affects the attitude towards lifelong learning.

Technological innovation in education simplifies learning processes, creates intuitive interfaces, and enables seamless integration of educational resources, resonating with learners seeking effortless navigation. Digital tools and resources mediate this relationship, ensuring technological advancements translate into perceived ease of use (Duong et al., 2023). Research by Li (2023) indicates that user-friendly interfaces and adaptive learning environments significantly enhance perceived ease of use, contributing to a positive user experience and continued engagement. Christian et al. (2023) further confirm that digital tools streamline learning environments, reinforcing the link between technological innovation and ease of use. Thus, this study proposes the following hypothesis:

H2. Technology innovation affects the perceived ease of use.

Technological innovation in education enhances the functionality and relevance of learning platforms, resonating with learners who seek real-world applicability and tangible benefits. Digital advancements mediate this relationship, translating technological innovation into perceived usefulness (Kang et al., 2021). Research by Shen et al. (2022) shows that tools designed for practical application and skill development significantly enhance perceived usefulness, adding broader value and relevance. Qu and Wu (2024) further confirm that digital tools mediate this relationship by offering tailored resources and interactive experiences, increasing learner engagement and satisfaction. Therefore, the following hypothesis is proposed:

H3. Technology innovation affects the perceived usefulness.

Digital human capital in education encompasses the collective skills and expertise of educators and administrators in using digital platforms. This expertise enhances

learners' experiences by making educational tools more intuitive and accessible. Adequate digital skills among educators are crucial mediators, ensuring that digital human capital translates into perceived ease of use for students (Sang et al., 2023). Research by Zhao et al. (2023) shows that proficient use of digital tools by educators makes it easier for students to engage with the material through clear communication and streamlined interactions. Nyathi and Kekwaletswe (2024) further confirm that educator expertise mediates this relationship by effectively utilizing digital resources, making platforms more user-friendly and enhancing the overall learning experience. Consequently, this study proposes the hypothesis as below:

H4. Digital human capital affects the perceived ease of use.

Digital human capital in the educational sector encompasses the skills and expertise of educators in using digital platforms to enhance learning experiences. This expertise influences learners' attitudes by demonstrating the practicality of digital tools for continuous education. Skilled educators and their ability to integrate digital tools into teaching are crucial mediators in shaping positive attitudes toward lifelong learning (Su & Yang, 2024). Research by Bariham (2022) shows that adept use of digital tools by educators makes continuous education more accessible and engaging, fostering favorable attitudes toward lifelong learning. Hu et al. (2021) further confirm that educators' expertise mediates this relationship by demonstrating how digital platforms facilitate self-paced, ongoing education, bridging the gap between digital resources and learners. Thus, the following hypothesis is proposed:

H5. Digital human capital affects the attitude towards lifelong learning.

Digital human capital in education encompasses the skills, knowledge, and competencies educators use to integrate digital platforms into their teaching. This capital significantly impacts learners' perceptions of the usefulness of these platforms, particularly in facilitating lifelong learning and skill development. The effective integration of digital tools by educators serves as a critical mediator, ensuring that the perceived benefits of digital education platforms translate into practical utility for learners (Duong et al., 2023). Research by Yang and Lou (2024) shows that when educators adeptly use digital platforms, learners view these tools as essential for ongoing education and skill advancement, boosting their confidence in digital education's ability to deliver relevant, career-oriented content. Additionally, Iqbal et al. (2021) reinforce that educators' expertise in blending digital tools with educational content enhances the perceived usefulness of these platforms, affirming their practical value. Therefore, the following hypothesis is proposed:

H6. Digital human capital affects the perceived usefulness.

Digital leadership in education involves the vision, strategies, and guidance provided by leaders to integrate digital tools and platforms into learning environments. This leadership is crucial in shaping learners' perceptions of the ease of use of these platforms, ensuring they are intuitively and seamlessly integrated into the educational process. Effective digital leadership mediates the adoption of digital tools, enhancing their perceived accessibility. Research by Shal et al. (2024) shows that clear strategies from educational leaders make digital platforms more accessible and easier to navigate, significantly boosting learners' willingness to engage with digital education. Additionally, Nguyen (2023) confirms that digital leadership mediates the relationship between technological integration and perceived ease of use, demonstrating that

strong leadership supports intuitive and approachable digital platforms. Consequently, this study proposes the following hypothesis:

H7. Digital leadership affects the perceived ease of use.

Digital leadership in education refers to the strategic guidance and management provided by educational leaders in implementing digital tools and platforms. This leadership is instrumental in influencing learners' perceptions of the usefulness of these platforms, particularly regarding their effectiveness in contributing to the learning process and educational outcomes. Digital leadership mediates this relationship by ensuring that digital tools are fully leveraged to align with educational goals and needs (Yao et al., 2023). Research by Wang (2023) indicates that clear strategies and supportive measures from leaders enhance learners' recognition of the benefits of digital tools, encouraging greater engagement with these platforms. Additionally, Ma (2021) reinforces that digital leadership mediates the relationship between technological integration and perceived usefulness, showing that leaders' ability to align digital tools with educational objectives affirms their value to learners. Based on these insights, the following hypothesis is proposed:

H8. Digital leadership affects the perceived usefulness.

Digital leadership in education encompasses the strategic vision and management provided by leaders in integrating digital tools and platforms into educational contexts (Mogavi et al., 2024). This leadership is crucial in shaping learners' attitudes toward lifelong learning by effectively using digital resources to support continuous education and skill development. Digital leadership fosters a culture of lifelong learning, demonstrating how digital tools can achieve broader educational goals (Tanniru & Peral, 2021). Research by Şen and Yildiz Durak (2022) shows that effective digital leadership creates an environment that encourages continuous learning and development, promoting an enduring mindset of lifelong learning. Furthermore, Zhu et al. (2022) reinforce that digital leadership mediates the relationship between technological integration and attitudes toward lifelong learning, establishing a framework where digital tools contribute to educational goals and foster positive attitudes toward continuous learning. Thus, the following hypothesis is proposed:

H9. Digital leadership affects the attitude towards lifelong learning.

The perceived ease of use of digital education platforms significantly shapes learners' attitudes towards lifelong learning. This concept reflects how intuitive and straightforward a platform is to navigate, directly influencing learners' comfort and willingness to engage with it for educational purposes. Ease of use mediates this relationship by reducing barriers to entry, allowing learners to focus on educational content rather than technical difficulties (Jin et al., 2022). Research by Huang et al. (2021) demonstrates that user-friendly platforms lead to more positive attitudes towards lifelong learning, building confidence and motivating learners to pursue further educational opportunities. Additionally, Abbas et al. (2022) show that learners are more likely to engage in lifelong learning when they find digital platforms accessible and easy to use, seamlessly integrating education into their daily lives. Consequently, the following hypothesis is proposed:

H10. Perceived ease of use affects the attitude towards lifelong learning.

Perceived usefulness in digital education platforms reflects how beneficial and practical learners find these platforms for advancing their educational goals and

personal development. This perception significantly influences learners' attitudes toward lifelong learning, motivating them to engage with digital platforms and pursue continuous education. Research by Asare et al. (2023) shows that platforms offering practical, real-world benefits, such as relevant content, career advancement opportunities, and skills development, foster a positive attitude toward lifelong learning. Additionally, Wang (2022) reinforce that perceived usefulness mediates the relationship between digital education platforms and lifelong learning attitudes. By providing tangible benefits like certifications and skill-based learning, these platforms help learners recognize the value of continuous education, strengthening their commitment to lifelong learning. Therefore, the study proposes the following hypothesis:

H11. Perceived usefulness affects the attitude towards lifelong learning.

In the realm of digital education platforms, perceived usefulness encapsulates the extent to which learners deem these platforms advantageous and applicable for achieving their educational objectives and personal growth. This perception significantly shapes learners' attitudes toward lifelong learning by incentivizing them to utilize digital platforms for continuous education. Investigative work by Wong et al. (2024) delves into how perceived usefulness influences learners' attitudes, showing that when digital platforms offer pragmatic, real-world advantages, they foster more positive attitudes toward lifelong learning. These advantages typically encompass access to pertinent content, opportunities for career progression, and avenues for skills enhancement, collectively bolstering learners' motivation to engage in continuous education. Additionally, research findings from Pihlainen et al. (2021) highlight that perceived usefulness acts as a mediator between the use of digital education platforms and learners' attitudes toward lifelong learning. Platforms that provide tangible benefits, like certifications or skills training, enable learners to perceive the direct value of continuous education, thereby strengthening their commitment to lifelong learning. Drawing from these findings, this study proposes the following hypothesis:

H12. Technology innovation affects the intention to promote lifelong learning opportunities.

This study explores how positive attitudes towards lifelong learning among students and faculty can drive educational institutions to prioritize and enhance lifelong learning opportunities. Individual predispositions significantly influence institutional strategies, as proactive engagement in continuous education shapes higher-level decision-making (Hongsuchon et al., 2022). When learners and educators value lifelong learning, universities are motivated to develop supportive policies and programs, such as expanding digital learning platforms, integrating career development services, and adopting innovative learning models (Kemp et al., 2022). A strong commitment to lifelong learning encourages institutions to embed these principles into both core curricula and extracurricular activities, enhancing overall educational offerings (Exter & Ashby, 2022). Consequently, the study proposes the following hypothesis:

H13. Attitude towards lifelong learning affects the intention to promote lifelong learning opportunities.

This study examines the impact of digital human capital on the strategic direction of educational institutions. Digital human capital, which includes the skills and knowledge of educators and administrators in using digital tools, is crucial for shaping educational

practices and policies (Ellis et al., 2021). Proficient educators enhance the learning environment by integrating advanced digital tools, creating dynamic and personalized learning experiences that promote lifelong learning (Zhao et al., 2021). Their effective use of digital platforms improves learning outcomes and fosters a culture that values technological advancements. Administrators with strong digital competencies advocate for policies that promote lifelong learning through digital platforms, invest in advanced technologies, provide professional development, and create supportive infrastructures for ongoing learning (Yalcin et al., 2022). This encourages innovative curriculum design, blended learning models, and the use of data analytics to tailor educational experiences (Huang, 2023). Therefore, the study proposes the following hypothesis:

H14. Digital human capital affects the intention to promote lifelong learning opportunities.

Exploring how digital leadership influences educational strategies, this section examines leaders' roles in promoting lifelong learning through digital innovations (Jameson et al., 2022). Digital leadership involves guiding and managing the integration of technologies in education (Bresciani et al., 2021). Leaders with strong digital skills enhance education and student engagement by implementing strategies that prioritize digital tools (Namboodiri, 2022). They advocate for necessary resources, support policy changes, and align digital strategies with educational goals (Senadjki et al., 2024). Effective digital leaders address challenges like equitable access and quality maintenance, enhancing the institution's capacity for lifelong learning (Kelly & Zakrajsek, 2023) Thus, the study proposes the following hypothesis:

H15. Digital leadership affects the intention to promote lifelong learning opportunities.

This research explores the mediating role of perceived ease of use in the relationship between technology innovation and attitudes towards lifelong learning (Panergayo, 2021). The simplicity and user-friendliness of digital education platforms significantly influence learners' engagement and acceptance of these technologies (Hossain et al., 2021). While technological innovations introduce advanced features to enhance learning, their success depends on user interaction. User-friendly platforms encourage exploration and continuous education, fostering positive attitudes towards lifelong learning (Goh & Wen, 2021). Therefore, the study proposes the following hypothesis:

H16. Perceived ease of use mediates the relationship between the technology innovation and the attitude towards lifelong learning.

