

Digital Innovations in Higher Education: A Systematic Review

Yang Qian^{1,3}, Melor Md Yunus¹, Karmila Rafiqah M. Rafiq²

¹Faculty of Education, Universiti Kebangsaan Malaysia, Bangi 43600, Malaysia, ²Faculty of Education, Universiti Teknologi MARA Puncak Alam Campus, 42300, Malaysia, ³Sichuan University of Science & Engineering, Zigong, Sichuan Province, China

Email: P133943@siswa.ukm.edu.my, melor@ukm.edu.my, karmilarafiqah@gmail.com

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Abstract

With the rapid development of information technology, digital change has penetrated into all fields, with no exception to higher education. The application of digital innovation in higher education has become more and more widespread, which not only changes the traditional teaching mode, but also provides a new way for the optimal allocation and sharing of educational resources. The purpose of this paper is to explore the current status, problems and development trends of the application of digital innovations in higher education by conducting a systematic review of the literature on digital innovations in higher education published during the period of 2013-2023. Using two databases, Web of Science (WoS) and Scopus, this paper extracted 21 articles out of 152 articles published in the last ten years according to the exclusion and inclusion criteria to conduct a systematic review of digital innovation in higher education.

Keywords: Digital Innovations, Higher Education, Higher Education Institutions (HEIS), Educational Resources

Introduction

Digital innovation in higher education has become a global trend, with key national figures focusing on this area (Ovrelid, 2022); after all, changes in higher education affect every aspect of society. The emergence of this trend is the result of a combination of continuous advances in information technology and society's need for innovative people.

First of all, the continuous progress of information technology provides the possibility of digital education (Yang, 2014). With the continuous development of the Internet, cloud computing, big data and other technologies, higher education institutions (HEIs) can access, store, process and analyze a variety of educational resources more conveniently, thus providing a broader space for digital education (Jaradat et al., 2020). At the same time, the emergence of various online education platforms, virtual laboratories, mobile learning (Rafiq

et al., 2021), online examination systems and other digital education tools also provides HEIs with more diversified teaching methods and means.

Secondly, society's demand for innovative talents has also pushed higher education to carry out reforms (Zhang et al., 2016). In today's fast-changing era, society's demand for talents is also changing, and more talents with innovative spirit and practical ability are needed. Therefore, HEIs need to constantly reform and innovate to meet the needs of society. The application of digital innovation in higher education can provide students with a more personalized and flexible learning experience, and cultivate their innovative thinking and practical ability, so as to better meet the needs of society.

In terms of the application of digital innovations in higher education, some colleges and universities have achieved remarkable results. For example, through digital technology, some universities have achieved the sharing and optimal allocation of online educational resources and improved the quality and efficiency of education. Some other colleges and universities have provided students with more diversified ways and means of learning through flipped learning (Santhanasamy & Yunus, 2022), online examination systems and other digital educational tools, which have fostered students' practical ability and innovative spirit.

The application of digital innovation in higher education has become a global trend Neborsky et al (2020) , and this will lead to a more diversified development of higher education. In the future, the application of digital innovation in higher education will be more extensive and in-depth with the continuous progress of technology and the changing needs of society for talents. However, there are not many research reviews on the digital reform of HEIs, and there are fewer discussions on their current status and trends. Hence, the objective of this systematic review is to examine the progress and current state of digitization in higher education and put forth two research questions

RQ1.What are the benefits of digital innovation in higher education ?

RQ2.What challenges and trends will innovation in higher education face?

The value of addressing these issues is that the integration of existing experiences with digital innovation in HEIs will help educators explore more up-to-date educational models.

Methods

The systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. PRISMA has been broadly used by researchers because it is comprehensive and can be applied to a variety of studies. It consists of four processes, namely identification, screening, qualification review and exclusion, as shown in Figure 1.

