

## A framework for digital transformation to bridge the education gap during COVID-19



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### ABSTRACT

The COVID-19 pandemic has disrupted education systems worldwide, creating significant challenges for both students and teachers. As schools have been closed, remote learning has become a widely adopted approach. This situation highlights an urgent need to address the education gap caused by the crisis. This study proposes a new framework, referred to as the Digital Transformation Framework to Bridge the Education Gap (DTFBEG), developed using the design science method. The framework includes six main components: online platforms, learning management systems, content creation, interactive tools, remote assessment, and parental involvement. The proposed framework offers promising solutions to the challenges faced by education systems during this critical period. Digital transformation plays a crucial role in maintaining the continuity of education, improving learning experiences, fostering collaboration and communication, and supporting personalized learning. The findings indicate that digital transformation contributes to bridging the education gap by increasing flexibility in the education system and facilitating the acquisition of technical and educational skills.

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### 1. Introduction

Digital transformation is the process of adopting digital technologies and strategies to transform businesses, operations, and customer experiences. It encompasses the seamless integration of digital technologies into all aspects of an organization, resulting in significant improvements in efficiency, productivity, and competitiveness (Hendrawan et al., 2024). Globally, the COVID-19 pandemic has disrupted traditional education systems, resulting in the emergence of remote learning. As education shifts to digital modes, there are challenges and opportunities to be addressed (Adeniyi et al., 2024). Educational gaps refer to the differences in academic achievement among students from different socioeconomic backgrounds, regions, or ethnicities. It was evident in many countries before the pandemic that this gap existed. The COVID-19 crisis exacerbated this gap, making remote education more challenging for students from low-income

backgrounds (Munir et al., 2023). Digital transformation refers to adopting and integrating digital technology into various sectors, including education (Fernández et al., 2023; Trevisan et al., 2024). In education, digital transformation encompasses using online platforms, virtual classrooms, and online learning resources to enhance learning experiences. It has excellent potential to bridge education gaps during the COVID-19 pandemic. By providing equal access to learning resources, personalized learning experiences, interactive learning tools, and continuous learning opportunities, technology can overcome the challenges posed by the pandemic and ensure equitable education for all students. However, to harness the potential of digital transformation in education, issues such as the digital divide, lack of digital skills, and social isolation many students face should be solved. Therefore, this paper aims to develop a new framework called the digital transformation framework to bridge the education gap (DTFBEG) using the design science method. The developed DTFBEG comprises six components: online platforms, learning management systems, content creation and delivery, interactive tools, remote assessment and evaluation, and parental involvement. The developed framework has numerous contributions, from improving access to quality education to fostering personalized and

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collaborative learning experiences. In this way, DTFBEG plays a pivotal role in bridging the education gap. Leveraging digital technologies and harnessing their potential can empower students, enhance learning outcomes, and create a more inclusive and equitable education system. This study will answer the following questions:

1. In times of crisis, what challenges do students and faculty perceive with digital transformation?
2. What is their perception of online/blended learning as a form of higher education?
3. How do faculty members and students cope with challenges they perceive during digital transformation?

The remaining parts of this paper are organized as follows: Section 2 discusses the related work. Then, Section 3 presents the problem statement. Next, Section 4 explains the methodology used in this study. Afterward, Section 5 offers the results and discussion. Finally, Section 6 introduces the conclusion and gives recommendations for future research.

## 2. Literature survey

The recent global COVID-19 pandemic, which forced education activities to be halted to curb the spread of the virus, has caused a perceived digital divide within the education sector (Katz et al., 2021).

Amorighoye (2020) pointed out that young adult Nigerian students additionally faced communication challenges with limited access to digital devices. Students who cannot afford distance learning often face barriers because of flexible schedules, requiring faculty to develop appropriate curriculums and plans to ensure their success (Asher, 2021). Effective communication is crucial in teaching and learning, especially during the pandemic.

Al-Kumaim et al. (2021) examined the use of computer software by students and educators, the authors found that there was not enough guidance on how to use it, resulting in outdated teaching plans.

