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RESEARCH ARTICLE

Development of Integrating Innovation of Education Technology Model in Chinese Higher Education Institutions

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ARTICLE INFO	ABSTRACT
	Given the rapid advancement of technology today, universities must stay up to date with these developments to enhance their management practices. Thereby, this study aimed to develop the model for integrating innovation of education technology in Chinese higher education institutions by synthesizing the concepts of personnel management practices, organization structure & culture, integration and innovation of education technology, and technological landscape through a literature review, and a semi-structured interview consisting of 20 experts has been organized to develop the model. Besides that, 5 experts from different Chinese universities have participated in a focus group to further discuss and validate the developed model. As a result, the developed model has been confirmed as of good quality.

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INTRODUCTION

Background

With the rapid development and widespread adoption of technologies like big data and artificial intelligence, Technological advancements have driven changes in teaching methods and learning approaches, such as the emergence of online education, AI-assisted teaching, and virtual reality simulation experiments has freed learning from the constraints of traditional classrooms and textbooks and removed geographical barriers, providing more flexible learning options, but also enhance teaching efficiency and quality through personalized instruction and real-time monitoring of students' learning progress and understanding (Gros & García-Peñalvo, 2023). Furthermore, technological advancements have optimized and promoted the sharing of educational resources by improving online course systems and sharing high-quality MOOCs, which gather resources from top domestic and international universities, including courses, textbooks, experiments, and research materials; the education system is facilitating the application of digital technologies in education, promoting the distribution, and sharing of high-quality resources (Ustun, 2021). It is worth mentioning that technological advancements in university education are crucial not only for

improving quality and efficiency in teaching practices but also for improving efficiencies in the management of higher education institutes (Abad-Segura et al., 2020). However, there was rare research on guiding higher education institutes to integrate the innovation of education technology from the perspective of institute management. This study aims to develop a model for Chinese higher education institutes to better integrate the innovation of education technology in management practices.

Research Objectives

1. To synthesize and develop the components of the integrating innovation of the education technology model for Chinese higher education institutions.

2. To validate the integration of innovation in the education technology model for Chinese higher education institutions.

LITERATURE REVIEW

Personnel Management Practices

Personnel management practices are the backbone of any educational institution's innovation and technology integration efforts. As Khan (2020) emphasizes, organizational factors profoundly impact fostering an environment conducive to employee innovation, which is especially pertinent in the educational sector. This is further supported by Puchkov (2020), who discusses the necessity of educating managers on disaster risk reduction through innovative management strategies. These practices encompass the overarching strategy and policies that govern the organization's recruitment, professional development, and retention of staffs.

Recruitment Strategies in educational institutions are critical for sourcing individuals who not only have the required technological skills but also the ability to innovate and adapt to new teaching and learning paradigms. As Khan (2020) suggests, the ability of an organization to foster innovation is significantly impacted by the quality of its recruitment strategies. Innovative recruitment practices are not simply about filling vacancies but about finding individuals who will contribute to the dynamic and evolving educational landscape.

Professional Development within educational institutions is a cornerstone practice that directly affects the capacity for technological innovation and integration. It serves not only as a method for improving existing skills but also as a platform for introducing new competencies and fostering a culture of continuous learning and adaptability. Khan (2020) underscores the importance of ongoing development for sustaining innovation, with a clear need for professional development programs that are responsive to the rapidly changing technological landscape.

Retention Strategies are integral to sustaining the innovative capacity of educational institutions. They are designed to nurture a committed and skilled workforce capable of driving continuous technological advancement and pedagogical innovation. Retention is not merely about keeping staff but about fostering an environment where their professional growth is aligned with the institution's strategic vision for educational technology. Khan (2020) emphasizes the significance of retention in maintaining workplace innovation, where the determinants of a positive work environment are crucial for staff to remain motivated and productive.

