The Survey of Digital Transformation in Education: A Systematic Review

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ABSTRACT

This study addresses a gap in the literature regarding the implementation of digital strategies in educational institutions, particularly universities. Despite significant advancements in the development of digital strategies, there remains a lack of commitment and vision for their effective implementation. This study systematically reviewed the literature to evaluate digital transformation in education across three dimensions: campus environment, teaching methods, and learning experiences. Employing the Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines, this study identified ten pertinent articles for thematic analysis. These findings highlight the critical role of digital transformation in various aspects such as data collection, management, academic advising, and personalized learning, revealing a trend towards improved educational outcomes through blended learning, video conferencing, AR/VR, and adaptive learning technologies. This research underscores the transformative impact of digital strategies on education, suggesting a paradigm shift in teaching/learning methods and emphasizing the need for educational institutions to embrace these changes proactively.

Keywords: Digital transformation, Education, Teaching methods, Learning experiences

Introduction

The advent of digital technologies has revolutionized various sectors, including education. Over the years, digital transformation has shifted from a trend to a central component of modern educational strategy (Saykili, 2019). However, while numerous studies have explored individual facets of digital transformation in education, comprehensive multi-dimensional analyses still need to be made available (Khitskov et al., 2017; Stone, 2019).

The COVID-19 pandemic has accentuated the urgency for digital transformation, making it a survival imperative rather than a competitive advantage (Nurhas et al., 2021). Yet, educational institutions face challenges in effectively utilizing digital technologies, often due to a lack of

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coherent strategy or vision (Oliveira & Souza, 2021; Tawfik, 2022). This research aims to address this gap by systematically reviewing the literature on three dimensions of digital transformation in education: the significance, learning experiences, and teaching methods. By doing so, this study will provide a comprehensive guide for educational authorities to implement effective digital transformation strategies.

This paper conducts a systematic literature review while targeting previous research articles to evaluate the three dimensions of digital transformation in education (the significance of digital transformation, the learning experiences, and the influence of digital transformation on teaching methods) (Truong & Diep, 2023). Thereby delivering a substantial comparison that will help authorities aim for and implement the most effective and potential transformation in education.

Literature review

Today, the digital revolution has nudged almost every aspect of people's lives. The study by Zafari et al. illustrated certain statistics claiming that over 3.5 billion people are estimated to have access to the Internet (Zafari et al., 2018). With this level of connectivity drenched in their lives, people have changed their ways of interacting with each other and have started to observe the world differently. Several sectors, especially the education industry, have necessitated digital transformation in pursuit of becoming highly competitive in their domains and acquiring the position of revolutionary leadership. Naimi-Sadigh et al. illustrated "Digital Transformation" as the process of utilizing digital technologies to either modify the business cultures, processes, and customer experiences or create new ones so that the ever-changing business and market requirements can be fulfilled (Naimi-Sadigh et al., 2022).

According to the study by Iivari et al., digital transformation has significantly influenced classrooms and teaching strategies used by primary as well as higher education educators, whereas the COVID-19 pandemic further accelerated these ongoing alterations (Iivari et al., 2020). To ensure consistent delivery of education to students during the pandemic, educational systems used technology as the ultimate tool to bridge the gap. Although there are numerous conventions in the educational sector, digital transformation is primarily used for tracking students' performance, leveraging analytics to obtain improved outcomes, promoting collaborative learning, encouraging future-focused curriculums, improving parental-teacher synergies, and saving time in education. Ting et al. (2020) indicated the essentiality of digital technology in real-time data collection, either from internal or external stakeholders such as parents, to help improve education for students. On the other hand, Hoel et al. and Car et al. discussed how digital technology can be used for data management and reporting through a centralized system, which helps the institutes to deliver timely and accurate information to stakeholders and also measure their academic performance by obtaining national and global reporting (Hoel et al., 2020; Car et al., 2019). With the advent of online tools such as video conferencing and cloud storage, teachers can access academic material on a global platform (Nguyen & Nguyen, 2023; Pham, 2022). Nevertheless, the need for a collaborative and interactive education system has encouraged teachers to change their teaching strategies and methods of approaching instruction in classrooms (Szymkowiak et al., 2021). At the same time,

digital changes have helped students learn by making it easier for them to work together and giving them more options through personalized learning.

