OPEN ACCESS Freely available online

Journal of Research and Development

Review Article

Global Digital Transformation of Higher Education: Vision 2050 New Innovative Digital Pedagogical Models and Improvement in India: Comparative Research

V Thangavel*

Department of Philosophy, St. Francis Institute of Management and Research, Mumbai, India

ABSTRACT

The higher education sector has come a long way in its digital transformation journey and an exciting road still lies ahead. The need for agility and adaptability is paramount and a forward-thinking digital strategy with a range of effectively harnessed digital technologies could revolutionize the sector in terms of innovating and improving the teaching, learning and assessment experience, improving student, researchers' engagement and the efficiency of all other processes, as well as increasing collaboration and research. Impressions of the virtual classroom in higher education maintaining an active connection between students and professors, as well as among students, is one element of successful online and distance education mode during the COVID-19 epidemic. Many recent studies have found that this level of interaction is substantially higher in a virtual classroom, *i.e.*, when digital as well as other term distance education is delivered synchronously. Digital learning or distance learning, according to some academics, can dramatically reduce absenteeism also students feel less shy to ask questions. However, some types of teaching, such as practical work and projects that need laboratory equipment, are not well suited to digital and other words distant learning. In many circumstances, the level of human interaction in area classroom is impossible to replicate in a virtual setting, according to these writers. Despite having many positive points, several authors suggest that virtual education teaching styles should implement a variety of innovative methodologies to fully engage students and assist them in achieving the main pedagogical objectives, such as successful learning and the acquisition of relevant skills. Compared to face-to-face instruction teachers need to expend a significant amount of time and effort to create effective virtual classrooms. To sum up this part, digital and distance education is not a new concept; many top institutions all over the world have been using it for many years. A new matter is the extent to which institutions are utilizing collaborative digital platforms and online resources to instruct both synchronously and asynchronously while maintaining student motivation. Overview of some digital tools used for conducting remote teaching collaborative platforms such as Google Meet, Microsoft teams and Zoom, which were initially designed for commercial uses, has become increasingly popular in recent years, particularly for the digital transformation of higher education. Microsoft teams, for example, is a customizable collaborative platform that integrates many features, including video conferencing, scheduling team meetings *via* Microsoft outlook, as well as sharing contacts and emails; file storage and transfer with Sharepoint; and note-taking with one-note. Zoom, for example, is a teleconferencing tool that combines video conferencing, online meetings, chat and mobile collaboration utilizing proprietary software. This tool has digital educational potential because it allows for the creation of a virtual room accessible to a large number of

Correspondence to: V Thangavel, Department of Philosophy, St. Francis Institute of Management and Research, Mumbai, India; E-mail: v.thangavel@rocketmail.com

Received: 16-Nov-2023, Manuscript No. JRD-23-28043; **Editor assigned:** 20-Nov-2023, PreQC No. JRD-23-28043 (PQ); **Reviewed:** 05-Dec-2023, QC No. JRD-23-28043; **Revised:** 08-Jan-2025, Manuscript No. JRD-23-28043 (R); **Published:** 15-Jan-2025, DOI: 10.35248/2311-3278.25.13.284

Citation: Thangavel V (2025) Global Digital Transformation of Higher Education: Vision 2050 New Innovative Digital Pedagogical Models and Improvement in India: Comparative Research. J Res Dev. 13:284.

participants and includes many features useful for the implementation of an online course, such as the ability to create a videoconference for a large number of participants; the ability to record a video conference and chat, allowing students to learn at their own pace, audio and chat interactions; screen sharing with teachers; as well as content sharing and real-time co-teaching. During the COVID-19 epidemic, several universities throughout the world used the zoom platform. Since March 2020, the number of downloads for this California-based software has increased dramatically. Zoom was extensively used by all students at prestigious universities such as Stanford, Princeton and Harvard, due to its simplicity and user-friendliness. The efficiency, quality of service, data security, user ergonomics and cost of remote learning tools are all factors to consider for using a tool in remote learning.

Keywords: Digital transformation; New education; Policy education; Higher education; Business education systems; Educational revolution; Smart classroom; Smart campus; Smart board; Innovative pedagogical model; Pedagogical improvement

INTRODUCTION

Digital transformation is a shift in the role of technology within an organization from being a mere support function to being integrated into all areas of business, thereby fundamentally transforming its operations and the way in which it delivers value to customers. This can be distinguished from business process re-engineering, as it extends beyond merely automating rule-based processes and instead, focuses more on re-imagining business models and operations There are a number of emerging technologies driving digital transformation, such as social media, the Internet of Things (IoT), big data and analytics, cloud computing, Artificial Intelligence (AI), machine learning, blockchain, cybersecurity, Robotic Process Automation (RPA) and quantum computing. However, according to a study conducted by the MIT Sloan Management Review and Deloitte, it is organizational strategy that drives digital transformation, not necessarily technology. Nevertheless, technology has been a significant disrupter for many years now, transforming global value chains and business models and resulting in a seismic shift of skills, bringing us to the Fourth Industrial Revolution or Industry 4.0. Education 4.0 will ultimately take us is anyone's guess, but it is likely that a truly digitally transformed, futuristic higher education environment would incorporate most of the following technologies. Chatbot, augmented reality, smart classroom and smart campus. This article dealt with the need for higher education digitization, objectives and types of digitized education systems, new educational policy, programming and adoption of new technologies with future recommendations. The higher education industry has gone a long way in terms of digital transformation and there is yet a long way to go. The need for adaptability of digitization in the education sector is very essential and a forward thinking digital strategy incorporating a variety of effectively adapted digital technologies could revolutionize the sector in terms of innovating and improving the teaching, learning and assessment experience, as well as increasing collaboration and research. Thus, distance education will continue to grow. The widely shared observation is that blended learning can offer many opportunities and the great flexibility required for tomorrow's higher education [1].

LITERATURE REVIEW

In the context of higher education institutions, digital transformation may be measured in terms of all digital activities necessary to complete a transformation process that allows higher education institutions to optimally employ digital technology. The digital transformation of higher education has already been explored in the context of digital content creation and life ong learning, but the COVID-19 epidemic has triggered the shift of educational processes to online beyond March 2020. First, the terms online learning, e-learning, digital learning and blended learning must be defined. In online learning most of the material commonly 80% or more of the total program is supplied online whereas in blended learning face-to-face and online learning are combined where 30 to 79 percent of the program is delivered online. E-learning and digital learning are like online learning. Any learning that is supported by digital tools and technology is referred to as digital or e-learning. Higher education's digital transformation has necessitated the arrangement of teaching and learning in an online context. But the question is what exactly must change to attain high efficiency of teaching and learning.

DISCUSSION

Digital transformation for the higher education sector

The higher education sector, like many others, has radically transformed over the last few decades. From the origins of the traditional tutor-centric classroom where technology was even forbidden (Education 1.0), to the gradual infiltration of technology, first in basic ways (Education 2.0) and then on a mass-scale through user-generated internet which made it easier to connect with tutors and learn virtually (Education 3.0), education has come a long way. The higher education sector has now aligned itself with the Fourth Industrial Revolution and is undergoing a digital shift of its own, which is known as Education 4.0. The COVID-19 pandemic has exponentially accelerated this digital shift within the higher education sector. Since March 2020, universities have plunged head-first into online teaching and learning and experimented with

synchronous and asynchronous lectures, online learning communities, online assessments and other innovative pedagogies and relied heavily on data analytics to monitor student engagement. Although this stemmed more from necessity than choice, there are nonetheless several benefits from this accelerated digital transformation in higher education. For instance, the sector has been able to widen participation, promote access to education and more effectively prepare students for complex and unprecedented situations around which the business world revolves. The digital literacy of both staff and students have greatly improved and students are also able to demonstrate their ability and willingness to learn and adapt, all of which are essential traits sought by employers today. Digital transformation within higher education is becoming even more important with the entry of Gen Z into universities. These young individuals are digital natives who live in a world of instant communication, and learn differently, with shorter attention spans and an increased ability to multitask, so it is essential to find more innovative ways to capture and hold their attention. However, it is important to note that for true digital transformation to take place, it should involve more than just a switch from traditional ways to online. For instance, merely converting a paper based examination into a computer based one is not in itself a true digital transformation. However, when biometrics and AI are used to authenticate examination candidates, data generated from online assessments are analysed and used to improve future assessments and exam performance and the full suite of tools is used to ensure exam rigor and security, such as question randomization, algorithm based question mix optimization, prohibition of backtracking, prevention of browser search and perhaps even remote proctoring, digital transformation has truly taken place. This is just one example, but in essence, it should involve using technology to completely transform all processes, as well as the organizational culture, to meet future needs. Although research on digital transformation is gaining momentum across multiple academic disciplines, there is still a paucity of research in the context of higher education. Within this context, digital transformation has been primarily discussed in tandem with individual technologies used to improve operational processes and the competitiveness of HEIs in a rapidly changing global market. For instance, has explored whether online technology constitutes a sustainable solution for HEIs in developing countries to continue to function and investigate the impact of online teaching delivery on students' academic success and job readiness. These studies are particularly interesting as they capture the implications of technology on value creation paths amidst the uncertainty created by the pandemic, while further such insight by proposing a policy framework that highlights how technological platforms should be used to support teaching delivery during emergencies. However, further research is still needed to explore the mechanisms intertwined with the transformation of multiple organizational dimensions. There are also other scholars who focus on the implications of digital technologies on workforce competencies by exploring the digital prowess of educators. Last, others focus on the use of digital technology to enhance teaching methods, for instance, suggest that gamification techniques can enhance teaching quality. Despite the valuable insight these studies provide, they only partially capture digital transformation as widespread organizational change. Instead, they primarily explore the digitalization of certain business dimensions or functions. Therefore, there is a need for further research to explore how different technologies are implicated in the transfiguration of organizational dimensions beyond pedagogical practices or professional skills. In what follows, we present our methodological approach [2].

Pandemic period and what is next

The COVID-19 pandemic has compelled us to rethink and reshape the overall higher education environment and experience. Where education 4.0 will ultimately take us is anyone's guess, but it is likely that a truly digitally transformed, futuristic higher education environment would incorporate most of the following technologies [3].

Chatbots: Some universities have already started using chatbots to facilitate prompt responses to the influx of student questions during key enrolment periods, direct students to the correct department or web page for further support and even for library support services. As these chatbots operate 24/7/365, students can be instantly signposted accordingly and this frees up a considerable number of staffing resources to manage more specialized queries/issues which cannot be dealt with by a chatbot. However, if chatbot technology could be taken up a notch to deliver more than mere administrative support, for instance, support reflective learning, that may revolutionize teaching and learning pedagogies.

Augmented reality, virtual reality and mixed reality Augmented Reality (AR): It means of layering digital information into the real world in real-time through a camera-equipped device, such as a mobile phone or laptop, in a manner that enhances or 'augments' reality. This contrasts with Virtual Reality (VR) which goes a step further by enabling a person to fully immerse in, explore and interact within a virtual, artificially simulated, 3D environment, using a special headset. Moreover, Mixed Reality (MR) is also becoming more and more common, with the artificial simulations of VR being combined with the real-world interactions of AR. Fuelled by a boom during the COVID-19 pandemic, the AR/VR industry is expected to grow by more than USD 125 billion by 2024 and radically transform numerous industries. AR/VR is gradually creeping into the higher education sector as well, with virtual campus tours and some universities even experimenting with holographic projections in classrooms. Moreover, studies are being conducted on teaching international business using VR avatars, so that students can practice negotiating and communicating effectively with multicultural business stakeholders. In fact, AR/VR has the potential to take higher education to new heights. For instance, with this technology, we can 'take' palaeontology students to a dig site in Egypt, accounting students on an audit or art students to the Louvre. With AR/VR, it is now possible to expose students to any practical scenario that is either too dangerous, too expensive or physically impossible to be done in a traditional classroom setting. Such technologies could also present new possibilities for an innovative assessment approach. It could be used to

complement case studies, effectively simulate real work environments for integrative assessments, facilitate immediate feedback and inspire reflective and creative learning.