Organizational Structure & Culture

The literature review on "Organizational Structure & Culture" reveals a multi-faceted analysis of how different components of organizational design contribute to the integration and innovation of educational technology. The works of Khan (2020), Puchkov (2020), and Karim et al. (2022) emphasize the critical role of hierarchical structures in providing clarity and direction for innovation efforts, while also highlighting the need for flexibility within these structures to encourage creativity and adaptability. Sun (2021) research underscores the importance of effective communication channels in facilitating the transfer and adoption

of new technologies within educational settings. The studies by Lam et al. (2021), alongside Sun (2021) and Abbas et al. (2022), further illustrate the significant impact of collaboration mechanisms. These works collectively suggest that fostering a collaborative culture not only enhances the institution's innovative capacity but also extends its reach through partnerships and networks beyond the organizational boundaries.

The hierarchical Structure of an Organization profoundly influences its ability to innovate and integrate educational technology effectively. In the realm of educational institutions, the configuration of this hierarchy - from leadership down to the classroom teachers - determines the flow of information, decision-making processes, and ultimately, the pace and direction of innovation (Khan, 2020; Puchkov, 2020). A well-defined hierarchical structure can provide clear guidance and support necessary for the adoption of new technologies, fostering an environment where innovation is not only encouraged but facilitated.

Communication Channels play a critical role in gathering feedback from faculty and students, which is essential for evaluating the effectiveness of technology integration efforts. This feedback loop enables institutions to make informed adjustments to their technology strategies, ensuring that they remain relevant and responsive to the needs of learners and educators (Miller & Kumar, 2022).

Collaboration Mechanisms within educational institutions serve as the foundational framework that fosters innovation, particularly in the domain of educational technology. These mechanisms when effectively implemented it would encouraged the sharing of knowledge, skills, and resources, thereby enhancing the institution's collective ability to adopt and innovate with new technologies. As noted by Stumbrienė et al. (2023), the motivation to transfer technology-enabled educational innovation is significantly influenced by the presence of a collaborative culture that supports and values the contributions of all stakeholders. Furthermore, collaboration mechanisms can also extend to partnerships with external organizations, including other educational institutions, technology companies, and community organizations. These external collaborations can provide access to additional resources, expertise, and perspectives that can enhance the institution's technological capabilities and innovative potential. Such partnerships are particularly valuable in the context of educational technology, where the rapid pace of change requires institutions to stay abreast of the latest developments and trends (Sun, 2021).

Technological landscape

Institutions that successfully navigate this landscape do so by investing in the continuous professional development of their faculty, ensuring that educators are not only proficient in current technologies but are also prepared to integrate future advancements into their pedagogical practices. The interplay between available technologies, the speed of technological evolution, and faculty technological skills creates a dynamic environment that, when managed effectively, can significantly enhance educational outcomes, and prepare students for the challenges of the digital age. This requires a strategic approach that balances the exploration of new technologies with the pedagogical goals and learning objectives of the institution, ensuring that technology serves as a tool for enhancement rather than a distraction.

Available Technologies as a critical element of the technological landscape within education has been transformed with education. From learning management systems (LMS) that facilitate online course delivery to augmented reality (AR) and virtual reality (VR) that offer immersive learning experiences, the range of technologies at educators' disposal is broader and more diverse than ever before. This proliferation of educational technologies is not merely a testament to human ingenuity but also a response to the growing demand for more personalized, engaging, and accessible education (Sun, 2021).

Pace of Technological Advancements in education is unprecedented, significantly altering the pedagogical landscape and imposing a continuous adaptation challenge for institutions worldwide. Rapid innovations in digital technologies are not only expanding the repertoire of tools available for enhancing learning but are also redefining the educational paradigms under which institutions operate. This swift evolution demands a proactive stance from educational entities to not only keep abreast of emerging technologies but

to critically evaluate and integrate these advancements in ways that meaningfully enhance teaching and learning (Puchkov, 2020; Lam et al., 2021).

 Technological Skills of Faculty members have become a linchpin in effectively leveraging the potential of new advancements to enhance teaching and learning. The rapid pace of technological advancements underscores the necessity for educators to not only be proficient with existing digital tools but also to continuously update their skills to incorporate emerging technologies into their pedagogical practices. This requirement extends beyond basic digital literacy to encompass a deeper understanding of how technology can transform educational outcomes and the student learning experience (Lam et al., 2021; Karim et al., 2022). The development of faculty technological skills is not solely for the benefit of enhancing instructional methods but also plays a critical role in preparing students for a digital world. Educators who are adept at integrating technology into their teaching practices model the digital competencies that students will need in their future careers. Thus, faculty development in technological skills is an investment in the future readiness of students, equipping them with the knowledge and skills to navigate the complexities of a technologically driven society (Karim et al., 2022).