Statistics from various studies have confirmed that to continue functioning efficiently within today's progressive environment, it is necessary for educational institutions to consistently evolve integrally in whichever technological aspect of the administration deems suitable (Cioffi et al., 2020; Ali, W., 2020; Iglesias-Pradas et al., 2021). In addition, businesses may find it challenging to efficiently exploit all the opportunities and potentialities provided by the available system of digital technologies while also reframing the business models across the value chain, as it may prove to be risky. A study by Faria and Nóvoa highlighted that as these challenges could be more critical and serious for organizations in a permanent struggle to attain a competitive edge, educational institutions are consequently related to the situation because of the increasing competition in selecting the best students and researchers (Faria & Nóvoa, 2017). Surprisingly, educational institutions are experiencing a disruptive scenario where organizations are developing new business models, changing their evolution methodology, actively relating to internal and external factors, and escalating their commitment (Benavides et al., 2020).

According to the study by PricewaterhouseCoopers International Limited (PWC), although educational institutions, especially universities, have significantly responded to this major technological shift by developing effective digital strategies, they still lack the commitment, capability, and vision to implement those strategies (PWC, 2018). There is also a lack of extensive research that could provide such aspects to the keen institutes, thereby creating a literature gap. Based on this scenario, the administration and researchers need to acquire a comprehensive vision of digital technology and the ways in which it is being incorporated into the educational system. This extensive overview will eventually assist the educational authorities and researchers in determining the three main areas of digital transformation in education, including transformation in "Campus environment," "Teaching methods," and "Learning methods."

Research Questions

We will discuss the following research questions in this paper:

RQ1. What is the significance of digital transformation in education?

RQ2. What are the digitally transformed learning experiences?

RQ3. What is the influence of digital transformation on teaching methods?

Methods

The methodology for this systematic literature review is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). This research study provides a rigorous approach to selecting, assessing, and analyzing pre-existing academic literature in the form of peer-reviewed papers. This approach assists in identifying trends and gaps in the research.

Our study employs a comprehensive search strategy spanning multiple databases. Additionally, our inclusion/exclusion criteria are uniquely designed to capture articles focusing on the technical and pedagogical aspects of digital transformation in education. While existing reviews have focused mainly on the administrative and technological aspects of digital transformation, our study uniquely incorporates three dimensions: "the significance of digital transformation," "learning experiences," and "the influence of digital transformation on teaching methods." This broader thematic scope allows us to present a more holistic view of the subject matter.

Data Sources

The first step in this methodology involved research identification, which was conducted using several data sources. This study used research identification to evaluate digital transformation in education. Although several data sources are used for targeting relevant academic material, in this study, electronic databases, including Google Scholar and Web of Science (WoS), were used. The reason for using these data sources is their relevance as the most suitable information platform that is often used to access the most significant publications in various areas of knowledge. These databases tend to offer advanced structures to allow for more accurate search and research identification, such as the utilization of logical operators, bibliometric analysis, and filtration tools.

Research Strategy

Search strategy is a process through which academic journals and papers are searched from various databases (Bramer et al., 2018). The search strategy used for this systematic review starts with delivering the major key terms that are most relevant to the research questions and are accessible through databases such as "digital transformation," "Digital technologies," "digital transformation in education," "digital technologies used for academic purpose," "digitally transformed teaching strategies," "improved campus environment through digital modification" etc.

This step is followed by identifying synonyms and alternative spelling that are associated with these terms through meaning, eventually leading to more extensive research such as using the word "modification" instead of transformation, "digitally" instead of digital, and "teaching methods" instead of education. For this purpose, Boolean operators, including (OR and AND), are used to connect founded terms such as "digital transformation" AND "education" and "Digital modification in education AND learning methods AND teaching strategies." While conducting the search on Google Scholar, the time limitation of 2018 to 2022 was used for publications.

Study Selection

This step involves developing screening conditions that can be used to obtain more concentrated, accurate, and precise literature in accordance with research questions. This step involves developing screening conditions that can be used to obtain more concentrated, accurate, and precise literature in accordance with research questions. All of the authors performed the document screening. After that, the authors discussed the number of samples selected together and agreed on it.

Considering the keywords and publication date, 192 articles were acquired through databases, which were further passed through the eligibility criteria. However, 68 of these articles were not openly accessible and were therefore excluded, leaving only 124. Specifically, the conditions used to narrow down the search results are as follows:

- The articles must be based on peer-reviewed research journals or conference papers. Several studies have mentioned that peer-reviewed research journals are credible for use in research by practitioners and academics to acquire information and publicize new findings (Hafsi & Assar., 2020; Feki & Boughzala, 2016). This research strategy will subsequently exclude theses, working papers, and textbooks based on this aspect. Peer review research journals and conferences will be targeted for this research.
- The research journals must be written in the English language.
- The publication date for the selected articles must be from 2018 to the present.
- The chosen articles must relate to the keywords mentioned in the search strategy.

