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Higher Education in the Arab World

E-Learning and Distance Education

جامعة البترا

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Chief Editor
Adnan Badran
Chancellor Office
University of Petra
Amman, Jordan

Editors
Elias Baydoun
Department of Biology
American University of Beirut
Beirut, Lebanon

Sandra Hillman
Dundee, UK

Joelle Mesmar
Department of Biology
American University of Beirut
Beirut, Lebanon

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Introduction

Adnan Badran, Sandra Hillman, Joelle Mesmar, and Elias Baydoun

Abstract Although distance education and e-learning have been gaining momentum in the past few decades, it is the recent COVID-19 pandemic that has emphasized its importance and driven the education sector online. Ever since, the nature of distance education and e-learning has been changing and evolving more rapidly, as higher education institutions, staff, educators, and learners are embracing a new level of digital maturity. In parallel, the online learning ecosystem has also been growing considerably. Today, more and more organizations are taking up e-learning and distance education, in addition to embracing the blended learning approach, which is becoming increasingly popular. This book reflects on how higher education institutions in the Arab world have been adjusting to this new normal and looks onward into the future of higher education. The authors also discuss challenges in shaping the future of education, drawing on the changing needs of students, educators, and staff in the wake of the COVID-19 pandemic. Largely, Arab institutions need to rethink teaching and learning, redesign assessment, enhance student engagement, survey digital education tools and trends in tech-savvy education, address the digital disconnect and inclusive learning, and look into the future of research, among others, and develop a vision for the future of higher education in the Arab world.

Keywords Higher education · Arab universities · Online learning · Distance education · Learning technologies · COVID-19

A. Badran
Department of Basic Sciences, University of Petra, Amman, Jordan
e-mail: abadran@uop.edu.jo

S. Hillman
Dundee, Scotland, UK
e-mail: shillman@tiscali.co.uk

J. Mesmar · E. Baydoun (✉)
Department of Biology, American University of Beirut, Beirut, Lebanon
e-mail: eliasbay@aub.edu.lb

J. Mesmar
e-mail: jm104@aub.edu.lb

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Education is the key to personal prosperity and fulfillment, and a well-educated population is a necessity for a country to prosper in a competitive world. With a world population that continues to expand, it has never been more important to ensure that all individuals have access to, and know how to access, the collective knowledge of the human race. The written historical knowledge of individual countries should help those countries to avoid repeating mistakes made in the past and promote their understanding of other cultures and nations, indispensable prerequisites for world peace.

So how is knowledge, both theoretical and practical, best gained and passed on? How is progress made? At the most basic level, knowledge is gained by individual experimentation, watching what others do and copying, followed by remembering and giving verbal instruction to those wanting to learn. The advent of written records and instructions means that remembering facts is less important and allows for greater experimentation and modification of existing ideas. Thus, information is passed among individuals and down through generations until, today, there is so much recorded knowledge that no one person can hope to do more than skim the surface of the entirety and delve more deeply into a small area. Knowledge is still the pathway to success and prosperity, but how can this be passed to so many young people and do they need to remember everything they are taught, or is it just sufficient to know how to access and use data?

Throughout the world, the recent COVID-19 pandemic has focused minds on education, its paramount importance to young, and not so young, learners and the methods used to disseminate knowledge. This book is the sixth in the series on higher education in the Arab world, produced by the Arab Academy of Sciences and published by Springer Nature Switzerland AG. In the 17 chapters of this volume, the authors share their recent experiences of trying to maintain the higher education system during the pandemic when, due to lockdown, traditional face-to-face teaching methods were no longer available. Many of the problems described are applicable to colleges and universities throughout the world, but others are specific to these institutions in the Arab world and in developing countries. The solutions involve using existing technologies on a much greater scale than before the pandemic and building on those technologies to produce new programs and systems to solve the specific problems of learning at a distance, i.e., the emergence of electronic learning (e-learning) as the potential future method of bringing education to the masses.

In chapter "An Overview of E-Learning and Distance Education in the Higher Education Landscape: The Good, the Bad, and the Ugly" (*Mesmar* et al.), the authors give an account of the evolution of education from the earliest civilizations to the present day. They present an overview of e-learning and distance learning, defining the terms used to describe the various forms now encountered, and emphasizing the diversification of the teaching systems required to meet the future needs of countries trying to bring quality education to large populations, and also the necessity of catering to the needs of individuals.

The concept of pedagogical ecology, the basis of which is Gibson's theory of affordances, is introduced in chapter "The Pedagogical Ecology of Learning Technologies: A Learning Design Framework for Meaningful Online Learning" (*Dabbagh*).

The evolution of technologies from pre-internet to Web 3.0 allows the reinvention of learning programs to suit the needs of both the learner and society. A new framework for online learning is presented which is designed to initiate reform of education in the Arab world from a system based on memorizing facts to an enabling system fit to deal with the complexities of the twenty-first century.

The future of universities in the twenty-first century, is reviewed in chapter "The Future of the University: Outlook for a 21st Century Economy" (*Al-Chaer*) with emphasis on their transformation from primarily institutions of a nation state, often with narrow goals, to transnational corporations that are financially sound with a focus on the academic excellence necessary for the knowledge economy of the future. There is recognition that the disruption caused by the COVID-19 pandemic has altered priorities and forced changes that might not have previously been considered with any urgency, and the situation of universities in the Lebanon is discussed as an example. The importance of academic freedom and free speech in future university systems is emphasized, as is the idea of teaching with the needs of the individual learner in mind. With respect to the latter, the author sets out proposals for five institutional models that focus mainly on the various requirements of different learning types, thus improving the university experience and final learning outcome of individual students.

The authors of chapter "Distance Education: Is it any Longer a Paradigm of Choice? The University of Jordan—A Case Study" (*Obeidat* et al.) make the assertion that online learning is now a necessity, not just a matter of choice, if education is going to properly serve the societies and increasing number of students of the twenty-first century. They give an account of how the University of Jordan set about implementing the changes needed to take full advantage of the opportunities presented by the 4th industrial revolution.

The development of online learning in higher education in Arab states, particularly Sohar University in Oman, is documented in chapter "Delivery of Online and Blended-Learning Higher Education Programs in the Arab World: A Case Study from Sohar University in Oman" (*Al Fazari*). The reluctance of some states to accept qualifications from online courses is noted, as is the need to overcome this prejudice by assuring the academic quality and integrity of such programs. It is recognized that while traditional education has its benefits the future lies with online learning, particularly with blended learning courses, which combine the best of both worlds.

A flexible approach to e-learning is urged in chapter "A Flexible Blended Approach to Learning" (*McKellar* and *Barton*), in which the authors recount the experiences of the University of Hertfordshire, UK, during the pandemic. As a result of the development of an in-house virtual learning environment, StudyNet, over the previous decade, and the incorporation of an element of blended learning into most subjects, the university was able to adapt rapidly to teaching fully online during lockdown. Moreover, during the two years of restrictions, the university was able to improve on the existing system, with respect to staff training, assessment methods, and the needs of individual students. A flexible, blended learning system is seen as the basis for future learning at the university.

In chapter "E-Learning at the University of Petra during the COVID-19 Pandemic: Lessons and Recommendations", *Abdel-Rahmen* and *El-Khalili* recount their experience of implementing hybrid e-learning programs at the University of Petra, Jordan. They report the results of a study to determine the degree of student and teacher satisfaction with the courses provided, placing particular emphasis on the computer skills of the participants, access to the necessary hardware, teaching experience, student ages and study levels, and use the information to make recommendations to enable the transition from classical teaching to e-learning.

Mualla and *Mualla* (chapter "Interactive and Collaborative Distance Learning Approaches: A Decision-making Framework for Higher Education in Developing Countries") give an account of the impact of COVID-19 on higher education institutions in developed and developing countries, with particular reference to the experience in Syria where the Syrian Virtual University was especially successful because of its established digital teaching resources. Based on the experience of various universities worldwide, the authors set out a decision-making framework for the successful implementation of distance learning.

The digital divide between and within nations is brought into focus in chapter "Bridging the Digital Divide in Higher Education: North African Challenges and Initiatives" (*Benjelloun*). The specific problems encountered in North African nations, and the opportunities presented by e-learning and distance learning to reduce this gap, are presented in light of current rapid technological advancements and the ability of individuals to access this information.

The difficulties of converting traditional engineering courses, which involve practical skills, to effective online programs are considered in chapter "Hands-On E-Learning and Distance Education in Engineering: Wishful Thinking or a Practical Reality?" (*Zabalawi* et al.). The authors review the concept of engineering, past and present, and what is required for a successful online course in the future, with discussion of the challenges and attributes of e-learning. Based on their experiences at the Australian University in Kuwait, they put forward a detailed governance framework for online engineering education.

The importance of learning-management systems (LMSs) in the future of e-learning is discussed in chapter "Enhancing Collaborative and Self-Paced Learning in Traditional and Distance Education Settings" (*Ebbini*), based on the author's experience of their use in electrical and computer engineering. Emphasis is placed on the ability of LMS platforms to promote collaborative and self-paced learning, leading to student's becoming life-long learners. The case is made for a top-down approach to teaching, with appropriate levels of abstraction for complex subjects, as well as using demonstrations of real-life examples of systems to promote student interest and understanding. The inclusion of ethics in the teaching program is recommended to counteract the increased opportunity for plagiarism facilitated by e-learning.

The origins and development of online learning are reviewed in chapter "The Impact of Online Learning on Career Performance among Practitioner Engineers" (*Baytiyeh*) with special reference to the careers of practitioner engineers. A survey of postgraduate engineers taking the online ProGreen Diploma in Lebanon and Egypt was undertaken to determine the skills that were considered most important for professional development, among which independent learning was rated the highest.

The particular problems of distance teaching of courses with a practical element are raised in chapter "The Implementation of Online Medical Education in the Arab World" (*Dashash*) with a review of medical education in the Arab world with respect to the technological capabilities of different countries. It was noted that modern online technology could, in fact, be effective in medical training, and in promoting life-long learning, which is necessary in order for healthcare professionals to keep up to date with the latest research. High-tech simulations of virtual patients and live streaming of surgical procedures were deemed to be useful supplements to hands-on training, provided that the underlying technologies and teaching skills were in place.

Transnational education, its benefits and downsides, as well as the challenges of implementation, is scrutinized in chapter "Transnational Education and E-Learning" (*Arida*). The various models are described, as is the need for proper quality assurance and regulation by internationally recognized bodies to ensure that both students and employers have confidence in the final qualifications.

In chapter "Cognitive Presence as a Catalyst for Creating a Community of Inquiry in Online Learning in a Lebanese Higher-Education Context" (*Zgheib* et al.), the authors emphasize an inquiry-based approach to online teaching and learning. They present the results of a study of higher education in Lebanon carried out to determine the extent to which learners engage in their courses, as measured by their cognitive presence, which is important for the creation of a community of inquiry, the ultimate goal being to promote a more student-centered approach to all types of online learning.

A major area of concern during the switch to distance and e-learning during the pandemic was the effect of student isolation on their mental health. This problem is assessed and addressed in chapter "Beyond Digital Learning Modalities and Tools: Centering Learners' Socioemotional Wellbeing in the Context of E-Learning in the Arab Region" (*Al-Freih* and *Maha Bali*) in which the authors interviewed university educators from Egypt and Saudi Arabia to elicit their ideas on how to place the learner's emotional and social well-being at the center of the e-learning experience. It was agreed that to do this, educators needed to adjust their courses to promote student engagement and interaction and thereby build a sense of community and belonging. The use of new assessment practices and utilization of online technologies, such as breakout rooms, quizzes, and polls, is recommended.

The take-home message of the 17 chapters of this book appears to be that online teaching, in some form, is the future of higher education in the Arab world, enabling the massification of education and promoting the flexible life-long learning needed for the modern technological age. However, it is not sufficient just to transfer classroom-based courses online, especially where there is a practical element involved. Programs must be redesigned to promote teacher–student and student–student interactions to maintain student interest and prevent problems associated with student isolation. Not surprisingly, there needs to be substantial and forward-thinking investment in all aspects of online learning.

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An Overview of E-Learning and Distance Education in the Higher Education Landscape: The Good, the Bad, and the Ugly

Joelle Mesmar, Adnan Badran, and Elias Baydoun

Abstract E-learning and distance education have become part and parcel of higher education around the world. Despite the fact that these alternative approaches to conventional learning have become increasingly popular in the COVID-19 era, their prevalence in the higher education landscape dates back to the early twenty-first century and is associated with the increase in power, popularity, and affordability of personal computers and communication technologies. This overview chapter encompasses the main aspects of e-learning and distance education around the world with particular emphasis on the Arab world, addressing status, current challenges, and future roles in shaping higher education. More specifically, it starts with definitions of the terms used in the chapter, scoping the topic, and covers a global analysis of the evolution of education and online education, documenting tools used, trends, and prospects.

Keywords E-learning · Distance education · Digital learning · Online · Higher education · COVID-19 · Industrial revolution · Quality assurance

1 Introduction

"E-learning" and "distance education" are often used interchangeably, but they actually denote two separate notions. Briefly, e-learning is a style based on formal teaching that makes use of digital and electronic resources for instruction and assessment. Distance education, however, is a method of education; it is more about the

J. Mesmar (✉) · E. Baydoun
Department of Biology, American University of Beirut, Beirut, Lebanon
e-mail: jm104@aub.edu.lb

E. Baydoun
e-mail: eliasbay@aub.edu.lb

A. Badran
Department of Basic Sciences, University of Petra, Amman, Jordan
e-mail: abadran@uop.edu.jo

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physical separation between the learner and the instructor and is characterized by non-contiguous communication, often with technology bridging this gap. The aim of both methods is for the learner to enhance from his/her learning experience.

The main differences between e-learning and distance education are associated with: (1) the type of interaction between the student and educator; (2) the purpose of learning; and (3) the setting or how it is put into practice. In this context, e-learning is a style, whereas distance education is a method. In the former, the instructor and the students can be in a formal setting i.e., in a classroom, and online resources are used to complement the teaching. In the latter, the instructor and the student are physically separated, with no face-to-face interaction. This interaction is limited to correspondence by mail or electronically and through the internet. In fact, both e-learning and distance education have been greatly influenced by technology since the start of the twenty-first century, becoming an increasingly important aspect of the education process.

There are numerous other definitions, with slight nuances and technicalities. According to Britannica, "distance education", "distance learning", "e-learning", and "online learning" all have the same meaning. They refer to a form of education that is characterized by the physical separation between the teacher and students, and makes use of various technologies to facilitate communication between the various parties involved. In our view, distinguishing between "e-learning" and "distance education" is inconsequential. The inherent use of technology in all aspects of our lives, particularly regarding the access to information and its use in the educational process, narrows down the differences between these notions. In the context of this chapter, the term "digital learning" will be the comprehensive term employed, indicating an instructional approach that makes use of information and communication technology (ICT) to enhance and support the learning process. This can be: (1) *web-supplemented,* where the learning process is carried out in the classroom and supplemented by instructional activities, tools, and projects done on the web; (2) *online*, which allows the students to study entirely online; and (3) *mixed* in which case the online element replaces some of the classroom time. The different types of digital learning can also be described according to the instructional environment. Hence, learning can be *synchronous*, where the instructor and student interact online or simultaneously. But where there is no real-time interaction between the different parties involved, then the learning process is described as *asynchronous* and gives the students control over time and space, allowing them to work at their pace. Typically, the students are provided access to lectures, learning material, and homework at any time and are given a timeframe to complete the coursework. There is also *blended* learning, or hybrid learning, where the learning environment allows for both online communication and face-to-face on-campus interactions. These three types of learning environment allow for communication between the instructor and the student and encourage networking between classmates. However, the major advantage of synchronous and asynchronous learning over hybrid learning is the ability to attend classes from anywhere. This is particularly beneficial to students that need flexibility in times of disruption.

While digital learning is promising, there is no doubt that it also risky. COVID-19 has certainly exposed the good in the adoption of online practice in higher education, emphasizing its advantages, particularly in times of crisis. It has set new trends in education and highlighted the importance of flexibility and adaptability. However, it has also shown the bad in terms of challenges; and the ugly, vis-a-vis social isolation and inequalities. This chapter aims to better discover the digital learning ecosystem, understand it, appreciate its value, and accept that universities need to meet the demands of a very diverse student body.