Building on the conceptual framework of digital competencies, this study explores how perceived ease of use mediates the relationship between digital human capital and attitudes towards lifelong learning (Zihan et al., 2024). Digital human capital, which includes educators' and administrators' technological proficiency, is crucial for effectively deploying digital tools (Prastyaningtyas et al., 2023). The success of these implementations depends on users perceiving the technology as easy to use. Skilled educational staff can integrate digital tools in user-friendly ways, enhancing perceived ease of use and fostering positive attitudes towards lifelong learning Liu et al. (2023). Conversely, if technology is not user-friendly, it can deter engagement and negatively impact attitudes. Thus, perceived ease of use bridges the gap between educators' capabilities and learners' attitudes towards lifelong learning (Wong et al., 2024). The study proposes the following hypothesis:

H17. Perceived ease of use mediates the relationship between the digital human capital and the attitude towards lifelong learning.

Continuing the examination of factors influencing attitudes towards lifelong learning, this study explores the role of digital leadership, which involves guiding the integration of digital technologies in education (Ellis et al., 2021). Effective digital leadership ensures that new technologies are accessible and user-friendly, enhancing learners' experiences and attitudes towards lifelong learning (Tan et al., 2023). When educational leaders prioritize usability, learners are more likely to find digital platforms manageable, fostering positive attitudes towards continuous education (Xu & Zhu, 2023). Conversely, poor usability can deter engagement and negatively impact attitudes (Shah et al., 2022). Therefore, this study proposes the following hypothesis:

H18. Perceived ease of use mediates the relationship between the digital leadership and the attitude towards lifelong learning.

Continuing the exploration of technology's impact on lifelong learning, this study addresses the role of perceived usefulness as a mediator between technology innovation and attitudes towards lifelong learning. This hypothesis posits that the practical benefits of innovative educational technologies are crucial in shaping learners' attitudes towards ongoing education. Technology innovation introduces advanced features designed to enhance learning outcomes and streamline processes (Saxena et al., 2023). However, these innovations' impact on attitudes depends significantly on perceived usefulness (Saif et al., 2024). If learners find the advancements beneficial and relevant to their goals, they are more likely to develop a positive attitude towards using these technologies for lifelong learning. Perceived usefulness, which includes benefits like increased efficiency, better resource accessibility, and enhanced learning experiences, makes learners more receptive to integrating technology into their learning habits (Tang et al., 2023). Consequently, the study proposes the following hypothesis:

H19. Perceived usefulness mediates the relationship between the technology innovation and the attitude towards lifelong learning.

Building on insights into digital capabilities within educational environments, this study examines how perceived usefulness mediates the relationship between digital human capital and attitudes towards lifelong learning. Digital human capital, which includes the digital skills of educational staff, is crucial for leveraging technology in teaching (Mubarik et al., 2022). Educators' proficiency with digital tools impacts learners' perceptions of these tools' usefulness, influencing their attitudes toward lifelong learning (Lim & Newby, 2021). Proficient use of digital technologies by educators demonstrates practical benefits, enhancing learning experiences and shaping learners' perceptions of these tools as beneficial (Downie et al., 2021). If students see digital tools as improving learning efficiency and accessibility, they are more likely to adopt them in their lifelong learning journeys (Antonietti et al., 2022). Therefore, this study proposes the following hypothesis:

H20. Perceived usefulness mediates the relationship between the digital human capital and the attitude towards lifelong learning.

This study examines how digital leadership influences attitudes towards lifelong learning through perceived usefulness. Digital leadership, which involves guiding and managing the integration of digital technologies in education (Avidov-Ungar et al.,

2022), plays a crucial role in shaping learners' perceptions of these tools. Effective digital leaders enhance the perceived usefulness of technologies by promoting their benefits and aligning them with educational goals (Morgado et al., 2021). When students see digital tools as beneficial to their learning and personal development, they are more likely to adopt them for lifelong learning (Kilag et al., 2023). Consequently, the study proposes the following hypothesis:

H21. Perceived usefulness mediates the relationship between the digital leadership and the attitude towards lifelong learning.

This study explores how attitudes towards lifelong learning mediate the relationship between technology innovation and strategic initiatives for lifelong learning. The hypothesis posits that the positive impact of technological innovations on promoting lifelong learning is mediated by learners' attitudes. Technological innovations introduce tools that transform learning environments, making them more engaging and effective (Cheung et al., 2021). However, the extent to which these innovations lead institutions to prioritize lifelong learning depends on learners' attitudes (Alenezi, 2023). Positive attitudes towards lifelong learning encourage learners to embrace and advocate for innovative technologies, influencing institutional policies and investment in lifelong learning technologies (Timotheou et al., 2023). Thus, learners' attitudes act as a crucial link between technology adoption and institutional commitment to lifelong learning (Abulibdeh et al., 2024), amplifying the perceived value of innovations and prompting greater support (Kaputa et al., 2022). Therefore, this study proposes the following hypothesis:

H22. Attitude towards lifelong learning mediates the technology innovation relationship between the and the intention to promote lifelong learning opportunities.

Building on how internal attitudes influence organizational strategies, this study examines how attitudes towards lifelong learning mediate the relationship between digital human capital and the promotion of lifelong learning opportunities within educational institutions (Wu et al., 2022). The hypothesis posits that the digital competencies of educators and administrators impact institutional strategies, mediated by shaping attitudes towards lifelong learning. Digital human capital, representing technological expertise, is crucial for integrating digital tools in education (Timotheou et al., 2023). Its effectiveness in promoting lifelong learning depends on its influence on the educational community's attitudes (Bankins et al., 2024). Positive attitudes fostered by effective use of digital tools create a supportive environment, encouraging institutions to invest in lifelong learning technologies (Miller & Ives, 2023). Thus, the study proposes the following hypothesis:

H23. Attitude towards lifelong learning mediates the relationship between the digital human capital and the intention to promote lifelong learning opportunities.

Building on the exploration of leadership's influence on educational strategies, this study examines the mediating role of attitudes towards lifelong learning in the relationship between digital leadership and the promotion of lifelong learning opportunities (Antonopoulou et al., 2021). The hypothesis asserts that the effectiveness of digital leadership in implementing lifelong learning strategies is significantly mediated by the institution's collective attitude towards lifelong learning. Digital leadership involves the strategic vision and capability to integrate digital technologies into education (AlAjmi, 2022). Leaders influence how technology is used, but their impact on lifelong learning initiatives depends on the educational community's

attitudes (Ketikidou & Saiti, 2022). Positive attitudes towards lifelong learning enhance support for digital initiatives, facilitating their implementation (Bansal et al., 2023). Conversely, negative attitudes can hinder these efforts. Thus, attitudes towards lifelong learning can amplify or diminish the impact of digital leadership on lifelong learning initiatives. Consequently, the following hypothesis is proposed:

H24. Attitude towards lifelong learning mediates the relationship between the digital leadership and the intention to promote lifelong learning opportunities.

This study explores how attitudes towards lifelong learning mediate the relationship between the perceived ease of use of digital education platforms and the promotion of lifelong learning opportunities within educational institutions (Almaiah et al., 2022). The hypothesis posits that while usability is critical for adopting digital tools, institutional commitment to lifelong learning is significantly influenced by how these tools shape attitudes towards continuous education. Perceived ease of use reduces barriers, making learning more accessible and fostering favorable attitudes (Wilson et al., 2021). Positive attitudes towards lifelong learning can enhance institutional support for continuous learning initiatives, motivating leaders to invest in relevant technologies and programs (Li & Wu, 2023). Therefore, this study proposes the following hypothesis:

H25. Attitude towards lifelong learning mediates the relationship between the perceived ease of use and the intention to promote lifelong learning opportunities.

This study examines how attitudes towards lifelong learning mediate the relationship between the perceived usefulness of digital tools and the promotion of lifelong learning opportunities within educational institutions. The hypothesis posits that perceived usefulness of digital education platforms influences strategic decisions through its impact on attitudes towards ongoing learning. Perceived usefulness enhances acceptance and use of technologies, improving educational outcomes (Qashou, 2021). Positive attitudes towards lifelong learning, fostered by useful digital tools, can bolster institutional commitment to supporting these platforms (Zhang & Sukpasjaroen, 2024). Conversely, without favorable attitudes, the impact on strategies may be limited. Understanding this mediation is crucial for aligning technological benefits with educational goals (Bowman et al., 2022). Consequently, this study proposes the following hypothesis:

H26. Attitude towards lifelong learning mediates the relationship between the perceived usefulness and the intention to promote lifelong learning opportunities.

3. METHODOLOGY

This study adopts a quantitative approach, aiming to identify factors affecting digital transformation management of education platforms from the perspective of promoting lifelong learning opportunities under the SDGs and construct a causal model for digital transformation management within this context. For data collection, purposive sampling was employed, targeting participants currently enrolled in higher educational institutions in western China, including Sichuan, Chongqing, Yunnan, Guizhou, Gansu, Shaanxi, Qinghai, Xinjiang, and Tibet. Structured questionnaires were distributed through Questionnaire Star, the most popular online survey platform in China. A total of 672 questionnaires were collected, with 521 deemed valid for analysis. The statistical analysis methods include descriptive analysis, assessments of reliability and validity, Confirmatory Factor Analysis (CFA), and Structural Equation

Modeling (SEM). To measure the variables, this study collects data through a range of systematic structured scales with 5-point Likert:

To assess technology innovation in educational environments, this study synthesizes dimensions from educational technology research, focusing on new digital tools, systems, and processes that enhance learning experiences and institutional effectiveness. Inspired by Niu et al. (2022), six tailored items are developed to capture technology innovation, reflecting aspects such as new methods of delivering learning experiences, development of organizational structures for digital education, integration of digital tools into teaching processes, introduction of new digital platforms and resources, policy implementation to support digital learning, and exploration of new educational models. To assess digital human capital in educational settings, this study synthesizes dimensions from educational technology research, focusing on the skills, competencies, and knowledge that educators, students, and administrators bring to digital platforms. Inspired by Agostineto et al. (2022), seven tailored items are developed to capture digital human capital, reflecting aspects such as participation in decisions regarding digital education strategies, creativity and initiative in digital educational tasks, commitment to the institution's digital initiatives, qualifications to perform digital functions, ability to innovate in digital tasks, teamwork in digital contexts, and knowledge-sharing with colleagues.

To assess digital leadership in educational institutions, this study synthesizes dimensions from educational technology research, focusing on leaders' technical capabilities, governance skills, and strategic vision for digital integration. Inspired by Niu et al. (2022), four tailored items are developed to capture digital leadership, reflecting aspects such as technical leadership capabilities, the ability to build digital governance structures, recognition of digitalization for educational competitiveness, and the ability to evaluate digital capabilities and technologies.

To assess perceived ease of use of digital education platforms, this study synthesizes dimensions from educational technology research, focusing on the intuitiveness and functionality of these platforms for learners. Inspired by Chintalapati and Daruri (2017), five tailored items are developed to capture perceived ease of use, reflecting aspects such as the ease of finding online courses, searching for relevant educational resources, navigating the platform, receiving links to digital resources, and experiencing smooth browsing on their devices. To assess perceived usefulness in digital education platforms, this study synthesizes dimensions from educational technology research, focusing on the practical benefits and value of these platforms for learners. Inspired by Chintalapati and Daruri (2017), seven tailored items are developed to capture perceived usefulness, reflecting aspects such as the availability of useful content for various subjects, the variety of content covering all topics of interest, utility for assignments and research, effectiveness of the search feature, comprehensive resources for a broad perspective, assistance in learning new ideas, and sufficiency in supporting self-learning across subjects.