At the end of the study selection procedure, 44 articles were not peer-reviewed research papers, and 19 articles that did not match this research aim were excluded, leaving 56 academic articles for quality assessment.

Quality Assessment

This step further extends the screening process, in which the chosen research journals will be monitored and undergo inclusion and exclusion criteria. The selected papers were thoroughly reviewed and evaluated based on their abstracts, keywords, themes, and concepts. To assess the quality of the research papers selected for this literature review, a comprehensive questionnaire mentioned by Nguyen-Duc et al. (2015) will be used as follows:

- Are all of the research questions adequately being answered?
- Are the abstracts presented in the journals relevant to this literature review, and do they present similar keywords, i.e., "digital transformation or modification in education," etc?
- Are the research aims present clear statements to be assessed?
- Is the concept of digital transformation associated with education in the selected journals?
- Does the article adequately describe the relevant context, such as digital transformation in education, teaching, and learning methods?
- Is the research design of the article appropriate for this literature review?
- Is the data collected from the journal useful in answering the research questions?
- Does the journal offer comprehensible findings?

The questionnaire was designed using a Likert scale, and articles that obtained a score of less than 1 were excluded from the eligibility criteria. The main objective of using this questionnaire is not only to maximize internal and external validity but also to minimize study bias. After quality assessment, 10 articles qualified for data extraction and analysis (Figure 1).