According to Gutiérrez-Santiuste et al. (2016), there are relatively few obstacles to effective communication and students see digital instruction as positive despite some technical problems.

In emergency remote learning (ERT) during COVID-19, students were given a greater sense of autonomy to regulate their learning. However, this autonomy was faced with several challenges, including uncertainty regarding the duration of isolation, distractions at home, and a reduction in social interaction (Son et al., 2020). Although some higher education students possess effective cognitive and metacognitive strategies for self-regulation, they often lack motivation, support, and digital competencies related to self-regulation (Rasheed et al., 2020). In the absence of familiar university environments, students may find it difficult to concentrate at home since they do not have access to

optimal study areas, isolation, and resource management that could help them concentrate in the classroom (Biber et al., 2021).

According to Fadde and Vu (2014), online learning can be run in several formats, including fully synchronous, asynchronous, and blended formats. Each format presents distinct challenges and opportunities for online learners. Asynchronous learning is time-efficient and socially interactive; however, educators and students often miss out on immediate feedback.

Gillett-Swan (2017) suggested that the concept of blended learning involves combining in-person meetings and online meetings. This can facilitate collaboration, but it may also lead to inefficiencies since it allows both methods to be used at the same time. The downside to learning from home is that it can cause more distractions than attending classes on campus or learning from a book.

According to Yee and Ean (2020), students are significantly affected by online discussions, and communication barriers caused by inadequate digital facilities must be eliminated to improve students' sense of belonging and autonomy in glitch-free online learning environments. Having an improved learning experience makes students more likely to actively participate in virtual classes when participating in remote learning. A study was conducted on 1,008 undergraduate students who switched from in-person to virtual classes in Spring 2020. Among them, 57 percent struggled to maintain their interest in online lectures when compared to physical lectures. As reported by Means and Neisler (2020), 65 percent of the students reported decreased opportunities for peer collaboration and 47 percent reported difficulty in maintaining their motivation.

Boyarsky (2020) believed that hybrid learning has become an increasingly popular form of learning, combining in-person and remote methods, as well as offering flexible learning experiences for students. This approach aims to encourage students to engage with learning materials, collaborate with educators, and communicate with them even if they are not physically present in the classroom. Synced real-time communication offers larger advantages for group work, presentations, and discussions when compared to asynchronous methods, which provide an additional method for providing instructions.

Ali et al. (2024) argued that hybrid learning is beneficial in Malaysian universities, emphasizing curriculum quality over cost savings to foster curriculum quality and efficiency. Technology facilitates the use of higher-order teaching processes in educational settings, which is an important tool for educators to use. As a result, it contributes to the universities remaining relevant by making sure students feel a sense of belonging and affiliation as they undergo a hybrid learning experience.

The literature focuses mainly on the expectations of higher education instructors, although a few articles explore student perspectives. The pandemic has created communication barriers that students

can overcome in remote learning. There has been limited research on strategies to reduce communication barriers. Schools that are closed for an extended period because of a pandemic impact human capital and economic opportunities over a longer period. Due to this, traditional teaching methods must be re-evaluated to effectively respond to students' challenges, particularly during emergencies.

The education gap is the disparity in access to quality education and resources among different socioeconomic groups, geographical locations, and demographics. This gap enlarges when students lack access to digital technology and internet connectivity, which are two essential tools for modern education.

The main objective of this study is to develop the digital transformation framework to bridge the education gap (DTFBEG) using the design science method. It can be broken down into these sub-objectives:

1. To identify the key factors that contribute to the educational gap.
2. To develop a comprehensive digital transformation framework (DTFBEG) to bridge the educational gap.
3. To apply the design science method to ensure the framework is practical, relevant, and feasible.
4. To Evaluate the effectiveness of the developed framework by comparing it with existing models/frameworks.