It is indeed an interesting time to be an educator and a student.

2 What Is Digital Learning?

2.1 The Evolution of Education

According to UNESCO, "education is a global public good with the power to transform individual lives, communities and the planet for the better over generations" [1]. It is an activity that aims to transmit knowledge, foster skills, and build character. Largely, it is the key to society's growth and advancement. This is the modern definition of education. In this section, we will review the purpose of education and the different forms it has taken throughout time. In fact, understanding the past is very important in enabling us to realize how we got here. Grasping the triumphs and failures, recognizing the good and the bad, and learning from past practices will help us move forward, plan where we are going next, and drive that change.

Education originated as a process of enculturation, which is the transmission of intangible cultural heritage from one generation to the next. It encompasses the norms and values of the people making up a community and knowledge of their civilization for the purpose of perpetuation. It was simply based on transmitting knowledge from the mentor to the learner. In the earliest societies, storytelling was used to transmit information from one person to another and to be passed down for generations. As societies grew into complex structures, forming civilizations, the transmission of cultural values, knowledge, and skills became more complex, and the outcome was formal education. Before the emergence of schools, education used to be carried out through community and faith-based groups. The earliest civilizations used religion as a means to exhibit social and cultural influences and disseminate knowledge. Particularly, formal education was controlled and carried out by priests for the purpose of training future priests and scribes. For example, in the highly developed ancient Egyptian and Mesopotamian civilizations, the "scribal mastery of writing and arithmetic provided access to high offices bringing power and social position" [2, 3]. It focused on religion, reading, and writing, in addition to some knowledge of mathematics, science, medicine, astrology, law, and architecture. In the Middle East, institutions of higher education were local religious schools known as "madrassa", such as the Ez-Zitouna University in Tunisia, which is the first Islamic university in the world and is still operating today, the University of Al-Qarawiyyin in Morocco, and the Al-Azhar University in Egypt [4, 5]. In Europe, the spread of Christianity led to the establishment of monastic schools and cathedral schools as institutions of higher education to enhance spiritual learning [6]. These also played an important role in the preservation and progress of science throughout the Middle Ages. Largely during the course of civilizations, formal education gradually shifted from religious-based studies regulated by religious leaders and the elite to focus on skills, agricultural practices, and vocational training, while maintaining the conservation of values and control of cultural deviances. Indeed, this knowledge fostered social progress and development up until the industrial revolution. Since then, massive efforts in education, science, and technology have been contributing to the development of knowledge, societies, and economies.

Intrinsically, the purpose of education is much more than simply acquiring, enhancing, and transmitting basic knowledge. Students have always been viewed as an investment that improves their own lives and also benefits their society, economy, and country. The knowledge they acquire through education is at the core of social and economic development. Accordingly, the functions of education are continuously changing to meet the needs of society. Since the industrial revolution, education has played a major role in the development of society and the country. In fact, with each industrial revolution, there has been an educational revolution, causing inevitable transformations to higher education [7, 8].

In modern history, an industrial revolution is a process that marked the shift from an agrarian and handicraft economy to a manufacturing economy. Consequently, four revolutions have been identified, each powered by innovations and technologies that transform society and make an impact on people's daily lives. The First Industrial Revolution (Industry 1.0 or 1IR), which began in the late eighteenth century, was about mechanical production driven by the use of steam and waterpower, or the shift from manual labor to machines and efficient forms of manufacturing, paving the way for mass production. The Second Industrial Revolution (Industry 2.0 or 2IR), known as the "Technological Revolution", was based in the mid-nineteenth century and attributed to additional manufacturing technologies making use of electricity. The first two industrial revolutions were marked first by a change in higher education followed by massive expansion of both public and private investment in order to meet the rapid expansion of the economy and manufacturing. As such, higher education became accessible to all and focused on scientific and technical education [9, 10]. This was accompanied by a commitment to research as shown by increased funding and investments for university scientists [11]. The Third Industrial Revolution (Industry 3.0 or 3IR), referred to as the "Digital Revolution", was initiated in the late twentieth century and was characterized by the development of computers, the internet, and interconnectivity. This was accompanied by an even greater access to higher education, showcasing greater diversity, enhanced academic research, the integration of ICT technologies into education, and the emergence of online courses. Finally, the Fourth Industrial Revolution (Industry 4.0 or 4IR) is a direct consequence of 3IR and is about automation and the integration of advanced technologies (artificial intelligence, the Internet of Things, robotics, nanotechnologies) resulting in the fusion of the physical, biological, and digital worlds. The basis of 4IR [12] is a knowledge economy in which the individual is the major driver of economic growth. For a country to participate in a knowledge-based economy, the World Bank draws attention to four essential pillars, the first being "education and training", which requires a skilled labor force that is educated and continuously learning skills to apply their knowledge efficiently and foster innovation. This places the human intellect at the center of economic growth and advancement. In parallel with knowledge, there is the technology element, which is the essence of the second pillar, an "information infrastructure" for the purpose of facilitating effective communication and interaction, as well as the processing of information and its dissemination. The remaining two pillars relate to innovation systems and the provision of favorable economic and institutional environments that promote a sustainable and open education system [13].

In fact, education has been going through its own revolutions, having evolved from Education 1.0 to Education 4.0, and having undergone reforms throughout to meet the needs of the industrial revolutions and equip students with the skills needed to enter the labor market. Concisely, Education 1.0 was a form of memorative learning that is teacher centered with the student depicted as a passive recipient of information. Then, technology began to infiltrate education at the beginning of the new millennium, marking the start of Education 2.0, and characterized by enhanced communication and collaboration. Education 3.0 has an even more connectivist approach and a richer interactive network thanks to the widespread adoption of the internet. It recognizes the unique and personalized needs of the learners by networking and having access to wide range of knowledge and information resources that is no longer limited to communication between teacher and student. Education 4.0 is the current state of education that has emerged from the technological advancement of 4IR. It aims to transform education into a learning approach or technique that exploits the potential of digital technologies and produces a labor force that is proactive and innovative, characteristic of a knowledge society [14]. These technologies, which include artificial intelligence, robotics, and smart systems, among others, have become an integral part of all industries. Moreover, in order to produce relevant and successful graduates, the learning process has to incorporate technology, and higher education must respond urgently in order to meet the advances of modern professions and produce graduates that are innovative, creative, and can take on challenges. The pandemic has provided a window of opportunity to test some of the elements of Education 4.0 by adopting the use of technology in learning. It has also provided an opportunity to re-think and re-imagine a higher education system for the purpose of inducing the necessary change and focusing on job training as opposed to educating [15]. The future of higher education is one that is based on connectedness and collaboration that is not limited to a typical classroom or a physical space and time. Learning can happen anywhere, anytime, and in a way that encourages communication and teamwork with the help of technology. The role of the educator is to empower students and unleash their creativity and innovation. Higher education should ride the wave of the digital era and embrace digital learning.

2.2 The Evolution of Distance Education to Online Learning

Traditionally, distance education is a learning approach that is characterized by the physical separation between the educator and the learner. It was initially geared toward part-time students and non-traditional students, including adult learners and students that are geographically remote and unable to attend traditional educational institutions and participate in classroom lectures. It is used at many educational levels to serve various purposes such as certificate and diploma programs, graduate degrees, as well as continuing professional education. Recently, distance education has been greatly influenced by technologies that have enhanced communication between the educators and learners and encouraged networking, making the educational process ever more digitalized and more learner centered. Hence its evolution into online or digital learning, which is becoming an integral part of our education and is set to be the future of education.

Distance education is not a new phenomenon. It can be traced back to the nineteenth century, as the postal service developed. In the 1840s, the English teacher Sir Isaac Pitman started a correspondence course in Britain to study his shorthand system by mailing postcards with texts transcribed into shorthand to his students who then sent back their work for corrections [16]. With that, he is regarded as the pioneer of distance education. Later in the 1850s, the University of London started offering distance learning degrees by correspondence to people from around the world; it still exists today as the University of London Worldwide [17]. Meanwhile, in the USA, the Chautauqua, a cultural and social movement in adult education that emphasized the then popular idea of self-improvement, established the Chautauqua Literary and Scientific Circle in 1878 as the first national education program and correspondence school, which is now the oldest continuous distance education program in the USA [18]. Distance education also played a key role in furthering the education of women. Several initiatives were launched in the late nineteenth century such as the "Society to Encourage Home Studies" in Boston, Massachusetts, also based on a correspondence model. Known as the "silent university", the society managed to reach around 7,000 women in two decades and enhance their access to higher education [19]. Also in Australia, the University of Queensland established a Department of Correspondence Studies in 1911 that made use of the postal system to send course materials to students. Another example is the University of South Africa (UNISA), which was established in 1873 as the University of the Cape of Good Hope and praises itself as the largest open distance learning institution in Africa and the longest-standing distance education university in the world, offering programs exclusively at a distance since 1946 [20]. In 1969, as the British government gave birth to its Open University, a new era for distance higher education was acclaimed characterized by an open access policy and mega university status [21].

With the advent of broadcasting early in the twentieth century, the educational radio station became a powerful distance education medium to support text-based curricula and literacy. Indeed, the radio has paved the way for the implementation of technology in education [22], closely followed by the use of television to offer classes to reinforce the understanding and learning of educational material. Television was particularly used for teacher education and development in several countries, including China which has provided diplomas in education to unqualified instructors and upgraded the skills and practices of teachers through its Central Educational Television network [23, 24]. In the USA, the University of Houston established the nation's first public television station, KUHT, in a mission to expand its reach and increase educational access and opportunities [25]. Egypt also made use of instructional television to train teachers across all governorates in an interactive way by allowing them to phone the broadcasters and ask questions that were answered live on television [26].

The rapid growth of distance education was noticed in the twentieth century with the development of technology and personal computers, and the advent of the internet, paving the way for online education. In fact, online education is defined as a form of distance education that makes use of computers for teaching and learning, with at least 80% of the course material delivered online [27]. The University of Phoenix was one of the earliest adopters of online education at a time when most people didn't have an e-mail provider, back in 1989, and made use of online services such as Prodigy and CompuServe [27, 28]. Moreover, with the emergence of the World Wide Web in the early 1990s, it was offering both bachelor's and master's degrees through the internet to thousands of students, many of whom could not embark on traditional educational programs for various reasons, including financial, geographic, or job commitments, among others. Following the success of the University of Phoenix, several universities and colleges followed suit and entered the online marketplace, reinforcing the expansion of higher education.

Overall, distance education and online learning has proven be an essential tool in closing educational gaps, expanding outreach, improving skills, and providing opportunities for growth and development in a fast-changing world.

3 Why Do We Need Digital Learning?

3.1 Demographics and Increasing Demand

Knowledge about the age structure of a population and its distribution plays a critical role in shaping society and impacts various aspects of community life, the economy, the availability of resources, and the provision of educational and healthcare services. Over the past century, the age structure of populations has been changing considerably; for instance, the global median age has increased from 20 years in 1970 to about 30 years in 2022 [29]. According to the UN, people aged 18–23, which corresponds to college-age people, numbered around 715 million globally in 2016, and this number is expected to reach 800 million by 2040 [30].

Per se, access to higher education has been growing at astounding rates in recent decades. According to UNESCO's Institute of Statistics for 2020, about 40% of the world population goes to some form of postsecondary education, an increase from a mere 20% only two decades ago [31]. Moreover, based on an analysis of global higher education enrolments, it is anticipated that there will be a dramatic growth of 200% by 2040, equal to nearly 600 million students, from 216 million in 2016. Enrolments are expected to grow at an average of 4.2% yearly, corresponding to an estimated 380 million students in 2030 and 472 million by 2035 [32]. The growth of higher education participation is explained by a growing and changing economic need for skills.

This overall population growth, and particularly the growth of the youth cohort, has put major pressure on the higher education sector and is a key challenge to governments and higher education institutions, which require major reforms, policy planning, and governance imperatives. Countries need to understand this trend in order to implement sound strategies for the expansion of the higher education ecosystem. This has been enabled so far by the growth of private institutions in an eased regulatory environment, by more flexibility for public institutions, and recently by the growth of distance and online education as a result of new technologies and enhanced internet access. However, massification of higher education is not without its challenges. Universal access can be hindered by poverty, crises, and inflated tuition fees, among other factors. Higher education institutions in many Arab states are viewed as a "source of huge collective disappointment and revolt", as governments often use them as a "waiting room" for the young [33]. In the Arab states, half of the entire population is under the age of 25 [30, 32]. Moreover, this region has the largest share of youth (15–29 years old) in the world and yet has the lowest participation in the labor market in addition to very high unemployment rates [33]. Today, higher education institutions in the Arab world are facing challenging moments as they need to expand to meet the demands of a huge college-age population while ensuring quality courses.

3.2 Cost of Education

While the demand for higher education is increasing to meet the needs of a growing young population, several countries are nevertheless witnessing a decline in higher education enrollments today. In certain regions, the reason for this reduction is demographic and due to decreased fertility rates, but increased tuition fees and associated costs such as housing, food, and transport are also contributing factors. In financial terms, digital learning may have some advantages over on-campus education because institutions can save on expenses such as campus infrastructure and services, which contribute greatly to tuition costs. In general, digital education will have fewer everyday costs. While several higher education institutions charge less for online instruction, exceptions do exist, and costs can depend on the course of study and vary from one institution to another.

3.3 Environmental Benefits

Digital learning has many environmental benefits and can effectively support the education sector in combatting climate change. Studies have shown that digital learning can leave a much smaller carbon footprint due to a reduction in transport and therefore carbon dioxide emissions; it also allows energy consumption and energy usage to be reduced. Researchers showed that adopting a digital education paradigm has a carbon footprint that is 90% lower than in-campus instruction [34]. This is attributed to: (1) limited campus operating expenses and maintenance; (2) a reduction in deforestation, with lower paper use and more digital media offerings; and (3) a reduction in pollution and emissions, due to decreased unnecessary transportation and lodging [34, 35].

4 How Fast Is Digital Learning Growing?

Digital learning has been growing rapidly in recent years in line with the development of the computer, the internet, and technology. The COVID-19 pandemic has accelerated this growth as more universities started adopting online programs and as e-learning opportunities were made available to the public. In fact, the pandemic has given digital learning a chance to re-emerge and prove its existence and benefits.

4.1 The Tools

The rationale for the use of distance or online learning in the early 1990s by certain universities was to reach out to a vaster audience and specifically to those who could not attend physically traditional classrooms due to geographical constraints, work commitments or schedule, and conflict, for example. As computers and the internet developed, digital learning mediums and approaches evolved from merely providing access to information to becoming important sources of learning and growth opportunities.

Essentially, digital learning wouldn't be possible without one key tool: the learning management system (LMS), a software-based platform that allows courses to be efficiently deployed and managed online. This type of system started in 1924 as a simple typewriter, or "typing machine", developed by Sydney Pressey, with two windows: one to administer questions and the other to enter answers. The concept of LMSs then started to gain interest in the early 1990s as universities were adopting them to upload course material, deliver content, monitor student attendance, track progress, carry out tests, post grades, and issue notices, from anywhere and at any time. Released in 1990, FirstClass is considered to be the first LMS and is a Macintosh-based interface that supports public forums and is mostly used as an e-mail system. Then in

2002, the Modular Object-Oriented Dynamic Learning Environment (Moodle) was released as the first open-source LMS and is now considered to be the most popular among open LMS systems. By 2020, Moodle was boasting over 200 million users from 242 countries engaged in 24 million courses worldwide [36]. The establishment of cloud-based, open-source LMS systems, which require only an internet connection for access from anywhere and at any time, further expanded the LMS ecosystem. Today, there is a growing variety of such software playing a significant role in distance and online education. These systems have been increasingly adopted by various parties, including universities, training institutions and organizations, and companies, as a vital component of online learning.

In 2001, Massachusetts Institute of Technology (MIT) launched its OpenCourseWare platform, offering free access to resources and material from over 2,500 courses that represent MIT's complete curriculum. "It unleashed the global open-sharing movement, helping to pave the way for the worldwide phenomenon of open digital learning", said MIT's 17th president Leo Rafel Reif in 2021 [37]. With that, the age of open education and digital sharing was just getting started.