Integration and innovation of education technology

The integration and innovation of educational technology, as explored by scholars such as Fernández et al. (2023), Zhang et al. (2023), and Yazdani et al. (2023), highlight the transformative potential and strategic necessity of digital initiatives within higher education. Besides that, it also has have profound effects on higher education institutes (HEIs), transforming how they deliver education, engage students, manage operations, and prepare for the future. Here's a detailed review on three elements of Integration and innovation of education technology.

 Level of Technology Integration within educational institutions is a multifaceted concept that extends beyond the mere presence of technology in the classroom to encompass how deeply and effectively technology is embedded into pedagogical practices. Fernández et al. (2023) emphasize the transformative potential of digital transformation initiatives in higher education, suggesting that the depth of technology integration significantly impacts the educational experience. This integration is not uniform; it varies widely across institutions and disciplines, influenced by factors such as institutional support, faculty expertise, and the availability of resources.Baig & Gillani (2023) highlight the importance of diversity and inclusion in modern human resource management practices, underscoring the need for technology integration efforts to be inclusive and accessible to all students, including those with disabilities or from diverse cultural backgrounds. This approach ensures that technology acts as a bridge rather than a barrier to learning, promoting equity in educational opportunities. The rapid advancement of digital technologies presents both opportunities and challenges for educational institutions. Idigova et al. (2023) discuss the role of modern technologies in personnel management during digital transformation, indicating that faculty development and support are crucial for successful technology integration. Educators must be equipped with not only the technical skills to use new technologies but also the pedagogical insight to integrate them effectively into their teaching practices.Tomé & Coelho (2023) provide a specific example of technology integration in physiotherapy education, illustrating how educational technologies can be tailored to meet the unique needs of allied health educators. This example highlights the importance of discipline-specific approaches to technology integration, ensuring that technological tools are relevant and add value to the learning process.

 Frequency of Innovative Practices in the evolving landscape of educational technology within institutions signifies an ongoing commitment to improvement, adaptation, and the pursuit of excellence in teaching and learning. Innovation in education encompasses a broad spectrum of practices, including the pedagogical application of emerging technologies, the development of novel learning models, and the implementation of progressive curriculum designs that leverage digital tools for enhanced educational outcomes. Zhang & Wang (2023) emphasize the importance of technology in leveraging university teaching and learning innovation, arguing that the consistent introduction and application of innovative practices are pivotal for

the diffusion of technology innovation from a knowledge creation perspective. The dynamic nature of technology in education demands that institutions remain agile, ready to adopt new tools and methods that can provide meaningful learning experiences. Fernández et al. (2023) discuss digital transformation initiatives in higher education, illustrating how these efforts require not only technological infrastructure but also a cultural shift towards embracing change and innovation. This cultural shift is foundational for increasing the frequency of innovative practices, as it fosters an environment where educators feel supported in experimenting with new teaching methods and technologies.

Teaching and Learning Outcomes Skills has been considered as the ultimate objective of integrating and innovating with educational technology. This goal is deeply intertwined with the development of specific skills in both teachers and students, which are crucial for navigating the digital landscape of the 21st century. The skills fostered through effective technology integration extend beyond technical proficiency to include critical thinking, problem-solving, collaboration, and digital literacy, all of which are essential for success in a rapidly evolving global economy (Zhang & Wang, 2023).Fernández et al. (2023) emphasize the transformative potential of digital initiatives in higher education, suggesting that these efforts can significantly impact teaching and learning outcomes by facilitating access to a broader range of resources and enabling more personalized learning experiences. However, the effectiveness of these initiatives depends on the ability of educators to integrate technology in pedagogically sound ways that enhance learning rather than detract from it.In this context, Baig & Gillani (2023) highlight the importance of diversity and inclusion, arguing that educational technology should be leveraged to create more equitable learning environments. This involves not only making digital tools accessible to all students but also ensuring that the content and pedagogical approaches employed are inclusive and responsive to the diverse needs of the student body. By doing so, institutions can improve learning outcomes across a wider spectrum of the student population, fostering a more inclusive and diverse educational community.Idigova et al. (2023) discuss the role of modern personnel management technologies in supporting educators during digital transformation. This support is critical for enabling teachers to develop the necessary skills to effectively integrate technology into their teaching practices. Professional development opportunities that focus on both the technical aspects of educational technology and its pedagogical applications are essential for enhancing teaching efficacy and, by extension, student learning outcomes.