### 3. Methodology

In this study, a digital transformation framework is developed that can be used to bridge the educational gap based on design science research. According to [Alhussan et al. \(2022\)](#), design science research is a multidisciplinary approach to developing innovative products. This methodology emphasizes developing prototypes and systems, evaluating them, and suggesting improvements based on a real-world context. Based on design science methodology, real-world problems and opportunities are identified, existing solutions are studied, and new artifacts or systems are developed to address or use those problems. [Fig. 1](#) displays the adapted methodology, and the stages involved. As [Fig. 1](#) demonstrates, the methodology adopted in this paper comprises the following four stages:

- Preparation stage: This stage prepares the principles of search that guide and control the process by which the research is conducted. This stage, in turn, consisted of two parts: identifying popular online databases and determining the search criteria that will be applied to the searches. The first part was focused on the identification of popular online databases, which resulted in the following: IEEE Xplore, Scopus, Web of Science (WOS), Springer Link, and Google Scholar. Then, in the second part, three rules were established: a)

the search covers the period from 2000 to 2024, b) the language of the resource should be English, and c) the keywords were set to "digital transformation," "education," and "crisis."

- Gathering and filtering stage: Data were gathered from the identified online databases and filtered based on the defined keywords and exclusion and inclusion criteria.
- Analyzing stage: This stage analyzed the collected data and determined the limitations of the digital transformation domain of education during COVID-19. The digital transformation that occurred during the pandemic crisis revolutionized the learning experience. However, it also introduced several limitations that need to be investigated and managed effectively. The digital divide, digital skills gap, lack of personalized learning, inadequate assessment and evaluation, limited social interaction and emotional support, cybersecurity concerns, physical well-being challenges, and digital infrastructure limitations all pose significant challenges. By recognizing these limitations and attempting to resolve them, educators and institutions can strive to create a more inclusive, equitable, and effective digital learning environment.
- Developing stage: In this stage, a digital transformation framework was developed to bridge the education gap. The developed framework comprises six components ([Fig. 2](#)): online platforms, learning management systems, content creation and delivery, interactive tools, remote assessment and evaluation, and parental involvement.

The digital transformation framework consists of several key components:

- Online platforms: The educational and virtual classroom is a place where educational materials are presented, assignments are given, and assessments are graded. As a result, modern education relies increasingly on these technologies to deliver educational materials, assignments, and assessments. Students are engaged and their learning journeys are facilitated through these platforms. A platform for education serves as a virtual classroom where students and teachers can communicate remotely. They provide a variety of features and functionalities that improve the learning process. Content creation and sharing tools, such as document editors, videos, and interactive presentations, may be included on these platforms.
- Learning management systems (LMS): LMSs are software applications designed to manage, document, track, report, automate, and deliver educational courses, training programs, materials, and training programs. The concept of learning management systems emerged directly from the concept of e-learning. Learning management systems make up the largest segment of the

learning system market. A Learning Management System (LMS) has been introduced in the late 1990s. It has become an integral part of the curriculum of almost every English-speaking

university in the world. LMSs have received a massive increase in usage in recent years because of the emphasis on remote learning during the COVID-19 pandemic.