A decade later, massive online open courses (MOOCs) began to emerge. Udemy was founded in 2010, with the goal to make quality education accessible and to apply knowledge to improve lives through a variety of courses created by everyday experts in more than 50 languages and covering over 190 countries. During this time, other successful online learning platforms emerged that offered thousands of online courses from top universities and institutions around the world. One of the world's largest platforms, Coursera, offers courses in partnership with leading academic institutions and corporate companies to ensure that the learner meets industry standards for professional growth and career advancement. Another established giant is edX, which was founded by Harvard and MIT and Udacity. Today, there are numerous online learning platforms that serve millions of people around the world. These are often defined by different user verticals as well; for instance, Coursera and edX mainly focus on professional training, while Skillshare is mostly geared at creatives. In addition to offering a variety of courses, these platforms allow the learners to use the course credits toward a master's degree at one of the partner universities.

As demand for digital learning has been steadily growing, players in the higher education field are vying for a piece of the market. In order to grow and survive, traditional universities have been taking bold moves with the aim of competing with online education giants. Many have launched new online learning programs. For example, leading universities such as Harvard, Stanford, and Ecole Polytechnique offer online courses in various topics and platforms at the undergraduate, masters, and doctoral levels, as well as certificates [38, 39]. This is a trend that is likely to keep growing, as more and more traditional universities are going online by upgrading their platforms, creating new tools, and increasing collaborations.

4.2 The Market Size

According to the Statista Global Consumer Survey, revenue from online education is expected to grow from USD 166.60 billion in 2023 to a projected market volume of USD 237.10 billion by 2027 at an annual growth rate of 9.22% [40]. The largest segment of this market is attributed to higher education, which is expected to reach USD 103.80 billion in 2023. Most of this revenue will be generated by the USA, followed by China, the United Kingdom, India, and Canada. Another survey estimates that revenue from online education is expected to reach USD 198.9 billion in 2030 at an annual growth rate of 23.12% from a baseline of USD 30.60 billion in 2021 [41]. North America dominates the global higher education market, contributing more than 35% of the global revenue, and will continue to do so owing to an advanced infrastructure, investment in EdTech products, and a highly skilled labor force [41, 42]. The Asia–Pacific region is another dominant area for online education, with a market that is expected to grow at the fastest compound annual growth rate due to increased internet and smartphone penetration, as well as the implementation of government policies that support online learning [43]. The Middle East's and Africa's share of the market is growing modestly and sporadically [44], Saudi Arabia having the largest share, followed by the UAE, owing to sustained investments by government authorities in the digital infrastructure and expansion of the corporate sector. Rising awareness of the benefits and advantages of digital learning, in combination with enhanced technology, is also expected to drive the growth of the online education market in this region [44].

4.3 The Consumer Segment

This rapid growth of the digital education market is due to a huge demand from people to learn online, which in turn is due to rapid changes in the world and the job market. Digital learning is an important tool with which to deal with the global skills gap. Today, careers are becoming more complex, as the job market is quickly evolving with technological change. Working professionals are realizing that learning is lifelong and that they need to sharpen skills or learn new skills, no matter their age or stage in a career. The key is to be aware of the emerging skills that ensure adaptivity at work and relevance.

Moreover, one shouldn't disregard the fact that the nature of the student in higher education has been changing [45]. The profile of the typical student has been shifting from one that enrolls in higher education directly after high school and is financially dependent to one that has delayed their postsecondary studies and has work commitments and other work and life responsibilities. In the USA, for example, traditional students (aged between 17 and 24 years, attending four-year colleges) made up 15% of undergraduates in 2021, but the remaining 85% were a more diverse group of students, comprising commuter students, low-income students, adult learners that had delayed college enrollment, part-time and full-time workers, and working parents, among others, according to the Postsecondary National Policy Institute survey [46]. Interestingly, this latter category of students, referred to as "non-traditional" or "post-traditional", who are 25 years and older, makes up 80% of students enrolled in online programs, which offer more flexibility and cost-effectiveness, as well as convenient and specialized course learning. This population of students existed before the pandemic and continues to grow at a faster rate today, as students need to balance the responsibilities and demands of their personal and professional lives [45].

The enrollments in online higher education have been outpacing those for traditional higher education. Running a traditional and campus-based higher education institution comes at a cost, including expenditures on building operations, housing, and dining, in addition to programs and overhead costs. When you add in shrinking government support for higher education, increased operational costs, escalating tuition fees, and growing student debts across the board, it is no surprise that enrollments in traditional higher education institutions have been dropping, as students question whether it is worth the investment.

Digital learning presents itself as a more affordable option. Coursera, for example, saw its number of new registrations increase by threefold in the years after the pandemic, with 20 million new registrations recorded in 2021, exceeding pre-pandemic figures, and bringing the total number of registrations to 92 million from 21 million in 2016 [47]. The highest rate of new learner registrations was observed in data from emerging countries, with Paraguay and Lebanon in the lead showing a growth of 98% and 97% per year, respectively [47].

5 Will This Trend Continue?

5.1 The Growth Aspect

Digital learning has been growing rapidly in recent years and is poised for more growth, as learners are increasingly accessing online courses. This trend has indeed gained momentum during the COVID-19 pandemic, which has not only stimulated a global acceptance of digital learning but also driven an increase in the quality and standards of online education, in a flexible and cost-effective manner thanks to advancements in educational technology.

Accessing quality digital learning has proven to be important for future-proofing careers, as it exposes students and working professionals to an array of skills and capabilities that will allow them to thrive in an increasingly complex and competitive workplace. As such, the digital learning marketplace has been evolving with the growing market needs, providing numerous options for reskilling and upskilling opportunities, and making educational attainments relevant. Moreover, research has shown that online learning can be even more effective than traditional learning, particularly in the context of corporate education: (1) it requires less time without affecting learning quality; (2) more material is covered in less time; and (3) it leads to increased productivity, revenue, and business performance [48].

Emerging technologies have been changing the face of online education by creating tremendous opportunities. For example, the use of machine-learning algorithms, a type of Artificial Intelligence, allows us to recognize patterns that personalize and tailor content for each learner in the platform and, therefore, adaptively enhance his/her learning experience, work smarter, and achieve personal objectives. Additionally, more-personalized learning experiences are achieved through virtual assistants or smart chatbots that support the learner in real time and facilitate navigation through the material. The result is a time-efficient, content-focused, and engaging learning experience. At the pace technology is evolving today, it will not be surprising to see more advanced algorithms that offer tailor-made learning strategies with the inclusion of virtual reality and augmented reality, making the learning experience more stimulating, interactive, and engaging [49].

On the whole, digital learning is no longer an educational trend, but rather a mainstream phenomenon that has become assimilated into the learning environment and thus an integral part of it. Digital learning is no longer a "nice to have" option in an institution's educational offerings. The COVID-19 pandemic has emphasized the need for higher education institutions to become more reactive and proactive toward the needs of the learners and break away from its deeply rooted traditions and embrace flexibility and change. Now that digital learning has become normalized, higher education institutions are diving into an era that sees an expansion of online offerings and encourages the exploration of new learning modalities that are compatible with the "new learners".

5.2 The Quality Issue

Quality is a major concern in online education. Before the COVID-19 pandemic, skepticism lingered around the quality of digital and remote education. One of the biggest challenges of digital education is the lack of face-to-face interactions between students and their instructors, which creates a sense of isolation and lack of social support. Creating a sense of community and belonging is an important aspect in any learning experience. This social dimension, i.e., the ability to share and engage with others, is the basis of our ability to learn. Learning is a dynamic process that requires interaction with others, whether collaboratively and/or competitively, to test knowledge, manipulate information, receive feedback, enhance initiative, and contribute to meaning. This is also important in building a sense of motivation and satisfaction. However, technical difficulties, such as poor internet connectivity or software, and the lack of technical equipment can also lower the quality of online education by disrupting the learning flow. These issues are not limited to the students but also concern the instructor, making teaching more tedious.

Despite these challenges, higher education institutions have been working to improve the quality of digital education. For example, they are offering teachers professional development programs in online learning, investing in technology and infrastructure to improve online learning experiences, and providing support to students. Today, digital education is becoming increasingly popular, as more and more learners are opting for online courses or programs, and entirely online degrees have become more popular and prominent. Although digital education has become more normalized, students are still wary of enrolling in an online education program as they worry it might impact their chances of finding a job once they complete their education. This is one of the most common drawbacks of online degrees as they can be perceived as less valuable or respectable than traditional on-campus programs. Several surveys have shown that managers are still not entirely positive about online education and hiring employees with an entirely online education background [50]. In fact, one of the main concerns of Arab students regarding digital learning is the lack of accreditation by Arab governments and the fact that online degrees are not widely recognized by employers [51]. However, these students feel that they are not sufficiently prepared to enter the labor market with just a traditional education, and are increasingly seeking online courses, mostly short courses, to complement their learning journey and acquire additional skills and knowledge. As such, they would prefer to enroll in short courses as opposed to full programs or degrees.

The pandemic may have changed attitudes toward the perceived value of digital education and may have stimulated its broader acceptance. With technology also advancing, employers recognize the need to re-think this mindset. As the digital education market is growing and maturing, the public perception is also shifting. Actually, it is no longer uncommon for employees to work online, as the workplace is becoming more flexible and agile. And the idea that work is judged by the number of hours in a day is also shifting. The same goes for online education. As learners are starting to value online education, employers are also following suit. Although data on the perception of online education by Arab employers is still scarce, it seems they are becoming open to online education and mostly have no issue hiring students with online credentials, as long as it is from an accredited and reputable institution. The reputation of the online degree therefore hinges more on the reputation of the institution, its legitimacy and accreditation status. Another condition that contributes to the legitimacy and high quality of online learning is the recognition of online qualifications by governments and flexible credit-transfer policies [51].

But how do we judge the quality of online education? Who decides how it is defined? One cannot provide an answer that tallies with everyone across the board. For instance, online learning is more likely to be appealing to working professionals and parents, as it allows for more flexibility and accessibility than traditional on-campus education, whereas novice learners and young students are more likely to prefer in-person education [52]. Therefore, this should be the basis for judging the mode of course delivery: comparing online versus in-person learning is a relative matter and subject to the learner's needs. "Moving toward online learning is part and parcel of better understanding who are our students, where are they, what are we offering and how well does it respond to their needs?", says Rick Staisloff, founder and senior partner of a higher education consulting firm focused on sustainable business models [45]. An important question in judging the benefit of their learning journey is: how successful are they in entering the labor market?

But how is the quality of online education regulated? Although many argue that there aren't quality standards for online education, there are many studies that measure the quality and standards of teaching and learning in online education. Quality Matters (QM), an international steward of online education quality, has developed course-design standards that describe best practices and provides guidance for improving course quality, evaluating courses, and training faculty. According to QM, what contributes to the high quality of online education, in terms of student learning and satisfaction, is related to: (1) course overview and introduction; (2) learning objectives and competencies; (3) assessment tools and measurement; (4) instructional material; (5) course activities and learner interactions; (5) course technology; (6) learner support; (7) accessibility and usability [52]. These are essential components of a high-quality online learning system. Monitoring and regulating is surely a complex problem that is not limited to online learning [45].

6 Conclusion

Since its inception, distance education has been about reaching out and making knowledge more accessible and affordable. It has made education possible to those who couldn't attend traditional learning institutions. Thereafter, with the emergence of information and communication technologies, making education possible online, the distance education landscape and higher education started changing. Digital education has made learning even more flexible and accessible, becoming increasingly appealing to learners, an interest that was accelerated by the COVID-19 pandemic when many universities shifted to remote education. The pandemic stimulated the massive expansion and diversification of digital learning because almost every higher education institution had either to shift to emergency remote learning using their current systems, or experiment with new tools and adapt to different means of instruction. Although teaching returned to the classroom as the pandemic receded, the possibilities of digital learning were unleashed and became engrained in the institutions' academic and educational agenda as an indispensable vehicle to meet the massification and diversification of higher education. This marked a new era of digital learning since it became irreversibly integrated into modern higher education and was no longer considered as just a "hobby".

However, the quality of digital education remains a major concern among various stakeholders, including the learners and employers. The pandemic has indeed illuminated the need to address the quality of digital education. High-quality digital learning is not just about a rich digital curriculum. Teachers need to be well equipped to engage students and promote learning. This era of digital education, which is about accessibility and transmitting knowledge, is moving today to another era, one that focuses on credibility and quality. This cannot be done without a paradigm shift in teaching and learning methodologies.

Nevertheless, there isn't one direction for the future of higher education. Different stakeholders will have different needs and objectives. The education ecosystem will become increasingly diverse. We should not be thinking of one future or one way forward for higher education. There will be many directions for increasingly diverse stakeholders, who will be able to seize à la carte educational opportunities. They will be able to decide what to learn, how, and when. The future of higher education is what the learners want. The challenge for us all is to be responsive and grasp this future.

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The Pedagogical Ecology of Learning Technologies: A Learning Design Framework for Meaningful Online Learning

Nada Dabbagh

Abstract This chapter introduces the concept of pedagogical ecology and its role in shaping the design of digital learning environments with specific emphasis on online and e-learning. The chapter analyzes the pedagogical ecology of learning technologies starting with pre-internet technologies and advancing to Web 1.0, Web 2.0, and Web 3.0 technologies. This analysis is premised on the theory of affordances and the non-neutrality of the learning space. The chapter presents a learning design framework that can be used to reinvent online and e-learning programs in higher education contexts locally and globally, by moving away from models that ask learners to memorize information and take recall tests, to a model in which technology enables the design of learning experiences that feel relevant, meaningful, and useful to learners. The Meaningful Online Learning Design (MOLD) framework can serve as a starting point for educational reform in the Arab world by moving the needle from "schooling to learning" in order to "serve the needs of pluralistic societies and foster the development of active, responsible citizens who are empowered to deal with complexity and advance constructive change".

Keywords e-Learning · Learning technologies · Learning design · Pedagogical ecology · Higher education · Web 3.0

1 Introduction

The "media versus method" debate regarding the linkage between technology (media) and instruction (method) has been going on for decades. It started in the early 1980s when Richard Clark [1] stated that media "are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in nutrition". In other words, Clark was arguing

N. Dabbagh (✉)
Division of Learning Technologies, College of Education and Human Development, George Mason University, Fairfax, VA, USA
e-mail: ndabbagh@gmu.edu

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that there are no learning benefits to the use of technology in instruction. Clark's statement triggered an uproar in the "educational technology" (EdTech) academic community with Robert Kozma taking the lead on addressing Clark's viewpoint. Kozma suggested reframing the question from "does technology (media) influence learning" to "*will* technology influence learning" given the lack of research evidence to make a judgment as to whether technology influences learning, and the premise that educational technology is not a natural science; rather, it is a design science; hence, new research paradigms are needed to examine the relationship between technology, learning, and instruction [2]. Kozma went on to argue that learning is not a static activity or the receptive response to instruction; rather, learning "is an active, constructive, cognitive, and social process by which the learner strategically manages available cognitive, physical, and social resources to create new knowledge by interacting with information in the environment and integrating it with information already stored in memory" [3]. Kozma and others [4–8] were essentially saying there is a reciprocal interaction or interplay between the learner's cognitive resources and aspects of the external environment that include both technology and pedagogy (instructional method).

Circling forward to the twenty-first century where many things have changed in education since this debate started, particularly technological advances that can be considered monumental with the explosion of social media and mobile devices enabling anytime-anywhere learning, online learning, and e-learning, the "media versus method" debate shifted to one that centers on erasing the technology–pedagogy dichotomy instead of determining which has more autonomy. For example, Fawns [9] views the relationship between technology and pedagogy as the mutual shaping of purpose, content, values, methods, and technology (see Fig. 1).

Fawns advocates an *entangled pedagogy* approach in which agency is negotiated between the elements of a learning environment to include teachers, technology, students, infrastructure, policy, outcomes, etc. Fawns suggests that we no longer think about the relationship between technology and pedagogy in terms of whether technology is the driver of educational activity (technological determinism) or pedagogy is the driver of educational activity (pedagogical determinism). Rather, Fawns suggests we transcend this technology–pedagogy dichotomy and perceive the relationship between technology and pedagogy as a complex entanglement of factors iteratively and mutually shaping each other in the learning space.