To assess attitudes towards lifelong learning, this study synthesizes dimensions from educational technology research, focusing on learners' perspectives on continuous education and self-improvement. Inspired by Chintalapati and Daruri (2017), six tailored items are developed to capture these attitudes. These items reflect encouragement to peers to use digital platforms, the value of these platforms for self-learning, pride in the learning achieved through digital resources, positive emotions

associated with using digital platforms for learning, access to materials from prestigious institutions, and enjoyment in spending time learning on digital platforms.

This study employs a comprehensive approach to measure key constructs influencing engagement with digital education platforms. Constructs include attitudes towards lifelong learning, digital leadership, digital human capital, perceived ease of use, perceived usefulness, and intention to promote lifelong learning. Each is assessed using tailored items adapted from established scales, ensuring relevance and accuracy. This methodology provides a nuanced framework for understanding the factors that influence engagement with digital education platforms.

4. FINDINGS

4.1 Descriptive analysis

Table 1 presents the essential demographic information of the study participants, encompassing age, gender, region, and level of academic examination or degree.

The age distribution shows that the majority of participants are aged 18-24, comprising 55.7% (n=290) of the sample. Participants aged 25-34 represent 26.5% (n=138), those under 18 account for 15.0% (n=78), and individuals aged 35 and above make up the smallest group at 2.9% (n=15). Gender distribution is nearly equal, with males constituting 49.9% (n=260) and females slightly higher at 50.1% (n=261).

Participants are distributed across various regions, with Gansu having the highest representation at 12.7% (n=66). Other regions include Shaanxi (11.5%, n=60), Tibet (11.9%, n=62), Yunnan (11.3%, n=59), Sichuan (11.1%, n=58), and Xinjiang (11.1%, n=58). Qinghai (10.2%, n=53), Chongqing (10.6%, n=55), and Guizhou (9.6%, n=50) also contribute significantly to the sample. Regarding the level of academic examination or degree, nearly half of the participants are undergraduates (49.8%, n=260). Master's students account for 25.0% (n=130), doctoral students comprise 15.4% (n=80), and specialists make up 9.8% (n=51).

Table 1: Essential Information

		Frequency	Percent
Age	Under 18	78	15.0
	18-24	290	55.7
	25-34	138	26.5
	35 and above	15	2.9
Gender	Male	260	49.9
	Female	261	50.1
Region	Sichuan	58	11.1
	Chongqing	55	10.6
	Yunnan	59	11.3
	Guizhou	50	9.6
	Gansu	66	12.7
	Shaanxi	60	11.5
	Qinghai	53	10.2
	Xinjiang	58	11.1
	Tibet	62	11.9
Level of academic examination or degree	Undergraduate	260	49.8
	Master's Student	130	25.0
	Doctoral Student	80	15.4
	Specialist	51	9.8

4.2 Reliability and validity analysis

Table 2 presents the reliability statistics for the study variables, measured by Cronbach's alpha, indicating internal consistency. Technology innovation, assessed with six questions, has a high reliability with a Cronbach's alpha of 0.889.

Digital human capital, measured by seven questions, also demonstrates high reliability with a Cronbach's alpha of 0.893. Digital leadership, with four questions, shows good reliability at 0.811. Perceived ease of use, consisting of five questions, has a reliability of 0.857. Perceived usefulness, measured by seven questions, exhibits excellent reliability with a Cronbach's alpha of 0.906.

Attitude towards lifelong learning, assessed with six questions, has a reliability of 0.878. Lastly, the intention to promote lifelong learning opportunities, measured by four questions, shows good reliability with a Cronbach's alpha of 0.825. These high values indicate that the constructs are consistently measured.

Table 3 provides the results of the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity.

The KMO value of 0.952 indicates excellent sampling adequacy, suggesting that the data are suitable for factor analysis. Bartlett's Test of Sphericity is significant ($p < 0.001$), with an approximate Chi-Square of 10881.097 and 741 degrees of freedom, confirming that the correlations between items are sufficient for factor analysis. These results validate the factorability of the dataset for further statistical analysis.

Table 2: Reliability Statistics

Study variables	Number of questions	Cronbach's α
Technology innovation	6	0.889
Digital human capital	7	0.893
Digital leadership	4	0.811
Perceived ease of use	5	0.857
Perceived usefulness	7	0.906
Attitude towards lifelong learning	6	0.878
Intention to promote lifelong learning opportunities	4	0.825

Table 3: KMO and Bartlett's Test

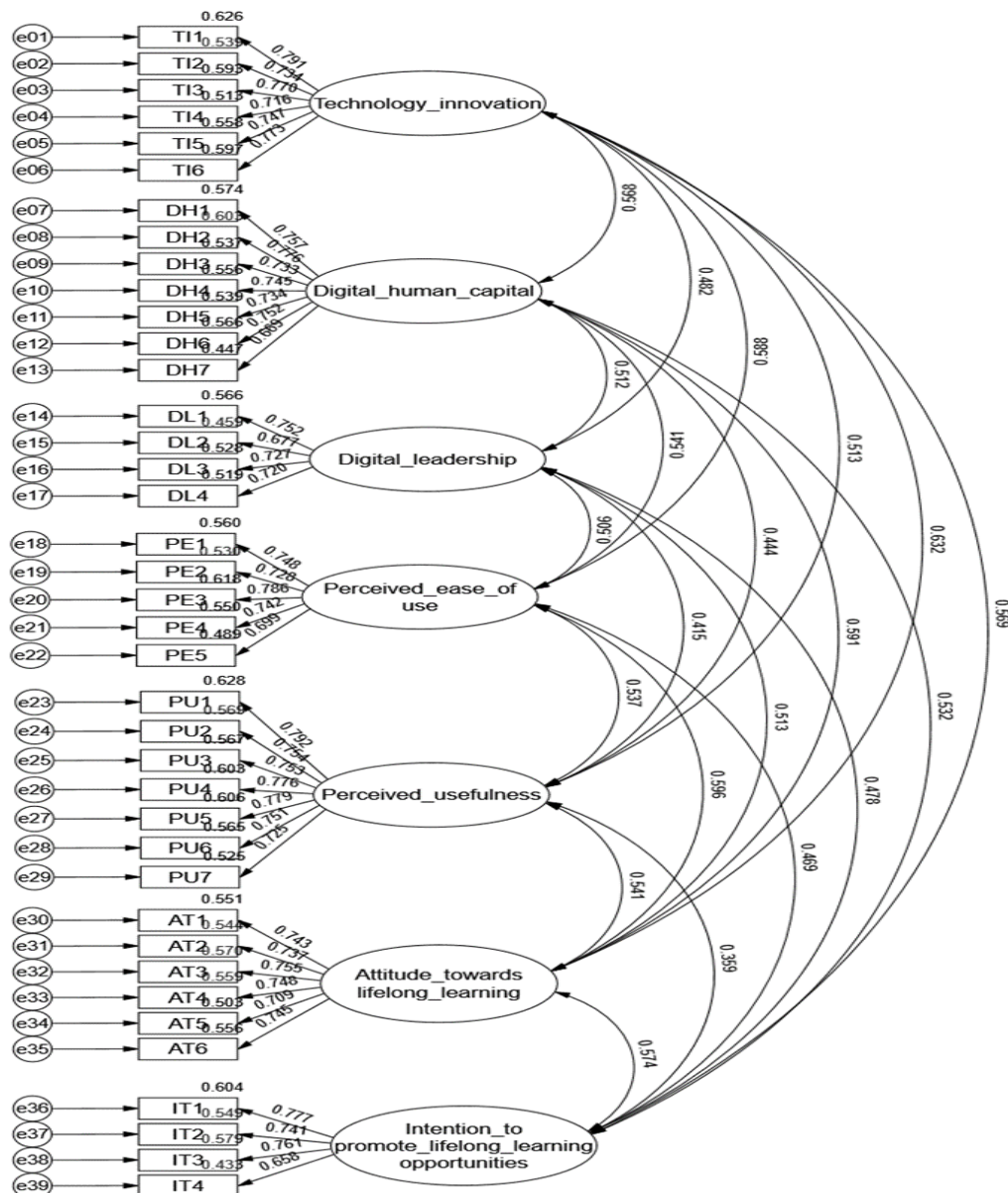| Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.952
Bartlett's Test of Sphericity	Approx. Chi-Square	10881.097
	df	741
	Sig.	.000

4.3 Confirmatory factors analysis

Figure 1: The measurement model for the confirmatory factor analysis.

Table 4 presents the fit metrics for the measurement model, indicating how well the model fits the observed data. The Chi-square to degrees of freedom ratio (χ2/df) is 1.399, well below the reference standard of less than 3, suggesting an excellent fit. The Root Mean Square Error of Approximation (RMSEA) is 0.028, significantly lower than the threshold of 0.08, further indicating a good fit.

The Goodness of Fit Index (GFI) is 0.916 and the Adjusted Goodness of Fit Index (AGFI) is 0.904, both exceeding the recommended value of 0.9, demonstrating strong model fit. The Normed Fit Index (NFI) stands at 0.915, the Tucker-Lewis Index (TLI) at 0.972, and the Comparative Fit Index (CFI) at 0.974, all surpassing the benchmark of 0.9, indicating excellent model fit. These metrics collectively suggest that the measurement model fits the data well, meeting all the reference standards and confirming the model's validity and reliability for the constructs under study.

Table 4: Measure model fit metrics

Fit index	χ2/df	RMSEA	GFI	AGFI	NFI	TLI	CFI
Reference standards	<3	<0.08	>0.9	>0.9	>0.9	>0.9	>0.9
Result	1.399	0.028	0.916	0.904	0.915	0.972	0.974

Table 5 delineates the convergence validity metrics for a study investigating VRIDP, detailing latent variables, observation indicators, factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE). The factor loadings for all indicators exceed the recommended threshold of 0.7, indicating a robust association between latent variables and their indicators, affirming the reliability of the constructs measured. CR values surpass the acceptable benchmark of 0.7 for all constructs, with values ranging from 0.811 to 0.906, highlighting the internal consistency and reliability of the constructs. Furthermore, AVE values are above the minimum standard of 0.5, varying from 0.518 to 0.580, which validates that the majority of the variance in observation indicators is captured by their corresponding latent variables, ensuring good convergence validity. This analysis confirms the validity and reliability of the constructs related to Technology Innovation, Digital Human Capital, Digital Leadership, Perceived Ease of Use, Perceived Usefulness, Attitude Towards Lifelong Learning, and Intention to Promote Lifelong Learning Opportunities. The table effectively demonstrates the methodological rigor in measuring the constructs pertinent to understanding consumer acceptance of VRIDP, providing a solid foundation for further analysis and interpretation within the study.