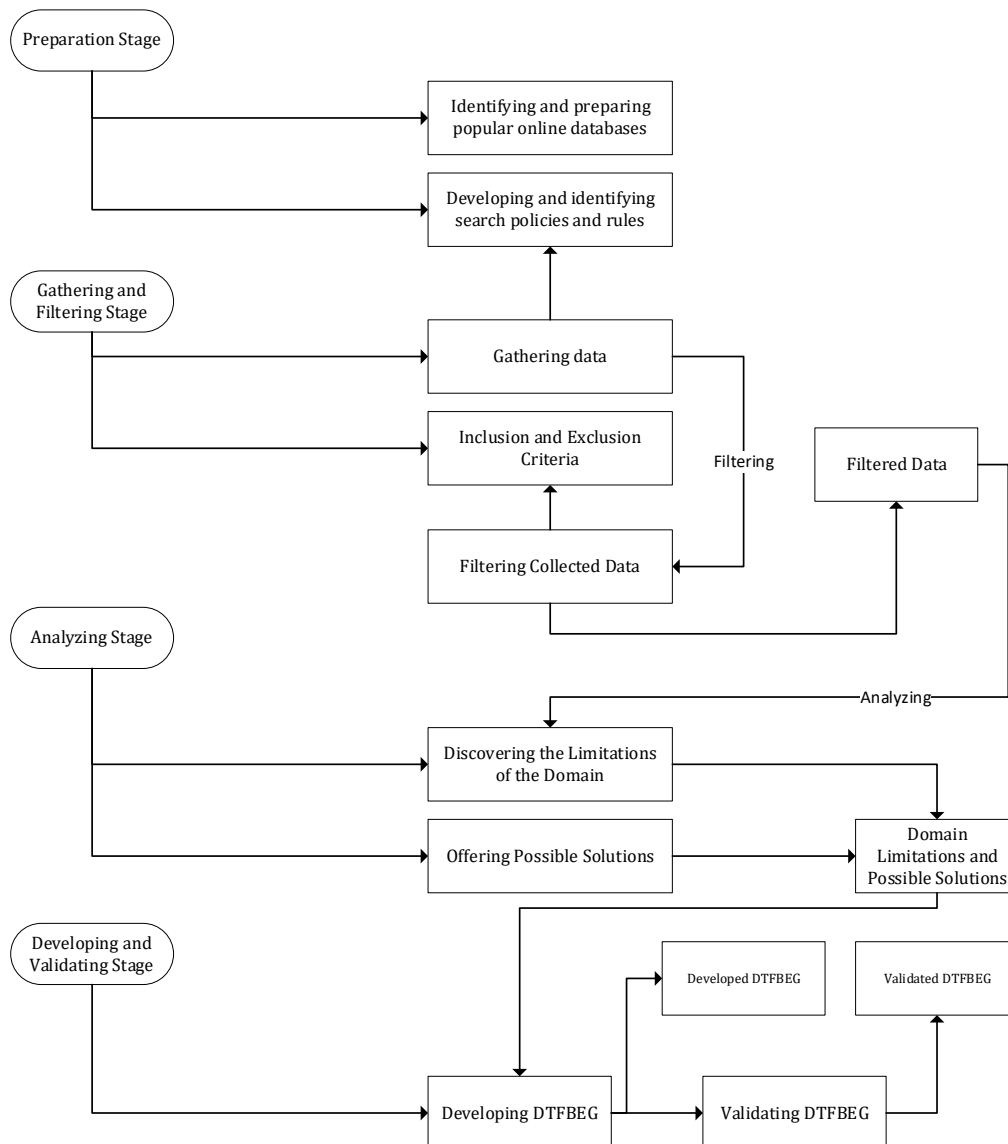


Fig. 1: Adapted research methodology (Albugmi, 2024)

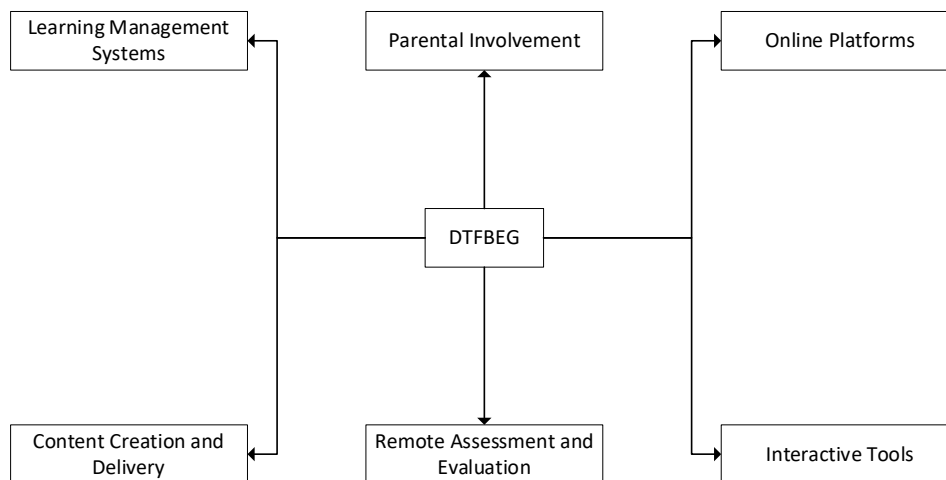
- **Content creation and delivery:** Digital tools enable teachers to create and deliver high-quality multimedia content, such as videos, interactive quizzes, and simulations, to enhance students' learning experience. Videos have become a powerful tool in education, as they can effectively communicate complex concepts in a visual and auditory manner. Teachers can use video editing software to create informative and engaging videos that explain complex concepts, demonstrate laboratory experiments, or provide virtual tours of historical sites. Quizzes have long been used as an assessment tool to measure students' understanding.
- **Interactive tools:** Online platforms offer interactive tools, such as whiteboards, chat features, and video conferencing, to facilitate real-time collaboration and communication among students and educators. Online whiteboards allow students