Smart classrooms and smart campuses: A smart classroom is a fully digitally equipped classroom that deploys a range of teaching and learning pedagogies using technology. It involves the integration of computers, specialized software/apps, assistive listening devices, artificial intelligence, AR/VR and audience response technology to facilitate and improve engagement and learning analytics to identify areas requiring more attention and perhaps even students with mental health issues and learning disabilities. These smart classrooms might even have auto-regulated lighting, temperature, humidity and CO_2 levels. A smart campus would take this concept further, using advanced technologies to digitally integrate various functions to improve experience, education and efficiency. For instance, smart timetabling could involve considering multiple variables, like a particular type of classroom with specific heating/lighting to suit the activities of that specific subject, so that student concentration and engagement levels are improved. A smart campus might also use AI and other technologies to optimize resource utilization and allocation or analyze noise levels and inform a student of the best spot for some quiet study or help the cafeteria staff to improve meal options based on consumption trends. The possibilities are endless. The pandemic has not managed to bring us here yet, although, with the global e-learning market estimated to grow to approximately USD 370 billion by 2026, we are surely getting closer. Any institution bold enough to venture into a fully digitally transformed smart campus using the full spectrum of digital technologies for teaching, learning, assessment and other key functions, would no doubt become a mover and shaker in the UK higher education sector and be able to gain a significant competitive advantage. Inevitably, implementing these digital technologies would come with its own set of challenges. It would involve a steep learning curve for staff, may be quite labour-intensive to deliver effectively and there may be general resistance by staff, bureaucracy in approval and implementation processes and a lack of financial resources.

Trends and technologies in education systems

Faced with this unprecedented health emergency, countries all around the world have been forced to develop an educational continuity plan that can be implemented as soon as possible. Educational continuity plans are meant to sustain the pedagogical connection between students and instructors in the case of temporary school closures. The major goal is to help students retain their existing knowledge while also assisting them in acquiring new knowledge. Despite the numerous challenges connected with synchronous and asynchronous distance education, the desire to deliver high-quality education remains. Physical distance and socio-emotional support; correct understanding of technological tools; access to a steady and secure internet connection; and access to suitable computer equipment are just a few examples. Organization for Economic Cooperation and Development (OECD) stated that 95% of students in Austria, Norway and Switzerland have access to a computer to do their coursework, but on the other hand, only 34% of Indonesian students have access to such devices. Higher education now uses a variety of programs, platforms and instructional materials for both synchronous and asynchronous distant learning. In the literature, several classifications containing multiple categories has previously been presented.

MOODLE: It is an internationally supported open learning platform and is an example of a digital learning management system (with more than 60 partners in the Asia-Pacific region, Europe and the United Kingdom, America and Africa).

Massive Open Online Course (MOOC): This kind of platform includes a wide range of subjects such as engineering, medicine, economics, the arts and culture, among others. During the COVID-19 epidemic, approximately 200 higher education courses were made available to students across the world for free.

Self-directed learning content: One example is Khan Academy's interactive platform, which has provided thousands of online courses for undergraduate students spanning a wide range of scientific areas since 2008. Students from across the world were able to use this site during the COVID-19 epidemic.

Collaboration platforms: Google Meet, microsoft teams and zoom are three notable examples of collaboration tools that offer live-video communication. Teams provide facilities that include chat, call and collaboration services. Zoom is a web-based video and audio conferencing, collaboration, chat and webinar platform.

Virtual classrooms in digital education

Maintaining active connections between students and professors, as well as among students, is one element of successful distant education during the COVID-19 epidemic. Many recent studies have found that this level of interaction is substantially higher in a virtual classroom, *i.e.,* when distance education is delivered synchronously. Distance learning, according to some academics, can dramatically reduce absenteeism also students feel less shy to ask questions. However, some types of teaching, such as practical work and projects that need laboratory equipment, are not well suited to distance learning. In many circumstances, the level of human interaction in a real classroom is impossible to replicate in a virtual setting, according to these writers. Despite having many positive points, several authors suggest that virtual education teaching styles should implement a variety of innovative methodologies to fully engage students and assist them in achieving the main pedagogical objectives, such as successful learning and the acquisition of relevant skills. Compared to face-to-face instruction teachers need to expend a significant amount of time and effort to create effective virtual classrooms. To sum up this part, distance education is not a new concept; many top institutions all over the world have been using it for many years. A new matter is the extent to which institutions are utilizing collaborative digital platforms and online resources to instruct both synchronously and asynchronously while maintaining student motivation [4].

Digital tools used for remote teaching

Collaborative platforms such as Google meet, Microsoft teams and Zoom, which were initially designed for commercial uses, have become increasingly popular in recent years, particularly for the digital transformation of higher education. Microsoft teams, for example, is a customizable collaborative platform that integrates many features, including video conferencing, scheduling team meetings *via* Microsoft Outlook, as well as sharing contacts and emails; file storage and transfer with SharePoint; and note-taking with OneNote.

Zoom, for example, is a teleconferencing tool that combines video conferencing, online meetings, chat and mobile collaboration utilizing proprietary software. This tool has educational potential because it allows for the creation of a virtual room accessible to a large number of participants and includes many features useful for the implementation of an online course, such as the ability to create a video conference for a large number of participants; the ability to record a video conference and chat, allowing students to learn at their own pace; audio and chat interactions; screen sharing with teachers; as well as content sharing and real-time co-teaching. During the COVID-19 epidemic, several universities throughout the world used the zoom platform. Since March 2020, the number of downloads for this California based software has increased dramatically. Zoom was extensively used by all students at prestigious universities such as Stanford, Princeton and Harvard, due to its simplicity and user friendliness. The efficiency, quality of service, data security, user ergonomics and cost of a remote learning tool are all factors to consider for using a tool in remote learning. The higher education industry has gone a long way in terms of digital transformation and there is yet a long way to go. The need for adaptability of digitization in the education sector is very essential and a forward thinking digital strategy incorporating a variety of effectively adapted digital technologies could revolutionize the sector in terms of innovating and improving the teaching, learning and assessment experience, as well as increasing collaboration and research. Thus, distance education will continue to grow. The widely shared observation is that blended learning can offer many opportunities and the great flexibility required for tomorrow's higher education.

Readiness for change

Factors of Organisational Readiness for Change ORC refers to two cognitive psychology concepts: "Commitment" and "efficacy" for change. Therefore, the two core factors that determine ORC in this theory are directly related to these two concepts. Like Bandura, et al. concept of targeted commitment, the concept of “change commitment” to change refers to shared constancy or determination by organisational members to pursue action processes related to implementing change. Focusing on the will to participate is crucial because organisational change cannot be accomplished by one individual, but it involves coordinated actions among people in the organisation. Each person contributes in some way to the efforts made towards the organisation’s overall success. This commitment varies among organisational members. As with team sports, problems arise when some players feel they can commit while others do not. It shows that each person in the organisation can be consistent or determined to implement change for different reasons and levels. According to the observational, organisational members can commit to an organisational change they want to because they see the value of change, they have to because they have few options or maybe because they ought to because they feel an obligation to do so. In which, a commitment based on “want to do" motivation reflects the highest level of organisational commitment to change. As with the concept in the social cognitive theory of Bandura et al. of collective effectiveness, "change efficacy” refers to the shared beliefs of organisational members in their collective capacities to organise and implement action processes related to change implementation. The emphasis on a shared sense of collective capacities is of paramount importance, as implementation within organisations often requires collective action between interdependent individuals and working units. Collaboration across individuals and groups and the promotion of organisational learning is a good example of collective capacities. Effectiveness evaluation refers to capacities for action. Performance evaluation is not an outcome expectation nor an evaluation of knowledge, skills or resources. The effectiveness of change is higher when people share a sense of confidence as a group that can implement a complex organisational change [5].

Framework for digital transformation

This research approach is based on Weiner’s theory of ORC, which is established by focusing on the characteristics of everyone within an organisation. According to the theory of change in general, ORC is a multi-level concept, such as individual, group, unit, department or organisational level. The theory introduced below focuses on readiness at the organisation level, particularly antecedent and organization level outcomes. The term “readiness”, like many other notions in the social sciences, is a concept borrowed from everyday language. That leads to many scholars and scientists not officially defining this concept because they believe that readers can understand and derive the general meaning of this term. ORC refers to the behavioural and psychological preparation of organisational members to implement change and be able to perform activities to drive organisational change. The theoretical model includes the factors of ORC and its influencing factors, including: Change commitment, change efficacy, change valence, information assessment, including two sub-constructs, tasks knowledge and resource availability.

Change valence: The term "valence" is an English concept used in psychology with origins taken from the German term "valenz". The original meaning of the German word "valence" is "binding", relating to the language field. It is often used in grammatical contexts to describe the semantic and syntactical association of a word with another word. Moreover, this word has been widely used in the field of chemistry since the nineteenth century to describe the mechanism of bonding between atoms. In psychology, “valence" is one of the most important scientific concepts at the heart of emotional experience. The term was first known by Lewin, when he used it in his field theory to refer to the forces that attract individuals to

desired subjects and push them away from unwanted subjects. This term was subsequently studied and expanded considerably in relation to the selection of certain emotions as having positive or negative valence, which is represented by opposite pairs of terms such as positive-negative, good-bad or satisfied-dissatisfied, capture something about the nature of emotion. Intrinsic attractiveness is seen as positive valence and aversiveness is negative valence about a certain thing, phenomenon or condition. In the theory of organisational change, the "valence" was introduced by a structuralist psychologist, Kurt Lewin, in studies on organisational development has a significant meaning. Change valence is a factor or aspect that, according to the motivation theory, is closely related to the element of change commitment in the theory of ORC. Based on the motivation theories, asserted that change commitment is a broader function of change valence. The commitments of organisational members to pursue actions related to organisational change will be higher when they themselves see the value of these changes for their benefit, claimed that the more organisational members value change, the more they will want to make that change or in other words, the more decisive they will feel when participating in the action processes related to implementing change. So, what are the reasons for such people to value this change? According to Weiner, organisational members value these changes because they maybe believe: i) It is urgent; ii) It is effective and addresses critical organisational issues; iii) It benefits them personally, other employees or their organisation; iv) It can resonate with their core values; or v) It is supported by leaders, managers and colleagues. In general, change valence, even for different reasons, can be a decisive factor in the aspect of change commitment.

Information assessment: Social cognitive theory suggests that change efficacy is primarily referred to as a function of organisational members' cognitive assessment of task needs, available resources and situational factors. Asking themselves questions from organisational members is important to help determine the best capacity to perform the tasks posed during the organisational change process. Information assessments of organisational change will help make the process better and more likely to be successful. When members share a common and mutually agreeable assessment of task needs, available resources and situational factors, they will have a shared sense of confidence that they can implement organisational change together in the same way. Overall, information assessment of organisational change implementation is a factor that plays a directly decisive role in developing ORC, particularly for change efficacy. This factor is determined by two variables, including task knowledge and resource availability (Figures 1-10) [6].

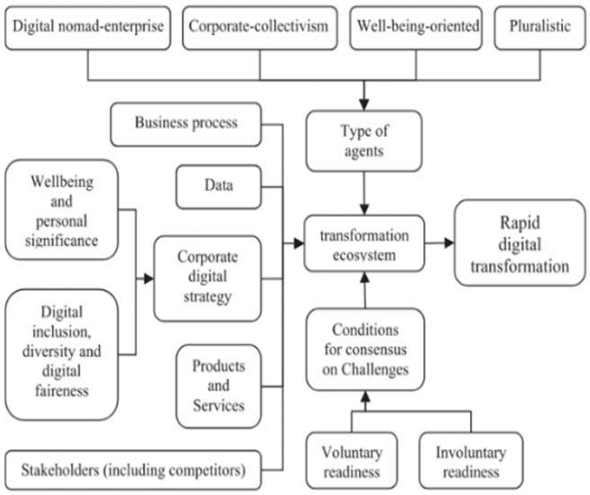

Figure 1: Framework for digital transformation education system.