Table 5: Convergence Validity

Latent variables	Observation indicators	Factor loading	CR	AVE
Technology innovation	TI1	0.791	0.889	0.571
	TI2	0.734		
	TI3	0.770		
	TI4	0.716		
	TI5	0.747		
	TI6	0.773		
Digital human capital	DH1	0.757	0.894	0.546
	DH2	0.776		
	DH3	0.733		
	DH4	0.745		
	DH5	0.734		
	DH6	0.752		
	DH7	0.669		
Digital leadership	DL1	0.752	0.811	0.518
	DL2	0.677		
	DL3	0.727		
	DL4	0.720		
Perceived ease of use	PE1	0.748	0.859	0.550
	PE2	0.728		
	PE3	0.786		
	PE4	0.742		
	PE5	0.699		
Perceived usefulness	PU1	0.792	0.906	0.580
	PU2	0.754		
	PU3	0.753		
	PU4	0.776		
	PU5	0.779		
	PU6	0.751		
	PU7	0.725		

	AT1	0.743		
Attitude towards lifelong learning	AT2	0.737	0.879	0.547
	AT3	0.755		
	AT4	0.748		
	AT5	0.709		
	AT6	0.745		
Intention to promote lifelong learning opportunities	IT1	0.777	0.825	0.541
	IT2	0.741		
	IT3	0.761		
	IT4	0.658		

Table 6 presents the discriminant validity test results for the study's latent variables. The diagonal elements represent the square root of the Average Variance Extracted (AVE) for each construct, while the off-diagonal elements are the correlations between the constructs. For adequate discriminant validity, the square root of the AVE for each construct (diagonal values) should be greater than the correlations involving the construct (off-diagonal values). The square roots of the AVE values are as follows: Technology Innovation (0.756), Digital Human Capital (0.739), Digital Leadership (0.720), Perceived Ease of Use (0.742), Perceived Usefulness (0.762), Attitude Towards Lifelong Learning (0.740), and Intention to Promote Lifelong Learning Opportunities (0.736). All these values exceed their corresponding inter-construct correlations, confirming discriminant validity. The correlations between constructs indicate significant relationships at p<0.001, shown with asterisks. For instance, Technology Innovation correlates with Digital Human Capital (0.568), Digital Leadership (0.482), Perceived Ease of Use (0.588), Perceived Usefulness (0.513), Attitude Towards Lifelong Learning (0.632), and Intention to Promote Lifelong Learning Opportunities (0.569). Similarly, other constructs show significant correlations with each other, suggesting strong interrelations while maintaining discriminant validity due to the higher diagonal values. In summary, this table confirms that each construct is distinct from others while demonstrating significant inter-relationships, establishing both the discriminant and convergent validity of the measurement model used in the study.

Table 6: Discriminant validity test

Latent variables	1	2	3	4	5	6	7
Technology innovation	0.756						
Digital human capital	0.568 ***	0.739					
Digital leadership	0.482 ***	0.512 ***	0.720				
Perceived ease of use	0.588 ***	0.541 ***	0.506 ***	0.742			
Perceived usefulness	0.513 ***	0.444 ***	0.415 ***	0.537 ***	0.762		
Attitude towards lifelong learning	0.632 ***	0.591 ***	0.513 ***	0.596 ***	0.541 ***	0.740	
Intention to promote lifelong learning opportunities	0.569 ***	0.532 ***	0.478 ***	0.469 ***	0.359 ***	0.574 ***	0.736
Note: The diagonal is the square root of the corresponding dimension AVE ***: p<0.001							

4.4 Structural equation model

Table 7 presents the model fit metrics, indicating the adequacy of the model in representing the observed data. The Chi-square to degrees of freedom ratio (χ2/df) is 1.430, which is well within the acceptable threshold of less than 3, suggesting a good fit. The Root Mean Square Error of Approximation (RMSEA) is 0.029, below the maximum acceptable value of 0.08, indicating a close fit of the model in relation to the degrees of freedom.

The Goodness of Fit Index (GFI) is 0.915, and the Adjusted Goodness of Fit Index (AGFI) is 0.903, both exceeding the recommended value of 0.9, demonstrating a strong fit. The Normed Fit Index (NFI) is 0.912, the Tucker-Lewis Index (TLI) is 0.969, and the Comparative Fit Index (CFI) is 0.972, all surpassing the benchmark of 0.9, indicating excellent model fit.

Overall, these metrics confirm that the model fits the data well, meeting all the reference standards, and providing strong evidence for the model's validity and reliability.

Table 7: Model fit metrics

Fit index	χ2/df	RMSEA	GFI	AGFI	NFI	TLI	CFI
Reference standards	<3	<0.08	>0.9	>0.9	>0.9	>0.9	>0.9
Result	1.430	0.029	0.915	0.903	0.912	0.969	0.972

Table 8 evaluates the direct effects of various constructs on attitudes and intentions towards lifelong learning. The hypotheses tested include the impact of technology innovation (TI), digital human capital (DH), and digital leadership (DL) on perceived ease of use (PE), perceived usefulness (PU), attitudes towards lifelong learning (AT), and the intention to promote lifelong learning opportunities (IT).

The results show that technology innovation significantly influences attitudes towards lifelong learning (β = 0.269, p < 0.001), perceived ease of use (β = 0.361, p < 0.001), and perceived usefulness (β = 0.344, p < 0.001).

Digital human capital also has a significant effect on perceived ease of use (β = 0.225, p < 0.001), attitudes towards lifelong learning (β = 0.211, p < 0.001), and perceived usefulness (β = 0.163, p = 0.005).

Similarly, digital leadership significantly impacts perceived ease of use (β = 0.225, p < 0.001), perceived usefulness (β = 0.176, p = 0.002), and attitudes towards lifelong learning (β = 0.119, p = 0.022).

Further, perceived ease of use (β = 0.173, p = 0.002) and perceived usefulness (β = 0.168, p < 0.001) significantly influence attitudes towards lifelong learning. Technology innovation (β = 0.249, p < 0.001), attitudes towards lifelong learning (β = 0.234, p < 0.001), digital human capital (β = 0.176, p = 0.003), and digital leadership (β = 0.147, p = 0.010) all significantly impact the intention to promote lifelong learning.

These results underscore the critical roles of technology innovation, digital human capital, and digital leadership in enhancing perceptions and attitudes towards digital learning, ultimately influencing the intention to engage in lifelong learning.

Table 8: Structural equation model path test

Hypothesis	Path	Estimate	β	S.E.	C.R.	P	Results
H1	TI→AT	0.253	0.269	0.054	4.666	***	Supported
H2	TI→PE	0.325	0.361	0.051	6.390	***	Supported
H3	TI→PU	0.339	0.344	0.057	5.960	***	Supported
H4	DH→PE	0.207	0.225	0.052	4.013	***	Supported
H5	DH→AT	0.203	0.211	0.051	3.979	***	Supported
H6	DH→PU	0.164	0.163	0.058	2.840	0.005	Supported
H7	DL→PE	0.204	0.225	0.050	4.094	***	Supported
H8	DL→PU	0.173	0.176	0.056	3.117	0.002	Supported
H9	DL→AT	0.112	0.119	0.049	2.283	0.022	Supported
H10	PE→AT	0.181	0.173	0.058	3.143	0.002	Supported
H11	PU→AT	0.161	0.168	0.045	3.603	***	Supported
H12	TI→IT	0.249	0.249	0.063	3.982	***	Supported
H13	AT→IT	0.248	0.234	0.070	3.545	***	Supported
H14	DH→IT	0.180	0.176	0.061	2.949	0.003	Supported
H15	DL→IT	0.148	0.147	0.058	2.569	0.010	Supported

Note: TI: Technology innovation; DH: Digital human capital; DL: Digital leadership; PE: Perceived ease of use; PU: Perceived usefulness; AT: Attitude towards lifelong learning; IT: Intention to promote lifelong learning opportunities.
***: p<0.001

Table 9 presents the results of the mediation effect bootstrap test, examining whether certain mediating variables influence the relationships between independent and dependent variables. The table provides effect sizes, standard errors (SE), and bias-corrected 95% confidence intervals (CI) to determine the significance of each mediation path.

For hypothesis H16, the path Technology Innovation (TI) → Perceived Ease of Use (PE) → Attitude towards Lifelong Learning (AT) has an effect size of 0.059, with a confidence interval of 0.008 to 0.147, supporting the mediation. Similarly, H17 shows that Digital Human Capital (DH) → PE → AT has an effect size of 0.037, with a confidence interval of 0.004 to 0.094, also supported.

Hypothesis H18 indicates that Digital Leadership (DL) → PE → AT has an effect size of 0.037, with a confidence interval of 0.009 to 0.095, supported. For H19, the path TI → Perceived Usefulness (PU) → AT shows an effect size of 0.055, with a confidence interval of 0.010 to 0.113, confirming the mediation. H20 and H21, concerning DH and DL mediated by PU affecting AT, show effect sizes of 0.026 and 0.028, with respective confidence intervals of 0.002 to 0.073 and 0.005 to 0.072, both supported.

Hypotheses H22, H23, H25, and H26 indicate significant mediation paths: TI → AT → Intention to promote lifelong learning opportunities (IT) with an effect size of 0.063, DH → AT → IT with an effect size of 0.050, PE → AT → IT with an effect size of 0.045, and PU → AT → IT with an effect size of 0.040, all supported within their confidence intervals.

However, H24, concerning DL → AT → IT, is rejected due to the confidence interval ranging from -0.007 to 0.081, indicating no significant mediation effect.

These results confirm the mediation effects for most paths, underscoring the importance of perceived ease of use, perceived usefulness, and attitudes towards lifelong learning in influencing the intention to promote lifelong learning opportunities.

Table 9: Mediation effect bootstrap test

Hypothesis	Mediation path	Effect size	SE	Bias-Corrected 95%CI		Results
H16	TI→PE→AT	0.059	0.032	0.008	0.147	Supported
H17	DH→PE→AT	0.037	0.023	0.004	0.094	Supported
H18	DL→PE→AT	0.037	0.021	0.009	0.095	Supported
H19	TI→PU→AT	0.055	0.026	0.010	0.113	Supported
H20	DH→PU→AT	0.026	0.017	0.002	0.073	Supported
H21	DL→PU→AT	0.028	0.016	0.005	0.072	Supported
H22	TI→AT→IT	0.063	0.032	0.011	0.142	Supported
H23	DH→AT→IT	0.050	0.026	0.008	0.115	Supported
H24	DL→AT→IT	0.028	0.024	-0.007	0.081	Rejected
H25	PE→AT→IT	0.045	0.029	0.004	0.117	Supported
H26	PU→AT→IT	0.040	0.022	0.007	0.102	Supported

Note: TI: Technology innovation; DH: Digital human capital; DL: Digital leadership; PE: Perceived ease of use; PU: Perceived usefulness; AT: Attitude towards lifelong learning; IT: Intention to promote lifelong learning opportunities.