RESEARCH METHODOLOGY

The literature review method plays a crucial role in academic research due to literature review can provide the researcher with comprehensive research information, helping the researcher quickly obtain the necessary information and grasp the trends, understanding the latest developments, academic insights, or recommendations in a particular field or subject, thus guiding scientific research. Additionally, a literature review serves as an effective retrieval tool, enabling researchers to efficiently find the necessary original literature references, saving time and effort. Thereby, the author of this study employed the literature review method to review the concepts of personnel management practices, organization structure & culture, integration and innovation of education technology, and technological landscape to obtain systematic and theoretical information to develop the model for integrating innovation of education technology in Chinese higher education institutions.

Furthermore, a semi-structured interview is an effective data collection method that plays a significant role in exploratory research. It falls between structured and unstructured interviews, allowing researchers to preset some questions, which are typically open-ended, without limiting the respondents' answers. The advantage of this method lies in its ability to ensure the direction and effectiveness of the interview while maintaining a degree of flexibility. This allows respondents the opportunity to guide the conversation, enabling researchers to gain a deeper understanding of their thoughts and feelings, thereby uncovering more genuine needs and perspectives. Hence, to develop the model in this study, a semi-structured interview consisting of 20 experts selected from different Chinese higher education institutes by purposive sampling method has been constructed. Besides that, the item-objective congruence (IOC) test has been used to test the quality of those 5 interview questions. The IOC values of these interviewing questions

ranged from 0.8 to 1. All items of IOC were greater than 0.5, indicating that the interview questions designed had passed the validity test and were effective. This also meant that interviews with experts could be conducted as expected.

To validate the developed model, a focus group consisting of 5 experts has also been organized. Before the interview, 5 interview questions have been designed to guide the semi-structured interview. Those interviewing questions were designed as follows:

1. Does this model comprehensively reflect the dynamic relationships among the key variables?
2. Can this model provide guidance for the subsequent quantitative phase of the study?
3. What role has this model played in elucidating the interactions and directionality of the relationships between the concepts identified in the conceptual framework?
4. Can this model accurately reflect the theories and empirical evidence available?
5. How to ensure its relevance and comprehensiveness when creating the model?

Besides that, the item-objective congruence (IOC) test has been used to test the quality of these 5 interview questions. The IOC values of these 5 questions were 0.8, 0.8, 0.8, 1.0, and 0.8, all the five items of IOC were greater than 0.5, indicating that the interview questions designed had passed the validity test and were effective. This also meant that interviews with experts could be conducted as expected.

Result of model development

In this study, based on the content of 20 interviews, the main themes were analyzed by content analysis, and an analysis of the theme framework has been established as follows in Table 1 :

Table 1 :Analysis of Theme Framework

Dimension	Variables	Representative text
Personnel management practices	Recruitment Strategies	attracting individuals with technical expertise and passion for education and innovation.
	Professional Development	our training programs emphasize the technical aspects and the pedagogical implications of using technology in education.
	Retention Strategies	to retain staff by creating a supportive work environment that values continuous learning and professional development opportunities.
Organization Structure & Culture	Hierarchical Structures	streamlining administrative processes and providing adequate technical support can help facilitate technology integration.
	Communication Channel	with effective leadership and communication, hierarchies can also facilitate the dissemination of technological initiatives throughout the organization by providing clear direction and support.
	Collaboration Mechanisms	A culture that values experimentation, collaboration, and adaptation tends to foster innovation in technology integration.
Technological Landscape	Available Technologies	a robust technological infrastructure that supports various educational activities, cutting-edge classroom technology, high-speed internet access, and a wide range of educational software and tools.
	Pace of Technological Advancements	fostering partnerships with industry leaders and other educational institutions can provide valuable insights and resources for innovation.
	Faculty Technological	Faculty members receive training and support to effectively integrate technology into their teaching practices while maintaining pedagogical integrity.
Integration & Innovation of Education Technology	Level of Technology Integration	interdisciplinary collaboration to identify emerging trends and best practices in educational technology.
	Frequency of innovative Practices	the frequency of innovative practices can be influenced by various internal and external factors.
	Teaching and Learning Outcomes Skills	Strategies for improving the technological competency of staff include providing comprehensive training programs, encouraging continuous learning and professional development, and creating incentives for staff to enhance their technological skills.