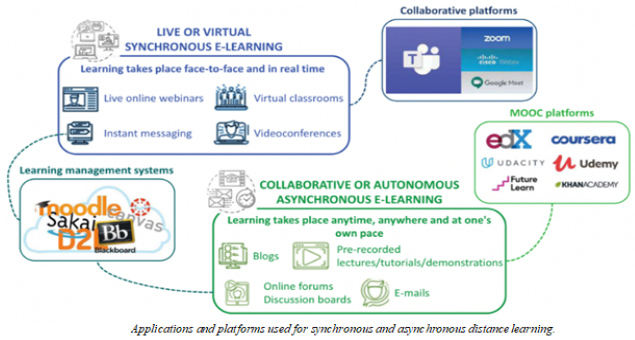

Figure 2: Distance learning systems.

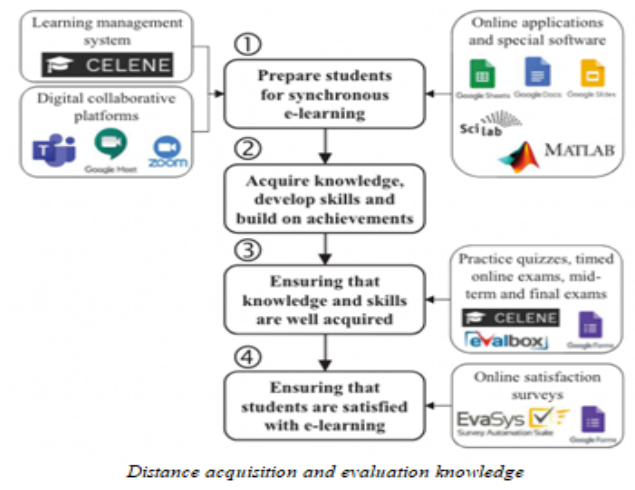

Figure 3: Online learning distance systems and ist acquistion and evaluation knowledge method.

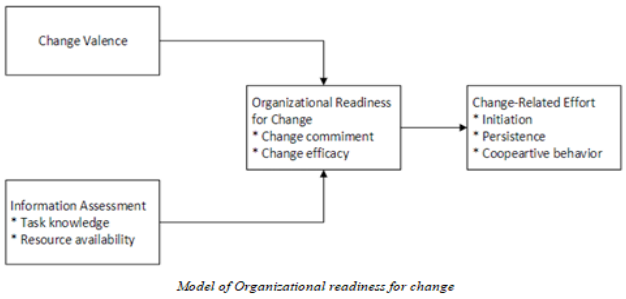

Figure 4: Organizational readiness for change.

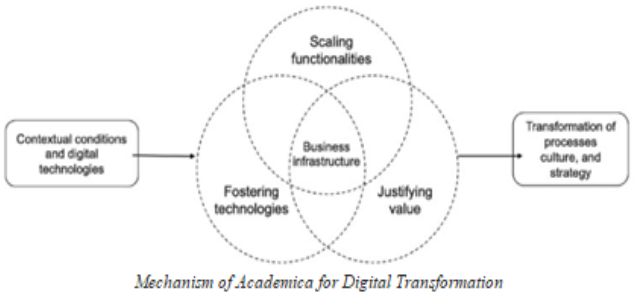

Figure 5: Digital transformation of academia for implication mechanism.

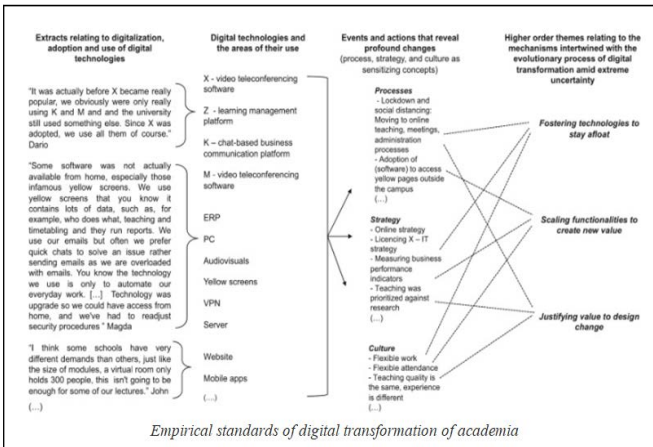

Figure 6: Digital transformation of academia-empirical standards.

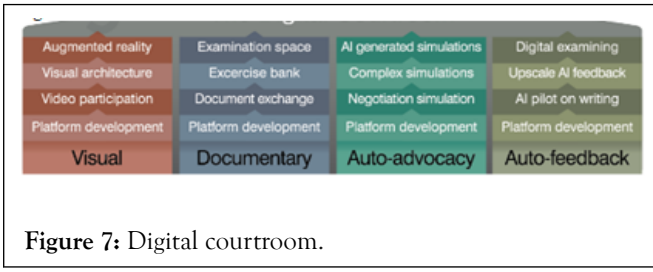

Figure 7: Digital courtroom.

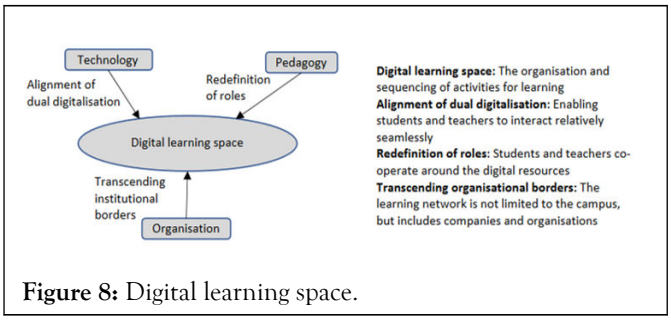

Figure 8: Digital learning space.

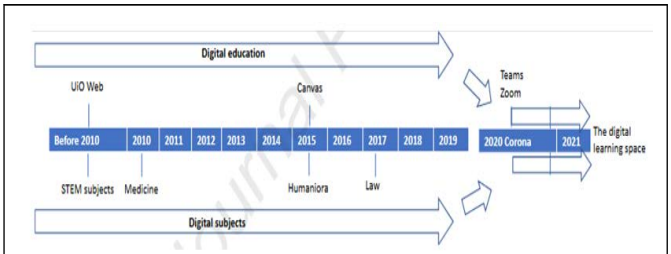

Figure 9: Digital education in higher educational institutions.

Sr. No	Tool used	Price	Type of learning	Ease of Use	Privacy	Accessibility	Class Size
1	Google Meet	Free	Google Account can create an online meeting with up to 100 participants and meet for up to 60 minutes per meeting	Good	Good	Good	100
2	Google Classroom	Free	Google Classroom, facilitates blended learning platform for educational institution by creating, distributing and grading assignments in a paperless way	Better	Better	Best	250 to Unlimited
3	PADLET	Free	Online "virtual wall" tool where learners/users/students can express thoughts on topics of their choice. It's like a piece of paper pasted on the board/wall, the virtual post placed on the virtual online wall, you can share with you can share with any student or teacher you want	Good	Good	Best	Unlimited
4	EdPuzzle	Free	A free assessment-centered tool that allows teachers and Learners to create interactive online videos by embedding either open-ended or multiple-choice questions, audio notes, audio tracks, or comments on a video	Good	Good	Better	Unlimited
5	PhET Simulations	Free	Interactive simulations of science and math concepts created by the University of Colorado Boulder. Students are able to run these simulations, manipulating different aspects of a construct to understand science and mathematics concepts.	Better	Best	Better	Unlimited

Figure 10: Tools for creating learning environment.

Digital transformation

Digital transformation amid extreme uncertainty: Digitalization and the onset of digital transformation. Over the last decade, a range of digital technologies supported and partially automated various organizational processes at Academia. Among others, audio visual technologies were in use to support teaching, an ERP software was used for back office support such as managing student registrations and university premises and digital library databases provided online access to resources such as books and journals. Magda, a Student Engagement Officer, explained how she was using technologies for different everyday work activities: "We use yellow screens that contain lots of data, such as, for example, who does what and teaching and timetabling and they run reports. We use our emails but often we prefer quick chats to solve an issue rather than sending emails as we are overloaded with emails. You know, the technology we use is only to automate our everyday work". Also, there were different digital resources for students available, such as online library databases for accessing published books, reports and datasets and a digital learning

management platform for accessing teaching materials and lecture recordings. In addition, most faculty members were using a range of digital technologies for research and teaching activities, such as research output repositories, timetabling and venue databases, lecture recording dashboards, research funding management platforms and payroll, HR and recruitment platforms, among others. Therefore, before the pandemic, digital technology was mainly considered as a tool for everyday work practices to digitally mediate or automate business processes. The use of various digital technologies was predominantly mandated, their adoption was taken for granted and any technological changes or updates were creating distress, scepticism and resistance. For example, many members of faculty were hesitant to learn how to use new platforms or software due to the time consuming learning curve that would distract them from their research obligations. Also, the digital recording of lectures posed a major concern as faculty members were hesitant of losing ownership of their intellectual property and being monitored from senior management. "We were using a different learning management system two years ago and when we changed, we had to learn how to use the new one and then the year after the adoption we had to redesign the module pages because of a template that was adopted. I have spent hours and it's very annoying. We create slides, design the module pages on the learning system and manually do the entry of attendances among many other things. It's very time consuming and if I had the option, I would not use any of these things". Overall, during the pre-pandemic period, an explicit digital transformation strategy was not in place and most importantly, these technologies were used in isolation, without profound implications for the business strategy of the organization. However, in recent years, it was apparent that strategic changes were necessary as other universities, seen as competitors, were constantly providing new digital offerings. There was an increasing demand for Academia to introduce distance learning programs as other organizations had started exploiting digitalization benefits by providing online courses. On 23rd March 2020, the UK government announced the first national lockdown as positive cases surged in the UK. However, shutting down Academia's operations was not an option. This was a crucial moment, as critical and rapid decisions had to be made to move all physical activities and operations online. Intensive discussions on a senior management level took place, with the aim of rapidly reshaping the organization's business strategy, at least for the short term. We observed that the Director of IT services and the Head of Technology-enhanced Learning played an important role in these discussions that aimed to discern how existing technologies and the adoption of new ones would help the organization stay afloat. Helen, a senior online distance learning coordinator provided an example of the interplay between scaling the use of existing technologies and adopting new ones, given the new conditions created by the pandemic "We had some of those technologies like B (cloud storage solution), but we were using it for administrative purposes and primarily to reduce the chaos with emails, but now we had to act fast to stay afloat. We had to think whether we could further use some of the existing platforms or whether we had to adopt new ones, how stable those platforms will be, how many students they could support simultaneously, the accessibility from other countries, because of course some of our students were not, and still are not all in the UK." At this point, it is important to highlight that the conditions created by the pandemic played a crucial role in the transformation process. There was uncertainty about the lockdown's duration, the rules imposed by the government and Academia's ability to respond to digital needs that related to issues such as needed bandwidth and student access to computers, cameras and headsets. Although Academia did not have budget constraints for investing into new technologies, its digital infrastructure was rudimentary. Very soon, all business processes would have to transform in a disruptive way to remain sustainable and this was the starting point for fundamental changes. As John, highlighted, the pandemic had catalytic effects "The digital transformation process definitely accelerated, we had to stay afloat". We present our findings of the transformational impact of digital technologies during the pandemic on business processes, culture and strategy at Academia [7].