Figure 2. uncovers the structural equation model diagram and explain the relationships among technology innovation, digital human capital, digital leadership, perceived ease of use, perceived usefulness, attitude towards lifelong learning, intention to promote lifelong learning opportunities. By this way, this study identifies perceived ease of use, attitude towards lifelong learning, and perceived usefulness as mediating roles.
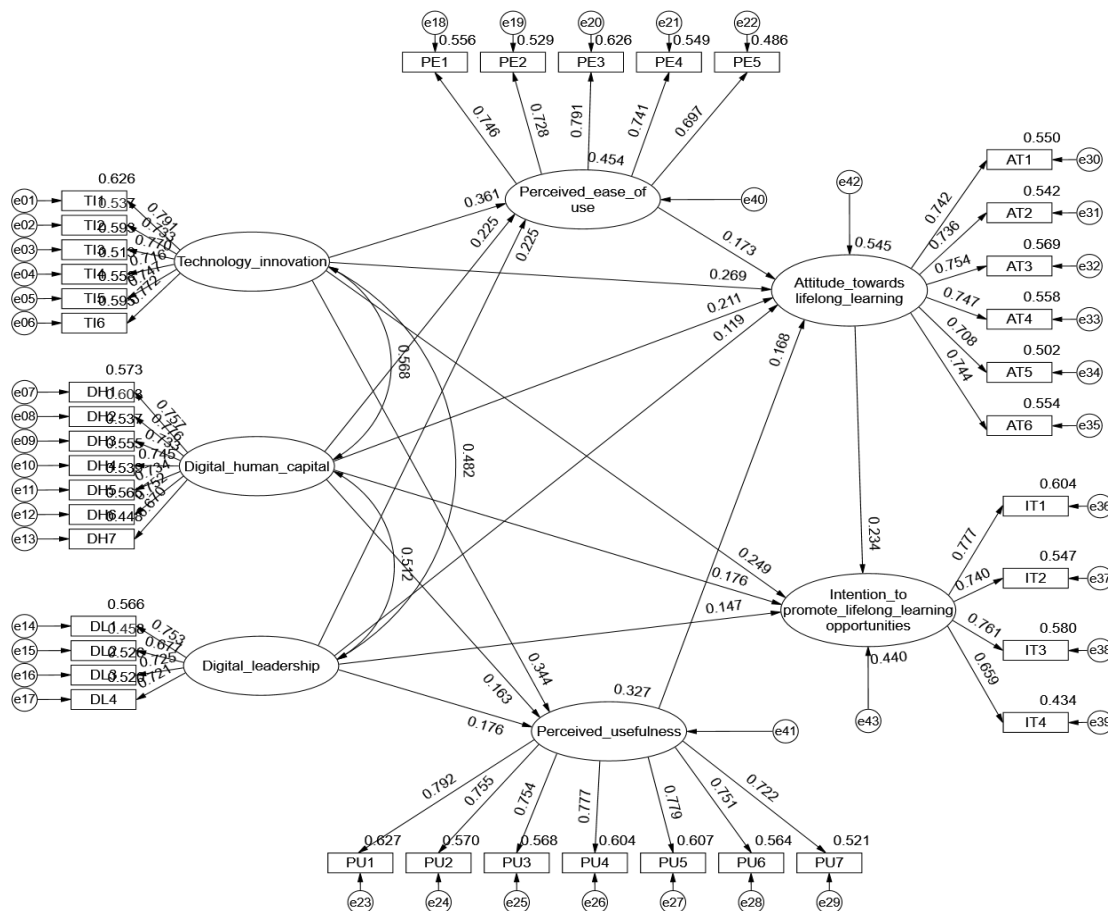

Figure 2: Structural equation model diagram

5. DISCUSSION AND CONCLUSION

The findings from the path analysis reveal significant mediation effects across various hypothesized relationships, underscoring the essential role of perceived ease of use, perceived usefulness, and attitudes towards lifelong learning in shaping the intention to promote lifelong learning opportunities. Specifically, the mediation effect of perceived ease of use in the relationship between technology innovation and attitude towards lifelong learning is supported, highlighting the importance of user-friendly digital tools in fostering positive learning attitudes. Similarly, digital human capital mediates its effect on attitude towards lifelong learning through perceived ease of use, reinforcing the value of digital competencies in enhancing educational attitudes. Moreover, the mediation of perceived usefulness in the effect of technology innovation and digital human capital on attitude towards lifelong learning further validates the practical benefits of digital tools in education. Notably, the direct paths from attitude towards lifelong learning to intention to promote lifelong learning are substantiated by significant effect sizes, emphasizing how positive attitudes towards lifelong learning drive the commitment to continuous education. However, the path from digital leadership to intention to promote lifelong learning via attitude towards lifelong learning is not supported, suggesting that while leadership is crucial, its impact may be more direct rather than mediated through attitudes. Overall, these results highlight the multifaceted nature of digital integration in education, illustrating that both the perceived ease of use and usefulness of digital platforms are pivotal in cultivating enduring educational attitudes and intentions.

5.1 Theoretical implications

This study integrates Digital Transformation Management, the Stimulus-Organism-Response theory, the Technology Acceptance Model, and Motivation Theory to comprehensively analyze factors influencing lifelong learning through digital education platforms. The results offer significant theoretical implications, illustrating the interconnectedness of these theories and aligning with or differing from previous research.

Digital transformation management emphasizes the strategic integration of digital technologies to enhance organizational efficiency and effectiveness (Niu et al., 2022). Our findings support this, demonstrating that technology innovation positively influences both perceived ease of use and perceived usefulness of digital platforms, thereby fostering positive attitudes towards lifelong learning. This is consistent with earlier studies that highlight the role of technological advancements in improving educational outcomes (Almaiah et al., 2022). However, unlike some studies that stress the direct influence of digital leadership on educational strategies (Tamar et al., 2023), our findings suggest that digital leadership impacts lifelong learning intentions more directly than through mediated attitudes, indicating a nuanced role of leadership in digital transformation.

The Stimulus-Organism-Response theory posits that external stimuli (e.g., digital platforms) influence internal states (e.g., attitudes) and subsequent responses (e.g., behavioral intentions) (Jacoby, 2002). Our study confirms this framework by showing that PE and perceived ease of use act as critical mediators between technology innovation and attitudes towards lifelong learning, and subsequently between attitudes towards lifelong learning and lifelong learning intentions. This aligns with prior research demonstrating that user perceptions of technology significantly impact their

behavioral intentions (Xu & Zhu, 2023). Our findings expand on this by emphasizing the specific role of educational stimuli in shaping lifelong learning attitudes and intentions, which is less explored in existing literature.

Technology Acceptance Model asserts that perceived ease of use and perceived usefulness are primary determinants of technology acceptance (Sagnier et al., 2020). Consistent with Technology Acceptance Model, our results indicate that both perceived ease of use and perceived usefulness significantly influence attitudes towards lifelong learning towards digital learning platforms. This corroborates previous studies that have applied Technology Acceptance Model in educational contexts, highlighting the importance of user-friendly and beneficial technologies in fostering positive attitudes (Alshurideh et al., 2024). However, our study also reveals that the impact of digital leadership on attitudes towards lifelong learning and lifelong learning intentions is less straightforward, suggesting that leadership may facilitate acceptance through other pathways, such as providing support and resources rather than directly influencing attitudes.

Motivation Theory, particularly the Theory of Planned Behaviorand Self-Determination Theory, highlights the role of intrinsic and extrinsic motivators in shaping behavior (Urhahne & Wijnia, 2023). Our findings align with these theories, demonstrating that attitudes towards lifelong learning significantly mediate the relationship between intrinsic motivators (e.g., personal benefits of digital learning) and the intention to engage in lifelong learning. This supports previous research indicating that motivation is crucial for the sustained use of digital learning tools (Anthonysamy et al., 2020). Additionally, the study underscores the importance of digital human capital in enhancing educational outcomes, suggesting that motivated educators and administrators are pivotal in leveraging digital technologies effectively.

Overall, our findings reinforce the importance of perceived ease of use and usefulness in technology acceptance, consistent with Technology Acceptance Model and Digital Transformation Management frameworks. They also validate the Stimulus-Organism-Response theory's application in educational contexts, highlighting the role of user perceptions in mediating the effects of digital innovations on learning intentions. However, the study reveals a more complex relationship for digital leadership, suggesting that its influence on lifelong learning may be more direct rather than mediated through attitudes, differing from some Digital Transformation Management and Technology Acceptance Model assertions (Niu et al., 2022). Furthermore, the emphasis on motivation aligns with Motivation Theory, yet highlights the unique context of digital education, where both intrinsic and extrinsic factors are critical for engagement and sustained use.

5.2 Practical implications

This study integrates Digital Transformation Management, the Stimulus-Organism-Response theory, the Technology Acceptance Model, and Motivation Theory to analyze factors influencing lifelong learning through digital education platforms. The results offer significant insights and managerial implications for various stakeholders, including educational leaders, policymakers, educators, and technology developers.

The findings indicate that technology innovation significantly enhances perceived ease of use and perceived usefulness of digital platforms, fostering positive attitudes towards lifelong learning. For educational leaders, this underscores the importance of investing in innovative technologies and ensuring their seamless integration into the

learning environment. Policymakers should advocate for funding and policies that support technological advancements in education, thereby promoting lifelong learning. Educational administrators need to focus on creating an ecosystem that continuously adopts and integrates new digital tools, enhancing the overall learning experience .

Our study confirms that perceived ease of use and perceived usefulness act as critical mediators between technology innovation and attitudes towards lifelong learning, which subsequently influence lifelong learning intentions. This suggests that user perceptions of digital platforms are crucial in shaping their learning behaviors. For educators, this means that adopting user-friendly and practical digital tools is essential for fostering positive learning attitudes. Technology developers should focus on creating intuitive and functional platforms that cater to educational needs, enhancing user experience and engagement.

Consistent with Technology Acceptance Model, our results indicate that perceived ease of use and perceived usefulness significantly influence attitudes towards lifelong learning through digital platforms. This highlights the need for educational institutions to select digital tools that are not only effective but also easy to use. For technology developers, it is crucial to conduct user feedback sessions and usability testing to ensure that the platforms meet the needs of both educators and learners. Moreover, the nuanced role of digital leadership suggests that leaders should focus on providing adequate support and resources to facilitate the adoption of digital technologies, rather than merely promoting their use.

Our findings align with Motivation Theory, demonstrating that attitudes towards lifelong learning significantly mediate the relationship between intrinsic motivator and the intention to engage in lifelong learning. For educators and administrators, this emphasizes the importance of fostering a motivational climate that supports continuous learning. This can be achieved by recognizing and rewarding learning achievements, providing opportunities for professional development, and creating a culture that values lifelong education. Policymakers should consider policies that incentivize lifelong learning, such as continuing education credits or professional development requirements.

In summary, the study offers valuable insights for stakeholders in the educational sector, emphasizing the importance of technology innovation, user-friendly design, motivational support, and strategic leadership in promoting lifelong learning through digital platforms. These insights can guide the development of policies and practices that enhance educational outcomes and foster a culture of continuous learning.

5.3 Conclusion

This study investigates the factors influencing lifelong learning through digital education platforms, integrating Digital Transformation Management, the Stimulus-Organism-Response theory, the Technology Acceptance Model, and Motivation Theory. The main findings indicate that technology innovation significantly enhances perceived ease of use and perceived usefulness of digital platforms, thereby fostering positive attitudes towards lifelong learning. Both perceived ease of use and perceived usefulness are critical mediators between technology innovation and attitudes towards lifelong learning, and subsequently between attitudes towards lifelong learning and the intention to promote lifelong learning. Additionally, digital human capital and digital leadership significantly influence perceived ease of use, perceived usefulness, and attitudes towards lifelong learning, though the impact of digital leadership on intention

to promote lifelong learning is more direct rather than mediated through attitudes towards lifelong learning. The study confirms the interconnectedness of these theories and highlights the importance of user perceptions and attitudes in adopting digital learning technologies.

This study makes several significant contributions to the existing body of knowledge. Firstly, it integrates four theoretical frameworks to provide a comprehensive understanding of the factors influencing lifelong learning through digital platforms. This holistic approach offers a nuanced perspective on how technology, human capital, and leadership interact to shape educational outcomes. Secondly, the study emphasizes the critical roles of perceived ease of use and perceived usefulness in fostering positive attitudes towards lifelong learning, aligning with and extending the Technology Acceptance Model framework. Thirdly, it highlights the importance of digital human capital and leadership in enhancing educational experiences, thus providing actionable insights for educational leaders and policymakers. Lastly, the study underscores the mediating role of attitudes towards lifelong learning, contributing to the Motivation Theory literature by demonstrating how intrinsic and extrinsic motivators influence lifelong learning intentions.