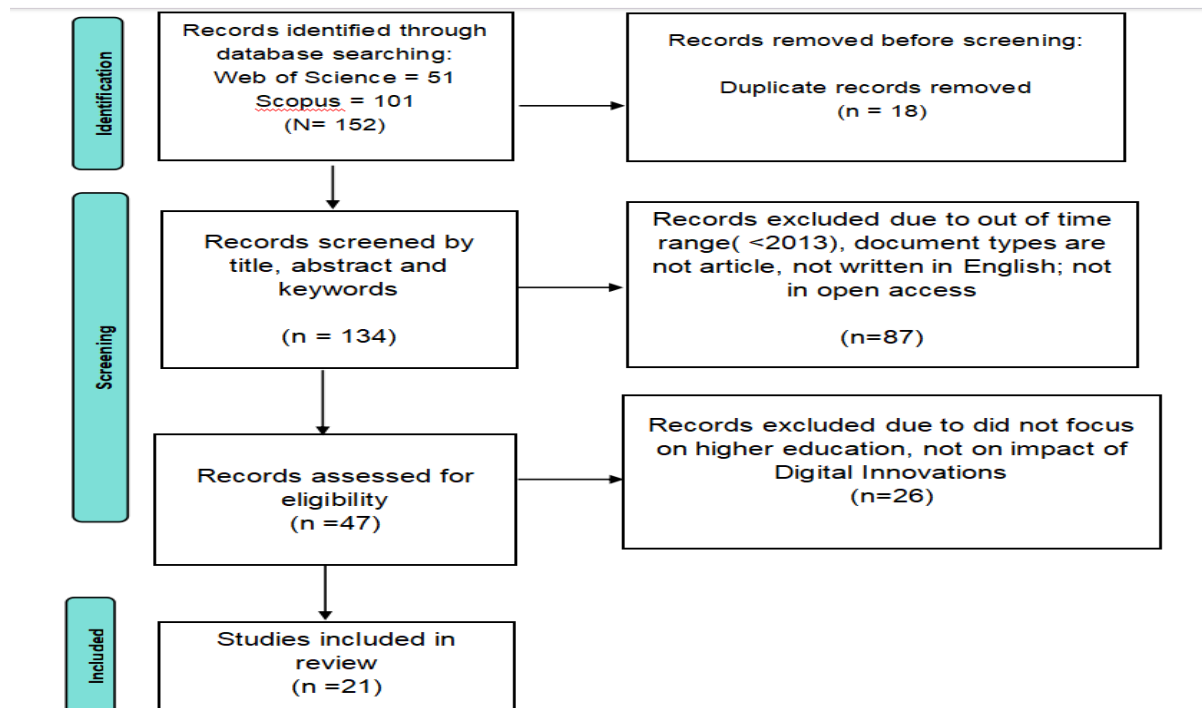


Figure 1. PRISMA systematic review adapted from (MJ et al., 2020)

Identification

Systematic reviews follow the PRISMA guidelines, and the first step is the identification of reports. Two databases were selected as applicable for the purposes of this subject: the Web of Science (WoS) and Scopus. The key terms used in this systematic review have been carefully designed to reflect the scope to be reviewed. These include words related to digital change and higher education. This table 1 below shows the search strings used in this study for each database.

Table 1

Search string used in this study

Database	Search String
Web of Science (WoS)	TS=(("Digital innovation" OR "Digital alteration" OR "Digital change") AND ("tertiary Education" OR "Higher Education" OR"Post-secondary Education"))
Scopus	TITLE-ABS-KEY (("Digital innovation" OR "Digital alteration" OR "Digital change") AND ("tertiary Education " OR "Higher Education" OR"Post-secondary Education"))

Screening

Once the article has been finalized the next step is to screen it. The first step in this phase is to exclude duplicate articles that appear in two databases. Use the first step of screening as a basis, 18 duplicate articles were removed and 134 articles were obtained that met the criteria for the next screening step. The 134 articles were selected as year, article type, language, and public access, and during this screening process, 87 articles were excluded

because they were not eligible. After exclusion, the remaining 47 articles were screened according to the inclusion and exclusion criteria and finally, the remaining 21 articles were included in this systematic review as shown in Table 2.

Table 2

Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Studies conducted between 2019 and 2023	Studies conducted before 2019
Articles from journals	Book, Review, Book chapter, Conference paper, Retracted
Articles with open-access	Articles without open-access
Articles written in English	Articles were not written in English
Related to higher education and digital innovations	Not Related to higher education and digital innovations

Included

The articles selected for this systematic review revolve around the digital transformation of higher education. Table 3 presents the results of the included studies.

Table 3

Summary of the selected studies

author	year	Database	Aim	Findings
Qasem et al.	2021	WoS, Scopus	To determine whether HEIs should continue to use cloud computing.	The results indicate that the continuance intention can be predicted by technology, organizational, environmental, and other contextualized factors
Montgomery et al.	2015	Scopus	To support faculty in realizing opportunities to support undergraduate learner engagement using blended learning as an experimental platform for addressing student engagement in virtual learning spaces.	Four technological innovations play an active role in activating and sustaining engagement in new blended learning environments that promise to support diverse students in virtual learning spaces.

Table 3

Cont.