Transfiguring business processes: At the beginning of the first lockdown, there was an immediate need to transform teaching delivery and administration processes. Most employees at academia were reasonably familiar with broad uses of digital technologies, but now, technology became a pre-requisite for business processes to merely exist. Kira, a lecturer, explained "Before, we were using technology to enhance student learning and experience, now without digital means there is no teaching, no knowledge creation, there is nothing"-Kira. The dissemination of teaching material and recordings continued without concerns through the existing learning management platform, but teaching delivery had to change as it was a crucial process of high importance. In the following quote, Dario, a professor at Academia, outlines how he experienced the transformation "Last March, we went into lockdown and suddenly we moved everything online, we had had to get familiar with online teaching and X (video teleconferencing software) that I have never heard before the crisis. This had a big impact on how we approach teaching and on how we interact with colleagues. So, I've been using all this technology for a full year to deliver teaching and service, including some quite intensive teaching, such as two-day workshops, something which would have been completely unimaginable to me in the recent past". As Dario mentioned, a new digital technology was licensed to facilitate the continuation of teaching activities, everyday communication and business meetings. Faculty, professional services staff and students in a short period of time became familiar with its different functions and were increasingly participating in daily work activities. Anna, a faculty member, explained that she could participate in an increasing number of daily activities, stating "I can join a meeting while I am uploading my teaching material, organizing things on Z (learning management platform) or formatting my slides. I can swap meeting rooms easily". Also, students became rapidly familiar with this technology and developed an appreciation of the flexibility and multitasking efficiency that it offered, while also remaining cognisant of a potentially diluted learning experience. For example, Alex, a student, explained "You are more flexible. Last time I joined the class while I was cooking. Not effective to learn, but at least you can still join the class, you

can still hear what they say and you can still discuss. I feel I can discuss even while I'm cooking". In addition, we observed that such technological reconfigurations were not met with scepticism or resistance. Instead, users were quick to embrace technologies and change their practices, due to a common understanding that quick adjustments had to be made. For example, when the main video teleconferencing software reconfigured its code to improve security, members of academia started also using it for confidential meetings. New functionalities, such as live transcription and polling, were used to enhance the student learning experience. In other words, the reconfiguration of technology was rapidly embraced and led to changes in various business processes. For example, this is evident by Mirela, a student engagement officer, who describes how student services had to quickly and efficiently adjust to working from home and tackle issues on accessibility, data sharing and communication "When it came to that (lockdown), we had to begin working from home, it suddenly meant everything had to adapt very quickly and there were aspects like access to systems that required access to VPN because we went into lockdown, we did a project plan of transferring all of our files onto B (cloud storage solution), because we were going to be suddenly working from home and that was going to be a huge change and it's quite hard to think about it because it happened so quickly. But for the first few weeks, a few months, just trying to get used to you know, using K (a chat-based business communication platform) as an office solution. So, we changed practices quite quickly and I think it was one of those situations where you had no other choice and now it's hard to think about life in a different way". In addition, such views reinforce the notion that technology was being scaled to further enhance the transformation of business processes. For example, users rapidly adjusted their practices when the learning management system was updated to support communication with students through messages, group discussions, the scheduling of online meetings and teaching sessions, as well as the submission and assessment of exam papers and assignments. Meanwhile, the transformation of several business processes involved more than one digital technology. For instance, a chat-based business communication platform that was initially used for internal communication between professional services staff, was eventually also used for teaching purposes. As Solo, a professor and associate dean at academia explained, some digital technologies were available before the pandemic, but their implementation was limited at the time due to a lack of necessity "There was a separate account for the video teleconferencing software that had been purchased and was set up specifically for distance learning. When we moved to online teaching, the decision was taken to bring X (video teleconferencing software) in and folded it into a much broader license and provision, so now it's part of the same provision, but it was existing in that one area previously. It was never picked up, used for teaching; it was used only for internal communication and co-ordination". Therefore, we observed that the adoption, combination and re-combination of multiple technologies became of paramount importance in processes that experienced sudden and drastic changes. As such, most of Academia's business processes were rapidly digitalized with no immediate need for embedding new technologies. However, senior management did not stop envisioning future changes and needs. For instance, a forthcoming hurdle to overcome was the transformation of physical exams to an online format. To retain various courses' accreditation eligibility from professional bodies, academia had to ensure that academic integrity would be protected. Therefore, senior management contemplated of adopting software that blocks access on webpages to mitigate collusion during online exams. However, there were technical constraints due to general data protection regulations and for this reason; the adoption of such technology was rejected. However, they decided to use a conjugation of two different technologies for the exam process; the learning management and the student management platform, because this combination enabled the integration of plagiarism detection in the marking process. Student assessments would be submitted in the learning management platform, which fed into the student management platform that faculty was using to mark, check plagiarism scores and provide feedback, while administrative staff would produce reports and retrieve data for updating student records. Then, the student management platform fed marks and feedback back to the learning management platform, making them available to students. In the next section, we present the transfiguration of academia's culture as part of the implications of digital transformation during the pandemic [8].

Transfiguring culture: We also observed that digital technologies had further implications on the overall culture that permeated the organization. In the beginning, there was uncertainty and confusion on how multiple technologies would be managed and affect business processes and especially those that were not entirely digital before. In fact, at the early stages of the pandemic and during the first lockdown, those involved in academia and its business processes did not have any formal training on new technologies or how to digitalize traditional activities. All were overwhelmed by the decisions made and the technologies adopted overnight to rapidly transform business processes. At this stage, there was not much resistance to technology adoption, as the uncertainty imbued by the pandemic did not leave space for manoeuvring. Very soon, academic faculty realized the benefits of the use of different digital technologies. They were participating more on research seminars and meetings, were able to spend less time for teaching preparation compared to the beginning of the pandemic and were feeling more efficient as they could do multiple tasks at the same time. Also, students reacted well to the transition into online teaching, embracing the changes. They considered that the continuation of their studies was crucial at a time of increasing unemployment rates and a challenging job market, thus they embraced the digitalization of teaching activities [9].

In addition, there were multiple digital technologies able to serve the same purpose for multiple groups of actors (e.g. faculty, professional services). However, actors relinquished their personal preferences and started using a conjugation of different available technologies to instigate collaborative working. For instance, Ann, a faculty member, explained that professional service staff were primarily using the teleconferencing software M to have meetings among themselves, faculty was using the teleconferencing software X and communication between faculty and professional services was primarily through emails or X.

Within this context and as time went by, the transformational impact of digital technologies in culture was more evident. The teaching and research-led culture of the organization did not change, but the culture surrounding digital technologies and the way people interact with them was transfiguring. Actors' engagement with digital technologies was riddled with a steep learning curve, yet such hurdles were quickly overcome and gave way to a redefined workplace culture. This is evident in the following quote from Kira, a lecturer, who explained that "In the beginning I was very stressed, I had to adjust all my teaching material, adjust the exams and all require time and this is against my teaching obligations. Later, everything was smoother, although the challenge for student engagement remains as many students have technical issues, do not switch on their cameras or use excuses for remaining silent. Also, I feel safe and I don't have to commute. I collaborate in a big part in the same way. The only problem is the separation of business from personal time, but the conditions are very particular". When actors started feeling more familiar with the use of multiple technologies and receiving more assistance from the IT services of the organization, we observed that many were content with the increased efficiency and control over different processes that digital technologies afforded. Also, faculty and professional services staff, to justify how they envision the future of their workplace, claimed that they wished to return to normality, mainly due to the absence of socializing in their workplace. For example, the following quote from an executive officer, Max, indicates this cultural change and highlights those digital technologies allowed for an increased sense of enjoyment "I realize the potential of technology and I kind of like my work more. I would say a balance of working from home and working in the office would be ideal". In a similar vein, students realized the potential of digital means. Although many students' initial impression was that online teaching provided a lesser experience when compared to face-to-face interaction, student interviewees further argued that they would prefer a hybrid model of delivery due to the flexibility this offers, rather than the re-establishment of the traditional norms. Alan, a final year undergraduate student claimed "In your home, the environment is not supporting you. It's the environment, when you were in the library; everybody studies, so you feel like you have classmates or friends who study also. Also, if you're spending a postgraduate year, one of the main reasons for coming to university is obviously the network and to meet other people and get contacts. But I think the good thing is that you are more flexible. Overall, I would like to have the choice. I mean, basically, if you're just paying £25,000 for an online course and a digital certificate is a lot, but it is enough to have the option". In what follows, we discuss how Academia's business strategy was transfigured as the crisis unfolded [10].

Transfiguring strategy: In the early stages of the pandemic, senior management considered that changes in the business strategy were necessary for the continuation of Academia's operations amidst the uncertainty. Considerations for re-shaping the organization's existing strategy succeeded other, UK-based Universities' strategy deliberations since for years, senior management was following a mimetic, risk-averse approach. According to John, Head of a Department "My sense is that they are often made at the last minute, by looking at what other people are doing. I think it's very rare for Academia to decide first and say okay we're going to do it this way, I think they are very risk-averse and scared, so they wait to see what everyone else is doing". According to senior management, the teaching-related aspect of Academia's strategy was not reliant on price differentiation, especially among the common undergraduate degrees that most competing universities also offered. The main strategic pillars of their offering were the quality of the curriculum and the geographical location that attracted many British students for undergraduate studies and both national and international students for postgraduate studies. Senior management did not intend to retain the online provision for existing programs once the crisis was resolved and instead, they were planning a return to normality to reduce the loss of revenue from suspended on-campus activities and accommodation services. Later, in September 2021, when the lockdown restrictions eased and a large part of the staff and student body in Academia was vaccinated, senior management had to justify whether they would retain the changes in their business processes. During this period, there was still uncertainty regarding the potential of any future, government-mandated lockdowns. Furthermore, there were travelling restrictions in place that caused difficulties for international students arrive to the UK, in addition to the government's guidelines on self-isolation upon infection. Within this context, we observed that there were many student requests that called for a return to traditional teaching delivery methods, deriving mainly from UK-based students. Such requests were contested by international students' desire to remain flexible and mitigate travel restrictions. Therefore, senior management decided that a hybrid model of service delivery was more appropriate, which was applied for both teaching and other business processes. At this point, teaching activities were both virtual and face-to-face and professional services staff were on hybrid working arrangements. During this transition, none of the adopted digital technologies were discarded. Instead, senior management was actively looking for better integration and optimization of their use. In addition, senior management and the University's Information Services Committee considered the adoption of more digital solutions, at the instigation of the IT Consultative Group. Factors such as modularity, scalability and interoperability were highlighted during meetings that aimed to justify investments and how academia's digital infrastructure could expedite a continuous organizational transformation. Although senior management was planning to revert to traditional teaching methods, they had started envisioning brand new offerings to capitalize upon the benefits of digital technologies. They considered developing new online programs with small courses that can be combined and re-combined to formulate degrees with high specialization and flexibility. The following quote from a Head of Department highlights that the transformation of strategy in academia was not entirely related to the University's core offering, but it had important ramifications for value creation and value creation paths [11].

"Over the past two years we've had all to work differently. The University was strategically shifting from a general teaching support unit to something entirely technology focused, basically,

how we bring tech into teaching. Now the technology is required to continue supporting and developing the needs of our evolving university. New services will be added with a focus on product improvement, agile working practices and enhanced student services." Last, the transfiguration of academia's business strategy was also evident from the organization's updated strategic framework. This framework emphasizes the use of a combination of different technologies through targeted investments and strategic partnerships to enhance student learning, facilitate knowledge creation aid educational administration and strengthen academia's governance. In addition, this framework aims at a transfiguration of processes and the establishment of a digital infrastructure to support students' educational needs, academics' teaching activities and their pursuit of new knowledge, engagement and impact and professional services in the delivery of their support activities.

Digital transformation in academia: The underpinning mechanisms of digital transformation in academia. Our analysis demonstrates that uncertainty acted as a catalyst for the transfiguration of business processes, culture and strategy in academia. As digital transformation rapidly evolved, three mechanisms emerged, namely: Fostering technologies to stay afloat, scaling functionalities to create new value and justifying value to design change. In what follows, we present in detail these mechanisms and how they were entwined in managing transformation and capitalizing upon the benefits of digital technology. They are classified as:

- Fostering technologies to stay afloat.
- Scaling functionalities to create new value.
- Justifying value to design change.