Despite its contributions, this study has several limitations. Firstly, the sample is geographically limited to higher educational institutions in Western China, which may not be representative of other regions or countries. This geographical limitation restricts the generalizability of the findings. Secondly, the study employs a cross-sectional design, capturing data at a single point in time, which limits the ability to draw causal inferences. Longitudinal studies are needed to examine the dynamic relationships among the variables over time. Thirdly, the study relies on self-reported data, which may be subject to social desirability bias and inaccuracies in self-assessment. Finally, while the study integrates multiple theoretical frameworks, it does not exhaustively explore all potential factors influencing lifelong learning through digital platforms. Future research should address these limitations by expanding the geographical scope of the study to include diverse regions and educational contexts, enhancing the generalizability of the findings. Longitudinal studies should be conducted to examine the temporal dynamics of the relationships among technology innovation, human capital, leadership, and lifelong learning intentions. Additionally, incorporating objective measures and observational data could complement self-reported data, providing a more comprehensive understanding of the factors influencing lifelong learning. Further research could also explore additional theoretical frameworks and variables, such as cultural influences, socio-economic factors, and individual differences in learning styles and preferences, to provide a more holistic view of digital learning adoption.

In conclusion, this study underscores the critical role of technology innovation, perceived ease of use, perceived usefulness, and attitudes towards lifelong learning in promoting the adoption of digital education platforms. By integrating multiple theoretical frameworks, the study offers a comprehensive understanding of the factors influencing lifelong learning and provides valuable insights for educational leaders, policymakers, and technology developers. Despite its limitations, the study lays a solid foundation for future research and underscores the importance of fostering a supportive and innovative educational environment to enhance lifelong learning opportunities.

Reference

1) Abbas, N., Whitfield, J., Atwell, E., Bowman, H., Pickard, T., & Walker, A. (2022). Online chat and chatbots to enhance mature student engagement in higher education. *International Journal of Lifelong Education*, *41*(3), 308-326. https://doi.org/10.1080/02601370.2022.2066213

2) Abulibdeh, A., Zaidan, E., & Abulibdeh, R. (2024). Navigating the confluence of artificial intelligence and education for sustainable development in the era of industry 4.0: Challenges, opportunities, and ethical dimensions. *Journal of Cleaner Production*, 140527. https://doi.org/10.1016/j.jclepro.2023.140527

3) Agostineto, R. C., Soares, T. C., Mazon, G., & Soares, S. V. (2022). Influence of intellectual capital and individual absorptive capacity on innovation performance. *Revista de administração da UFSM*, *15*, 270-289. https://doi.org/10.5902/1983465968613

4) AlAjmi, M. K. (2022). The impact of digital leadership on teachers' technology integration during the COVID-19 pandemic in Kuwait. *International Journal of Educational Research*, *112*, 101928. https://doi.org/10.1016/j.ijer.2022.101928

5) Alenezi, M. (2023). Digital learning and digital institution in higher education. *Education Sciences*, *13*(1), 88. https://doi.org/10.3390/educsci13010088

6) Almaiah, M. A., Alfaisal, R., Salloum, S. A., Al-Otaibi, S., Al Sawafi, O. S., Al-Maroof, R. S., Lutfi, A., Alrawad, M., Mulhem, A. A., & Awad, A. B. (2022). Determinants influencing the continuous intention to use digital technologies in Higher Education. *Electronics*, *11*(18), 2827. https://doi.org/10.3390/electronics11182827

7) Alshurideh, M., Jdaitawi, A., Sukkari, L., Al-Gasaymeh, A., Alzoubi, H., Damra, Y., Yasin, S., Kurdi, B., & Alshurideh, H. (2024). Factors affecting ChatGPT use in education employing TAM: A Jordanian universities' perspective. *International Journal of Data and Network Science*, *8*(3), 1599-1606. https://doi.org/10.5267/j.ijdns.2024.3.007

8) Anthonysamy, L., Koo, A. C., & Hew, S. H. (2020). Self-regulated learning strategies in higher education: Fostering digital literacy for sustainable lifelong learning. *Education and Information Technologies*, *25*(4), 2393-2414. https://doi.org/10.1007/s10639-020-10201-8

9) Antonietti, C., Cattaneo, A., & Amenduni, F. (2022). Can teachers' digital competence influence technology acceptance in vocational education? *Computers in Human Behavior*, *132*, 107266. https://doi.org/10.1016/j.chb.2022.107266

10) Antonopoulou, H., Halkiopoulos, C., Barlou, O., & Beligiannis, G. N. (2021). Associations between traditional and digital leadership in academic environment: During the COVID-19 pandemic. *Emerging Science Journal*, *5*(4), 405-428. https://doi.org/10.28991/esj-2021-01286

11) Asare, S., Amponsah, A., Agyemang, M. O., & Akwaah, V. (2023). Utilizing educational apps and online platforms for home economics learning: An investigation of students' attitudes and perceptions. *World Journal of Advanced Research and Reviews*, *19*(3), 411-419. https://doi.org/10.30574/wjarr.2023.19.3.1831

12) Avidov-Ungar, O., Shamir-Inbal, T., & Blau, I. (2022). Typology of digital leadership roles tasked with integrating new technologies into teaching: Insights from metaphor analysis. *Journal of Research on Technology in Education*, *54*(1), 92-107. https://doi.org/10.1080/15391523.2020.1809035

13) Ayvat, A. G., & Gunturkun, F. (2022). Analysis of the effect of a university's integrated marketing communication activities on university choices using the decision tree technique. *Journal of Marketing for Higher Education*. https://doi.org/10.1080/08841241.2022.2152919

14) Bankins, S., Ocampo, A. C., Marrone, M., Restubog, S. L. D., & Woo, S. E. (2024). A multilevel review of artificial intelligence in organizations: Implications for organizational behavior research and practice. *Journal of Organizational Behavior*, *45*(2), 159-182. https://doi.org/10.1002/job.2735

15) Bansal, A., Panchal, T., Jabeen, F., Mangla, S. K., & Singh, G. (2023). A study of human resource digital transformation (HRDT): A phenomenon of innovation capability led by digital and individual factors. *Journal of Business Research*, *157*, 113611. https://doi.org/10.1016/j.jbusres.2022.113611

16) Bariham, I. (2022). Senior high school teachers' and students' perception about the integration of online learning and its impact on their application of technology in teaching and learning of social studies in northern region, Ghana. *Social Education Research*, 161-174. https://doi.org/10.37256/ser.3120221268

17) Benitez, J., Arenas, A., Castillo, A., & Esteves, J. (2022). Impact of digital leadership capability on innovation performance: The role of platform digitization capability. *Information & Management*, *59*(2), 103590. https://doi.org/10.1016/j.im.2022.103590

18) Bowman, M. A., Vongkulluksn, V. W., Jiang, Z., & Xie, K. (2022). Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value and ability beliefs. *Journal of Research on Technology in Education*, *54*(2), 188-204. https://doi.org/10.1080/15391523.2020.1830895

19) Bresciani, S., Ferraris, A., Romano, M., & Santoro, G. (2021). Digital leadership. In *digital transformation management for agile organizations: a compass to sail the digital world* (pp. 97-115). Emerald Publishing Limited.

20) Chen, Y., Wang, D., Zhu, W. X., Hou, Y. F., Liu, D. L., Ma, C. S., Li, T., & Yuan, Y. (2023). Effective Conditions for Achieving Carbon Unlocking Targets for Transport Infrastructure Development-Joint Analysis Based on PLS-SEM and NCA. *International journal of environmental research and public health*, *20*(2), Article 1170. https://doi.org/10.3390/ijerph20021170

21) Cheung, S. K., Kwok, L. F., Phusavat, K., & Yang, H. H. (2021). Shaping the future learning environments with smart elements: challenges and opportunities. *International journal of educational technology in higher education*, *18*, 1-9. https://doi.org/10.1186/s41239-021-00254-1

22) Chintalapati, N., & Daruri, V. S. K. (2017). Examining the use of YouTube as a Learning Resource in higher education: Scale development and validation of TAM model. *Telematics and Informatics*, *34*(6), 853-860. https://doi.org/10.1016/j.tele.2016.08.008

23) Christian, C., Jove, C. E., Dendy, L. E., & Tileng, K. G. (2023). Analysis of Perceived Usefulness, Perceived Ease of Use, and Self-Service Technology of Student Mobile Application in University. *JATISI (Jurnal Teknik Informatika dan Sistem Informasi)*, *10*(4). https://doi.org/10.35957/jatisi.v10i4.6405

24) Chukwuedo, S. O., Mbagwu, F. O., & Ogbuanya, T. C. (2021). Motivating academic engagement and lifelong learning among vocational and adult education students via self-direction in learning. *Learning and Motivation*, *74*, 101729. https://doi.org/10.1016/j.lmot.2021.101729

25) Cui, Y., Ma, Z., Wang, L., Yang, A., Liu, Q., Kong, S., & Wang, H. (2023). A survey on big data-enabled innovative online education systems during the COVID-19 pandemic. *Journal of Innovation & Knowledge*, *8*(1), 100295. https://doi.org/10.1016/j.jik.2022.100295

26) Dah, J., & Hussin, N. (2021). A conceptual framework of a streamlined extended technology acceptance model for mobile application adoption. *International Journal of Social Science Research*, *9*(2), 42. https://doi.org/10.5296/ijssr.v9i2.18649

27) Downie, S., Gao, X., Bedford, S., Bell, K., & Kuit, T. (2021). Technology enhanced learning environments in higher education: A cross-discipline study on teacher and student perceptions. *Journal of University Teaching & Learning Practice*, *18*(4), 12. https://doi.org/10.53761/1.18.4.12

28) Duong, C. D., Vu, T. N., & Ngo, T. V. N. (2023). Applying a modified technology acceptance model to explain higher education students' usage of ChatGPT: A serial multiple mediation model with knowledge sharing as a moderator. *The International Journal of Management Education*, *21*(3), 100883. https://doi.org/10.1016/j.ijme.2023.100883

29) Ellis, M. L., Lu, Y.-H., & Fine-Cole, B. (2021). Digital learning for North Carolina educational leaders. *TechTrends*, *65*(5), 696-712. https://doi.org/10.1007/s11528-021-00649-x

30) Exter, M., & Ashby, I. (2022). Lifelong learning of instructional design and educational technology professionals: A heutagogical approach. *TechTrends*, *66*(2), 254-264. https://doi.org/10.1007/s11528-021-00657-x

31) Gan, W., Qi, Z., Wu, J., & Lin, J. C.-W. (2023). Large language models in education: Vision and opportunities. 2023 IEEE International Conference on Big Data (BigData),

32) Goh, E., & Wen, J. (2021). Applying the technology acceptance model to understand hospitality management students' intentions to use electronic discussion boards as a learning tool. *Journal of Teaching in Travel & Tourism*, *21*(2), 142-154. https://doi.org/10.1080/15313220.2020.1768621

33) Gupta, P., Prashar, S., Vijay, T. S., & Parsad, C. (2021). Examining the influence of antecedents of continuous intention to use an informational app: the role of perceived usefulness and perceived ease of use. *International Journal of Business Information Systems*, *36*(2), 270-287. https://doi.org/10.1504/IJBIS.2021.112829

34) Gürbüz, T. (2021). Enabling Digital Transformation in Education and Training: Towards Effective Human Capital Development. In *Recent Developments in Individual and Organizational Adoption of ICTs* (pp. 228-243). IGI Global. https://doi.org/10.4018/978-1-7998-3045-0.ch014

35) Han, X. B., Yang, C. M., & Zhou, Q. (2023). Digital Transformation in Vocational Education: Present Situation, Problems, and Countermeasures. *Frontiers of Education in China*, *18*(1), 70-82. https://doi.org/10.3868/s110-008-023-0005-2

36) Harrigan, M., Feddema, K., Wang, S., Harrigan, P., & Diot, E. (2021). How trust leads to online purchase intention founded in perceived usefulness and peer communication. *Journal of Consumer Behaviour*, *20*(5), 1297-1312. https://doi.org/10.1002/cb.1936

37) Hofer, S. I., Nistor, N., & Scheibenzuber, C. (2021). Online teaching and learning in higher education: Lessons learned in crisis situations. *Computers in Human Behavior*, *121*, 106789. https://doi.org/10.1016/j.chb.2021.106789

38) Hongsuchon, T., Emary, I. M. E., Hariguna, T., & Qhal, E. M. A. (2022). Assessing the impact of online-learning effectiveness and benefits in knowledge management, the antecedent of online-learning strategies and motivations: an empirical study. *Sustainability*, *14*(5), 2570. https://doi.org/10.3390/su14052570

39) Hossain, M. N., Talukder, M. S., Khayer, A., & Bao, Y. (2021). Investigating the factors driving adult learners' continuous intention to use M-learning application: a fuzzy-set analysis. *Journal of Research in Innovative Teaching & Learning*, *14*(2), 245-270. https://doi.org/10.1108/JRIT-09-2019-0071

40) Hu, D., Yuan, B., Luo, J., & Wang, M. (2021). A Review of Empirical Research on ICT Applications in Teacher Professional Development and Teaching Practice. *Knowledge Management & E-Learning*, *13*(1), 1-20.