Dabbagh and Castaneda [10] also advocate that we perceive the relationship between technology and pedagogy or technology and learning through the lens of what some scholars call *sociomaterial entanglement,* i.e., the intersection of the technical (material) and the social (human) through thought and action, also known as multiagent socio-technical systems [11–13]. This suggests that humans and things are "ontologically inseparable from the start" and are observable through the intra-action and the relationships with the other elements of the learning environment. In other words, the components or elements of the learning environment, which include the instructor and the learner, mutually condition and transform each other while they interact, continuously shaping the learning process. Tietjen et al. also advocate for a sociomaterial approach when analyzing learning environments [14] and argue that a

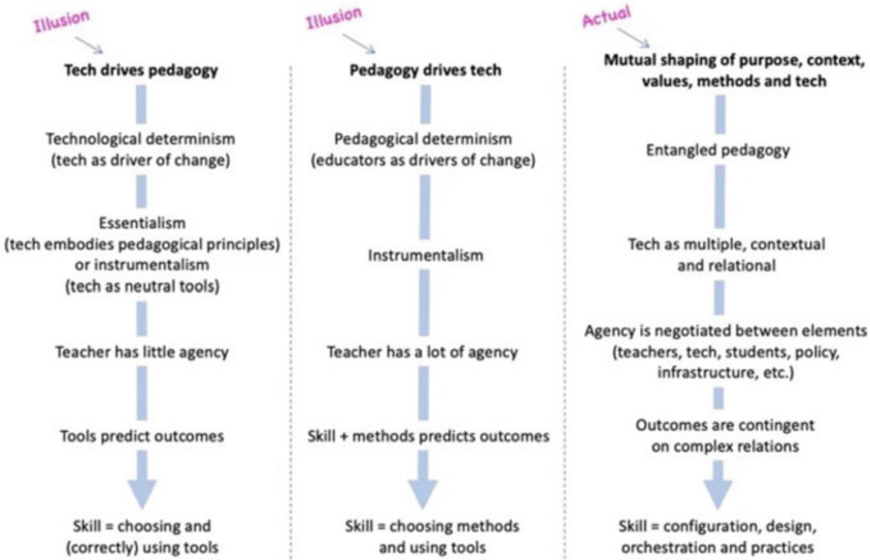

Fig. 1 Technology–pedagogy dichotomy

sociomaterial perspective resists viewing things (physical or material) and humans as separate or dichotomous entities. Instead, they advocate perceiving all elements in a learning environment, whether human or material, as equivalent or symmetrical in terms of their ability to exert force on one another. For example, technology is conceptualized as capable of shaping human activity in the same way that a human can direct or shape the use of technology. Thus, in sociomateriality, agency is not positioned as a human characteristic above the material; instead, both the human and the material elements have agency in relation to the other; they are enmeshed and entangled.

2 Pedagogical Ecology

The roots of sociomaterial entanglement or entangled pedagogy can be traced to the construct of pedagogical ecology. Pedagogical ecology emphasizes the non-neutrality of the learning space and consideration of the expectations and interaction potentials that each learning medium or resource brings forth to the teaching and learning process [15, 16]. Supporters of this view argue that each medium has a unique set of characteristics and that understanding the ways in which teachers and students use the capabilities of the medium is essential to understanding the influence of the medium on learning and on building media theory [3, 17]. Frielick suggests that the learning setting, whether the classroom, the lecture hall, the e-learning environment, the department, or even the institution itself, can be viewed as an ecosystem that transforms, influences, and shapes the quality of learning outcomes.

Pedagogical ecology has challenged traditional teaching practices, faculty and student roles, institutional roles, and academic infrastructures, prompting a reconceptualization of distance learning and a rethinking of the broader practice of education and training. The concept of pedagogical ecology is grounded in Gibson's theory of affordances, which is an ecological approach to psychology that emphasizes perception and action rather than memory and retrieval. Gibson proposed that objects, materials, and artifacts (e.g., technologies) have certain affordances (possibilities for action) that lead organisms (e.g., people) to act based on their perceptions of these affordances [18]. In other words, action and perception are linked through the affordances present in each situation and the abilities or capabilities of an agent to act upon these affordances.

> Affordances and abilities are relative to each other: a situation can afford an activity for an agent who has appropriate abilities, and an agent can have an ability for an activity in a situation that has appropriate affordances [19].

Affordances provide strong clues to the operation of things. For example, chairs "afford" sitting, glass "affords" seeing through or breaking, knobs "afford" turning, balls "afford" throwing or bouncing, etc. [20, 21]. The theory of affordances has direct implications on how we may understand the evolution or ecology of online learning and the technology-based design of learning activities and interactions [15, 22]. As we trace the affordances of learning technologies (a) from pencils and paper pads where writing was the primary functional affordance, to surface tablets and smart phones where touch typing and gesture-based computing is the primary affordance; (b) from correspondence courses where individual learning triumphed, to broadcast technologies such as film, slides, radio, and educational television where audiovisual learning became the primary affordance; (c) from pre-internet technologies to Web 1.0 technologies that paved the way to asynchronous and synchronous forms of online education in the late 1990s and early 2000s; to Web 2.0 technologies of the twenty-first century where 73% of students in the United States claimed they would not be able to study without digital devices such as laptops, smartphones, tablets, and e-readers [23]; to Web 3.0 technologies that are permeating the learning space with artificial intelligence (AI) and machine learning (ML) interventions (e.g., chatbots); and immersive learning technologies that are providing semantic, spatial, and 3D instruction using augmented reality, virtual reality, and mixed reality (AR/VR/MR) interventions; one thing remains consistent across this evolutionary path:

> As technology evolves our pedagogical practices also evolve.

To illustrate the role of technology affordances in shaping the pedagogical ecology of online learning and e-learning, we trace the pedagogical ecology of pre-internet technologies, Web 1.0 technologies, Web 2.0 technologies, and Web 3.0 technologies in the next sections. See Fig. 2.

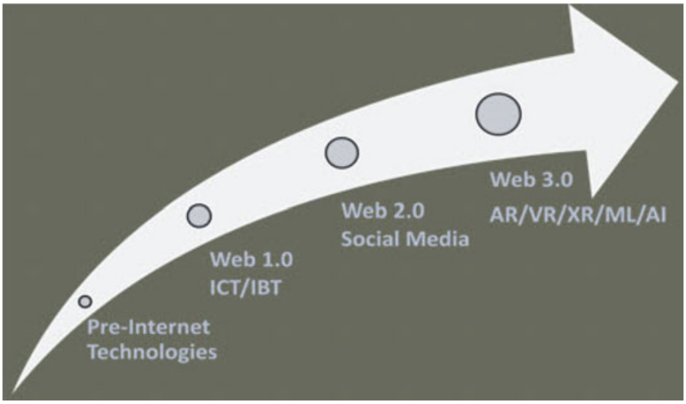

Fig. 2 Technology evolves

2.1 The Pedagogical Ecology of Pre-Internet Technologies

Pre-internet technologies can be characterized as print media or broadcast technologies such as film, educational television, video (compressed video) lectures, and PowerPoint (PPT) presentations. Broadcast technologies are effective in transmitting information (i.e., one-way provision of content) addressing assimilation rather than construction of knowledge and are largely utilized by the instructor, teacher, expert, or are system driven. In terms of pedagogical affordances, broadcast technologies characteristically enable teacher-centered instruction such as direct instruction, self-contained curricular units, and drill and practice activities resulting in predetermined technology-based adaptive systems such as programmed instruction (PI), stimulus response reinforcement (SRR), computer-assisted instruction (CAI), enabling cognitive information processing (CIP). These instructional practices are grounded largely in behaviorist and cognitivist learning theories and principles. The learning setting is usually that of an authoritative and knowledgeable figure who has been entrusted with the task of imparting reliable knowledge to the student and assessing student mastery of knowledge through tests and other observable and measurable behaviors. Learning interactions designed with pre-internet technologies were largely confined to learner-instructor and learner-content interactions. Distance learning was limited to correspondence courses, individual learning, and self-contained isolated curricular units, and learning was bound by time, space, and media constraints. Figure 3 illustrates the pedagogical ecology of pre-internet technologies showing the interactions among three components: technology type (top vertex), teaching and learning activities or learning interactions (right vertex), and pedagogical or instructional models and theories (left vertex).

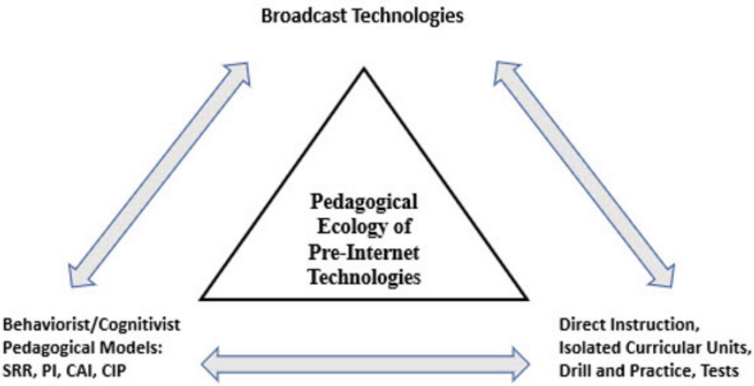

Fig. 3 Pedagogical ecology of pre-internet technologies

2.2 The Pedagogical Ecology of Web 1.0 Technologies

With the onset of information and communication technologies (ICT), the internet, and the World Wide Web (WWW), technology evolved from static and unidirectional to dynamic, networked, communicative, and collaborative. This class of technologies has come to be known as Web 1.0 technologies. Web 1.0 technologies characterized the first stage of the WWW, which consisted of an information portal made up of web pages connected through hyperlinks that users can access without being given the opportunity to post reviews, comments, or contribute content. The internet and the WWW prompted learning interactions and pedagogical models to evolve, enabling more open and flexible learning spaces and affording multiple forms of interaction.

For example, learning spaces and interactions became unbounded and distributed so that learning could happen anytime, anywhere synchronously or asynchronously using a variety of media; the "physical" distance between the learner and the instructor or the learner and other learners became blurred or relatively unimportant; learning resources proliferated prompting a reconsideration of what is an acceptable academic source; and the concept of learning in groups or collaborative learning flourished.

As shown in Fig. 4, the pedagogical ecology of Web 1.0 technologies resulted in teaching and learning activities that are more constructivist in nature, such as collaboration, articulation, social negotiation, exploration, and reflection. Web 1.0 technologies also supported pedagogical models that are grounded in theories of constructivism and situated cognition such as communities of practice (COP), knowledge networks, and distributed learning [24].

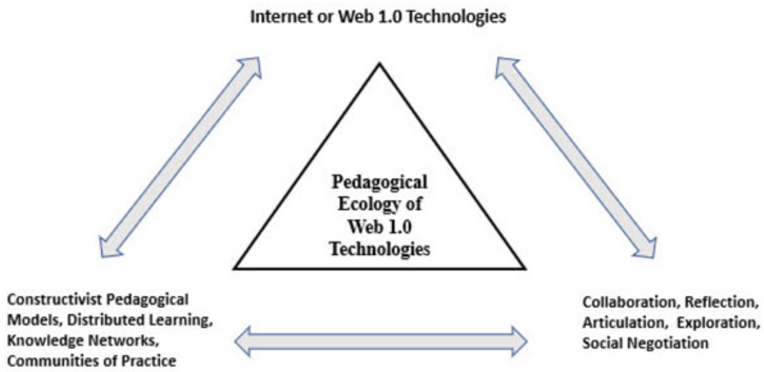

Fig. 4 Pedagogical ecology of Web 1.0 technologies

2.3 The Pedagogical Ecology of Web 2.0 Technologies

Technology evolved again in the twenty-first century leading to a new wave of ICT known as Web 2.0 technology. Web 2.0 technology possessed many of the inherent technological and pedagogical affordances of older computer-mediated communication tools but also represented a qualitative shift in how information is created, delivered, and accessed on the web [15]. Web 2.0 became a concept that embodied themes such as openness, personalization, customization, participation, social networking, social presence, user-generated content, the people's web, read/write web, and collective wisdom leading to its characterization as the "social web" [25–28]. In 2008, Mills Davis characterized Web 2.0 as the "The Social Web" and described it as the second stage of internet growth that is all about "connecting people" and "putting the "I" in user interface, and the "We" into Webs of social participation" [26]. The 2014 New Media Consortium (NMC) Horizon Report also emphasized the social side of Web 2.0, particularly as this relates to the ubiquitous use of social media technologies in the education sector and the way this use is changing how students and educators interact, present information, and judge the quality of content and contributions [29].

For example, blogging, microblogging (tweeting), podcasting, social bookmarking, social tagging, and social networking became the new affordances of Web 2.0 technologies, and as a result, new teaching approaches, theories, and constructs evolved such as connectivism [30], networked learning, MOOCs, mobile learning, and personal learning environments (PLEs). Figure 5 illustrates the pedagogical ecology of Web 2.0 or social media technologies, showing the relationship between the technology affordances of Web 2.0, the pedagogical practices (learning activities) (bottom right vertex), and the pedagogical models and constructs (bottom left vertex).

Unlike Web 1.0 technology where use was limited to only 14% of the adult population, most of which were programmers and tech-savvy individuals [31], Web 2.0 technology use grew to 90% of the US population and 65% worldwide because of its

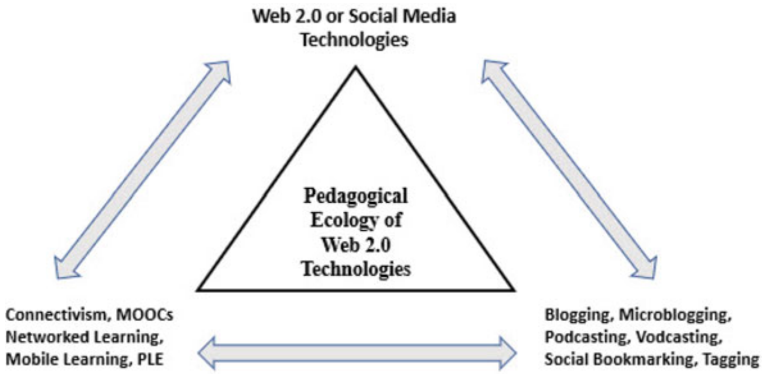

Fig. 5 Pedagogical ecology of Web 2.0 technologies

read/write affordances (the ability for users to create and post content) [32]. The new activities that grew out of Web 2.0 technologies (e.g., blogging, wikis, creating and posting videos) moved web-based learning activities away from having to be teacher centered to the possibility of being more learner centered. First, Web 2.0 technologies made it possible for learners to engage in high levels of dialogue, interaction, collaboration, and social negotiation through social networks and provided learners with the ability to generate and share knowledge across learning networks. Second, Web 2.0 technologies deflected control of learning away from a single instructor or expert by distributing learning among all participants in the learning community, promoting agency in the learning process and an appreciation of diversity, multiple perspectives, and epistemic issues. And third, Web 2.0 technologies enabled learners to personalize their learning environment by selecting the technologies they wish to use (e.g., apps on mobile devices), accessing and organizing information sources, customizing the user interface of a technology, and building personalized learning and professional networks [24].

2.4 The Pedagogical Ecology of Web 3.0 Technologies

Web 3.0 technology is the next iteration of the WWW and is sometimes referred to as the "semantic", "spatial", or "3D web" [33, 34]. As Evans describes, rather than seeking information by keyword, activities, or interests, users will be able to define their preferred means of information seeking. Enabled by blockchain technologies, the Web 3.0 movement has been characterized by embracing the principles of "open, decentralized, censorship-resistant, immutable, trustless, and permissionless" interactions [35]. These platforms cut out the middleman of the larger corporations so that the user can control their own data analytics, set their own rules, and obtain the full monetary gain from their efforts online. For example, a user getting a cut of profits from their offerings in Medium.com may be able to leverage Web 3.0 technologies to gain the full profit using blockchain technologies like Mirror.

Web 3.0 also promises interoperability so that end users do not need to create multiple accounts for multiple services. Web 3.0 also promises users voting rights that regulate the governance of overarching communities' roles as opposed to relying on the dictates of the bigger platforms like Twitter, Google, or Meta. Given the promised interoperability, Web 3.0 may enable personalization across platforms, yielding a cryptographically-backed digital identity to be represented across the web, and resources that better connect to the end users based on their interests and powered by machine learning [33]. These extended capabilities, however, are in their nascent stages and beg questions about privacy, security, bias, and censorship.