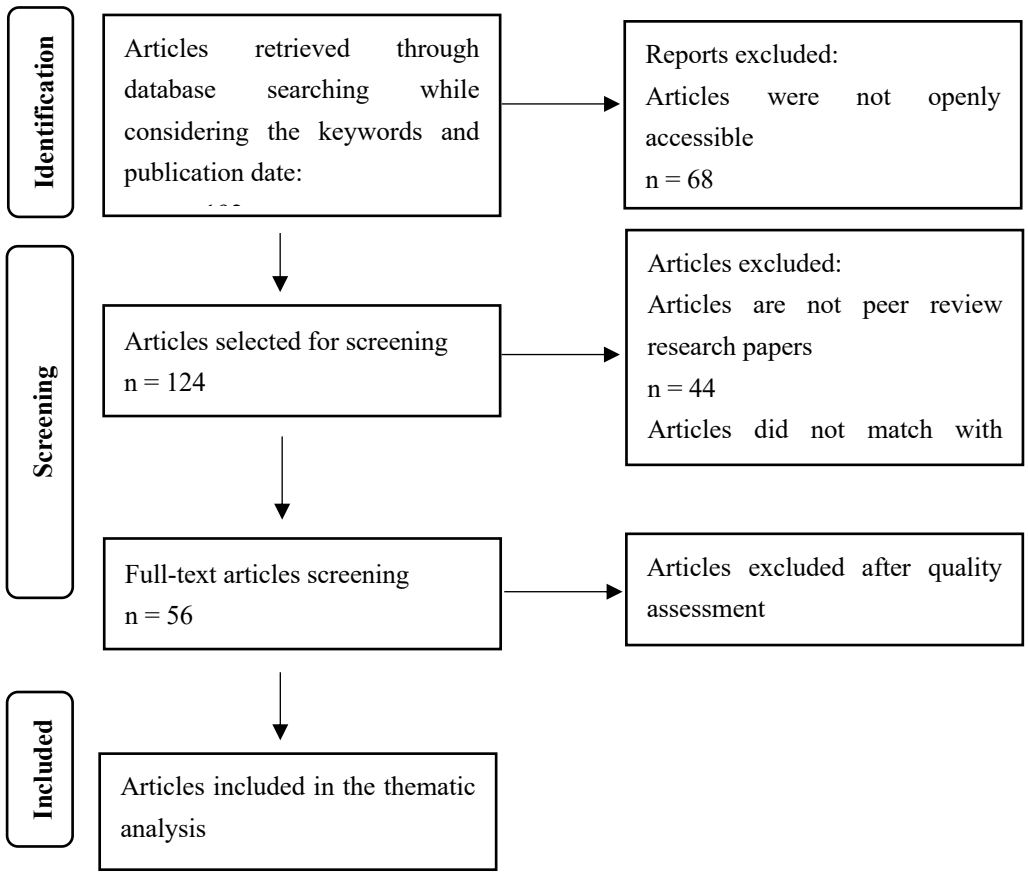

Figure 1. PRISMA flow diagram of study

Data Synthesis and Analysis

Microsoft Excel was used to manage the retrieved articles in sequence. Relevant data were extracted from the selected literature. The retrieved research journals were scrutinized for text fragments that clearly acknowledged any of the research questions mentioned in the literature review. Similar traits and patterns were evaluated along with the identification of variables such as "Areas of digital transformation in education." According to the four phases of literature analysis mentioned by Morakanyane et al., the thematic analysis technique was used to synthesize the retrieved journals in order to create a conceptualized body of literature (Morakanyane et al., 2017).

Results/Findings and discussion

Several studies have highlighted thematic analysis as a method for investigating qualitative data (Kiger et al., 2018). Considering the research questions in this systematic literature review, answers are technically required in a qualitative format, which urges the need to utilize thematic analysis. A concept-centric matrix was developed for each research question to achieve a more concentrated thematic analysis of the targeted studies while elaborating the research from each article. Further analysis was performed through conceptualization.

RQ1. What is the significance of digital transformation in education?

To answer this research question, three important studies were chosen and put in order by year in a concept-centric matrix (Table 1).

Table 1.

Importance of Digital transformation in education

Author (year)	**Key elements (importance of Digital transformation in education)**
Seres et al. (2018)	Digital transformation helps with • Data collection • Data management • Data reporting
Castro (2019)	Digital transformation in education allow • Datafication • Human-to-human interactions enabled by technology • Human-to-machine interactions enabled by technology • Scalability • Teaching-learning experience
Rao (2021)	Digital transformation helps in the development of • Collaborative and interactive learning environments • Promote personalized learning

The incorporation of digital transformation into educational systems has turned education into a collaborative and interactive activity while preventing students from solely depending on class lectures (Barabanova et al., 2019). Therefore, digital transformation is assumed to positively affect students' academic performance and learning abilities by providing continuous and massive possibilities and collaboration. Digital learning forces collaboration, creating collaborative and creative learning environments like Google Docs. Online applications make it simpler to conduct blended learning classes.

Starting with the first targeted study by Seres et al. (2018), digital transformation in education is often categorized into three components: data collection, management, and reporting by utilizing digital technology tools (Seres et al., 2018). The data collection process is associated with obtaining feedback from various external or internal stakeholders, such as teachers, parents, students, and school administrations (ElMassah & Mohieldin, 2020). In terms of education, technological advancement fulfills students' specific needs associated with learning while also assisting the institute's staff in creating an effective learning environment with diversified opportunities. Therefore, according to the study, digital transformation can be illustrated as an ecosystem that readily combines technology, security, and services to create and sustain a personalized, collaborative, and interactive learning environment for students (Rao, 2021). This study further highlights some significant issues that tend to drive digital transformation in educational systems, such as campus security, student academic performance, information security, digital integration, artificial intelligence, data enablement, affordability, IT strategy, and student-centric services.

Data Collection, Management, and Reporting

Educational institutes collect data to monitor students' performance so that loopholes can be filled and the overall education process of students can be improved. The process of using automated tools and technologies to collect and analyze data to improve the framework of learning and teaching activities is referred to as datafication (Zhao et al., 2020). The process of how data is collected, managed, and reported in analytics tools (during admission tracking, result tracking, and academic advising) correlates with the findings of Seres et al. (2018) and Castro (2019). This further indicates that digital transformation has also been used in education to enhance the process of data management and reporting other than data collection. A centralized system such as big data analytics allows the staff to acquire accurate information quickly (Tarmizi et al., 2019). In light of the provided facts, it is evident that administrative personnel possess the capacity to render decisions that are efficacious in meeting the requirements of the students. In addition to administration, data regarding students' academic performance can also be used to promote personalized learning in institutes. Therefore, the school can eventually measure its effectiveness in education.