Author	Year	Database	Aim	Findings
Stepura & Kuzmak	2023	Scopus	Assessing the gap between people's readiness for effective activities in the digital economy and identifying the functional capabilities of universities to close this gap	Promoting the development of educational services can improve the digital literacy of citizens in their daily work and help employers to minimize the gap between the digital environment and the skills of people
Qasem et al.	2020	WoS, Scopus	Develop a conceptual model to assess the key factors that HEIs consider when deciding whether to continue using CC services.	Provides potential insights to assist IT decision makers in their quest for the best institutional resources.
Li & Wu	2023	Scopus	Building an Embedded Speech Teaching System Based on Cloud Computing and Deep Learning Models to Meet the Current Development Needs of Digital Transformation in Higher Education	The new system significantly improves the intelligence and adaptability of teaching methods in colleges and universities, and is conducive to promoting the cultural literacy and innovation ability of college students
Petchamé et al.	2023	WoS, Scopus	Gather information on student and faculty perceptions of completing a pilot master's program delivered in a blended virtual format	Students appreciate this format because it allows them to synchronize their master's courses in real time from abroad, which is a viable option for hybrid virtual courses that can be improved to be more compliant with future versions of this particular master's program.
Agasisti et al.	2020	WoS, Scopus	Exploring How COVID-19 Outbreak is Driving Digital Innovation in HEIs.	Crisis has a push for digital transformation and digital innovation has a significant impact on sustainable development

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Author	Year	Database	Aim	Findings
Crittenden et al.	2019	WoS	In order to introduce various digital technologies, and their advantages and disadvantages, so that teachers can empower their students and get better learning outcomes through increased sensory experiences and enhanced digital activities.	Stakeholders such as HEIs, professional associations, publishing companies, and technology companies need to support and enhance faculty efforts to embrace technology for continuous learning improvement.
van den Berg	2018	WoS	Explore the skills needed to improve the ability of information systems students to participate in, and ultimately coordinate, the digital transformation of business and society.	Eight design principles were generated to prepare students for the future world of work, where technology can be utilized to enhance the effectiveness of business, the environment and society.
van den Berg & Verster	2022	Scopus	Co-creating social digital innovations to address pressing environmental issues facing marginalized communities in Cape Town, South Africa.	Four design principles are revealed, namely: creating immersive context-sensitive learning experiences; designing opportunities for collaborative (co-)construction of knowledge; focusing on the internal role of socio-technical and socio-cultural entanglements; and using relationships as a tool to promote agency.
Ovrelid	2022	WoS, Scopus	An investigation to understand how digital strategies in higher education are emerging and how they fit into the educational environment.	Constructed a digital model with two prototypes, a digital transformation strategy and a digital innovation strategy, demonstrating how specific faculties can adapt digital strategies to educational practices and enhancing the understanding of digital

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Author	Year	Database	Aim	Findings
Avetisyan et al.	2022	WoS	To explore the educational problems in the process of transformation of higher education in Armenia and Belarus during the neocoronavirus epidemic and since March 2020 after the neocoronavirus epidemic.	Online forms of learning present some difficulties and offer advantages over traditional forms of learning, and currently the most promising form of learning is blended learning, a model of blended education that improves the competitiveness of the entire higher education system and helps to eliminate geographical and time constraints.
Vicente et al.	2020	WoS, Scopus	Identify the dilemmas encountered by the two universities in terms of digital innovation.	Problems encountered by the two universities centered on the shortage of resources, facilities and technology.
Samedov et al.	2020	Scopus	Revealing innovations in digital technology in the process of teaching automotive electronics	Innovative educational technologies can improve the professional competence of participants in the teaching and learning process and develop deep and comprehensive knowledge and skills.

Sikora et al.	2023	WoS	The main challenges and directions of informatization and digitization of higher education in the conditions of development of modern society in order to increase the efficiency of higher education.	Informatization has had a positive impact on education, modern people need is not to memorize, store and reproduce information, but the ability to navigate through the information flow and to attract missing resources to solve problems.
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Author	Year	Database	Aim	Findings
Straatmann et al.	2023	WoS, Scopus	To effectively manage change and better understand process factors under management control.	Opportunities for engagement, vision communication and change facilitation were positively correlated with cognitive and behavioral change support, as well as with available local resources.
O'Connell	2016	WoS, Scopus	Integrate various types of digital information into a reflective and participatory approach to learning.	In order to support the diverse learning patterns of our students, we should innovate technologically and pedagogically.
Thuan & Antunes	2022	WoS	Helps educators integrate this innovative tool into curriculum design by exploring the purpose and significance of design science in undergraduate higher education programs.	Design science plays an important role in the study, presenting four design principles that emphasize actionable guidance for implementing the DS learning process and suggesting that educators use them dynamically in relevant DS curricula.