Regarding to personnel management practices, recruitment strategies focus on attracting candidates who possess both technical skills and a strong enthusiasm for education and innovation. Professional development programs highlight the importance of technical abilities while also addressing the pedagogical impact of technology in education. Retention strategies focus on creating a supportive work environment that values continuous learning and professional development. Personnel management practices are fundamental in shaping the effectiveness and efficiency of an organization. For educational institutions, particularly in higher education, three critical areas in personnel management are recruitment strategies, professional development, and retention strategies. Recruitment is the first step in building a strong workforce. Effective recruitment strategies are crucial for attracting the right talent to meet organizational needs and support institutional goals.

In terms of organizational structure and culture, a hierarchical framework is advantageous for optimizing administrative processes and offering technical support for technology integration. Clear communication channels and strong leadership promote the spread of technological initiatives across the organization. A culture that emphasizes collaboration, experimentation, and adaptability encourages innovation in technology integration. Effective organization structure and culture are crucial in shaping the operational efficiency, employee satisfaction, and overall success of an institution. For educational institutions, especially those in higher education, focusing on hierarchical structures, communication channels, and collaboration mechanisms can significantly impact their effectiveness and adaptability. Firstly, Hierarchical structures define the levels of authority and reporting relationships within an organization. In educational institutions, these structures can influence decision-making processes, operational efficiency, and staff engagement.

In the technological landscape , the availability of technologies, including classroom technology, internet access, and educational software, supports various educational activities. Partnerships with industry leaders and other institutions contribute to the pace of technological advancements. Faculty members receive training and support to integrate technology into teaching practices while maintaining pedagogical integrity. The technological landscape in educational institutions is crucial for driving innovation, enhancing learning experiences, and improving administrative efficiency.

Regarding integration and innovation of educational technology, interdisciplinary collaboration is facilitated to identify emerging trends and best practices. The frequency of innovative practices varies depending on internal and external factors, including institutional culture and resources. Strategies for improving technological competency include comprehensive training programs, continuous learning, and incentives for staff development. Integrating and innovating with educational technology is crucial for enhancing teaching methods, improving learning outcomes, and staying competitive in the education sector. This involves assessing the level of technology integration, the frequency of innovative practices, and the impact on teaching and learning outcomes.

Result of model validation

Result of question 1: Does this model comprehensively reflect the dynamic relationships among the key variables?

All five experts confirmed the comprehensiveness and accuracy of the model in capturing the interrelations between leveraging personnel management practices, organizational structure and culture, technological landscape, and driving educational technology innovation. One of experts explained that there are positive influences of personnel management practices, organizational structure and culture, and technological landscape on educational technology integration and innovation in higher education institutes.

Reuslt of question 2: Can this model provide guidance for the subsequent quantitative phase of the study?

Experts believed the model comprehensively captures the interrelations between personnel management practices, organizational structure and culture, technological landscape, and driving educational technology

innovation and provides guidance for the subsequent quantitative phase of the study experts highly recommended further conducting an experimental study with this model in higher education institutes.

Result of question 3: What role has this model played in elucidating the interactions and directionality of the relationships between the concepts identified in the conceptual framework?

They all agreed that the model helps elucidate the interactions and directional relationships among personnel management practices, organizational structure and culture, technological landscape, and educational technology innovation. From the perspective of theoretical and empirical support, Expert 5 believed the model aligns with existing theories and empirical evidence, further enhancing its reliability. Experts 2 to 5 mentioned the importance of ensuring the relevance and comprehensiveness of the model, suggesting rigorous literature review and stakeholder consultation for this purpose. These viewpoints underscore the importance of transparency and engagement in the research process to enhance the model's credibility and applicability.