Datafication

Castro further explicated the concept of datafication in a second targeted study (Castro, 2019). An educational institute's management and administration department also functions as analytics, which is why datafication is deemed a major advantage for this department, which often holds diverse data associated with students' academics. However, several types of research have indicated that when pedagogical approaches used by teachers, such as flipped classrooms, are aligned with students' information regarding educational tools, they could eventually lead to improvements in learning and teaching activities. This further highlights the importance of using analytics in students. Castro (2019) explains how digital transformation has changed the trend of analytics and introduced the modern concept of self-service analytics, which could be highly beneficial for the management department of an educational institute. Self-service analytics is a process in which such departments are provided with tools to find answers to their questions rather than direct reporting (Arnaboldi et al., 2020).

Although datafication capabilities for students are often provided by traditional digital tools, such as Massive Open Online Courses (MOOCs) and Learning Management Systems (LMSs), there is still room for improvement in these tools to deliver efficient data (Marachi & Quill, 2020). To augment existing practices, these digital tools or platforms primarily use "big data" and "learning analytics" as their technological approaches. These analytics platforms tend to undergo a sequencing process of data collection, organization, and analysis to evaluate a set of information and provide a final report. The following are the capabilities of the analytics platform.

Table 2.

Analytics Platform Capabilities (Seres et al., 2018).

Collect **Hybrid Data Management**	**Organize** **Unified Governance & Integration**	**Analyze** **Data Science & Business Analytics**
• Collect all types of data, structured and unstructured; • Include all open sources of data; • Leverage a simple platform with a common application layer; • Write once and deploy anywhere	• Satisfy all matters of finding, cataloging and masking data; • Integrate fluid data sets; • Deliver built-in compliance; • Leverage advanced machine learning capabilities	• Deliver descriptive, prescriptive and predictive insight across all types of data; • Empower the teams and their unique use cases; • Enable advanced analytics and data science methods

These aspects illustrate that the key elements proposed by both studies (Seres et al., 2018; Castro, 2019) demonstrate a close association, thereby conforming datafication as one of the major benefits of digital transformation in education. The study by Seres et al. further highlights the sectors where big data analytics tools and the process of datafication could be used by the administration of an educational institute (Seres et al., 2018). On our technologically advanced day, multiple measurements give schools, colleges, and trainers insights into potential students, internal efficiency, user experiences, and more. Briefly, this is a crucial degree of detail (De Boissieu & Deutsch, 2022). The issue is that these data, particularly in the education industry, are slick, occasionally erroneous, and unreliable. To obtain fluid, rapid, accurate, and structured data, educational leaders must make informed forecasts, integrated business decisions, and innovative educational measures to grasp the most relevant and informative data.

Admission Tracking and Enrollment Optimization

Recruiting and retaining brilliant students is deemed a priority of an educational institute, regardless of whether it is a school, academy, college, or university. The administration department may need to collect data associated with how to conduct the admissions procedure and which scholarships must be offered to students (Seres et al., 2018; Castro, 2019). These data may help the administration department to understand the types of students applying for admission and those who are brilliant enough to succeed (Attaran et al., 2018). With the help of such data analytics, the administration could create a model to improve organizational efficiency and decision-making during admissions, assess the interaction of parents and prospective students with their official websites, and monitor the effectiveness of demographic changes (Gaftandzhieva & Doneva, 2021). Advanced statistical algorithms created by staff could help improve the effectiveness of each admission and recruitment cycle. Tableau and Access are significant examples of data analytics, which allow institutes to merge their data with local data to establish a robust database (Yakubu & Abubakar, 2021).

Academic Advising

Higher secondary staff in academic advising for university and college students could use data obtained from analytics tools, according to Gutiérrez et al. (2020), indicating the importance and criticality of improved academic advising for better student outcomes, whereas with digital transformation, this process has only speeded ever since (Rao, 2021). Academic advising analytics provides extensive insights into students' academic information. With the help of this information, advisors tend to make effective decisions and provide recommendations to students, such as altering the accumulation of credit hours and highlighting critical alternate-year courses (Loucif et al., 2020). Moreover, academic advice can be further extended to personalize learning.

Personalized Learning

While administrative staff and teachers are deemed responsible for tracking students' academic performance, they could eventually use this information to customize learning for each student in accordance with their needs, interests, and skills. This educational approach is referred to as personalized learning (Zhao et al., 2020). This aspect estimates the correlation between all three targeted studies (Seres et al., 2018; Castro, 2019; Rao, 2021) while highlighting the relationship between datafication, analytics tools, data management, and academic advising (personalized learning).