Nair & Solanki	2023	WoS, Scopus	Examines student perceptions of institutional readiness for online learning and conducts a reflexive thematic analysis to identify direct and indirect factors associated with student readiness and engagement in online learning environments.	The ability of higher education institutions to conduct online courses depends on their adaptability, flexibility and accessibility for virtual learning. The readiness of teachers, students and the integration of learning resources are the main aspects that determine online learning, while various psychological, technological and personal characteristics influence their perception and adaptability to the needs of virtual learning.
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Table 3
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Author	Year	Database	Aim	Findings
Zawacki-Richter	2021	WoS, Scopus	A longitudinal study of student media behavior in the context of the current state of digitalization of higher education in Germany.	There are always pros and cons, advantages and disadvantages to using digital media in teaching and learning. The experience of distance learning may also lead to a greater desire for digital learning and raise expectations to a certain extent.
Rabin et al.	2020	WoS, Scopus	To examine the use of the business model concept in the context of digitalization in the field of higher education.	Higher education institutions will continue to steer the higher education ecosystem in cooperation with other organizations.

Data Analysis Procedure

All selected articles were exported to a reference software mendeley. the 21 literature articles on digital innovation in higher education selected for this study cover a wide range of aspects, including the use of cloud computing, blended learning models, issues of digital inequality, smart classroom systems, student engagement and interaction, collaborative online learning spaces across disciplines, the harmonization of digital strategies and educational practices, philosophical reflections , challenges, specific use cases, student and

professor perspectives, and the impact of the epidemic on digital higher education, among others, to answer the following research questions

RQ1.What are the benefits of digital innovation in higher education ?

RQ2.What challenges and trends will innovation in higher education face?

Result

RQ1:What are the benefits of digital innovation in higher education ?

By combing through the literature, we can see that the application of digital innovation in higher education has achieved remarkable results. The application of cloud computing has made it possible to share educational resources and improve the efficiency of education. Through cloud computing, students can access educational resources at any time and any place without the limitation of time and space. Meanwhile, teachers can also manage and organize teaching resources through cloud computing to improve teaching efficiency (Li & Wu,2023; Crittenden et al.,2019).

The blended learning model combines the benefits of both online and offline to enhance the learning experience and engagement of students. The blended learning model combines traditional classroom teaching with online learning, allowing students to take courses online and participate in classroom discussions and hands-on activities offline. This model not only improves students' learning efficiency, but also enhances their learning experience and engagement (Montgomery et al.,2015) .

Intelligent classroom systems, on the other hand, improve the quality and interest of teaching in the classroom through technological means. Intelligent classroom systems utilize advanced technological means, such as artificial intelligence and big data, to monitor and analyze students' learning in real time and provide teachers with more accurate teaching suggestions. At the same time, the smart classroom system can also enhance the fun and interactivity of the classroom through interactive games, virtual reality and other technical means to improve students' interest and motivation in learning (Crittenden et al.,2019).

In the future, as technology continues to evolve, the application of digital innovation in higher education will be more extensive and deeper.

RQ2 : What challenges and trends will innovation in higher education face?

Digital innovations have brought many conveniences to the field of education, but they have also brought some challenges. Among them, the issue of digital inequality is an aspect that cannot be ignored. In some schools or districts, students cannot enjoy the convenience of digital education due to the lack of digital educational resources. This not only limits students' learning opportunities, but may also lead to inequality in the quality of education (Stepura & Kuzmak, 2023).

In addition, interdisciplinary collaborative online learning spaces face problems of low student engagement and insufficient interaction. The design of online learning platforms, technical support, and students' psychological, technological, and personal characteristics can affect their perceptions of learning. Some students may not be able to actively participate due to lack of self-confidence, technical skills, or comfort with online learning (van den Berg & Verster, 2022).

In response to these problems, some scholars have proposed corresponding solutions. First, in order to improve students' participation and interactivity, an effective online learning platform can be designed. The platform should provide rich learning resources and diversified learning modes to accommodate the learning needs and styles of different students. At the

same time, the platform should have real-time interactive features so that students can communicate and collaborate with teachers or other students at any time. Second, providing adequate technical support is also necessary (van den Berg, 2018; van den Berg & Verster, 2022; Petchamé et al., 2023). Schools or districts should provide students with the necessary digital equipment and training to help them master the technical skills required for online learning. In addition, schools can provide technical support services to help students solve technical problems encountered in the learning process (O'Connell, 2016; Stepura & Kuzmak, 2023; Petchamé et al., 2023).