Immersive learning technologies such as AR, VR, and MR are also examples of Web 3.0 technologies that allow participants to be totally "immersed" in the context that the environment represents. They create virtual experiences that strive to look and feel like real settings. Immersive environments can be created as a "classic" immersive reality where the participant may wear goggles and interact via a headset and a joy-stick or other controller, and experience the environment through these devices. Immersive technologies also allow the participant to create an avatar to represent themselves. Simulations, educational games, and virtual reality environments are all examples of immersive environments. The immersive environment would include a three-dimensional (3D) visual experience, audio and potentially olfactory stimuli. Advances in artificial intelligence (AI), computational design, machine learning, and smart technologies like the Internet of Things (IoT) are automating the design of human-centered environments and human–machine partnerships, whether in real or virtual reality, transforming the future of work, entertainment, health care, education, business, and everyday life.

Figure 6 demonstrates the pedagogical ecology of Web 3.0 technologies suggesting that teaching and learning experiences are going to become more immersive, personalized, and AI supported. You will also note that sociomaterial entanglement theory (SET) will be a new pedagogical construct that aligns with the affordances of Web 3.0 technologies. As an approach that enacts contemporary ideas about how people learn, SET embodies the sociomaterial entanglement with which people learn and the technosocial reality we live in. SET can be considered as an extension of Gibson's theory of affordances because it addresses the prevailing tendency to limit conceptions of social interactions to between persons rather than between persons and things [36]. Moreover, SET is not an explanatory theory, rather an approach or framework with a broad spectrum of applications that are able to integrate some of the most naturalistic ideas about how people learn in the digital environment, the most relevant of which are: (a) learning anytime, anywhere, or what has come to be known as ubiquitous learning [37]; (b) adult learning, specifically as this relates to self-directed learning or what is known as heutagogy [38, 39]; (c) learning with others as conceptualized by social constructivism [40, 41]; and (d) learning in connection or connected learning as embraced by connectivism [30, 42] and networked learning [43–45].

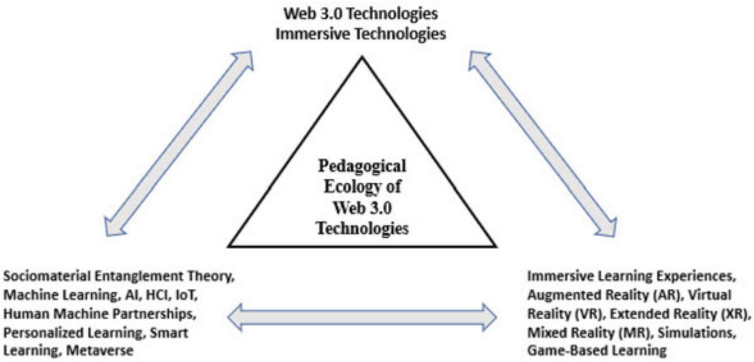

Fig. 6 Pedagogical ecology of Web 3.0 technologies

Figures 3–6 demonstrate that the pedagogical ecology of learning technologies is recursive and transformative in nature as a result of the reciprocal interplay between the affordances of technology and pedagogy. Anderson and Dron describe this interplay as a dance where technology sets the beat and creates the music while pedagogy defines the moves [46]. Anderson and Dron posit that pedagogical models "have evolved in tandem with the technologies that enable them" [46]. The co-evolution of technology and pedagogy suggests that technology can no longer be perceived as a neutral tool that may or may not be used for teaching and learning. Rather, technology is an enabler of virtually every teaching model or strategy and an empowering agent for its users. Patterns of technology use across the decades have shaped our teaching and learning practices, and consequently, our learning theories and pedagogical models. Henry Beston eloquently stated this when he said:

> There exists a mutuality between our tools and our intentions—while our tools are the product of our intentions, they also shape our intentions in turn [47].

More specifically, pedagogical ecology demonstrates that there is a recursive and transformative interaction between three components of a learning environment that work collectively to shape our learning spaces, perspectives, and interactions. These components are: (1) learning technologies (the top vertex in Figs. 3–6), (2) instructional practices and activities (the bottom right vertex), and (3) learning theories and pedagogical models or constructs (bottom left vertex). The arrows in Figs. 3–6 depict a reciprocal, cyclical, and iterative relationship between these three components in which patterns of technology use shape our instructional practices and learning interactions, which in turn shape our learning theories and pedagogical models leading to the emergence of new learning technologies with new pedagogical affordances. This three-component model (explained in more detail later in this chapter) embodies the non-neutrality of the learning space and emphasizes the pedagogical affordances of learning technologies.

Väljataga, Pata, and Tammets argue that Gibson's theory of affordances has been misconstrued in educational technology settings or interpreted to take into consideration *only* the "objective properties of the tools or functionalities provided by the developers of the tools" [48]. However, instructional designers and faculty need to be aware of the concrete or intended affordances of these tools in order to harness their pedagogical potential and design appropriate learning activities. So, the question for teachers, faculty, and instructional designers becomes "What is it about this technology that makes users [students] want to interact with it in this way?" and "What perceiving abilities does it provide or enable?" and "How can we leverage or harness this technology in educational contexts?".

Technology and internet connectivity have disrupted industries and transformed the lives of billions of people. Twenty-five years ago, less than 3% of the world's population had a mobile phone, and less than 1% had access to the internet. Today, 69% of the world's population (over 4.9 billion people) have access to the internet [49], and the United Nations International Telecommunication Union estimated that around 73% of the world's population over ten years of age own a cellphone [50]. Additionally, over 59.3% of the total global population (around 4.74 billion) use social media on average 146 min per day [49, 51]. Among the popular social media platforms, six platforms claim one billion or more monthly active users per month and 17 platforms have at least 300 million active users as of October 2022 [51]. As a result of this increased access to networked devices and platforms, online education, in its numerous pedagogical and delivery models, is becoming a major phenomenon around the world and has had its own pedagogical ecology due to advances in technology.

In the final sections of this chapter, we describe the pedagogical ecology of online learning and present a framework that can serve as a starting point for educational reform in the Arab world by moving the needle from "schooling to learning" in order to "serve the needs of pluralistic societies and foster the development of active, responsible citizens who are empowered to deal with complexity and advance constructive change" [52]. As technologies evolve, we have more and more opportunities to reimagine and reinvent e-learning and online education programs in higher education contexts locally and globally, moving away from models that ask learners to memorize information and take recall tests to an ecosystem in which technology enables the design of learning experiences that are relevant, meaningful, and useful to learners.

3 Online Learning Models and Frameworks

As discussed earlier in this chapter, distance education started with correspondence courses back in the late 1800s where individual learning triumphed, and evolved to audiovisual instruction using broadcast technologies in the early 1900s, then to asynchronous and synchronous forms of online learning in the late 1990s and early 2000s with the onset of the internet (Web 1.0 technologies), and eventually to fully online and hybrid courses, MOOCs, e-learning, microlearning, and other forms of blended learning (e.g., hyflex learning, bichronous learning, mobile learning) and immersive learning with the onset of Web 2.0 and Web 3.0 technologies.

In its simplest form, online learning might be described as any learning that takes place using the internet as a delivery system [24]. However, terminologies such as online learning, e-learning, blended learning, or hybrid learning are often used interchangeably, and definitions of online learning continue to be debated and reconstructed. Generally, it is safe to say that online learning can range from learning environments where individuals work primarily independently, experiencing little or no interaction with an instructor or other learners (e.g., e-learning), to instructional interventions where students are highly engaged in interactions with the instructor and peers (e.g., synchronous and asynchronous online courses).

In this chapter, online learning is defined from a pedagogical perspective as follows:

> An open and distributed learning environment that utilizes pedagogical tools enabled by internet- and web-based technologies to facilitate learning and knowledge building through meaningful action and interaction.

This definition emphasizes the link or interaction between perception and action as it pertains to the affordances that learning technologies present in a learning situation and the abilities a learner has to harness these affordances and engage in meaningful activity. To maximize the potential of this interaction when designing online learning environments, a three-component model, based on the construct of pedagogical ecology discussed earlier in this chapter, is presented (Fig. 7). The three components of this model are: (1) learning technologies (top vertex), (2) learning activities or interactions (bottom right vertex), and (3) pedagogical models or constructs (bottom left vertex).

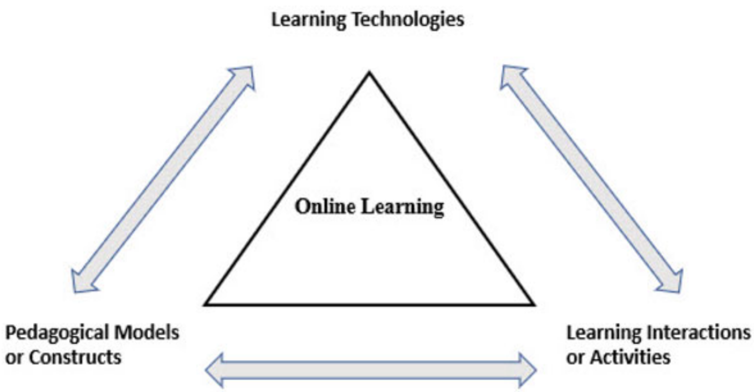

Fig. 7 Three-component model for online learning

3.1 The Three-Component Model for Online Learning

The three-component model for online learning is different from other learning design models in that it allows the instructional designer, developer, or online teacher/instructor the flexibility to begin thinking about designing an online course or course events with any of the three components of the model, and proceed clockwise or anti-clockwise to integrate the other two components in the design process. The decision regarding which component to start with is largely based on the instructional context and the expertise of the instructional designer, developer, or online instructor. For example, if a learning technology such as LMS has already been selected as a course delivery platform at an institution, the instructional designer or course developer should start by exploring the features of the LMS to understand its pedagogical potential in supporting online learning interactions and then proceed to design learning activities that maximize the pedagogical affordances of the LMS features to ensure overall instructional effectiveness and compatibility of the learning design.

Alternatively, a college professor who may be more experienced in pedagogical approaches can choose to begin with a familiar pedagogical model (e.g., experiential learning, personalized learning, game-based learning) and proceed to explore learning technologies and learning activities that support this pedagogical model to create an integrated learning design. Another unique feature of the three-component model is its emphasis on various media (learning technologies) as key components in the overall design process. Rather than treating these media as delivery vehicles or transmissive educational technologies, they are placed on an equal footing with the other two components to ensure that the affordances they bring forth to a learning situation are given appropriate consideration.

3.2 Meaningful Online Learning

The aforementioned definition of online learning also implies that learning should be *meaningful* and that learners should engage in *meaningful action and interaction.* Meaningful learning is grounded in a constructivist perspective, which grew in part from the work of Dewey and Piaget, and can be described as learning that has value, purpose, and significance. Constructivist learning theories posit that we (humans) learn by acting upon our environment, observing the results of our actions, and bringing our prior experience to the task at hand. Through reflection and retrospection, we either integrate what we have learned into our existing schema or we restructure our schema in order to reconcile the new knowledge with what we previously believed to be true [24].

So why is meaningful learning important in the online environment? If we (faculty/designers) make the mistake of thinking that an online course can be easily created by uploading lecture notes, creating online tests, and including some PowerPoint files and web links, we will be deeply amiss in terms of our knowledge of designing effective online learning environments. More importantly, we will be doing our students an injustice. While online courses can easily be developed by uploading recorded lectures, content materials, and resources online, this approach results in passive learning where students are receiving information to remember and restate without any real thinking, and where the instructor decides what is to be learned and students have no incentive to engage deeply with the concepts. Students would likely be disengaged from each other, forfeiting opportunities for learning with and from one another. More specifically, this approach to online instruction would be similar to the pedagogical ecology of broadcast technologies (pre-internet technologies) discussed earlier in this chapter and would not be taking advantage of the affordances of networked learning using Web 1.0, Web 2.0, or Web 3.0 technologies. Passive learning contrasts sharply with meaningful learning, which is described as learning that involves students "doing things" (learning by doing) and "thinking about the things they are doing" [53]. It is well documented in the research literature that designing learning activities that involve active teaching and learning have a positive impact on cognitive outcomes [54–56].

The most applied and impactful definition of *meaningful learning* comes from Howland, Jonassen, and Marra [57]. Howland et al. state that *meaningful learning is when we design learning tasks that are active, constructive, intentional, authentic, and cooperative.* This definition includes five characteristics, principles, or attributes, defined as follows:

- **Active learning** is when the learner is actively or intimately engaged in learning, manipulating the artifacts, objects, and materials of the learning environment, observing the effects of these actions, and reflecting on the consequences of these actions. Through our manipulations or interactions with things in our environment, we build meaningful knowledge and gain applied skills. Active learning is manipulative and observant.
- **Constructive learning** is when the learner is able to construct their own simple mental models that explain (articulate) their understanding of new knowledge. With experience and support in the online learning environment, learners will engage in reflective thinking that enables them to construct more complex mental models to represent their understanding of new concepts and processes. The active and constructive principles of the meaning making process are symbiotic. They work hand in hand for meaning making to occur.
- **Intentional learning** is when we ensure that learning is goal oriented and personally relevant. When learners are actively and deliberately working toward achieving a cognitive goal, such as getting a degree or developing a new career skill, they think and learn more because they are fulfilling a personal intention. This principle of meaningful learning aligns with the self-directed learning principle of adult learning. Self-directed learning requires the learner to engage in metacognitive self-regulatory strategies that include organizing, time-management, and self-discipline, which are critical in online learning and should be nurtured and supported in order to prevent attrition, a common problem of learning online.

- **Authentic learning** is learning that is complex and contextual. Research has shown that learning tasks that are situated in a meaningful real-world task or simulated using a case-based or problem-based pedagogical approach are not only better understood and remembered, but are also more consistently transferred to new situations. Relating learning concepts to something that is concrete and real, rather than abstract, allows learners to apply their knowledge in future conditions in which that knowledge may be applicable.
- **Cooperative learning** is learning that is collaborative and conversational or dialogical. Humans naturally engage in social activity, working together in communities and taking advantage of each other's skills and knowledge to support their goals and actions. Social learning can lead to the co-construction of knowledge among individuals. While one person may have good ideas, working together with others can collectively build greater knowledge. To work collaboratively, learners must communicate with each other by sharing ideas, listening to each other's perspectives, and working together to accomplish the task at hand. This requires specific design approaches in online learning leveraging the affordances of social media and information communication technologies.

As illustrated in Fig. 8, the characteristics of meaningful learning are interrelated, interactive, synergistic, and interdependent. That is, learning and instructional activities should be designed to include combinations of active, constructive, intentional, authentic, and cooperative learning rather than designing for each individual characteristic in isolation because that is how your online learning designs will result in meaningful learning [24].

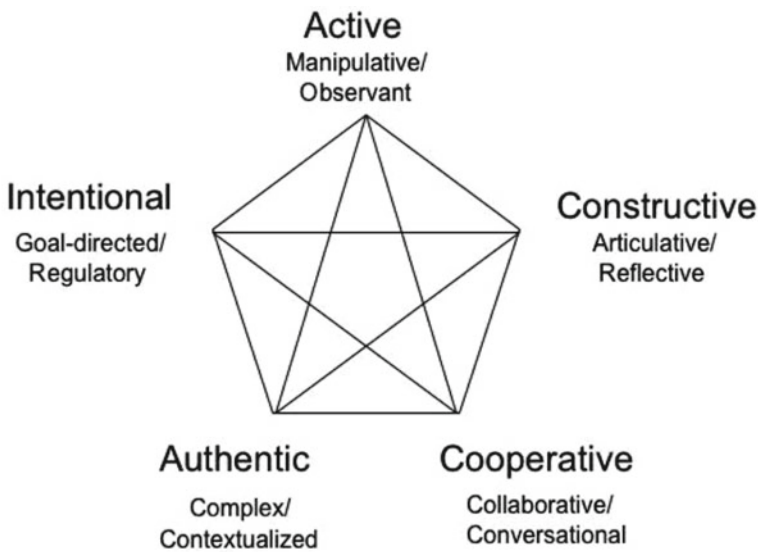

Fig. 8 Characteristics of meaningful learning

Designing meaningful learning activities using *The Three-Component Model for Online Learning* ensures that we are leveraging the pedagogical affordances of learning technologies for effective learning designs. Leveraging the pedagogical affordances of learning technologies results in providing opportunities for online learners to engage in meaningful learning activities that are active, constructive, intentional, authentic, and cooperative. Additionally, when interactions with technologies in the online environment are learner initiated and learner controlled, learners are empowered to take charge of their own learning and to use technologies as dynamic learning tools rather than information delivery tools. Figure 9 provides a classification of learning technologies based on their pedagogical affordances.