Improved Results

The first targeted studies (Seres et al., 2018; Castro, 2019) highlight how teachers can use big data analytics to digitally record each student's performance to understand which one of them needs more attention and, thereby, take necessary steps to enhance it. In this way, analytics tools and data communication can improve students' results. Big data analytics also allows institutes to compare their results with other educational institutes on national and global levels.

RQ2. What are the digitally transformed learning experiences?

The recent COVID-19 pandemic has significantly affected the world's economies, hindering the progress of several departments, including "education." According to the statistics, 90% of students around the globe who are in primary, secondary, and tertiary education were unable to attend school physically due to quarantine (Psacharopoulos et al., 2021). While this disaster could have affected the students in worst-case scenarios, the utilization of digital technologies slowed teachers from maintaining the rhythm. Online class platforms have also been established to support remote education and learning. Although schools and universities have been using technology for a long time, the necessity of digital transformation was only recognized during the pandemic outbreak. In the educational sector, digital transformation is not restricted to learning and teaching; rather, both students and their personnel can benefit from digital transformation.

Similarly, in a situation similar to the pandemic, where social distancing becomes the first hygienic priority, digital transformation could also be used to transform educational campuses through technologies that can prevent the spread of infection. Table 3 consists of articles targeted at evaluating some digitally transformed learning methods that were only recently

recognized, whereas these articles are arranged in a concept-centric matrix.

Table 3.

Digitally transformed learning methods

Author (year)	Digitally transformed teaching-learning experiences
García-Morales et al. (2021)	• web-based learning platforms • Tools used for Video-conferencing • Massive Open Online Courses (MOOCs) • Streamline conferences • Tools used for instant messaging
Zain (2021)	Learning-teaching methods • blended learning • multimedia and open education resources (OER) • Communities of practice • E-learning • Online assessment Pedagogical changes • Adaptive learning • Artificial intelligence • Microlearning • Critical digital literacy • Teaching through audio-visual media • Blockchain • Virtual and augmented reality • Big data • Increased accessibility • Chatbots Future digital pedagogies • Playful learning • Learning with robots • Decolonizing learning • Drone-based learning • Virtual studios
Weerawardane (2021)	Learning experiences • Chatbots • Augmented and virtual reality, as well as mixed reality (AR/VR) • Smart classes

Three significant studies evaluated teaching-learning experiences after digital transformation in education. A major ratio of similarity could be illustrated in all the targeted studies concerning the year of publication (2021) and, more importantly, the digitally transformed methods of learning highlighted by each of the studies. García-Morales et al. (2021) focused on online platforms for education while affirming that with the increase of video conferences and online classes as a solution to quarantine, educational institutions have taken a potential step towards acknowledging the importance of digital transformation in education. Based on this aspect, it is deemed appropriate to digitally transform learning strategies and methods through the implementation of digital technology. Zain (2021) and Weerawardane (2021) illustrated chatbots, AR/VR, and the implementation of artificial intelligence (AI) in education as digitally transformed learning experiences for students (Weerawardane, 2021). Many schools aim to adopt chatbots to satisfy students' expectations and effectively use teachers' time in the most

efficient way possible. Chatbots with AI capabilities can be used to assess student quizzes and deliver academic materials, such as notes, based on their requirements. AI-powered chatbots can also be used to instruct pupils by breaking down a lecture into subsequent messages that compile to become a discussion. For instance, Botsify is a chatbot that functions in a manner similar to online lecture delivery. It provides pupil information on a subject through videos, pictures, documents, or a combination of both. Each lecture was followed by a brief quiz, allowing faculty staff to monitor students' performance on one platform.

Blended Learning

García-Morales et al., Rain, and Weerawardane agreed with the assumption that many educational institutions are transforming into tech and releasing learning apps for students, allowing them to access their notes, curriculum and administer practice exams before exams (García-Morale et al., 2021; Zain, 2021; Weerawardane, 2021). This enables them to continue their education. Teachers can create a learning platform with the highest interaction for their students as an education provider that gives them access to the greatest study materials in the form of text, photos, audio, videos, and PDF documents (Neborsky et al., 2020). Online learning activities, led by a teacher where student engagement is the central objective and teacher-led instructions are minimized are referred to as blended learning, as described by Zain. Similarly, García-Morales et al. (2021) stressed that "online learning" platforms, including video conferencing and MOOCs, could also be deemed platforms for blended learning. García-Morales et al. (2021) also mentioned that during the COVID pandemic, students could sustain their learning through online platforms, including video-conferencing tools (such as Google Hangouts, Zoom, and Skype), universities' official websites, instant messaging apps, and educational apps such as Google Classrooms.