Fostering technologies to stay afloat: First, we observed that the members of academia were constantly promoting the growth and development of digital technologies to continue operating under the conditions imposed by the pandemic. We refer to this mechanism as 'fostering technologies to stay afloat' and argue that this is facilitated by digital technologies' open-ended and flexible affordances across business and functional boundaries. We observed that faculty, professional services staff and students started using multiple, both new and pre-existing, technologies to transform existing business processes. For instance, a new video teleconferencing software was very quickly adopted, thus allowing the continuation of teaching delivery, student assessment, research activities and professional meetings, among others. However, the transformation of business processes was not entirely reliant on this one piece of software. In the case of teaching delivery, for instance, it was used in conjugation with other technologies such as the learning management and student management platforms. In addition, we observed that actors were facing difficulties in coping with the complexity of an ever-changing technological and organizational environment, but uncertainty eventually played a role in limiting actors' resistance in engaging with such technologies and changing their practices. Therefore, the view of digital technology as a necessary evil was progressively replaced by a culture that fostered a digital mindset, digital literacy and competencies. Also, this mechanism was apparent in the transfiguration of strategy. The first lockdown created an emergent need of figuring out a business strategy based on the conjugation of digital technologies for the continuation of academia's operations [12].

Scaling functionalities to create new value: We refer to 'scaling functionalities to create new value' as the mechanism that it is facilitated by digital technologies' recombinant and reprogrammable nature. For example, before the pandemic, most of those involved in teaching processes were using the learning management platform to merely upload teaching material such as slides and documents. However, during the pandemic, the platform was also used to communicate with students through messages, facilitate group discussions, arrange meetings and online sessions, as well as to submit exam papers and essays, among others. In addition, we observed that every time this mechanism was actualized, there were implications on different organizational dimensions. In the example above, it is apparent that the scaling of different technological functionalities entailed valuable implications for business processes and a newly found, digitally prone culture. Regarding culture, once faculty and professional services staff had realized the benefits of technologies on delivering teaching, research and administrative tasks, they demonstrated resistance towards returning to their old practices after the pandemic. Last, the actualization of the scaling mechanism further underpinned changes in strategy. Senior management was contemplating the adoption of new technologies after exploiting various capabilities and possibilities of existing systems' interoperability and re-configuration.

Justifying value to design change: Lastly, we identify a third mechanism of significance, which we refer to as 'justifying value to design change'. The members of Academia were constantly attempting to justify the potential and value of digital technologies for the transfiguration of the organization to stay afloat amidst ever-changing circumstances and design further changes to leverage the organization's core competencies. In this regard, our empirical analysis illustrates that senior management was in a constant discussion with employees and students to peruse how they experience and value the latest round of changes in the organization and how they envision the future of their education or workplace. Through such justifications, they aimed to design additional changes for existing processes, culture and strategy. For instance, senior management was considering the launch of new taught programs that are available solely online and adopting flexible working arrangements that accommodated tele-working. Last, we argue that this is the mechanism that instantiates the multiple possible ways of creating future value and allows the design of strategic manoeuvres amidst uncertainty.

Theory for implications: Existing organizational change and IT-driven organizational transformation literature treats technology as a primarily back-office support function that has superficial or marginal effects instead of profound transformational implications in core business dimensions. Consistent with our conceptualization of digital transformation, organizational change at academia was facilitated by multiple digital technologies that reshaped its organizational aspects. Within this context, it is widely recognized that the recombinant and multi-layered nature of digital technologies has disruptive

potential that may enable firms undergo a fundamental transformation on multiple organizational dimensions. However, scholars have either focused on individual technologies or their implications on specific organizational dimensions. Our view of digital transformation, as outlined earlier, provides a comprehensive attempt to understand the "holistic nature" of digital transformation by demonstrating how multiple technologies, when woven together, transfigure our case study site's business processes, culture and strategy. In addition, our theorization also addresses the paucity of research in providing an understanding of the mechanisms in managing transformation and capitalizing upon the benefits of digital technologies. It is trough actualizing the three mechanisms of fostering technologies to stay afloat, scaling functionalities to create new value and justifying value to design change, that our case study site managed digital technology deployment and organizational transformation. Therefore, we articulate the dynamics by which digital transformation in our case study site deploys radical modifications of business processes, culture and strategy in an "unfolding process(es) involving actors making choices interactively, in inescapably local conditions, by drawing on broader rules and resources". Also, our findings demonstrate that in academia, these mechanisms were interrelated in a dynamic rather than sequential way and it is through these mechanisms that the rapid and ongoing capitalizing of the benefits of digital technologies manifested. Third, our findings also have implications in terms of the relationship between uncertainty and digital transformation. Although extant literature argues that uncertainty exists in organizational transformation it primarily focuses on the lack of information on competitors' behaviours, constant changes in customer preferences and demand and the ever-changing nature of digital technologies. Our paper contributes to these studies by providing an in-depth understanding of digital transformation amidst uncertainty in the form of a 'black swan' event that entails severe consequences on both the economic and social sphere. As shown in our empirical analysis and discussion so far, the uncertainty caused by the pandemic catalysed digital transformation in our case setting. It supported radical and rapid changes in multiple organizational dimensions and triggered complex interactions between social and technical factors that were constitutively entangled. Therefore, although extant literature has primarily dwelled on the negative connotations of the notion of uncertainty, emphasizes its harmful effects and organizations' efforts to reduce it, we instead highlight the enabling power of uncertainty that cultivated fertile ground for digital transformation to manifest. Last, our paper contributes to the digital transformation literature in the context of higher education. While extant research provides useful insight on the implications of digitalization in, he amidst uncertainty, we provide a comprehensive understanding of how multiple technologies underpin digital transformation and can transfigure business processes, strategy and culture in a HE institution. Our findings show that, despite the uncertainty caused by the pandemic, academia was able to continue its operations by conjugating multiple technologies and fundamentally changing its overall business infrastructure. Therefore, in our case study site, we noticed that no individual technology, department or organizational champion could lead all the changes required for digital transformation. On the contrary, we propose that, in empirical settings like ours, a fundamental shift is needed towards a more collaborative, participative mindset and a shared sense of mission across all business functions for achieving digital transformation [13].

Practices for implications: The insight gained from our study also has implications for practitioners who face the challenge of managing digital transformation in highly dynamic, complex, and uncertain conditions. According to the World Health Organization 2020, the COVID-19 pandemic may be the latest worldwide health crisis but not the last. It is one of many global challenges and crises that imbue uncertainty and have severe financial, social, and organizational consequences, such as climate change and the energy crisis, natural disasters, financial recessions, and geopolitical conflicts. This paper serves as a foundation for informing our understanding, as well as future studies, of digital transformation highlighting possible ways for organizations to continue their operations by capitalizing upon the benefits of digital technology in times of crises. Finally, in our paper, uncertainty accelerated rather than obstructed digital transformation. Our findings highlight three potential mechanisms that indicate how organizations with similar characteristics. e.g., similar digital maturity, socioeconomic background, and subject to policy regulations, can deal with uncertainty *via* exploring the spectrum of functionalities within existing digital technologies and exploiting their inherent re-programmable and reconfigurable nature. Therefore, when the complete disruption of an organization's operations is not possible, our paper suggests that digital transformation, *via* the conjugation of multiple digital technologies, may help knowledge-intensive organizations avoid drastic measures, e.g., staff dismissal, selling of assets, to mitigate uncertainty, loss of revenue, and eventually stay afloat [14].

Alignment and Availability of Digital Resources (AADR)

The education stream started in the 1990's with university and course web pages, which gradually were standardized. Around 2005 the first LMS was introduced, but only partly adopted and never liked much by the students. A new LMS, Canvas, was introduced ten years later, slightly more successful. Although promising, these technologies were used only to a limited degree, especially in particular online universities around the world. In most of the universities, education was primarily conducted in physical locations. The digital subjects' stream emerged bottom-up, as different disciplines developed digital solutions. Several of the STEM disciplines, such as physics, chemistry and mathematics, started digitizing their data in the 1980s, some of them (for instance meteorology) even earlier. However, around 2010 something new emerged, the disciplines became more data-oriented and algorithm-oriented. An example from biology illustrates this; biology students used to go for walks in the woods to collect and analyse plants. Today they (unfortunately, some might think) sit in the lab, programming gene sequencing in Python. At the University of Oslo, several subjects were digitalized in this period. Within the faculty of medicine, the section for medical informatics was appointed to

develop and implement a large e-learning package for medicine students. The initiative arose partly to experiment with new teaching forms, and partly to satisfy students' expectations of digital resources as a part of the learning process. A unit called section for medical informatics was appointed by the faculty to implement an e-learning system. Approximately 150.000 Euro is allotted annually to these projects. "The initiative does not come from the departments, but from the ground floor the teachers. We try to involve students in all projects their view is important because the product is for them, but students are usually far more than "viewers" they often produce most of the resources under the guidance of teachers." Even if the faculty of law has a long history of digitalization, a more systematic approach to digitalisation of subjects had to wait until 2000 when Lov data was implemented. Lovdata had functionality for looking up sources of law, but the system use was limited and the digitalization of the subject was slow. Physical books were still dominating in education, research and examination until 2017 when a new version of Lovdata was implemented in full-scale teaching. At the faculty of humanities, some researchers collaborated with the national library to create extensive digital corpuses to enable effective searching in vast amounts of data. It is especially the studies of modern history that were changed as a result. The change lies primarily in the fact that the availability of extensive amounts of data from newspapers, journals, books and research material enables a change of focus from concentrating on canonical texts to gaining an overview of lesser-known stories and their impact at the time. Technically, the development of digital subjects implied that boundary resources, *i.e.*, API and other mechanisms for integration and digital interaction had to be developed. E-learning in medicine implied that physical resources were made digital and that APIs were used to implement this as a web solution (the e-learning portal). At the faculty of law, APIs were developed to enable use of digital legal sources and by linking these sources to a specific case in Lov data. In the digital humanities, students could use digital corpuses that enabled extensive identification of digital sources [15].

Digital library initiatives

Many massive libraries throughout the world started digitizing their materials in early 90's. The idea of digital libraries in India began within the mid-1990's with the unfold of knowledge technology, the web and therefore the support of the Central Government. In 1996, this idea was recognized throughout the conference on digital libraries organized by the society of information science at Bangalore. Though several libraries have created earlier considering this direction, the digital library initiative in India remains at developing stage. Majority of the digital library initiatives were mostly confined to restricted uses like subscribing to e-joumals, scanning documents and putting in them on the computer network. However there is requirement for speedy amendment during this situation of libraries in India to use the Information Technology (IT) and ICTs that area unit confined thus far to the celebrated national institutes like the Indian Institutes of Technology (UT), Indian Institutes of Management (JIM), Indian Institutes of Science (IJS) analysis however, it's evident from the initiatives taken thus far during this direction that the nice potential of ICTs for developing digital libraries has not nonetheless been totally used. As of now the Indian digital library initiatives are concentrated on academic and research oriented. Though some useful resources are available, but they are not on large scale. These initiatives are done separately without any coordination with similar institutions. It has been observed that many of the initiatives are only one-time projects having a limited grant and without any proper planning for future growth. Important issues like project objectives, preservation methods, content selection, development and coordination with similar institutions.