41) Huang, C. Y., Su, H., Cheng, S. M., & Tan, C. S. (2021). The effects of group art therapy on adolescents' self-concept and peer relationship: A mixed-method study. *New directions for child and adolescent development*, *2021*(179), 75-92. https://doi.org/10.1002/cad.20435

42) Huang, T. (2023). Using SOR framework to explore the driving factors of older adults smartphone use behavior. *Humanities and Social Sciences Communications*, *10*(1), 1-16. https://doi.org/10.1057/s41599-023-02221-9

43) Imran, F., Shahzad, K., Butt, A., & Kantola, J. (2021). Digital transformation of industrial organizations: Toward an integrated framework. *Journal of Change Management*, *21*(4), 451-479.

44) Iqbal, S., Rasheed, M., Khan, H., & Siddiqi, A. (2021). Human resource practices and organizational innovation capability: role of knowledge management. *VINE Journal of Information and Knowledge Management Systems*, *51*(5), 732-748. https://doi.org/10.1108/VJIKMS-02-2020-0033

45) Jacoby, J. (2002). Stimulus-organism-response reconsidered: an evolutionary step in modeling (consumer) behavior. *Journal of consumer psychology*, *12*(1), 51-57. https://doi.org/10.1207/S15327663JCP1201_05

46) Jameson, J., Rumyantseva, N., Cai, M., Markowski, M., Essex, R., & McNay, I. (2022). A systematic review and framework for digital leadership research maturity in higher education. *Computers and Education Open*, *3*, 100115. https://doi.org/10.1016/j.caeo.2022.100115

47) Jiang, J., & Ke, G. (2021). China's move to mass higher education since 1998: Analysis of higher education expansion policies. *Higher Education Quarterly*, *75*(3), 418-437. https://doi.org/10.1111/hequ.12313

48) Jin, Q., Liu, Y., Yarosh, S., Han, B., & Qian, F. (2022). How will vr enter university classrooms? multi-stakeholders investigation of vr in higher education. Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems,

49) Kang, Y., Choi, N., & Kim, S. (2021). Searching for new model of digital informatics for human–computer interaction: testing the Institution-Based Technology Acceptance Model (ITAM). *International journal of environmental research and public health*, *18*(11), 5593. https://doi.org/10.3390/ijerph18115593

50) Kaputa, V., Loučanová, E., & Tejerina-Gaite, F. A. (2022). Digital transformation in higher education institutions as a driver of social oriented innovations. *Social innovation in higher education*, *61*, 81-85. https://doi.org/10.1007/978-3-030-84044-0_4

51) Kelly, K., & Zakrajsek, T. D. (2023). *Advancing online teaching: Creating equity-based digital learning environments*. Taylor & Francis.

52) Kemp, K., Baxa, D., & Cortes, C. (2022). Exploration of a collaborative self-directed learning model in medical education. *Medical science educator*, *32*(1), 195-207. https://doi.org/10.1007/s40670-021-01493-7

53) Ketikidou, G., & Saiti, A. (2022). The promotion of inclusive education through sustainable and systemic leadership. *International Journal of Leadership in Education*, 1-16. https://doi.org/10.1080/13603124.2022.2032368

54) Kilag, O. K. T., Almendras, R. C., Manguilimotan, A. M. G., Arcillo, M. T., Mansueto, D. P., & Ibañez, D. D. (2023). Choosing the Right Educational Technology Tool a Pedagogical Perspective into Teaching with Technology. *Web of Scholars: Multidimensional Research Journal*, *2*(6), 55-66.

55) Kurniawan, I. A., Mugiono, M., & Wijayanti, R. (2022). The effect of Perceived Usefulness, Perceived Ease of Use, and social influence toward intention to use mediated by Trust. *Jurnal Aplikasi Manajemen*, *20*(1), 117-127. https://doi.org/10.21776/ub.apmba.2021.009.03.4

56) Li, J. (2023). A research on relationship between student-centered approach and student competence development in higher education: case studies in China and Italy. *Education in Italy*, *2*(2), 1-17.

57) Li, J., & Wu, C.-H. (2023). Determinants of Learners' Self-Directed Learning and Online Learning Attitudes in Online Learning. *Sustainability*, *15*(12), 9381. https://doi.org/10.3390/su15129381

58) Li, X., Yang, Y., Chu, S. K. W., Zainuddin, Z., & Zhang, Y. (2022). Applying blended synchronous teaching and learning for flexible learning in higher education: an action research study at a university in Hong Kong. *Asia Pacific Journal of Education*, *42*(2), 211-227. https://doi.org/0.1080/02188791.2020.1766417

59) Liang, Y. (2023). *A Parenting Training Curriculum to Modify Problem Behaviors of Urban Chinese High Achieving Elementary School Students*. University of Rochester.

60) Lim, J., & Newby, T. J. (2021). Preservice teachers' attitudes toward Web 2.0 personal learning environments (PLEs): Considering the impact of self-regulation and digital literacy. *Education and Information Technologies*, *26*(4), 3699-3720. https://doi.org/10.1007/s10639-021-10432-3

61) Liu, S. Y., Vega, A. R., & Dizy, M. (2023). Assessing ultrapremium red wine quality using PLS-SEM. *Lwt-Food Science and Technology*, *177*, Article 114560. https://doi.org/10.1016/j.lwt.2023.114560

62) Ma, Y. (2021). To shop or not: Understanding Chinese consumers' live-stream shopping intentions from the perspectives of uses and gratifications, perceived network size, perceptions of digital celebrities, and shopping orientations. *Telematics and Informatics*, *59*, 101562. https://doi.org/10.1016/j.tele.2021.101562

63) Mhlanga, D. (2022). Digital transformation in education: relevant paradigms and theories of teaching and learning in the industry 4.0. In *Intelligent systems in digital transformation: Theory and applications* (pp. 453-470). Springer.

64) Miller, G. E., & Ives, K. S. (2023). *Leading the eLearning transformation of higher education: Leadership strategies for the next generation*. Taylor & Francis.

65) Mladenović, D., Todua, N., & Pavlović-Höck, N. (2023). Understanding individual psychological and behavioral responses during COVID-19: Application of stimulus-organism-response model. *Telematics and Informatics*, *79*, 101966. https://doi.org/10.1016/j.tele.2023.101966

66) Mogavi, R. H., Deng, C., Kim, J. J., Zhou, P., Kwon, Y. D., Metwally, A. H. S., Tlili, A., Bassanelli, S., Bucchiarone, A., & Gujar, S. (2024). ChatGPT in education: A blessing or a curse? A qualitative study exploring early adopters' utilization and perceptions. *Computers in Human Behavior: Artificial Humans*, *2*(1), 100027. https://doi.org/10.1016/j.chbah.2023.100027

67) Mohamed Hashim, M. A., Tlemsani, I., & Matthews, R. (2022). Higher education strategy in digital transformation. *Education and Information Technologies*, *27*(3), 3171-3195. https://doi.org/10.1007/s10639-021-10739-1

68) Morgado, J. C., Lencastre, J. A., Freires, T., & Bento, M. (2021). Smart education as empowerment: Outlining veteran teachers' training to promote digital migration. *Technology, Knowledge and Learning*, *26*(4), 897-916. https://doi.org/10.1007/s10758-021-09494-6

69) Mubarik, M. S., Shahbaz, M., & Abbas, Q. (2022). *Human capital, innovation and disruptive digital technology: A multidimensional perspective*. Routledge.

70) Namboodiri, S. (2022). Zoom-ing past "the new normal"? Understanding students' engagement with online learning in higher education during the covid-19 pandemic. In *Re-imagining Educational Futures in Developing Countries: Lessons from Global Health Crises* (pp. 139-158). Springer. https://doi.org/10.1007/978-3-030-88234-1_8

71) Ng, P. M., Chan, J. K., Wut, T. M., Lo, M. F., & Szeto, I. (2021). What makes better career opportunities for young graduates? Examining acquired employability skills in higher education institutions. *Education+ Training*, *63*(6), 852-871. https://doi.org/10.1108/ET-08-2020-0231

72) Nguyen, M. (2023). I see myself in my leader: transformational leadership and its impact on employees' technology-mediated knowledge sharing in professional service firms. *Journal of service theory and practice*, *33*(2), 257-279. https://doi.org/10.1108/JSTP-04-2022-0093

73) Niu, S., Park, B. I., & Jung, J. S. (2022). The Effects of Digital Leadership and ESG Management on Organizational Innovation and Sustainability. *Sustainability*, *14*(23), 15639. https://doi.org/10.3390/su142315639

74) Nyathi, M., & Kekwaletswe, R. (2024). Electronic human resource management (e-HRM) configuration for organizational success: inclusion of employee outcomes as contextual variables. *Journal of Organizational Effectiveness: People and Performance*, *11*(1), 196-212. https://doi.org/10.1108/JOEPP-08-2022-0237

75) Panergayo, A. A. (2021). Students' Behavioral Intention to Use Learning Management System: The Mediating Role of Perceived Usefulness and Ease of Use. *Albert Andry E. Panergayo and John Vincent C. Aliazas," Students' Behavioral Intention to Use Learning Management System: The Mediating Role of Perceived Usefulness and Ease of Use," International Journal of Information and Education Technology*, *11*(11), 538-545.