Video conferencing

According to García-Morales et al., e-learning is one of the most suitable solutions for international students (García-Morales et al., 2021), whereas Zain also highlighted e-learning as a digital learning experience for students, thereby relating to the first targeted study (Zain, 2021). Due to the pandemic, students are currently unable to travel overseas to complete their higher education, and postponing classes could put students at a disadvantage. To enable students from other countries to continue their education, schools and colleges can introduce video conferencing technologies into their apps or websites (Mladenova et al., 2020). Universities can conduct online exams and support virtual onboarding, student recruitment, and admission through video conferencing. Once overseas travel is approved, students can attend physical, online, or webinars.

AR/VR for Improved Learning Experience

A better learning experience using AR and VR could provide a better learning experience, as illustrated by Weerawardane (2021) and Zain (2021). The education industry must adopt new technologies to remain up to date in an ever-changing world. Virtual and augmented reality will be the next developments in educational systems. As virtual and augmented reality have interactive visual-audio components, these technologies help simplify the process of conveying difficult concepts to students. For instance, Elements 4D is a perfect example of an AR app that

enables students to mix different chemical elements on a digital scale to understand chemistry.

This approach uses a 4D program from DAQRI, in which the elements are presented as an animated set of exquisitely crafted wooden blocks. The periodic table elements are represented by a distinct chemical symbol on each face of the block, which quickly transforms into a 4D representation of that element. This may help students comprehend chemical ideas better. Using VR/AR would also reduce the need to interact with the actual object, which could be dangerous to touch in reality (Block et al., 2020). VR can also offer touchless learning for children in this era of pandemics when social distancing is becoming a health priority.

Adaptive Learning

Educational institutions can radically customize academic materials and learning experiences through personal adaptive learning technologies (Zain, 2021). Utilizing particular teaching tools to manage student interactions is known as adaptive learning, which aims to provide personalized solutions tailored to each individual's learning requirements. Another definition of adaptive learning is an educational system built on data analysis that enables faculty members to monitor each student's progress and modify programs in accordance with the needs of each learner. For instance, quizalize is a learning tool that enables teachers to transform tedious assessments into engaging activities. Based on a student's performance, the platform automatically distinguished the learning modules for each student. The inclusion of AI in educational software can aid in providing students with adaptable learning.

RQ3. What is the influence of digital transformation on teaching methods?

Table 4.

Digitally transformed teaching methods

Authors (year)	Digitally transformed teaching methods
Bai and Zhang (2020)	• Smart classrooms • 3D video, (Ultra high definition) screens • Augmented and virtual reality • IoT framework model for teaching methods
Das et al. (2021)	• Video broadcasting tools • Asynchronous learning systems • Online assessment programs • Online proctoring • Audio-visual analysis • MOOCs
Castaño et al. (2021)	• Remotely proctored testing (RPT)
Hall et al. (2022)	• Remote proctoring process

Educational institutions view technology as an opportunity to improve teaching strategies and establish effective connections with students. Everyone has smart gadgets, including smartphones, computers, laptops, and tablets. A key strategy for improving student learning is to understand how technology can be used to improve teaching approaches. Three studies that

evaluated enhanced teaching experience after digital transformation showed a significant level of similarity among these targeted studies (Table 4).

Smart Class

Bai and Zhang (2020) compared the effectiveness of a smart classroom system (classroom lessons along with circuit boards and teacher writing on board) and a traditional, simple class with oral referrals. The results obtained by the study showed that the ratio of learners who strongly agreed to use a smart class was higher (approximately 55%), whereas the level of agreement was 73%. Based on these results, it can be estimated that most learners prefer smart classes to traditional ones.

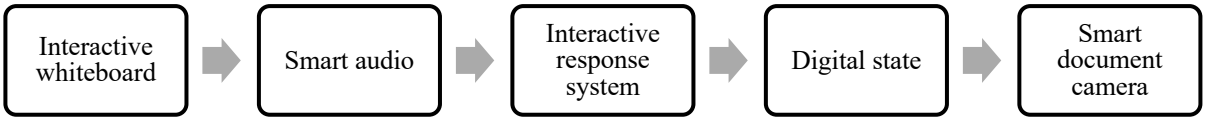

Figure 2. Smart Classroom Teaching Diagram (Bai & Zhang, 2020)

The digital whiteboard, an online classroom, can help students engage in an interactive learning environment that is similar to a traditional or virtual classroom. Teachers are allowed to utilize more than one color so that they can demonstrate concepts in a more comprehensive manner. Unlike whiteboards, they can use colorful shapes such as circles, rectangles, and stars to show complex ideas quickly and in an interesting way.