Figure 9 shows six classes of learning technologies that can be used to design and develop meaningful online learning environments:

1. Technologies for content creation and delivery
2. Technologies for collaboration and communication
3. Technologies for information search and resource management
4. Technologies for knowledge representation
5. Technologies for assessment and analytics
6. Technologies for immersive learning

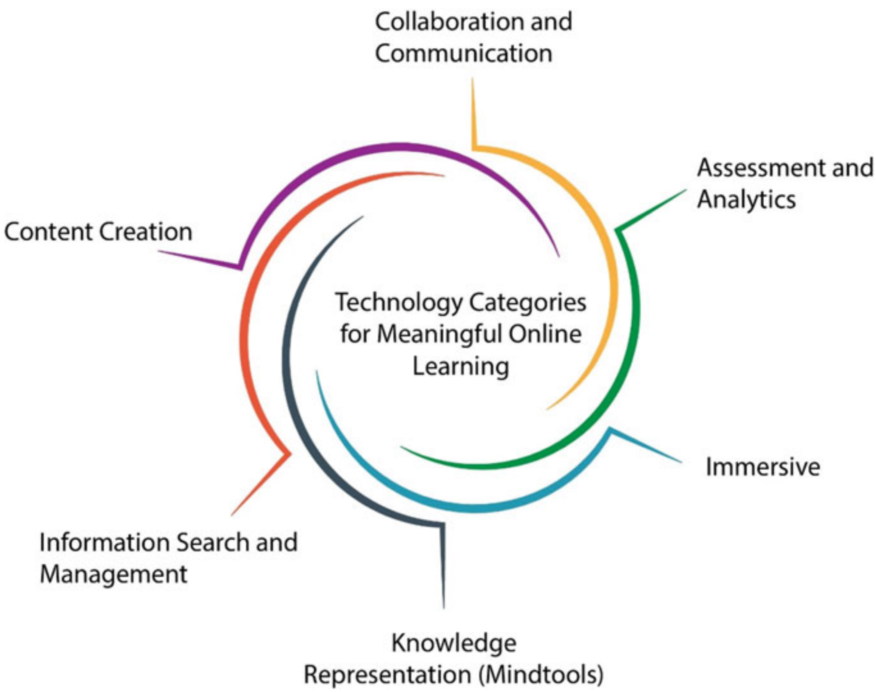

Fig. 9 Technology categories for meaningful online learning

Briefly, ***content creation and delivery technologies*** are primarily used by instructional designers or instructors (faculty/teachers) to create and manage digital content, but they can also be used by learners to create and contribute content such as assignments, journals, and resources. Examples of content creation technologies include tools embedded in learning management systems (LMS) (e.g., Moodle, Canvas, Blackboard, Google Classroom) such as course templates for setting up the course syllabus and content modules; a repository for content sharing, tagging, and reuse (e.g., a digital portfolio, wiki spaces); and instructional design tools for creating flexible learning sequences and designs as in e-learning (e.g., Articulate Storyline, Articulate Rise) among others. Web publishing tools such as Canva, Wix, Weebly, and Screencast-o-matic also belong in this technology category. ***Collaboration and communication technologies*** are technologies that help facilitate communication and collaboration between the learner and the instructor, the learner and other learners, and between and within learner groups. Collaboration and communication technologies can help reduce the isolation that can go along with being an online student as well as personalize the learning experience. Examples of collaboration and communication technologies include asynchronous communication technologies such as e-mail, discussion forums (features of LMS), blogs, wikis, social media technologies, and document storage spaces (e.g., Dropbox), as well as synchronous communication technologies such as chat, video-based synchronous sessions (e.g., Zoom, Skype), screen sharing technologies, and group synchronous workspaces (e.g., Google Drive and OneDrive).

Information-search and resource-management technologies are a class of technologies used to search for resources on the internet or in specific knowledge repositories (e.g., databases at a library) and technologies that help us manage these resources that are at the heart of many online learning activities. When learners need resources, they almost immediately turn to an internet search engine to find what they are looking for. This illustrates how important search tools are to today's online learners. Examples of information search and resource management technologies include knowledge bases (e.g., dissertation abstracts, EBSCO, Library of Congress, e-resources); internet search engine tools (e.g., Google, Bing); and content collection, aggregation, and annotation tools (e.g., Zotero). ***Knowledge representation technologies*** are primarily used by learners to help them represent their understanding using audiovisual technologies. A simple example that shows how knowledge representation tools can be used is for an exploratory activity such as generating a concept map to represent the relationships between key components that the student is learning. Learners are actively constructing their external knowledge structures when using knowledge representation technologies. Other examples include learner-created databases, expert systems, videos, and spreadsheets, as well as interactive web publishing tools such video-creation tools.

Technologies for assessment and analytics are used to assess student learning in online learning environments as well as the overall effectiveness of the course or instructional intervention. This category of technologies includes rubric generation tools and rubric banks (e.g., iRubric, Rubistar); analytic tools (e.g., Google Analytics, LMS-specific analytics reports, xAPI powered interfaces); test and quizzing tools (e.g., Kahoot, QuizStar, Articulate Quizmaker); digital portfolio systems (e.g., Weebly, Wix, WordPress); and learner response systems (e.g., Mentimeter, PollyEverywhere). ***Immersive learning technologies*** are technologies that enable the creation of virtual experiences or digital spaces that strive to look and feel like a real-world setting, allowing participants to be "in" or "immersed in" the experience to the extent possible [58]. Examples of immersive learning technologies include simulations, VR games for learning (e.g., Minecraft or FutuClass), 3D immersive learning environments (e.g., Second Life by Linden Lab), and augmented reality (AR), mixed reality (MR), and extended reality (XR) technologies.

For an in-depth look at how these technology categories can be used to design meaningful online learning activities and experiences based on their pedagogical affordances and to view specific examples and applications, you can consult Dabbagh, Marra, and Howland's 2019 book titled *Meaningful Online Learning: Integrating Strategies, Activities, and Learning Technologies for Effective Designs* [24].

3.3 Putting It All Together—The Meaningful Online Learning Design Framework

Figure 10 presents the Meaningful Online Learning Design (MOLD) Framework, which illustrates the relationship between the three-component model for online learning (Fig. 7) and the five characteristics of meaningful learning (Fig. 8). The five characteristics of meaningful learning shown in the outer circle of the MOLD framework in Fig. 10 should be considered as overarching pedagogical principles for designing meaningful online learning experiences and used to guide the designer as they select learning technologies, learning activities, and pedagogical models or constructs.

The MOLD framework suggests that in order to create active, engaging, and authentic online learning environments designers must consider the meaningful learning characteristics in their choices of each of the components of the three-component model for online learning while retaining the reciprocal and transformative interaction among these components.

3.3.1 Online Learning Example Using the MOLD Framework

To end this chapter, we provide an example of how the MOLD framework can be used to design online learning experiences for adult populations. The example was designed and developed by a student enrolled in a graduate class of the ***Learning Design and Technology (LDT)*** graduate program at a higher education institution in the United States. Students in this class are required to submit a proposal for an online learning environment that includes the following elements: (1) instructional

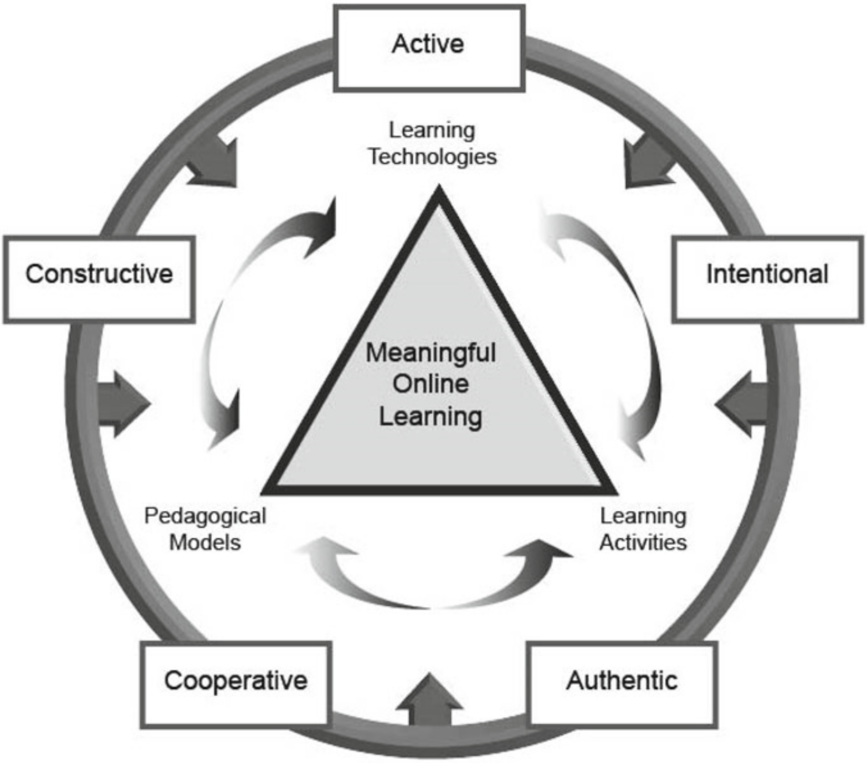

Fig. 10 Meaningful Online Learning Design (MOLD) framework

problem, (2) target audience, (3) general knowledge domain, (4) learning outcomes, (5) pedagogical model, (6) learning problem that will engage the target audience, (7) learning activities and learning technologies, and (8) assessment. The title of the student's proposal used in this example is: ***Math Education Challenge: K-12***.

3.3.2 Use Case Example of Applying MOLD—Math Education Challenge: K-12

(1) ***Instructional Problem***

Mathematics is one of the core subjects in K-12 education in the public school system in the United States. In the earlier school years, at the elementary level, teachers share similar issues in teaching English, math, or science. Most students can read and write by the middle elementary school years yet math can be intimidating for many students as they progress from basic math calculations like addition or subtraction to advanced concepts like algebra and geometry. Math educators face multiple challenges in their classrooms.

A math curriculum is built on concepts learned in previous school years. If a student does not have the prerequisite knowledge, then a math teacher can either do some remediation or forge ahead and cover concepts that the student might not understand. Often, students are not able to find a connection between important concepts in math and real life. For example, students do not find real applications of trigonometry, geometry, or algebra in their daily life. Mathematics teachers often have classes with students of varying ability levels within the same classroom. This might result from gaps in prerequisite knowledge or students' individual feelings in relation to their ability to learn math. Immediate feedback from the teachers can allow the students to understand their mistakes, work to correct the errors, and use the information effectively. Another important issue is the lack of practice and review by classroom students to achieve the mastery of concepts.

The problem, which needs to be addressed from a variety of angles, has been how to effectively teach mathematical concepts to a class of students with varying intellectual abilities. Suitable instructional opportunities specific to the mathematical concept are needed to engage classroom students to develop their mathematical thinking by creating connections to the concepts in the real world, listening and responding to students' thinking, supporting them to consolidate their understanding, and fostering regular math practice.

Various in-person workshops have been conducted at schools and there have been partial improvements in the mathematical abilities of students at the county level; however, with the reduction in the number of such workshops and teachers' hectic schedules, additional interventions are needed to address this instructional problem.

(2) ***Target Audience***

The target audience for this learning environment are the math educators in K-12 education (i.e., teachers). The learners can be novice trained teachers, teachers with some experience but lack the conceptual fluency in the subject, or experienced teachers but with limited experience in the use of technology in teaching mathematics. Some of these teachers are undergraduates or graduates majoring in math, while others are majoring in English or humanities. Learners without strong mathematical knowledge may be struggling with the content fluency and must get comfortable with using technology on a variety of devices.

(3) ***General Knowledge Domain***

The knowledge domain consists of the understanding of student learning and effective math teaching strategies in a classroom setting, i.e., understanding math in ways that help students develop their own mathematical thinking, seeing mathematical connections, being able to determine appropriate instructional representations for mathematical ideas, and recognizing what questions to ask next, in order to further students' thinking.

(4) ***Learning Outcomes***

The learning outcomes for these teachers are as follows:

- Assess the topic to engage students in mathematical activity like investigation, conjecturing, proving, collecting data, describing, solving, calculating, etc.
- Develop the skills of creating meaningful mathematical tasks.
- Develop the skills of listening to student's thinking and responding to the student thinking.
- Recognize and connect student thinking to meaningful mathematical ideas.
- Develop the skills to help students consolidate their understanding of mathematical concepts.
- Analyze the concepts to determine the connections with the real-world applications.
- Develop the skills to engage students in discussion about mathematical ideas to enhance their justification and argumentation skills that lead to proving the concept.
- Apply lessons learned from analyzing and assessing an example scenario to interpret their own scenario in the classrooms.

(5) ***Pedagogical Model***

The pedagogical model that will be suitable for this learning environment is the MOLD framework. The five characteristics of meaningful learning are active, constructive, cooperative, authentic, and intentional. The learners will be engaged in active learning as they examine the scenario example, research information, and analyze data to produce instructional strategies best suited for the situation. As the learners work through the problem, they will reflect on their experiences and observations to represent their understanding in multiple ways. They will be working in authentic learning settings in which the learning tasks are situated in meaningful real-world contexts that promote deeper understanding and transfer of skills to newer or different situations. Through authentic learning activities, learners will develop collaboration and critical thinking skills. The learning environment will enable the learners to work collaboratively, communicating with each other, sharing their ideas and knowledge, and building a collective knowledge base.

(6) ***Learning Problem***

The learners are presented with an example scenario that actively engages them in experiential learning to analyze and assess the situation for designing appropriate instructional opportunities specific to the mathematical concept for their students in the real classroom settings. The learning problem allows the learners to develop their students' mathematical thinking, creating connections, listening and responding to their student's thinking, and guiding them to consolidate their students' understanding of the mathematical concept.

(7) ***Learning Activities and Learning Technologies***

The learning activities and the learning technologies used will be based on real-world math teaching in K-12 classrooms. The learner adopts the role of a math teacher in a classroom setting. The learners are presented with a scenario to teach a mathematical concept. The learner will be provided with various curated resources to read articles and watch videos on the topic.

Scaffolding and Coaching: The learner will be presented with an example scenario. Each learner will be assigned a mentor or a coach. They can collaborate with the mentor or peers as they work on the scenario to build their instructional opportunities for their classroom students.

Collaboration and Social Negotiation: There will be a discussion forum where the learners will participate. Learners will be encouraged to share their strategies to solve the scenario. These discussions will foster collaboration and social negotiation and help the learners to learn newer perspectives or approaches to the problem.

Reflection: Learners will be encouraged to develop a journal that will help them reflect on the progress of their work. This will enable the learners to think deeper and explore the different ways to understand their students' thinking and connect them to mathematical ideas.

Articulation: The learners will articulate their knowledge by sharing multiple perspectives of the given scenario with their peers in order to generalize their understanding and knowledge.

The Math Education Challenge will be available to the learners as an online portal. The portal will provide access to all the relevant articles, videos, and other course content. The course activities will be structured and will follow a timeline for completion of the course. The portal will act as a learning community where learners will have access to the resources and will be able to communicate and collaborate in the future to share their experiences with others and learn from each other to construct a rich knowledge base.

(8) ***Assessment Strategy***

The learning environment will provide multiple forms of assessment to assess the learners on their use of suitable methods for teaching a mathematical concept to an individual student with different ability levels. This will include self-assessment strategies, peer-assessment strategies, mentor or coach assessment strategies, as well as the use of rubrics and feedback analytics.

- Self-assessment that allows the learner to compare and contrast their instructional strategies with that of the expert, coach, or mentor.
- A peer-assessment using a scoring rubric on the selection of the instructional strategies for the classroom teaching scenario.
- An assessment of the individual report summarizing the methods and tools used to address the situation. Expert math teachers will assess the report.

Table 1 shows a snapshot of how the components of this online learning environment align across learning outcomes, instructional strategies, learning activities, learning technologies, and assessment. This alignment is demonstrated for the first three learning outcomes.