Result of question 4: Can this model accurately reflect the theories and empirical evidence available?

the experts believed the model aligns with existing theories and empirical evidence, a sentiment echoed by the data provided in the research conclusions, enhancing the model's reliability in theoretical and empirical aspects. Furthermore, he still suggested a thorough literature review, stakeholder feedback, and iterative refinement based on empirical data to ensure the model's relevance and comprehensiveness aspects evident in the data analysis of the research conclusions.

Result of question 5: How to ensure its relevance and comprehensiveness when creating the model?

 Experts mentioned the importance of ensuring the relevance and comprehensiveness of the model, suggesting rigorous literature review and stakeholder consultation for this purpose. These viewpoints underscore the importance of transparency and engagement in the research process to enhance the model's credibility and applicability.

In conclusion, the consistent perspectives of Experts 1 through 5 support the reliability of the research findings, providing important qualitative support and reinforcing the significance and value of the study in the field of educational technology innovation. Thereby, the model of this study has been developed as followed Figure 1:

Figure 1: Integrating Innovation of Education Technology Model

DISCUSSION

These findings carry important implications for university administrators and policymakers. Firstly, they underscore the importance of investing in human resources and creating conducive organizational environments to facilitate technology adoption and innovation. Secondly, they highlight the need for strategic planning and investment in technological infrastructure to support sustainable integration efforts.

Personnel management practices are essential for the integration and innovation of educational technology. Educational institutions that focus on effective personnel management foster an environment conducive to incorporating technology in teaching and learning (Pinglei & Haibing, 2016). These practices involve recruiting and hiring educators with a strong grasp of technology and its classroom applications, offering ongoing professional development to enhance teachers' technological skills and pedagogical expertise, cultivating a supportive and collaborative culture that encourages experimentation with new technologies, and providing adequate resources and support for technology integration (Mojgan et al., 2012). By adopting these personnel management practices, educational institutions can ensure that teachers possess the necessary skills and knowledge to successfully integrate technology into their teaching methods.

Organizational structure and culture are vital in supporting the integration of educational technology, as they establish the foundation for effective implementation. Organizational structure encompasses the formal arrangement of roles, responsibilities, and reporting relationships within an educational institution. A well-structured organization enables clear communication, efficient decision-making, and effective coordination among various departments and stakeholders involved in technology integration (Gunawan et al., 2020). Additionally, while organizational structures indicate formal status and power hierarchies, the actual dynamics of information flow and collaboration are significantly influenced by the organization's culture.

The technological landscape fosters the integration and innovation of educational technology (Zhang, 2014). This paper reviews existing literature, empirical data, and case studies to examine the benefits and challenges of incorporating technology into education, evaluating its effects on student achievement and engagement (Bhat, 2023). Integrating technology prepares students with essential digital skills for their future careers. Additionally, technology enhances efficiency by simplifying administrative tasks, record-keeping, and communication among educators, students, and parents, ultimately streamlining the educational process and minimizing paperwork. Furthermore, it promotes inclusion and accessibility, as it can be tailored to support students with disabilities, creating a more inclusive learning environment (Davies & West, 2010).

Integrating technology promotes a habit of lifelong learning. Students learn to use technology as a tool for continuously seeking new information, skills, and knowledge throughout their lives (Bhat, 2023). The technological landscape enhances the integration and innovation of educational technology by offering opportunities for personalized learning, encouraging collaboration among students, simplifying administrative tasks, and improving access to educational resources. This dynamic environment positively influences the development and integration of educational technology (Zhang, 2014).

CONCLUSION

This study explored personnel management, organizational culture, the technological landscape, and innovation in educational technology, enriching the knowledge base on integrating educational technology in Chinese higher education. Additionally, the proposed model provides practical insights for university administrators, policymakers, and practitioners aiming to effectively utilize technology to improve teaching, learning, and institutional effectiveness. It supports the creation of a modern, integrated educational system where technology, culture, and people function harmoniously, fostering a sustainable and progressive learning environment that prepares students for future challenges.

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