Alignment of Education and Digital Subjects (AEDS)

The situation was dramatically changed with the COVID-19 lock-down in Norway in March 2020. The university closed immediately and a central task group of deans and the CIO made the necessary arrangements for digital classrooms may be zoom and teams, access and security mechanisms and online support. Within one week, the whole university operated as a digital organization, with teachers in home offices and students in campus lodgings or home at their parents. One expert informant commented "Most teachers responded by a combination of online and pre-recorded lectures on zoom. Only a few teachers felt that they were overwhelmed by technology and reported that they were unable to lecture this way. The students have responded relatively positively, accepting the situation and participating online. We do, however, know much less about the students that do not turn up in the zoom lectures and we worry that some of them give up." Then a process of improvisation and experimentation started, with teachers and students in new roles. We interpret this development as the alignment of the two streams, *i.e.*, the educational and digital subjects streams met in the digital learning space. Even though most of the teachers were able to produce lectures online, the subjects that had already established building blocks for alignment between education and subject had some advantages. We use three examples from law, medicine and humanities. After 2017, Lovdata is not only used to educate law students but also to digitalize the subject. Lovdata has functionality to link digital references within the system. The use of colors and drawings is comparable to previous paper aids but contributes by referring to related sources of law *via* links. This makes the use of the digital system dynamic and practical. During the semester, the students configure their Lovdata profile with knowledgeable resources and may use this configuration on the exam. The system also checks what comments and references that may be accessed on the digital exam. The learning outcome for the student is according to the dean of education, substantial. "The practice changes the subject. Earlier the student used learning tools no one controlled, there was no clear learning strategy and the preparation work (done through the semester) was not awarded. Now the practice of law is done more correctly, with less focus on memorizing and more reward given to use of juridical method through the semester. Even if the exam becomes a search competition, which rewards the nerds, the work done through the semester is rewarded. From autumn 2019, Lovdata is used in all compulsory subjects in the law

study, as well as Norwegian courses (some courses like criminology, as well as optional courses with other challenges that do not have an equally urgent need for legislative data, will not use it). At the end of 2019, 70 courses and about 4500 students used Lovdata in the educational process as well as the exam. Since Lovdata is required for the exam, the students will also use it throughout the semester. This also meant that physical books became redundant. The last book was printed in 2018. The digitalization of sources of law can be further expanded to include machine learning and artificial intelligence. The strategy has met some criticism. A person said, "It is a shame if the legal faculty is in the lead to tearing down the symbol of the Norwegian state of law". A second example is e-learning in medicine which not only improves education by enabling self-study for students through digital resources but also digitalizes the subject. This applies to images, such as X-rays, eye diseases, skin diseases and sound, for example, auscultation training. Furthermore, movies are used for case histories, e.g. in psychiatry and clinical communication and procedure visualization. Animation can be used to visualize process dynamics such as physiology and disease processes and simulation helps to understand the processes and consequences of interventions. Thus, both practical and cognitive skills are developed technology is used to "link together material in learning hierarchies so that one can go seamlessly from overview learning to in-depth learning." "Through e-learning fragmented disciplines can get virtual homes that bind the fragments together in an integrated presentation. E-learning is also used for student activating teaching using virtual patients and interactive quizzes. These many facets make e-learning an integrated knowledge system." Based on this, we can say that e-learning also digitalizes the subject. Resources within the portal were also integrated with examination systems like question mark perception and inspera. The e-learning portal, thus, has become a communication channel for subject-related digitalization in teaching, as a central part of a blended learning approach. A third example is from the humanities. Some subject areas within humanities-like history of ideas-have historically been occupied with identifying and understanding historical periods as well as their cultural thoughts and drivers. Examples are the renaissance, the enlightenment and romanticism. Researchers have then investigated canonical thinkers and thoughts within these periods. Digitalization projects that digitize manual newspapers and books improve the accessibility to popular literature. An example of such an initiative is the National Library in Norway that systematically digitizes its entire collection. Researchers then create digital corpuses by using algorithms. These corpuses can be used to search in large databases. "We collaborate with the national library as part of the research and education. NL digitizes the entire Norwegian text corpus and this provides enormous opportunities. At the same time, tools are needed to systematize access to these extensive amounts of data." "We are working with a researcher at the national library to improve access and research opportunities and he has been involved in several projects we develop at the university." "NB has as a part of the extensive digitalization efforts developed a national infrastructure for language technology where you can develop more specific searches. An example is N-Gram, which is a sophisticated structure that enables searching in more structured text sets. Doctoral degrees have been written where this technique is used and internationally there is an environment for this." This example demonstrates how huge amounts of digitized material can be seen as an important source for education and research. It also shows that it is necessary to create algorithms that structure the searches in such extensive amounts of data. The data provides access to a comprehensive amount of unknown data, which can potentially change the subject's perspective. The three examples show that the digitalization efforts are both educational and a part of the digitalization of the subject. It also demonstrates the alignment between these two processes. New educational practices and digital subjects may lead to institutionalization, which we describe next [16].

Institutionalization in a Shared Digital Space (ISDS)

In the spring of 2021, the end of the pandemic was still uncertain, as were the long-term effects of digital experiences. In a nationwide survey, 71% of the Norwegian students replied that the learning outcome was poorer and that 50% felt lonely. Also, 71% felt that the amount of education had been reduced after the lockdown in March 2020, with large variations between institutions. In poorer countries, where Internet access is scarcer, the outcomes were notably worse. These numbers illustrate, not surprisingly, that the social aspects of both structured education and student life play an important role and were greatly missed. However, in another survey, UiO collected data from 9450 students and found that even if the students felt that the quality of teaching went down; their actual progress was not hampered. On the optimistic side, there were signs that some aspects were in the process of being institutionalized. Our findings indicate some changes that might be lasting. After the convergence of the two streams, teaching and digital subjects will continue as separate processes, but they will be integrated into the digital learning spaces. A key aspect of institutionalization is the emergence of a digital learning space. An example is from education in programming. The digital learning space consisted of both logistical elements such as video conference and digital subjects, such as programming lessons and data analysis. One of the informants, however, commented "This digital classroom consists of many elements; it is zoom and canvas and discussion forums and exercises and data, video clips and simulations. These elements are not integrated, which means that the students have to integrate them. This is not optimal and I spend considerable time trying to mitigate this. One of the challenges for the students is that the mix of technologies and procedures vary, depending on the subject and the teacher." A more mature example of a digital learning space, however, is from the faculty of law. The digital courtroom is a comprehensive digital platform for legal learning that includes various stakeholders like students, teachers, law firms, court administration and judges. This means that Lovdata and other digital resources are embedded in a major reorganization of both the education and the subject. The institutionalization of Lovdata in teaching means that the student acquires more digital skills as an integral part of knowledge development.

Digital courtroom: Digital courtroom institutionalizes digital practices at the faculty of law. We may regard the digital

courtroom as an ecosystem where several stakeholders like students, teachers, law firms, court administration, judges and the university administration can interact regularly through sharing experiences and collaborating on knowledge creation. The digital courtroom is an educational ecosystem that "enable students to learn by conducting digital proceedings, preparing and handling court documents and perform other actions required in dispute resolution exercises" said one informant. It provides several digital offerings that facilitate deep experiential learning. This is done by facilitating the use of and experimentation with digital resources that can be used in legal practice. It also facilitates new forms of investigation by using modern technologies such as artificial intelligence and machine learning. Pedagogically, the digital courtroom can be used for identifying new teaching methods and research-based education. Within medicine, the e-learning portal is a central part of blended learning practice and a pioneer in identifying how medical objects can be digitalized. The introduction of e-learning in medicine entails a more dynamic organization of teaching that includes the use of digital resources in blended learning. E-learning is anchored in professional environments. An example is from pathology where they closed the physical labs and used digital images accessible within the e-learning solution. The solution is integrated into the teaching and is especially popular as exam preparations. The expert lecturer commented "A couple of days ago, one of our retired teachers held a course for medical students under the auspices of the students themselves on ECG. The teacher has just developed a large e-learning resource about ECG which he used and advertised for. In the days before the course, the use was almost zero (it was shortly after Easter). The day after the course, there were 1000 side hits on the resource." Within the digital humanities, the digital corpus similarly brings forward new institutional practices to conduct education and research. This facilitates the creation of new educational methods where students can learn to use language banks and similar to develop precise search engines. This practice potentially changes the object of teaching and research from the occupation of canonical texts and thinkers, towards "the great unread". This transition may facilitate more contextual insights into thought streams and ideas in particular historical periods. A new service is quantitative analyses of media references, provided by the national library.

The Alignment of Dual Digitalization (ADD)

In the previous section, we showed how the alignment of the two digitalization streams enabled the emergence of a digital learning space, allowing students and teachers to interact relatively seamlessly.

We have analysed this process as an evolving digital infrastructure, where technical and social elements interact and integrate. We see the evolution as a combination of bottom-up processes, where subjects are gradually digitalized by internal actors and top- down processes where strategic and logistical needs are served by larger and shared solutions. This balance of centralized governance and local autonomy is in tune with the modern university configuration. The alignment does not merge the two streams, but rather integrates them, as from our findings are Lovdata, which both address educational purposes, while at the same time digitalize the subject of law. Lovdata is primarily part of a top-down strategy from the faculty but is integrated with an emergent bottom-up tendency primarily driven by subject development. Another example is e-learning at the faculty of medicine. E-learning is part of a faculty strategy to facilitate educational activities through a blended learning approach. Simultaneously, however, the activity also digitalizes the subject of medicine. For e-learning to be an effective strategy it needs to be anchored to bottom-up activities emerging within each subject area. Our last example came from digital humanities. Within this area, former hard copies of newspapers, books and other types of articles were digitalized and made accessible through a large database at the national library. To enable searching in these big data, sophisticated search engines like N-gram were developed. Digital humanities are the result of a combination of a top-down strategy where huge amounts of "physical data" are digitalized and a bottom-up digitalization of the subject. It is important to realize that the digital learning space is enabled by a large digital infrastructure, *i.e.*, the interconnected systems and networks of the university and other internet resources. Research has shown that a modularized digital infrastructure offers rich opportunities for continued innovation, through recombination. This enables continuous innovation of new affordances.

In our case, the alignment of the dual streams of digitalization made many new recombinations possible, such as the digital courtroom and other innovations. The digital learning space is not a predefined solution and it is not one space, but many. Bomsdorf used the term plasticity to describe the ability of a digital learning space to retain suitability for learning in different, changing contexts. The redefinitions of roles the technical solutions are enabling the digital learning space, but it must be enacted by students and teachers. As our University of Oslo case shows, the intense experimentation during the COVID-19 crisis changed some old-age practices. Pedagogically, it offers the opportunity to experiment with new learning forms, such as new roles for teachers and students, exploration of large volumes of data and the involvement of actors outside the university. It is illuminating to describe this development as a redefinition of roles. The traditional 2 × 45 minutes lecture becomes less central and is being replaced by shorter, often pre-recorded video sessions as part of the teaching trajectory. With so many digital resources at hand, the role of the teacher will be less direct teaching and more as a facilitator of resources. The teacher's role involves designing and monitoring activities over time. Lectures (long or short) are only one activity that matters; to facilitate the students' learning trajectory teachers need access to new types of data, such as student engagement with digital sources. We showed in our study how Lovdata, at the faculty of Law, facilitated self-learning activities amongst the students. By using and configuring Lovdata during the semester students improved their digital competency and teachers can concentrate on cultivating the most challenging issues. We also showed, from medicine, where the e-learning platform became a blended learning solution that relieved some of the work burdens of the professors. The e-learning solution is also facilitating the transition towards a more flexible educational situation, where

resources can be orchestrated for educational purposes. In the same line, within digital humanities, the digitalized corpus at the national library facilitates a transition towards new forms of educational interaction, where students maintained the ability to interpret texts, while also learning to create sophisticated search engines. This may also imply that additional teaching resources with particular digital competencies can be drawn upon. These examples are in line with predictions of the digital organization. However, we fully agree with Dick et al., who observed that the increased dependence on online platforms for course management and video conferencing requires these systems to be as seamless and inclusive as possible and added, the environment in which online classes are offered must be robust enough to be seen to equal that provided face-to-face. The data streams must be tailored for the teachers' tasks. The campus is changing from a physical location to a hybrid, where the digital learning space will be a permanent feature. The consequences of this remain to be seen, but perhaps the social arenas and personal supervision will be the key affordances of the physical campus. Also, the increased access to algorithms and data is changing most subjects, in various ways, even redefining the domain. The increased importance of data may also indicate that data science is developing into a foundational discipline. Transcending organizational borders organisationally, there is not one digital learning space, but many and they intersect with hybrid and physical spaces. In pursuing knowledge, a student may move from a lecture to wikipedia to an international discussion group on social media and to an industry webinar-all rather effortless. Several researchers have argued that the future university should include actors outside the university in the teaching and learning processes. A compelling example of transcending organizational borders is the digital courtroom of the faculty of law, a solution described in the previous section. The digital courtroom is an ecosystem where several stakeholders can interact in a simulated environment. Students and teachers can enact roles as barrister, judge and defendant. However, this solution also allows for participation from law firms, court administration and judges, for instance in assessing the interpretation of new laws or new court proceedings. The opportunities illustrate that the digital learning space enables new forms of knowledge development, including new actors outside the academic institution.