76) Pihlainen, K., Korjonen-Kuusipuro, K., & Kärnä, E. (2021). Perceived benefits from non-formal digital training sessions in later life: views of older adult learners, peer tutors, and teachers. *International Journal of Lifelong Education*, *40*(2), 155-169. https://doi.org/10.1080/02601370.2021.1919768

77) Prastyaningtyas, E. W., Ausat, A. M. A., Muhamad, L. F., Wanof, M. I., & Suherlan, S. (2023). The Role of Information Technology in Improving Human Resources Career Development. *Jurnal Teknologi Dan Sistem Informasi Bisnis*, *5*(3), 266-275. https://doi.org/10.47233/jteksis.v5i3.870

78) Qashou, A. (2021). Influencing factors in M-learning adoption in higher education. *Education and Information Technologies*, *26*(2), 1755-1785. https://doi.org/10.1007/s10639-020-10323-z

79) Qu, K., & Wu, X. (2024). ChatGPT as a CALL tool in language education: A study of hedonic motivation adoption models in English learning environments. *Education and Information Technologies*, 1-33. https://doi.org/10.1007/s10639-024-12598-y

80) Quinn, T. A., & Kohl, P. (2021). Cardiac mechano-electric coupling: acute effects of mechanical stimulation on heart rate and rhythm. *Physiological reviews*, *101*(1), 37-92. https://doi.org/10.1152/physrev.00036.2019

81) Razmak, J., & Farhan, W. (2024). A proposed digital transformation model for implementation by digital leaders. *Smart and Sustainable Built Environment*. https://doi.org/10.1108/SASBE-11-2023-0369

82) Rodríguez-Abitia, G., & Bribiesca-Correa, G. (2021). Assessing digital transformation in universities. *Future Internet*, *13*(2), 52. https://doi.org/10.3390/fi13020052

83) Sagnier, C., Loup-Escande, E., Lourdeaux, D., Thouvenin, I., & Valléry, G. (2020). User acceptance of virtual reality: an extended technology acceptance model. *International Journal of Human–Computer Interaction*, *36*(11), 993-1007. https://doi.org/10.1080/10447318.2019.1708612

84) Saif, N., Khan, S. U., Shaheen, I., ALotaibi, F. A., Alnfiai, M. M., & Arif, M. (2024). Chat-GPT; validating Technology Acceptance Model (TAM) in education sector via ubiquitous learning mechanism. *Computers in Human Behavior*, *154*, 108097. https://doi.org/10.1016/j.chb.2023.108097

85) Salter, B., Dong, Y. M., & Hunter, B. M. (2022). Constructing healthcare services markets: networks, brokers and the China-England engagement. *Globalization and Health*, *18*(1), Article 102. https://doi.org/10.1186/s12992-022-00892-8

86) Sang, G., Wang, K., Li, S., Xi, J., & Yang, D. (2023). Effort expectancy mediate the relationship between instructors' digital competence and their work engagement: evidence from universities in China. *Educational technology research and development*, *71*(1), 99-115. https://doi.org/10.1007/s11423-023-10205-4

87) Saxena, A. K., García, V., Amin, M. R., Salazar, J. M. R., & Dey, S. (2023). Structure, Objectives, and Operational Framework for Ethical Integration of Artificial Intelligence in Educational. *Sage Science Review of Educational Technology*, *6*(1), 88-100. https://doi.org/0009-0002-1647-9266

88) Şen, N., & Yildiz Durak, H. (2022). Examining the relationships between English teachers' lifelong learning tendencies with professional competencies and technology integrating self-efficacy. *Education and Information Technologies*, *27*(5), 5953-5988. https://doi.org/10.1007/s10639-021-10867-8

89) Senadjki, A., Au Yong, H. N., Ganapathy, T., & Ogbeibu, S. (2024). Unlocking the potential: the impact of digital leadership on firms' performance through digital transformation. *Journal of Business and Socio-economic Development*, *4*(2), 161-177. https://doi.org/10.1108/JBSED-06-2023-0050

90) Shah, V., Murthy, S., Warriem, J., Sahasrabudhe, S., Banerjee, G., & Iyer, S. (2022). Learner-centric MOOC model: A pedagogical design model towards active learner participation and higher completion rates. *Educational technology research and development*, *70*(1), 263-288. https://doi.org/10.1007/s11423-022-10081-4

91) Shal, T., Ghamrawi, N., & Naccache, H. (2024). Leadership styles and AI acceptance in academic libraries in higher education. *The Journal of Academic Librarianship*, *50*(2), 102849. https://doi.org/10.1016/j.acalib.2024.102849

92) Shen, S., Xu, K., Sotiriadis, M., & Wang, Y. (2022). Exploring the factors influencing the adoption and usage of Augmented Reality and Virtual Reality applications in tourism education within the context of COVID-19 pandemic. *Journal of hospitality, leisure, sport & tourism education*, *30*, 100373. https://doi.org/10.1016/j.jhlste.2022.100373

93) Songkram, N., Songkram, N., Chootongchai, S., & Samanakupt, T. (2021). Developing students' learning and innovation skills using the virtual smart classroom. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(4), 34-51.

94) Stavroulakis, G. E., Charalambidi, B. G., & Koutsianitis, P. (2022). Review of computational mechanics, optimization, and machine learning tools for digital twins applied to infrastructures. *Applied Sciences*, *12*(23), 11997. https://doi.org/10.3390/app122311997

95) Su, J., & Yang, W. (2024). Digital competence in early childhood education: A systematic review. *Education and Information Technologies*, *29*(4), 4885-4933. https://doi.org/10.1007/s10639-023-11972-6

96) Tamar, C.-L., Yaffa, B., Lea, S., Haia, A., & Nitzan, E. (2023). Digital leadership: Managing schools' virtual spaces in times of crisis. *International Journal of Educational Reform*, *32*(2), 127-147. https://doi.org/10.1177/10567879221142551

97) Tan, P. S. H., Seow, A. N., Choong, Y. O., Tan, C. H., Lam, S. Y., & Choong, C. K. (2023). University students' perceived service quality and attitude towards hybrid learning: ease of use and usefulness as mediators. *Journal of Applied Research in Higher Education*. https://doi.org/10.1108/JARHE-03-2023-0113

98) Tang, W., Zhang, X., & Tian, Y. (2023). Investigating Lifelong Learners' Continuing Learning Intention Moderated by Affective Support in Online Learning. *Sustainability*, *15*(3), 1901. https://doi.org/10.3390/su15031901

99) Tanniru, M., & Peral, J. (2021). Digital Leadership in Education. In *Effective Leadership for Overcoming ICT Challenges in Higher Education: What Faculty, Staff and Administrators Can Do to Thrive Amidst the Chaos* (pp. 73-91). Emerald Publishing Limited. https://doi.org/10.1108/978-1-83982-306-020211001

100) Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M., & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technologies*, *28*(6), 6695-6726. https://doi.org/10.1007/s10639-022-11431-8

101) Unal, E., & Uzun, A. M. (2021). Understanding university students' behavioral intention to use Edmodo through the lens of an extended technology acceptance model. *British journal of educational technology*, *52*(2), 619-637. https://doi.org/10.1111/bjet.13046

102) Uoc, T. M. (2023). Digital transformation in higher education in Vietnam today. *Revista De Gestao E Secretariado-Gesec*, *14*(8), 14582-14599. https://doi.org/10.7769/gesec.v14i8.2699

103) Urhahne, D., & Wijnia, L. (2023). Theories of motivation in education: An integrative framework. *Educational Psychology Review*, *35*(2), 45. https://doi.org/10.1007/s10648-023-09767-9

104) Wang, C. (2022). Comprehensively summarizing what distracts students from online learning: A literature review. *Human Behavior and Emerging Technologies*, *2022*. https://doi.org/10.1155/2022/1483531

105) Wang, Y. (2023). Report on smart education in China. In *Smart Education in China and Central & Eastern European Countries* (pp. 11-50). Springer.

106) Wei, Z. (2023). Navigating Digital Learning Landscapes: Unveiling the Interplay Between Learning Behaviors, Digital Literacy, and Educational Outcomes. *Journal of the Knowledge Economy*, 1-31. https://doi.org/10.1007/s13132-023-01522-3

107) Wilson, N., Keni, K., & Tan, P. H. P. (2021). The role of perceived usefulness and perceived ease-of-use toward satisfaction and trust which influence computer consumers' loyalty in China. *Gadjah Mada International Journal of Business*, *23*(3), 262-294.

108) Wong, J. T., Chen, E., Au-Yeung, N., Lerner, B. S., & Richland, L. E. (2024). Fostering engaging online learning experiences: Investigating situational interest and mind-wandering as mediators through learning experience design. *Education and Information Technologies*, 1-27. https://doi.org/10.1007/s10639-024-12524-2

109) Wu, C.-H., Liu, C.-H., & Huang, Y.-M. (2022). The exploration of continuous learning intention in STEAM education through attitude, motivation, and cognitive load. *International Journal of STEM Education*, *9*(1), 35. https://doi.org/10.1186/s40594-022-00346-y

110) Wu, C. (2024). Data privacy: From transparency to fairness. *Technology in Society*, *76*, 102457. https://doi.org/10.1016/j.techsoc.2024.102457

111) Wu, S., Duan, J., & Luo, M. (2024). Evaluating and analyzing student labor literacy in China's higher vocational education: an assessment model approach. Frontiers in Education,

112) Xu, J., & Zhu, Y. (2023). Factors influencing the use of ICT to support students' self-regulated learning in digital environment: The role of teachers in lower secondary education of Shanghai, China. *Psychology in the Schools*, *60*(11), 4312-4331. https://doi.org/10.1002/pits.22938

113) Yalcin, A. S., Kilic, H. S., & Delen, D. (2022). The use of multi-criteria decision-making methods in business analytics: A comprehensive literature review. *Technological Forecasting and Social Change*, *174*, 121193. https://doi.org/10.1016/j.techfore.2021.121193

114) Yang, J., & Lou, K. (2024). Exploring the nexus of self-efficacy in digital literacy and technology acceptance: insights from L2 Chinese teachers. *Asia Pacific Journal of Education*, 1-19. https://doi.org/10.1080/02188791.2024.2336247

115) Yao, Q., Tang, H., Liu, Y., & Boadu, F. (2023). The penetration effect of digital leadership on digital transformation: the role of digital strategy consensus and diversity types. *Journal of Enterprise Information Management.* https://doi.org/10.1108/JEIM-09-2022-0350

116) Zeng, S., Cheung, M., Leung, P., He, X., Li, X., & Huang, R. (2021). Major-to-employment mismatch in social work: A values-based framework explaining job-search decisions among Chinese graduates in Shanghai, China. *International Social Work*, *64*(2), 201-215. https://doi.org/10.1177/0020872819884997

117) Zhang, P., & Sukpasjaroen, K. (2024). Promotion Of Open Educational Resources (OER) Utilization Among Academic Staff In Chinese Higher Education Institutions. *Educational Administration: Theory and Practice*, *30*(3), 899-915. https://doi.org/10.53555/kuey.v30i3.1399

118) Zhao, Y., Sánchez Gómez, M. C., Pinto Llorente, A. M., & Zhao, L. (2021). Digital competence in higher education: Students' perception and personal factors. *Sustainability*, *13*(21), 12184. https://doi.org/10.3390/su132112184

119) Zhao, Y., Zhao, M., & Shi, F. (2023). Integrating Moral Education and Educational Information Technology: A Strategic Approach to Enhance Rural Teacher Training in Universities. *Journal of the Knowledge Economy*, 1-41. https://doi.org/10.1007/s13132-023-01693-z

120) Zhu, W., Liu, Q., & Hong, X. (2022). Implementation and challenges of online education during the COVID-19 outbreak: A national survey of children and parents in China. *Early childhood research quarterly*, *61*, 209-219. https://doi.org/10.1016/j.ecresq.2022.07.004

121) Zihan, W., Makhbul, Z. K. M., & Alam, S. S. (2024). Green Human Resource Management in Practice: Assessing the Impact of Readiness and Corporate Social Responsibility on Organizational Change. *Sustainability*, *16*(3), 1153. https://doi.org/10.3390/su16031153