Table 1 Pedagogical alignment across components of MOLD

Learning outcome	Instructional strategies	Learning activities	Learning technologies	Assessment
Assess the topic to engage classroom students in mathematical activity such as investigation, conjecturing, proving, collecting data, describing, solving, and calculating	Exploration Collaboration and Social Negotiation	Learners will research the mathematical activities applicable to the project topic (scenario example) Learners will work in pairs to design an instructional plan to identify the set of activities for the project topic	The learning environment with all the resources will be available for math educators online using an LMS or similar platform Google docs for collaborative work and Zoom for synchronous discussions	A rubric tool will be used by the instructor (expert, coach, mentor) to assess the appropriateness of the learning activity
Develop the skills of creating meaningful mathematical tasks	Exploration Collaboration and Social Negotiation	Learners will develop mathematical activities and steps to engage their students Learners will work in the same pair to design engaging mathematical tasks for their project Learners will create a presentation of the activities they have designed to explain their strategies to their peers and instructor	They work collaboratively using Google slides and Zoom meetings for discussions A video presentation of their slides using screencasting or zoom recording	Peer assessment based on a rubric tool will be used by every learner to assess two of their peers' instructional interventions or activities
Develop the skills to listen to students' thinking and responding to students' thinking	Scaffolding	Learners will view a video where a math educator listens to the thinking of their learner and responds accordingly	A video resource embedded in the learning environment demonstrating the skills	A rubric tool is used by the instructor to grade the video

(continued)

4 Conclusion

This chapter focused on the pedagogical ecology of learning technologies and described how technology evolved from the pre-internet era to the Web 1.0, Web 2.0, and Web 3.0 eras, and how the affordances of these technologies changed our teaching and learning practices as they evolved. An important argument was made regarding the non-neutrality of the learning space and the reciprocal interaction

Table 1 (continued)

Learning outcome	Instructional strategies	Learning activities	Learning technologies	Assessment
Apply lessons learned from analyzing and assessing an example scenario to interpret their own scenario in the classroom	Articulation Reflection	Learners will analyze and assess the example scenario Learners will participate in a discussion board to explain why the example scenario will work well or why it may not work for their classroom context The discussion board will have peer responses. At the end of the discussion, the instructor consolidates the learners' understanding related to the scenario and presents this to the learners for further reflection	A discussion board on analyzing and assessing the scenario, with at least two peer reviews Google Forms is used for the online quiz	Rubric tool will be used by the instructor to grade the discussion posts based on appropriate categories of the scenario Self-assessment in the form of a quiz that allows the learner to compare and contrast their instructional activities with those of the instructor or expert

between technology and pedagogy and how this interaction is recursive and transformative, yielding more innovative learning designs as technology advances. Transcending the pedagogy–technology dichotomy was emphasized by focusing on the concepts of entangled pedagogy and sociomaterial entanglement that place all the factors of a learning environment on an equal footing, particularly when technology is at stake, as technology is not just a delivery tool; rather, technology impacts our pedagogical and socio-cultural practices.

A three-component model for online learning was shared in which learning technologies, learning activities, and pedagogical models or constructs are placed on an equal footing, demonstrating the reciprocal interaction between these three elements and the importance of recognizing these interactions when designing online learning. This model was embedded in the principles of meaningful online learning resulting in a framework called MOLD. A use case example was provided to illustrate how MOLD can be used to develop online learning activities. Additionally, a classification of learning technologies based on their pedagogical affordances was provided.

As technologies evolve, we have more and more opportunities to reimagine and reinvent e-learning and distance education programs in higher education contexts locally and globally, moving away from models that ask learners to memorize information and take recall tests, to a world in which technology enables the design of learning experiences that are relevant, meaningful, and useful to learners, enabling them to develop a twenty-first-century skillset that is critical for modern-day workers.

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The Future of the University: Outlook for a Twenty-First-Century Economy

Elie D. Al-Chaer

Abstract Universities played a seminal role in the economy of the past century, a role that paralleled, to a large extent, the needs of nation-states, industrial production, and corporate management. In the twenty-first century, the structure and function of the contemporary university are changing rapidly in trying to keep up with knowledge-based economies and the demands of the times. Historically, the integrity of the modern university has been linked to promoting and protecting the idea of a national culture and catering to the local workforce. Now that the notion of the nation-state is declining and the nature of the workforce is morphing, universities are increasingly turning into transnational corporations, and the idea of national culture is being gradually replaced by a discourse of "excellence" driven more by global market forces and profit margins than thought and thought processes. This change was further escalated by the coronavirus pandemic, which, in many instances, appears to have gutted higher education. A number of colleges and universities across the world were forced to downsize or close their doors totally by the end of 2020. Others appear to have adapted rather quickly and made emergency investments in online technology to keep up with the mandates of the pandemic. This chapter takes a close look at the different roles the university has played historically and reviews the changing role of higher education over time. It also contemplates whether the university has reached the twilight of its social function or whether a new age is dawning with a renaissance of higher education. Certainly, higher education is not the only sector in which stakeholders are faced with the possibility of creative destruction to positively disrupt the way things are done. But while experiments with enhanced online instruction may offer opportunities for efficiency, the most important opportunity presented by the pandemic is the chance to rethink the political economy of the entire higher education system and reshape it to fit the challenges of the twenty-first century. To that end, the chapter proposes revamping university programs to focus more on the student/graduate and the skills needed in a twenty-first-century economy.

Keyword University · Higher education · Pandemic · Economy · Future · Creative destruction · Renaissance · Polymath

E. D. Al-Chaer (✉)
Law Offices of Elie D. Al-Chaer, Dallas, TX, USA
e-mail: elie@alchaer.com

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1 Introduction

1.1 Higher Learning in Ancient Times

Higher and advanced learning existed long before universities came about. Early records from Mesopotamia suggest that ancient scholars conducted systematic research and likely taught and passed on their learning to their pupils; whether these activities were conducted individually or within institutions cannot be definitively ascertained. The Royal Library of Ashurbanipal at Nineveh and the Library at Sippar were collections of knowledge from the seventh and eighth centuries (BC) that likely also had students and teachers associated with them. It wouldn't be far-fetched to presume that these institutions taught select groups of individuals the complex written languages of their day and used their experience and skills to further preserve and develop newly acquired knowledge [1, 2].

The first institution of advanced learning that was more fully documented was Plato's Academy, founded in 387 BC, followed by Aristotle's Peripatetic school founded in 335 BC. These two schools were not institutions for mass education; they only had a select few pupils [3]. Perhaps one of the first truly international institutions of higher education was the Musaeum institution [4, 5], which brought knowledge from around the known world. The Library of Alexandria in Egypt was part of this institution. It served primarily as a repository for knowledge from the Hellenistic world. In addition, it accumulated knowledge from Babylonia and Persia antecedent to Greek scholarship. Arguably, the Musaeum functioned like an international university. It attracted students from all around the Mediterranean basin who would come to be educated by the best teachers. The Ptolemaic Kingdom (305–30 BC), which ruled Egypt at the time, was supportive of scholarship and welcomed scholars from many regions to Alexandria [6].

Beyond the Mediterranean basin, several regions developed traditions of scholarship in the ancient world. In the Indian subcontinent, Pushpagiri and Nalanda were two well-known centers of advanced learning. They were devoted primarily to Buddhist teaching but trained individuals in arts, medicine, mathematics, astronomy, and early forms of political science. Taxilia was an earlier Hindu center of higher learning. It is associated with one of the earliest economic and political statecraft treatises, the Arthashastra [7].

By the first century (AD), China had developed Taixue, an imperial academy to train bureaucrats. It was the highest educational establishment in Ancient China created during the Han dynasty. By contrast to other academies that were more like private institutions, the Chinese imperial training system was more like public education. The school recruited students from across China. It is estimated that up to 30,000 students may have attended the academy at a given time [8].

In ancient Persia, Gundeshapur was a medical training and higher education institution during the Sassanid dynasty, around the third century AD. After the introduction of Islam, Gundeshapur continued to function for a while; it became one of the most important foundations for Islamic higher education in the years that followed [9].

In Europe, scholarship followed the Greeks' Platonic tradition. Ancient institutions of higher learning, during the Roman and later Antiquity period, were sponsored and overseen by courts and by scientific institutions, such as museums, hospitals, and observatories, and by respective scholars. Examples include the Roman Law School in Beirut (238 BC; see [10]) and others. Naturally, each sponsor used their institution to disseminate their knowledge, ideology, and view of the world. However, by the sixth century AD, these institutions were closed due to their association with pagan practices and philosophies. With the fall of the Roman Empire and the rise of Christianity, scholarship became confined to religious institutions, which sponsored cathedral schools and monastic schools. In their early days, these monasteries trained mostly priests and monks who documented the knowledge available at the time [11]; however, in many places, they became the forerunners of the later university.

With the rise of Islam in the seventh century, several Islamic religious schools came about in the Middle East. Foremost among those was at the estate of Zaid bin Arkam near a hill called Safa, where the prophet Muhammad taught some of his followers. Similar other schools (Madrassa) were established in other cities where Islam took hold. The curriculum, usually set by the madrassa's founder, consisted of teaching the Qur'an, the Hadith, fara'id, and other religious material. Teaching was generally carried out in mosques rather than in separate specialized institutions. In that sense, mosques were more than a place of worship. They were the community center where most of a city's social and cultural life took place [12]. Over time, the curriculum began to diversify with many madrassas teaching religious and secular sciences, such as logic, mathematics, and philosophy [13]. Some madrassas included in their curriculum history, politics, ethics, metaphysics, medicine, astronomy, and chemistry [14]. In the late eighth century, Abbasid Caliph Harun al-Rashid founded the House of Wisdom (*Bayt El-Hikmah*) in Baghdad as a library to store the collections of his papers, which was later turned into a public academy during the reign of Caliph Al-Ma'moun. The House of Wisdom, also known as the Grand Library of Baghdad, housed rare books and collections of Arabic and Persian poetry [15–17]. Al-Khwarizmi, the Persian polymath and father of algebra and algorithm, was purportedly appointed as the astronomer and head of the House of Wisdom around 820 AD [18, 19]. Other prominent examples of Islamic schools of higher learning include the ninth century al-Qarawiyyin in Fez, Morocco, and the tenth century al-Azhar in Cairo, Egypt.

1.2 A Brief History of the University

The Western-style university, in the sense of an autonomous organization of scholars, originated in medieval Europe. Before that, European higher education took place in cathedral schools or monastic schools (*scholae monasticae*), many of which became universities (see Sect. 1.1). The earliest universities developed under the protection of the church by papal bulls as *studia generalia* (the old Latin name of a medieval university). Although many of them evolved from existing cathedral schools, the development of cathedral schools into universities was quite rare, with the University of Paris being an exception [20]. Some universities were also founded by kings or municipal administrations with most of them developing from pre-existing schools when those had become primarily sites of higher education.

The concept of the modern university, however, was shaped in the Papal Decree of 1079 AD issued by Pope Gregory VII, in which he ordered the regulated establishment of cathedral schools [21]. The decree required the creation of cathedral schools, controlled by local bishops, for the purpose of educating the clergy. These cathedral schools became more influential than the older monastic schools and later transformed themselves into the first European universities [22]. The first such universities to have a form of corporate/guild structure were: (1) the University of Bologna (1088 AD), (2) the University of Paris (c.1150 AD, later associated with the Sorbonne), and (3) the University of Oxford (1167 AD) [23].

The University of Bologna began as a law school teaching the Roman Law of Nations (*Jus gentium*: Latin); this was an early form of international law, in demand across Europe at the time, supporting the rights of emerging nations against the empire and the church. The university's moto "Alma Mater Studiorum" (Nourishing Mother of Studies) was arguably based on its academic structure, awarding of degrees, and autonomy. These organizational arrangements made the University of Bologna the oldest institution of higher education continuously operating since the eleventh century in the sense of: (1) using the term *universitas*, coined at its foundation and derived from the Latin phrase *universitas magistrorum et scholarium*, which roughly means "community of teachers and scholars"; (2) being a high-degree-awarding institute; (3) having independence from ecclesiastic schools, kings, emperors, rulers, or other direct religious authorities; and (4) issuing secular and non-secular degrees in grammar, rhetoric, logic, theology, canon law, and notarial law [21, 24, 25]. Although the specific date of the University of Bologna's founding, set as 1088 AD, may not be certain, the development of the institution at Bologna into a university was a gradual process, which makes it unlikely that enough instruction and organization existed prior to 1150 AD to merit the term university [26]. The university was granted a charter (*Authentica habita*) by Roman Emperor Frederick I Barbarossa in 1158 AD [27]. The charter guaranteed the right of traveling scholars to unhindered passage in the interests of education. Today, the University of Bologna charter is claimed as the foundational origin of "academic freedom" [28].

1.3 Rise of the Modern University and the Emerging of Secular Education

The medieval universities were more of an association or a guild for learning specific crafts. They trained students to develop professional skills within disciplines. In the case of Bologna, the focus was law. The University of Oxford is the second oldest university and the oldest university in the English-speaking world. Its date of foundation is not clear, but teaching existed at Oxford in 1096 AD and developed rapidly after 1167 AD, when Henry II banned English students from attending the University of Paris [29]. By the thirteenth century, Oxford had founded its oldest colleges, and traditions, such as having a chancellor and residence halls, had become established (see [27]).

Although early universities were closely affiliated with the Catholic Church, they offered a broad education and important skills outside of religious teaching. Despite their religious association, they developed independently and trained individuals whose views would eventually come into conflict with those of the church [30]. When the University of Naples was founded in 1224 AD as a public institution, it was dedicated to a king rather than the pope or the Catholic Church. Many historians regard this development as key in the emergence of the concept of secular education, although most higher education institutions maintained religious studies as part of their curriculum. In Germany, municipalities and local city governments took on the founding of universities. This is the case with the University of Cologne (founded in 1388 AD) [31].

By the late medieval and early modern period, the number of institutions of higher education in Europe grew rapidly. By the eighteenth century, there were around 143 universities not counting other forms of higher education institutions, such as academies. The idea of faculties that differentiated areas of study first came about at the University of Paris. The topics of focus were philosophy, medicine, logic, theology, law, mathematics, astronomy, and grammar. These branches of study were seen to be related to a humanistic perspective, as many required translations of ancient works in addition to a focus on the discipline [32]. As the number of universities grew and they attracted scholars from various walks of life, they began to experiment with new ways of teaching and knowledge development, and gradually distanced themselves from Aristotelian notions of sciences and learning. Disciplines diversified and differentiated the sciences from the humanities within an education system. By the eighteenth century, universities began developing research journals and encouraging scholars to disseminate and publish their findings. In Germany, for example, the Prussian philosopher and linguist Wilhelm von Humboldt advanced the ideas of academic freedom, seminars, and laboratories as means for universities to foster debate, develop knowledge, and encourage scientific inquiry [33].

During the nineteenth century, public universities became more widespread and open to the masses. Most of them de-emphasized religion in the curriculum and gradually became secular institutions of higher education. With the Industrial Revolution, many universities shifted their focus more on the sciences than the humanities. In Britain, the university was seen as an engine for developing a secular, economic potential that could tap into the power of the masses by giving them access to education and subsequently an edge in a competitive industrialized world [34]. Empires throughout Europe began to transplant their education model throughout their colonies and the world was schooled with European concepts. These became so pervasive and entrenched within communities, cultures, and countries that when colonial powers diminished in the twentieth century, the educational models and university systems they had fostered were largely preserved in places like India, Africa, and the Middle East. On the other hand, the USA had adopted mostly the German models for a research university, and it wasn't until after World War I that the American University model would start spreading around the world [35].

2 the Twentieth-Century University and Impact on Academic Independence

Higher education was transformed in the nineteenth and twentieth centuries to meet the needs of an emerging **national, analog, industrial** economy. During the nineteenth century, the purpose of the university evolved from teaching the "*regurgitation of knowledge*" to "*encouraging productive thinking*" [36]. Two new university models came about: the German model and the post-revolutionary French Grandes Écoles. Along with Oxford and Cambridge in Britain, they were linked to freethinking, experimentation, the rise of the bourgeoisie during industrialization, and the decline of classical medieval Scholasticism.