Cybergogical implications

Convenient and flexible: The respondents interpreted e-learning as flexible and convenient to use. Students can access their instructional materials using an e-learning platform and study anytime, anywhere using any digital device. Furthermore, e-learning gives students the element of control over time, place and pace of study.

Collaboration and interaction: These are available technology tools for the students and teachers to collaborate and interact with one another. This technology allows the students to 1) Independent learning such as learning the topic, submitting the activity/assignment and accomplishing their test; 2) Communicate and share their ideas and opinions by using different online platforms/peer-based resources; and 3) Received quick feedback to their teachers after completing a specific task.

Ease to use platform: The respondents highly accepted the non-traditional method of education, e-learning. The results illustrated that students were secure and confident in using e-learning because of its intuitive user interface. The e-learning platform simplifies student knowledge acquisition.

Personalized learning path: As online education supports the new curriculum and teaching strategies. Learning platforms can be modified according to the learner's convenience and make it easy for them to gather information. The survey results show that e-learning promoted learning autonomy and improved the students' knowledge after using e-learning platforms.

Review of related literature

Adnan Qayyum reported that education digitization indices are priorities for a given country. The pandemic stress-tested the digital index. Of the four indices, it seems that for many countries digital assets and digital labour have made the crucial difference in keeping education systems afloat. This should give pause to educators and decision-makers about the immense money and resources used to create, implement and research digital use. This is a major practice and research issue about digitization. There is no shortage of digital tools and resources for learning. There has been a shortage of resources for digital assets and digital labour. This suggests researchers must focus more on teacher-facing challenges and issues for digitization (e.g., what are best practices for faculty development; is outsourced instructional design a fair opportunity?). If digitization is to address access, cost and quality inequities revealed during the pandemic. Education researchers and practitioners will need focus on digital access and digital labour and not just digital use. The digital transformation is often portrayed as the future of education and is certainly well underway in many countries. At the very least, the pandemic has evinced that digitization is important during times of emergencies [17].

RK Toleubekova, RS Maussumbayev reported that methods of using digital technologies in the education system are a way of organizing a modern educational environment. Dynamically developing digital technologies offer new tools that effectively complement the traditional tools for the educational process, which many teachers quickly introduce into their methodological system and work with intensively. The use of digital educational resources provides fundamentally new opportunities for improving the efficiency of the educational process. Digital educational resources are an operational means of clarity in teaching, an assistant in working out practical skills of students, organizing and conducting questionnaires and monitoring students, as well as monitoring and evaluating homework; have a large place in working with diagrams, tables, graphs and symbols, editing texts and correcting errors in students' creative works. The goal of their research is to analyse the features of the application of methods of using digital technologies in the education system. Achieving this goal required setting and solving the following tasks to consider the essence of digital technologies in the education system, to determine the role and importance of effective digital technologies in the educational process, to study the practice of

using effective digital technologies, to develop proposals and recommendations for methodological improvement of the use of effective digital technologies in the education system. The researcher study about the social relations that develop in the process of applying digital technologies in the higher education system. The subject of the research mainly focused on adoption of digital technologies in the higher education system [18].

Gafurov, et al. reported that pedagogically and organisationally, our starting point is that universities should regard it, not as something completely new and different that can be bought or copied, but as solutions building on the existing structures and practices. We start our review with a brief overview of the digitalization of higher education, then we review the dual digitalization and use it to assess the challenges of establishing the digital learning space [19].

Dharshankumar Patel reported that he examines the emergence of digital and on-line learning environments and along with the reasons for its appearance. India becoming a global leader in information communication and technology along with domains like space. Quality education playing very important role in this transformation and technology itself playing an important role in the improvement of educational processes and outcomes. The recent advancement of wireless net and mobile communications devices has provided exceptional opportunities for 21st century mixed learning models along with on-line and face-to-face learning. In response to those developments, several innovative learning environments has been trailed at various platform. The potential of technology enabled teaching, will facilitate us in establishing the knowledge society, which in turn will help us in improving our GDP and nation growth. Our educational institutions were built in line with industrial era rather than a digital era. Thus, teachers and students are faced with a massive challenge of change. Applicable integration of technology into all levels of education to support teacher preparation and development, improve teaching, learning and analysis processes, enhance instructional access to deprived groups and streamline educational planning, administration and management. Since technological changing very rapidly, it is essential to find out key technology trends to identify ways in which education can leverage not just current technologies but emerging technologies as well [10].

Research methodology

To meet the objectives of this research, survey methodology was used to process the data. According to the relevance following elements, author profile, purpose, acceptance to use digital educational online resources and platforms, awareness of online learning systems, awareness of teaching techniques, retrieval of digital information, usage to promote the digital education systems, uploading of documents (text, scanned, photos, other types), hosted or publication information, web hosting details has been adapted to analyse and evaluated to find the result. There are 93 research articles are cited by the researchers related to the digital education systems and its various function starting from 2010 to 2023. The researcher revels that majority of the articles related to the digital higher education systems of online teaching and learning, and its management regarded. 85% of articles only related to the digital higher education system for online teaching learning methods.

Need for the study

The digital higher education or online teaching learning systems are enabled to provide better service to the student's community. The study observed that few considerable types of points mentioned below.

- To know the different types of technical requirement used by the user community.
- To know the majority reputed demanded zoom facilities utilised by the users.
- To know the interest of utilising digital environment for teaching learning.
- To know the copyrights, copyleft act basic rules.
- To know about the cybercrime rules of information transformations within group.
- To know the speedy recovery of information and its selection of online resources.
- To know the key data and web portal facilities to learn specific subject related information related to their research or studies.
- To know the specific time, spend on the digital environments.
- To encourage co-operative efforts to save and share the online portal details and its related resources and various function and structure of digital education system.
- To know the advantages of digital education systems for teaching learning.
- Analysed the purpose of using this digital education policy programme and Importance of the online facilities providing by the national or state government aims.
- To promote efficient delivery to the students and researcher for their educational growth and future development.
- To know other future requirement for digital educational systems to utilize for online teaching learning facilities to the user categories and experts' feedback to add new IT facilities for development.

Objective of the study

In this study, the following hypotheses have been framed. Students and research scholars or technical students are interested to using online or digital teaching facilities. Research scholar are utilizing digital environmental facilities for teaching and electronic resources related to their educational curriculum and research related. The experience professional is eager to using digital environmental facilities for digital education system of teaching and learning. The teaching faculty only feared about their job security. They are situated with the base of economic factors which helps to their lively hood live to eat. The research experts cited relevant articles related to their research works. The resource person cited and downloaded full text articles for their future references which are interrelated with digital education systems and online teaching learning facilities around the world platform. Majority of the professional recommended to promote digital higher education system of online teaching learning programme facility to the school students to university researcher. It is the teaching and research activities for feature generation networks of high resolution and computer

programming of on-line accessing, programming, preserving, retrieving process of the digital learning system and retrieve digital resource through digitized data centres.

Data analysis and hypothesis formation

The researcher cited 93 documents out of 79 research papers, which has been published in various site for the purpose of feature innovative services. Out of 93 research publications, 85% of the author or researchers studied about digital education systems and them given assurance for digital education systems for higher educational research and its features to retrieval of information form digital resources. 15% research publications only related with school and technical education systems. Majority of the studies are done and utilized for the creation of digital and IT related technical tools for new formation of teaching learning. The digital resources and digital libraries are the backbone for every digital base innovation to discover new ideas for future. From this study, researcher analysed null hypothesis, digital education system has more future and deliver the respective information at any time for speedy recovery to fulfil the students, researchers demand at the end (Figures 11-16) [19].

Innovative digital pedagogical models and Improvement in India

Digital technology and practices for school improvement: Teachers need for support and training of digital technology.

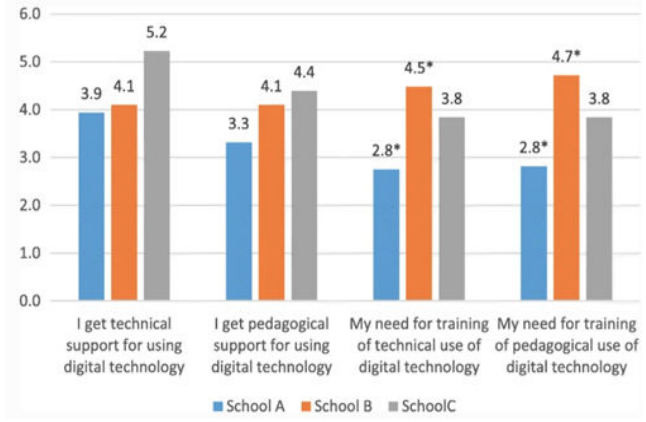

Figure 11: Digital technology and practices for school improvement.

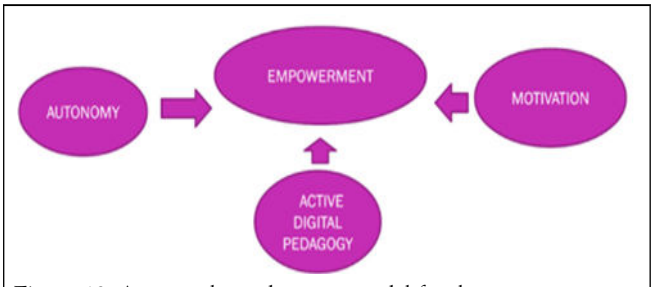

Figure 12: Active online education model for the empowerment of university students.

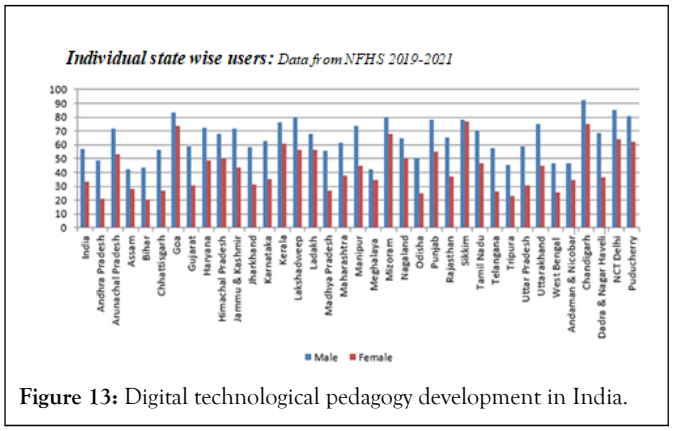

Figure 13: Digital technological pedagogy development in India.

Figure 14: Individual rural and urban state wise users data from NFHS 2019-2021.

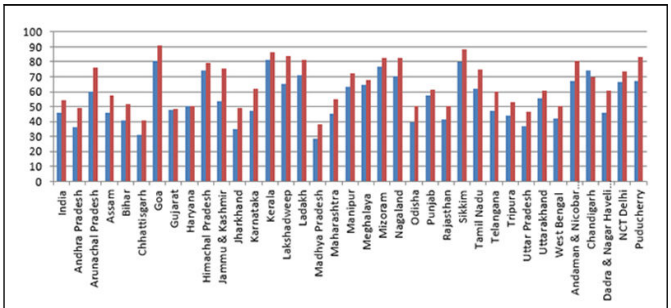

Figure 15: Growth between 2015-2021 state wise women beneficiaries data from NFHS 2019-2021.