Finally, advance preparation is also key to increasing student engagement and interaction. Schools should provide students with clear learning goals and expectations and encourage them to actively participate in online learning (Stepura & Kuzmak, 2023). In order to help students adapt to the online learning environment and approach, teachers need to provide students with the necessary guidance and support (Petchamé et al., 2023).

In these ways, we can help students better adapt to the digital education environment and improve the effectiveness and quality of their learning.

Discussion

Research suggests that digital reform in higher education is imperative. The digital transformation of higher education has already borne fruit. Many HEIs have established online education platforms to digitize and onlineize their courses, making it easier for students to acquire knowledge and skills (van den Berg & Verster, 2022). At the same time, digital technology has been widely used in education management, scientific research and social services, improving the efficiency and quality of education.

However, there are still some problems with digital change in higher education. Firstly, the uneven distribution of resources, some schools and regions have a relative lack of educational resources and are unable to make full use of digital technology (Vicente et al., 2020; Avetisyan et al., 2022). Second, inadequate application of technology, some teachers and educational institutions have limited ability to understand and apply digital technology, and are unable to utilize the affluence of digital technology fully (Avetisyan et al., 2022). Finally, the quality of education varies, and it is difficult to ensure the same quality of education when digital education is compared with traditional education (Vicente et al., 2020).

Digital innovation is not a panacea and it is not a complete substitute for traditional teaching methods. In the process of digital education, the question of how to maintain the same quality of education as traditional education is an important one. This requires educational institutions and teachers to continuously improve the quality and level of digital education to ensure that students have access to high-quality education.

As technology is constantly being updated, the question of how to stay up to date with the latest technology is also an important one. Educational institutions and teachers need to continuously learn and master new digital technologies and apply them to education in order to improve the efficiency and quality of education (Vicente et al., 2020; Samedov et al., 2020; John & Yunus, 2021).

In addition, how to rationalize the distribution of digital education resources is also an important issue. Educational institutions need to ensure that all students have access to high-quality digital education resources and avoid unfair and unequal distribution of resources (Vicente et al., 2020).

Finally, how to combine digital technology with traditional education culture is an important issue (Ramalingam et al., 2022). Digital technology can bring a lot of convenience and efficiency, but some elements of traditional education culture are also very important. Therefore, HEIs and teachers need to combine digital technology (Rajendran & Yunus, 2021) with traditional educational culture to create a new educational model to better cultivate talents (Crittenden et al., 2019; Sikora et al., 2023).

In summary, there are many problems that need to be solved in the digital innovation of higher education. This review presents these issues in a centralized manner, and higher education practitioners point the way to problem solving that has practical implications. Only by solving these problems can we better promote the digital transformation of higher education, improve the efficiency and quality of education, and cultivate more excellent talents.

Conclusion

With the rapid development of science and technology, digital innovation in higher education has become an important issue in the field of education. To gain a deeper understanding of the research and future direction of this field, this project conducted a systematic review of papers related to digital innovation in higher education through WoS and Scopus.

According to the results of this project, the future about digital innovation in higher education will be characterized through these following trends:

The application of artificial intelligence, big data and other technologies will become more widespread, promoting the development of higher education in the direction of intelligence (Allam & Dhunny, 2019). The application of these technologies will provide higher education with more accurate and personalized teaching services and improve the quality and efficiency of education.

Personalized education will become an important feature of higher education in the future, meeting the individual needs of students. With the application of big data and artificial intelligence technology, higher education will pay more attention to the personalized needs of students and provide more flexible and diversified educational services (Gierl, Bulut & Zhang, 2018).

The combination of online and offline education will become the main form of higher education in the future (Almazova, Andreeva & Khalyapina, 2018; Kaplan & Haenlein, 2016), realizing the diversification and comprehensiveness of teaching. Traditional learning methods can bring students a real, participatory experience, while online teaching severs through the time and space constraints to bring students an efficient and convenient experience. The combination of the two will provide students with more comprehensive and diversified educational services.

Higher education will pay more attention to contact and interaction with society and promote the socialization of education (Jongbloed et al., 2008). With the development of society, higher education will pay more attention to contact and interaction with society, closely integrate education with social needs, and improve the practicality and application value of education (Kabilan et al., 2010).

Digital innovation has brought new changes and opportunities to higher education. In the future, we expect to see more studies that delve into the application of digital innovation in higher education beneficial to promote the further development of higher education. At the same time, HEIs and policy makers need to actively address the challenges and

opportunities brought by digitization to promote digital transformation and innovative development of higher education.

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