Online Assessments Powered by Artificial Intelligence

Study Das et al. highlighted the concept of online assessments through video broadcasting tools and online platforms such as MOOCs (Das et al., 2021). According to this study, the ability of an AI-based online assessment system to lock down the app where the assessment is being conducted would limit students' ability to navigate away from the assessment. The shift from a pen-and-paper method to an automated Internet platform serves as a cornerstone in the education industry. Educational institutions have switched to online teaching techniques as colleges and schools close their doors. However, conducting tests and evaluations and establishing learning outcomes presents a dilemma for educational providers.

Artificial intelligence has enabled educational institutions to hold online exams using the Internet and computer networks. AI uses deep learning algorithms and neural networks to teach machines from experience in performing human-like tasks (Mohamed Hashim et al., 2022). To prevent impersonation, an AI/ML-based evaluation system was taught to analyze and compare photographs of the examinee taken during the examination with the candidate information provided.

Remote Proctoring Technology

Among the targeted studies, Hall et al. and Castaño et al. conducted research to evaluate the effectiveness of remote proctoring technology (Hall et al., 2022; Castaño et al., 2021). Hall suggested that remote proctoring procedures tend to affect students differently based on their year within the program, whereas Castaño et al. (2021) indicated that remote proctoring systems

tend to determine academic dishonesty, thereby sustaining examination integrity. With remote proctoring technology, educational institutions can administer online exams without worrying about their students using unethical tactics (Weiner & Henderson, 2022).

Online processing can be performed using an AI-powered facial recognition algorithm and an embedded web camera. It provides several options for online assessment. It does not require manual invigilators to watch over pupils while they are taking the test. Teachers can record every exam from start to finish with AI-enabled online proctoring, not just in the video, but also in screenshots, chat logs, and photos of the desktop. Additionally, it can keep an eye on any unusual event, such as a student turning away from their webcam or leaving the room during the entire exam period. The pupil can be tracked remotely using an AI-assisted facial recognition and tracking system.

Limitations and Future Implications

This study potentially targeted ten pertinent sources, ensuring sufficient thoroughness. Second, the different perspectives of analysis gave the search method access to a wider range of sources; however, these diverse sources made it challenging to reach conceptual saturation while looking for and choosing new materials. However, the most probable limitation of this study is the segmentation analysis of each research question, thereby lowering the literature source for each objective. Future research may examine further tendencies discovered from social, organizational, technological, and pedagogical viewpoints to validate the conclusions and enhance the educational technology capabilities highlighted in this study. Researchers may also examine and summarize empirical investigations to better understand the potential of educational technology. Researchers may also examine and synthesize empirical data on educational technology capabilities to support claims regarding the maturity levels of capability for technological development and user expertise dimensions. Identifying variables and obstacles that support or hinder the deployment of greater capacity maturity levels in blended learning may also be a subject of future research. Finally, a typology-based map of digital technologies may be extremely helpful for practitioners and their future implementations.

Conclusion

By reevaluating the digital tools utilized in the classroom, digital transformation has a significant effect. Digital tools to build a campus with limitless learning opportunities have sparked new levels of invention and collaboration. Schools are making remarkable progress and have started to see the value of digital transformation in education, but there is still much to do. The biggest beneficiaries of these modifications are students who may now take advantage of new collaboration and learning opportunities. Schools gain from improved efficiency and a better ability to satisfy the requirements of their pupils at the same time. Both students and teachers can improve their ability to design an interesting educational process through digitization of the learning process. School administrators may alter their educational institutions in a variety of ways, from online learning to smart classrooms, performance analysis of students, individualized learning, and online exams. Schools may make most of the digital

transformations in a variety of ways.

Training teachers on how to use new technology effectively is crucial. Teachers must be able to use technology to assist students in learning in novel and creative ways. Additionally, school administrators must provide a setting that allows efficient technology usage throughout the entire institution. The availability of tools and Internet connectivity at all times and locations is part of this. The advantages of the digital transformation of education are evident for both schools and students. Both parties stand to gain a great deal by ensuring that these adjustments are implemented successfully.

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