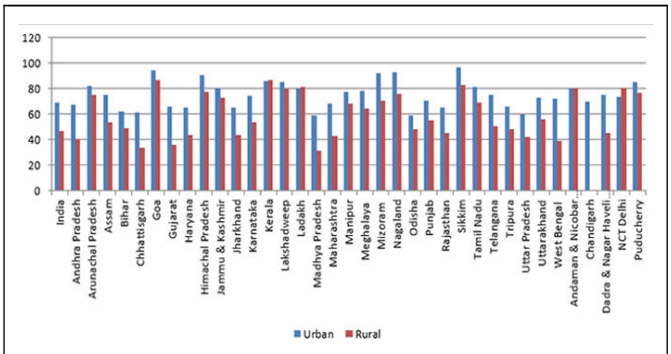

Figure 16: Digital pedagogical growth between women researchers data from NFHS 2019-2021.

Recommendation for future research and limitation

Our research also comes with limitations. First, the study builds on a single case study, where the type of insights generated should be seen as causal tendencies rather than certainties. Therefore, the findings reported in the paper are constrained to a degree by this choice. However, this limitation of our typical, single case setting cannot be avoided in an explanatory investigation of a nascent area such as the one studied here. Second, although our findings identify three mechanisms through which our case study organization accelerated its digital transformation amid uncertainty, we do not argue that our identified mechanisms are exhaustive, all encompassing, or applicable to any setting. Our in-depth investigation focuses on a case study site with specific characteristics in terms of its internal and external environment. Therefore, the insights generated do not aim to generalize for every public or private organization or for organizations based in developing nations. Future work, such as comparative studies that embark on cross-examination opportunities, may explore possible variations in how digital transformation is instantiated in different settings and clarify whether our identified mechanisms underpinning digital transformation may be different or applicable in other organizations [20].

Online learning content preparation and presentation tools: The advent of online learning has been a shock to some folks. Flexibility may be an immense issue. The administration might have courses tutored face-to-face, online or hybrid to fulfill the requirement of the establishment, the department, the college and the scholars. The technological demands of a web course will produce chaos for school and students alike. Technology enabled learning is evolved through a mixture of hardware, software, media delivery system and communication systems together with networking. Some of the tool's comparison is given below from which we can get to understand which platform is feasible as well as suitable for our teaching methodology and accessibility of network.

For other future research: We must mention that the proposed robot has no cognitive skills and cannot guarantee the successful performance of tasks in exceptional situations, such as, for example, weak, inconsistent data. However, with significant recent technological advances, including the AI revolution, processes that can be automated with RPA (Robotic Process Automation) technology can help Higher Education (HE) will be less limited by the quality and consistency of input data. Combining the robotic process automation strategy with the power of intelligent technologies marked the beginning of the age of intelligent automation. Artificial intelligence and related new technologies, including machine learning, data analytics, computer vision, cognitive automation, brings great intelligence and decision making to the RPA moving it to a higher level and enabling so-called cognitive RPA. This mix enables a wider digital transformation.

Types of E-learning or online learning methods

Asynchronous methods: Asynchronous which suggests "not at an equivalent time" allows the participant to finish the Web Based Training (WBT) at his own pace, without live interaction with the trainer.

Synchronous methods: Synchronous means "at an equivalent time," involves interaction of participant with a teacher *via* the online in real time.

Blended method: A new sort of learning referred to as blended learning is emerging. It is combination of synchronous and asynchronous learning methods. Most companies prefer better to use a mixture of both synchronous and asynchronous online learning methods consistent with their requirement.

Future of online and digital education system in India

India incorporates a major role to play within the international online learning services trade. It's already one amongst the leading IT service supplier countries and it's currently reaching to come through identical position within the IT enabled services. On the domestic front, the govt. and personal sectors have taken several online learning initiatives. Though' these initiatives are met with loads of enthusiasm and user acceptance, their industrial viability remains into consideration. The govt. has been taking some proactive measures in a very regulative and monetary capability to spice up the online learning atmosphere in India. Funds are invested with in putting in place web in rural areas for the aim of communication, which might be used for online learning initiative additionally and might facilitate in providing informal and vocational education additionally as formal education. Several models for the creation of code for education exist, ranging from code platforms like SWAYAM commissioned by the MHRD to be utilized by the full country, to applications and code developed and tested by tutorial institutions like UT. Some of the recent Indian solutions or platforms for facilitating computer assisted learning are SWAYAM, SAKSHAT and Virtual Lab, NPTEL (National Project on Technology Enabled Learning), EDUSAT based network AVIEW virtual classrooms etc. Many other such resources are available online. Many youtube channels deliver specific content. A teacher can create his own channel on youtube.

Challenges faced in digital and online education in India-a glance

COVID-19 pandemic has forced us to shift from the classroom system to online mode for several educational institutes across the world. In India, most of students are facing difficulties in remotely attending the online lectures due to unreliable and intermittent electricity connection, internet connectivity and non-availability of mobile/laptop to attend lectures. Since technological modification is speedy, it's essential to acknowledge key technology trends to spot ways in which during which education will leverage not simply current technologies however rising technologies likewise. In sight of those trends, it is very important that their implications for infrastructure, end-user hardware, code development, preparation and information. The use of technology in education is likely to require investment in basic infrastructure such as electricity, hardware

and connectivity. The bulk of schools and colleges in remote and rural areas do not have access to the basics like electricity, hardware and reliable connectivity and government must ensure that this situation is sorted out at the earliest. With regards to enduser hardware, it is important to draw a distinction between institutional devices such as desktop computers, classroom projectors, Wi-Fi routers and personal devices such as smartphones and laptops. A key area of concern is the shortage of local expertise to help and maintain all the necessary hardware and software at these locations. The price for hiring trained IT staff, at school complexes for instance, must be provided as and when it required. However, this effort can be complemented by providing trained local youth, either engineers or those with adequate technical training in hardware and software. Most of the population staying in rural areas and creating them privy to the idea of on-line leaming may be a major challenge. Lack of infrastructure in terms of property, accessibility of net, etc. is another issue. The govt. is taking varied measures to boost the communication systems and new technologies like 3G within the medium area have already begun to be enforced to create things higher. Social implications of elearning square measure another phase of study that's vital to be understood for the success of e-learning in Asian country. The social implications of e-learning could also be classified into the subsequent forms of issues: Cultural, gender, lifestyle, geographical, religious/spiritual, literacy, disabilities and digital divide. Among the cultural problems of the class square measure content, multimedia, writing designs, writing structures, web design and participant roles. Some content, though crucial to the course, could also be either unacceptable or unfavourable with bound members of the category.

CONCLUSION

Digital transformation is an inevitable process in the current context, leading to the need to "transform" into a new state for high schools globally, including developed and developing countries high schools, colleges, research institutes and universities. This change in global level innovative centres is planned and should take place over a certain period. Educational institutions and universities need to have teachers' readiness for change to be able to navigate this transformation successfully. The research has partly described the reality of the readiness of global level schools from the teacher's viewpoints. In addition, the data analysis results have shown the correlation between change valences and the higher educational institutions and universities are readiness for implement digital transformation. In this study, the research results on the correlation between information assessment factors from the high schools' readiness for digital transformation have shown a difference compared to previous studies' results. These discoveries provide useful information for teachers, school leaders and administrators, as well as researchers in organisational development and organisational change on issues related to changes of educational institutions for implementing digital transformation. For teachers, these results help them to know that in order for the school to be ready to change for digital transformation, the change commitment, the awareness of the values or interests of digital transformation and the clear understanding of tasks and resources to implement digital transformation in school and college activities play a decisive role. From the teacher's point of view from the school's itself to research centres and university level educational systems are be readiness for digital transformation, school leaders and administrators have helpful information to be able to come up with fundamental solutions to minimise the resistance of the teaching staff in particular, the entire staff of the school in general to help to create a solid foundation for implementing digital transformation. These solutions need to be developed into specific plans with appropriate action plans to ensure the successful implementation from the school's changes up to university levels towards digital transformation. For researchers in this field, the study findings are valuable empirical evidence that they can expand or deepen their studies on organisational readiness for digital transformation and contexts that require similar change and examine and explore the correlation among elements of organisational readiness with each other and its influencing factors. Although the study made some significant explores, it still has some limitations. First, with the use of the convenience sampling method, the study lacks clear generalisability. Second, the research focus on from higher educational studies to university researcher study level and its specific studies on a number of higher education and research innovative studies with different characteristics, such as regions and the percentage of ethnic minorities, to be able to provide a more comprehensive view of the global digital educational systems starting from high schools' to research and innovative studies up to university levels' readiness for digital transformation. Third, the survey subjects were only teachers, while in the school, colleges, innovative centres, university research programmes levels' there were also non-teaching staff and leaders/managers, who also played a critical role in organisational change. These are also suggestions so that future studies will be conducted with a more comprehensive and larger sample size with a more reliable sampling method.

AUTHOR CONSENT

As per international standard for school education systems to higher education board or university standard, participants' written consent has been collected and preserved by the author.

ETHICS APPROVAL

Authors hereby declare that all experiments have been examined and approved by the appropriate ethics and have therefore been performed in accordance with the Helsinki ethical standards have been adopted for these studies.

ACKNOWLEDGEMENTS

The paper is the product of the citation base desk study on the topic "Global Digital Transformation of Higher Education: Vision 2050" New Innovative Digital Pedagogical models and Improvement in India: A Comparative Research" measure the basic needs and technical details, methods want to adopt, measurement, recommendation and types of digital education systems, readiness for digital transformation at general school

education system to higher education institutions at all over the world.

REFERENCES

1. Weerawardane D. Digital transformation of higher education: What's next?. New Vistas. 2021;7(2):3-7.
2. Hasan A. Digital transformation in education amid of COVID-19. 2019.
3. Sansa NA. Analysis for the impact of the COVID-19 to the petrol price in China. SSRN Electron J. 2020.
4. Kang B. How the COVID-19 pandemic is reshaping the education service. 2021:15-36.
5. Bughin J, Deakin J, O'beirne B. Digital transformation: Improving the odds of success. McKinsey Quarterly. 2019;22:1-5.
6. Jacques S, Ouahabi A. Distance learning in higher education in France during the COVID-19 pandemic. chapter 4, European Liberal Forum asbl, 2021, p. 45.
7. Tran TG, Hoang TD. Readiness of Vietnamese High Schools for Digital Transformation and Its Influencing Factors: A Quantitative Study. Asian Res J Arts Soc Sci. 2022;157-171.
8. Bygstad B, Ovrelid E, Ludvigsen S, Dahlen M. From dual digitalization to digital learning space: Exploring the digital transformation of higher education. Comput Educ. 2022;182:104463.
9. Gafurov IR, Safiullin MR, Akhmetshin EM, Gapsalamov AR, Vasilev VL. Change of the higher education paradigm in the context of digital transformation: From resource management to access control. Int J High Educ. 2020;9(3):71-85.
10. Patel D. Digital online systems in India. 2020;10(1):75-80.
11. Lawson TJ. Teaching a social psychology course on the web. Teach Psychol. 2000;27(4):285-289.
12. Means B, Toyama Y, Murphy R, Bakia M, Jones K. Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. 2009.
13. Ridley DR. The 1998 assessment report on CNU on-line. Paper presented to the State Council of Higher Education for Virginia, Newport News, VA, 1998.
14. Ruttenberg A, Ruttenberg R. Railway Workers Hazardous Materials Tarining Program: Evaluation of On-line Eight-Hour Awareness Training Pilot. 2000.
15. Brolpito A. Digital skills and competence and digital and online learning. ETF. 2018.
16. Turcu CO, Turcu C. Accelerating digital transformation in higher education with Robotic Process Automation. Authorea Preprints. 2023.
17. R K Tolebekhova and R S Maussumbayev. Methods of using digital technologies in the education systems, 2021, p. 26.
18. Diaz-Noguera MD, Hervas-Gomez C, de la Calle-Cabrera AM, Lopez-Meneses E. Autonomy, motivation and digital pedagogy are key factors in the perceptions of Spanish higher-education students toward online learning during the COVID-19 pandemic. Int J Environ Res Public Health. 2022;19(2):654.
19. Ilomaki L, Lakkala M. Digital technology and practices for school improvement: innovative digital school model. Res Pract Technol Enhanc Learn. 2018;13(1):25.
20. Chandola B. Exploring India's digital divide. Observer Research Foundation. 2022.