and educators to collaborate on a shared virtual canvas. Like a traditional whiteboard, online whiteboards enable real-time drawing, writing, and annotation, allowing participants to work together on projects, diagrams, and brainstorming sessions.

- **Remote assessment and evaluation:** Digital tools enable remote assessment and evaluation, which provides teachers with efficient ways to assess students' progress and provide feedback. These tools offer a range of features and benefits that streamline the assessment process. They eliminate the physical limitations of traditional assessments by allowing teachers to assess students remotely. Through online quizzes, assignments, or video submissions, students can submit their work electronically, eliminating the need for physical copies of assignments or exams.

- Parental involvement: It provides parents with a platform to access educational resources, communicate with teachers, and support their children's learning journeys. The framework's emphasis on making educational resources accessible to parents is one of its most important

aspects. In addition to finding out more about curriculum topics, homework assignments, and study guides, parents are also able to benefit from a wide selection of resources, such as information on curriculum topics, homework assignments, and study guides.



**Fig. 2:** The framework developed to bridge the education gap during COVID-19

#### 4. Results and discussions

This section discusses the findings and the output of the study. This study addressed three questions:

##### 4.1. Challenges of digital transformation in times of crisis

The digital transformation process brings various challenges that faculty members and students encounter in times of crisis. These challenges impact multiple aspects of the educational journey, leading to difficulties and disruptions in teaching and learning. The answer to this question will delve into the significant challenges that faculty members and students face in the digital age during times of crisis. [Table 1](#) summarizes these challenges.

##### 4.2. Perceptions of online and blended learning in higher education

Attitudes towards online and blended learning in higher education can vary significantly among individuals. While some students embrace these learning modes, others may struggle to adapt or find the format less than ideal. [Table 2](#) displays the common attitudes held by students, faculty members, and administrators toward online and blended learning.

##### 4.3. Coping with challenges in digital transformation

DTFBEG, which was developed in this paper, could be a solution to the challenges faculty members and students encounter during crises. This framework aims to mitigate the disruptions caused by emergencies, such as natural disasters,

pandemics, or political unrest, by seamlessly transitioning from traditional face-to-face education to remote learning. One of the primary goals of the DTFBEG is to bridge the education gap that arises during times of crisis. This gap typically stems from the abrupt shift from traditional teaching methods to remote learning, which can result in a lack of access to educational resources, limited social interaction, and a lack of engagement among students.

In contrast, the developed DTFBEG has the potential to narrow the education gap that exists in marginalized communities during COVID-19 as well. The framework provides marginalized students with a wide range of learning and development opportunities using digital infrastructure, adaptive learning platforms, and e-learning content, as well as virtual tutoring and collaboration tools. As a result of enhanced learning opportunities, reduced dropout rates, promoting equity, flexibility, and community engagement, this framework aims to transform education to better serve all students and provide them with a brighter future.

#### 5. Conclusions

The COVID-19 pandemic has disrupted education systems around the world, posing significant challenges to students and teachers. Increasingly, schools are closing due to remote learning. Due to this crisis, there is a serious need to effectively manage the education gap. By utilizing design science methodology, this paper developed a new framework for bridging the education gap (DTFBEG). In this framework, there are six components: an online platform, a learning management system, a content creation tool, a remote assessment tool, and parental involvement.

**Table 1:** The challenges faculty members and students perceive throughout digital transformation in times of crisis

Faculty Members	Detail	Students	Detail
Adapting to new technologies	Faculty members must adapt to new technologies in their teaching practices and be knowledgeable about the digital tools and platforms that enable remote learning and online collaboration	Digital divide	The digital divide is a significant challenge for many students during a crisis. Some may not have access to the necessary technology or internet connectivity to participate in online learning effectively. This resource disparity limits students' ability to fully engage with course materials and interact with their peers and teachers
Effective online instruction	Faculty members often struggle with engaging students remotely, maintaining classroom dynamics, and ensuring that students actively participate in the learning process	Distance learning challenges	Distance learning presents several challenges for students, such as self-discipline, time management, and motivation. Without the physical presence of teachers and classmates, students may struggle with staying focused and organized and completing their assignments on time. Additionally, the lack of face-to-face interaction may hinder collaboration and support networks, making the learning process less engaging
Supportive infrastructure	The availability of a reliable and supportive infrastructure is essential to successful digital transformation. Faculty members may face challenges when they need to have access to high-speed internet and necessary software and need to maintain technological devices that are suitable for online teaching	Technical Difficulties	Technical difficulties, such as software glitches, hardware failures, and internet connectivity issues, can disrupt the learning process for students. They may face challenges in accessing online learning platforms, submitting assignments, or participating in online discussions. These technical problems can be frustrating and hinder their overall learning experience
Time management	Digital transformation requires faculty members to effectively manage their time, as they now need to combine their regular teaching responsibilities with online activities. Balancing administrative tasks, planning lessons, grading, and providing support to students remotely can be demanding and time-consuming	Mental Health Concerns	The transition to online learning during times of crisis can create mental health challenges for many students. The lack of social interaction, increased isolation, and uncertainty about the future can negatively impact their well-being

**Table 2:** Attitudes held by students, faculty members, and administrators toward online and blended learning

Positive attitudes	Negative attitudes
<p><b>Flexibility:</b> One of the main advantages of online and blended learning is its flexibility. Students can study at their own pace and schedule and complete coursework at times that suit them best. This flexibility is particularly beneficial for working professionals or those with other commitments that make it difficult to attend traditional in-person classes</p> <p><b>Convenience:</b> Online and blended learning eliminates the need for physical commuting, allowing students to access course materials and complete assignments from anywhere. This convenience will enable students to balance their academic responsibilities with other commitments, such as work or family obligations</p> <p><b>Access:</b> Online and blended learning platforms provide equal access to education for students regardless of their geographical location. This opens opportunities for individuals who may have previously faced limitations due to geographical barriers or mobility issues</p> <p><b>Peer Interaction:</b> While traditional classroom learning often emphasizes face-to-face interaction, online and blended learning platforms offer opportunities for peer interaction through discussion forums, video conferencing, and collaborative projects. These interactions can help foster a sense of community among students, regardless of their physical location</p>	<p><b>Lack of Personal Interaction:</b> Some students may find the lack of personal interaction with instructors and peers challenging in online and blended learning settings. The lack of immediate feedback and opportunities for spontaneous discussions may hinder the learning process for some students</p> <p><b>Technical Challenges:</b> Online learning requires a certain level of technological proficiency, which some students may struggle with. Technical issues such as internet connectivity, computer troubleshooting, and accessing learning resources can hinder learning progress and deter some students from fully engaging with the online platform</p> <p><b>Motivation:</b> Some students may struggle with motivation and self-discipline without the physical presence of classmates and instructors. They may also find it challenging to maintain consistent study habits or complete assignments on time without the accountability of attending regular classes</p> <p><b>Procrastination:</b> The convenience of online and blended learning can lead to procrastination among students. Without the time constraints of attending in-person classes, some students may delay starting assignments or completing them at the last minute</p>

A developed framework can solve the challenges education systems face at this critical time due to its promising potential. As part of digital transformation, education is continuously enhanced, collaboration and communication are cultivated, and personalized learning is supported. As a result of the results, digital transformation contributes in several ways to filling the above-mentioned gap: it enhances flexibility in the education system and helps to learn new technical and educational skills. In future research, the developed framework could be applied to real-world scenarios so that its applicability can be tested.

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### Compliance with ethical standards

### Conflict of interest

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