In Germany, Wilhelm von Humboldt reformed the country's educational system based on new liberal ideas [37] and established the new University of Berlin. The goal was to exhibit the process of discovery of knowledge and teach students to "*take account of fundamental laws of science in all their thinking*." Humboldt envisioned university education as a student-centered activity of research. Subsequently, seminars and laboratories started to evolve [38]. Similar changes in the structure of knowledge and its organization into disciplines were taking place in the USA. These changes started, worldwide, in the late nineteenth and early twentieth centuries, although many argue that they were an outgrowth of post-World War II developments, such as the G.I. Bill in the US [39], the rise of federal funding for higher education, and the arrival of higher education for the masses. This is not necessarily the case. The formative years of America's higher education modern industry started in 1890 with the flourishing of the research university and the emergence of public sector institutions. This broadened the scope of institutions of higher education and yielded new and more specialized sub-disciplines. These changes were precipitated by several factors, among them the application of science to industry and the growth of the scientific and experimental methods.

The university that was hatched in a monastic cocoon nine centuries ago transformed into an evolving species, slowly adapting its values, mission, and goals to the demands of society. Significant evolutionary milestones could be noted along this journey; these include secularization, specialization, mushrooming of administration, growth of research, a redefinition of academic freedom, and the concept of tenure. With the acceleration of knowledge production, the evolutionary pace of higher education could now be measured in years and no longer in decades or centuries. Top research universities that once produced new knowledge became dependent upon financial ties with national economic agendas and those of the private sector. They ceased to be the bastions of new knowledge; many were transformed into just nodes in a global network of corporate research and development.

The twentieth century saw global wars, the end of colonialism, and the emergence of nation-states. The nation-state regulated almost every service sector of life including higher education. It controlled, to a large extent, the institution of universities and the policies that govern them, including who comes to the university and who graduates from it, from regulating admission policies, issuing visas to foreign students, using funding to incentivize and disincentivize programs, to quality control, and accreditation of degrees. In this context, many universities, private and public, became tools that serve and support national interests. The private sector and interested corporations also had their share of influence on university policies and plans, through earmarked donations and endowments. To these ends, curriculum design, classrooms, teaching methods, and the selection of students and their trainings were modeled after government and corporate needs to generate mostly workers on production lines or employees in office cubicles, with very little creative talent or drive to innovate. In fact, many of the creative thinkers and innovators of the twentieth century were not products of university education but college dropouts! Unfortunately, this archetypal model of the university spilled over into the twenty-first century with minor and insignificant updates.

Even in the absence of direct interference by government or the private sector, corruption, favors, and lack of a meritocracy often prevented talented people from advancing and fulfilling their ambitions, putting strong pressure on them to leave their discipline areas or migrate abroad. In many places, where government, money, and ideology are closely intertwined, little room is left for personal freedom. Research, production, and dissemination of knowledge must toe the official line. Academics and students could only succeed if they adhered to “official” opinions and views or “complied” with national policies and regulations. In many others, where religious beliefs and practices permeate life and hinder free discovery of knowledge, science stagnates, and social and economic progress is difficult.

This dependence, sometimes total, on governmental resources and extramural support from special interests, made the university quite vulnerable, and often compromised the integrity of its mission and skewed the pursuit of its ambitious goals. Ironically, the funding that built up higher education throughout the twentieth century has become its Achilles heel toward the century’s end.

3 The Twenty-First-Century University and the COVID-19 Disruption

As we emerged from the twentieth into the twenty-first centuries, the scope of university programs revolved around four main domains: arts, sciences, skills, and professional education. For each domain, a learner could receive theoretical or practical education (hands-on training, experimental and clinical work), or both. Whereas the theoretical could be delivered remotely, the practical required attendance and participation at physical facilities. For more than a decade now, private companies, nonprofit organizations, and universities alike have been experimenting with online courses. Then, COVID-19 hit, and what seemed like an experiment in modern distant learning transformed overnight into the norm. The global spread of the coronavirus and the resulting pandemic have upended business as usual for colleges and universities. Not only have campuses shifted to remote learning almost overnight, but many institutions found themselves suddenly grappling with grave financial challenges as the domestic and global economies faced a major recession. Enormous amounts of information have become available online for free, ready for watching, listening, or reading at any time, by anyone who's connected. Research has shown that online teaching was as effective for students as traditional in-classroom instruction (see [40]). Access, connectivity, and availability of free knowledge online imposed new pressures on the mission of the university as a venue for the exchange of theoretical knowledge, forcing higher education to be transformed yet again, this time to serve the needs of a **global, digital, knowledge** economy. Automation and artificial intelligence technologies are transforming manufacturing, corporate work, and the retail business, as well as higher education. These technologies were mostly developed outside the academic sector, and colleges and universities have been rather slow to acknowledge them. As a matter of fact, when the pandemic forced several sectors of active life into a near halt, many colleges and universities were caught off guard, falling behind and trying to catch up with technology, rather than being the drivers of innovation, at least in higher education; they seemed more concerned about their survival against competition from schools or training systems using online learning technology.

As universities and colleges continue to compete among each other for students, by showcasing metrics irrelevant to the learning experience (rankings, number of publications, impact factors, shady accreditations, etc.), existing alternatives to traditional higher education have emerged and made headways into the job market. Several companies are moving toward requiring workers have specific skills, trainings, and certifications—as opposed to college degrees. Providers of massive open online courses (MOOCs) are refining the means for people to complete classes and present their accomplishments in ways employers can understand easily. These present a serious threat to universities' business model. In one example, students in certain classes from a major MOOC provider—EdX—can get an official Arizona State University transcript listing their courses and grades [41]. An employer has no way of knowing that the person studied online. In another example, students can take classes online and get their grades for free; they would only need to pay if they are happy with their grades, and if they want an official college credit. This is a period of rapid change unlike that which universities have dealt with for centuries. Is the traditional university ready for a major disruption? Is it able to survive such a disruption, let alone lead it? With every economic downturn, universities suffered and had to resort to business tactics, often unbecoming of their history and prestige. These included closing good academic programs that were no longer self-sustaining financially, opening new programs that had little to do with the university's mission, strictly to "sell" degrees and certificates to paying enrollees, laying off people, or branching into new "greener" environments where they could make more money to sustain their business model.

3.1 Examples from Lebanon's Institutions

The above scenario is typical of what gradually happened with many institutions at the turn of the century and was accentuated anew during the COVID-19 pandemic. A case on point is the downfall of higher education in Lebanon over the past few years. Lebanon's higher education system is one of the oldest in the Levant and the Arab world. Up until the late twentieth century, Lebanon was the main hub for prestigious institutions of higher education in the Middle East, hosting historic private universities like the American University of Beirut (AUB), the University of Saint Joseph (USJ), and the Beirut College for Women (founded in 1948), which became later the Lebanese American University (LAU; see [10, 42]). Over the past 20 years, these institutions, particularly AUB and LAU, exhibited mushrooming growth with the development of new programs of knowledge. They invested in buildings, infrastructure, and research, expanding their education programs and recruiting highly qualified faculty from prestigious schools around the world. In doing so, they relied mostly on capital endowments, generous extramural donations, and the hope that foreign financing would sustain their ambitious goals. The USJ's growth was more conservative by comparison and, retrospectively, wisely scaled for sustainability and internal resilience, a credit to its poised and seasoned leadership.

The collapse of Lebanon's economy in 2019 [43] precipitated existential challenges for many an institution in the country, including institutions of higher education. Whereas USJ was able to weather the storm with dignified measures that affirmed its resilience and commitment to knowledge advancement and to affordable education, AUB's reaction was akin to that of a sinking Titanic, unable to contain the disaster. For the first time in its history and the history of Lebanon, the largest private employer in the country (second only to the Lebanese government) resorted to mass layoffs. The institution terminated about 800 employees (nearly 25% of its workforce), mostly from the Medical Center, a decision that will come back to haunt it amidst the pandemic [44] (see also [45]). Another challenge was the crash of the national currency's value against the US dollar. It exposed what appeared to be a lack of administrative and financial readiness at AUB—perhaps a want of leadership and administrative will—to help maintain the value of salaries paid to its faculty and staff, despite several early warnings. Furthermore, it revealed a schism in the institutional values of AUB's business model. This came to light when AUB continued to pay salaries to a handful of its top executives, in "fresh" US dollars deposited in US banks, in amounts that ostensibly surpassed, in the aggregate, the cumulative compensation of the employees laid off in 2020; those were paid in local currency (see [46]). The seemingly erratic administrative decisions and the apparent mismanagement of university affairs generated a lot of mistrust among faculty and staff in their university's leadership, which culminated in a mass exodus. Upward of 30% of employees in some faculties and schools had left AUB by the end of 2021, many of them to less prestigious institutions in Lebanon and the Arab world. To make things worse, AUB resorted to a tuition hike of 160% in 2021, citing the financial crisis [47, 48] (see also [49]). As this chapter is drafted, AUB has partially dollarized the students' tuition fees and there is fear of total dollarization of AUB's tuition. This comes as its sister American institution, LAU, has resorted to such a measure, prompting hundreds of students to march in protest [50, 51]. These measures force Lebanese students and their families, who work in Lebanon and are paid with the Lebanese lira, to purchase the US dollar on the black market to pay their university's tuition fees.

Adding anxiety to an uncertain situation, and despite its declared financial problems, AUB recently announced that it will be opening two new campuses in Cyprus and Dubai [52, 53]. Although the decision is in line with what many other institutions of higher education have done over the past 20 years, the announcement came at the heels of repeated denials by AUB's leadership that the institution had plans to move outside Lebanon. In 2022, AUB inaugurated its campus in Cyprus—AUB Mediterraneo [54]. Other institutions, LAU and Balamand University, are following suit. These plans, albeit expansive on the surface, are unlikely to meet the needs of a twenty-first-century higher education. They are, at best, mitotic replicas of twentieth-century models of the university, driven mostly by financial bottom lines and concepts superfluous to the academic mission, and proven obsolete when it comes to driving creativity and innovation. Furthermore, such plans could be easily substituted by more affordable and convenient alternatives, including distant or online education.

3.2 Academic Freedom and Free Speech on Campus

Academic freedom is usually defined as the "*freedom of teachers and students to teach, study, and pursue knowledge and research without unreasonable interference or restriction from law, institutional regulations, or public pressure*" [55]. Its basic elements include the freedom of teachers to inquire into any subject that arouses their intellect; to present their findings and publish their data and conclusions without control or censorship; and to teach in the manner they consider professionally appropriate. The main argument in support of such freedom is that knowledge is best advanced when inquiry is free from restraints by the state, by religious or other institutions, or by special interest groups. At the heart of academic freedom lies the promise of unleashing the creative potential of faculty and students by giving them the right to break the mold and be all they can be without fear of repercussion from society [42, paragraph 5]. However, it is important to recognize that there exists, today, a vast difference between academic freedom and free speech: the first protects rights held by educators to engage in academically recognized expression within their disciplinary competence, whereas freedom of speech is the right to express one's ideas, however true or false they may be. The latter is usually recognized as a human right and, in the USA, is guaranteed to the individual by the First Amendment to the Constitution. Surprisingly, the difference between the two has been recognized by special interests, including unions representing faculty [56], and exploited by some institutions to suppress free speech on campus. Additionally, several reports allege that many American institutions of higher education have "weaponized" Title IX of the Education Amendments of 1972 [57] to suppress free speech on campus [58–61]. However, a study conducted at the University of Baltimore in 2019 appears to refute these claims [62].

This may be hard to believe, but in the third decade of the twenty-first century, academic freedom, gutted of free speech, has become an elusive concept; defining it must consider the interests of society, institutions, students, faculty, and special interest groups. Ironically, many advocates of academic freedom have been diligently working to promote it through the development of more policies, procedures, rules, and prohibitions (see [56]), so much so that the notion of academic freedom itself has become highly encumbered with the need for compliance and political correctness, much like an old ship accumulating barnacles [42]. Even in academic research, scientists are expected to comply with a complacent research environment and with certain social and cultural policies. Anything short of that will put them at a tremendous disadvantage in the scientific community, from lack of funding to denial of publication in reputable journals, and subsequent implications on academic standing, and promotion; challenges that threaten any researcher's ability to survive at a modern university. This has led many scientists to question whether there is any real freedom to be creative in academic research. If anything, academia these days appears to stunt creativity when it needs to nurture it. In fact, those who manage to succeed in advancing to leadership positions in academic institutions are anything but creative; they are often cautious individuals, loyal to their leaders, making few enemies along the way, and stirring little controversy in their career—hardly the characteristics of avant-garde leadership.

One cannot overstate how crucial academic freedom is to the health of the modern university in general and the American style of higher education. Yet in the twenty-first century, it appears to be threatened on many fronts, most alarmingly within Western democracies including the USA. Challenges to academic free speech have intensified in recent years as many higher education institutions have become hubs of far-left neo-liberal extremists, and issues of free speech on campus have grown increasingly controversial. A growing number of universities find it rational to suppress freedom of speech, particularly by "the right," and are regularly canceling conservative speakers under pressure from so-called progressive groups [63, 64]. Paradoxically, a strong opposition to free speech seems to be posed by student activism, allegedly manipulated by progressive-thought leaders and social-media influencers, many of whom readily leap to defend the expressive rights of students as part of academic freedom (see [65]). At a specific level, this calls for a debate about the extent to which college campuses should be places for the free exchange of ideas, even those that are offensive to some students, or should be safe havens where some provocative ideas are kept off limits. At a broader level, it presents a question about the need for a national approach to speech protection—especially on the university campus—even that which may be deeply offensive to entire segments of the population (see [66]).

These limitations on academic freedoms and speech are further aggravated in countries with limited resources and failing economies. In Lebanon, for example, senior university administrators resort to direct intimidation of political speech, and they do it with impunity. In the aftermath of the 2016 US presidential elections, the President of the American University of Beirut, as the guest of a national television program to commemorate the 150th anniversary of the institution, used the occasion to deliver a scathing criticism of the newly elected US president then, Donald J. Trump, and his supporters declaring that they belonged in "the trash bin of history" [67]. At a time when anti-American sentiments were raging in the region, this had a chilling effect on a great number of American faculties and students who supported Trump and were forced into silence for fear of retaliation. The same university president would not hesitate to grab a bullhorn and join protesters on the streets of Beirut at the onset of the 2019 uprising in the country—a move that was perceived by many as inciting unrest and taking sides in a divided country, thus suppressing the voices of faculties and students opposed to the uprising.

Besides direct threats to free speech in these corners of the world, faculties in Lebanese universities have no access to extramural resources or international funding. With the collapse of the national currency, their salaries, in most cases, have been reduced to 10% of their 2018 values. Whereas a few private institutions (such as AUB and LAU) have adjusted their faculty salaries, these adjustments were minimal and arbitrary at best, and structured to keep the faculty "in line" and at the mercy of the institutions command. Faculty salaries continue to be "officially" reflected in local currency on contracts and salary letters, although institutions use discretion in reporting them in US dollars or in Lebanese liras at their financial convenience. A similar approach was adopted with students' tuition fees. As those were "dollarized," students were promised financial aid in the form of loans and scholarships subject to university rules and regulations. This effectively places a proverbial tight collar with a short leash around students' necks, controls their freedom of speech, and compels them to remain "docile" and tame vis-à-vis the university's policies and leaders.

The examples from Lebanon are but a sample of what higher education is wrestling with everywhere else. Today, the university continues to be, purportedly, in crisis: a crisis of ideas, a crisis of liquidity, a crisis of freedom, a crisis of identity, and most importantly, a crisis resulting largely from inequality between administration and faculty, and where the students are increasingly regarded as customers and asked to shoulder the financial burden of their education. Administrative decisions seem to be made mostly on the basis of extraneous markers [68] driven by profit seeking, and the academic mission appears to be adrift, although see [69]. Whatever the causes of this state of affairs may be, disruption is the most commonly recommended solution. To quote a philosopher of higher education, Ronald Barnett: "*Ideas of the university in the public domain are hopelessly impoverished. 'Impoverished' because they are unduly confined to a small range of possible conceptions of the university; and* *'hopelessly' because they are too often without hope, taking the form of either hand-wringing over the current state of the university or merely offering a defense of the emerging nature of 'the entrepreneurial university'*" [70].

4 A Vision of the Future

Current ideas about innovation in higher education seem to focus almost exclusively on technological disruption: maintaining in-classroom teaching, switching to online education, or some hybrid form of both. It is as if higher education is slowly moving from a singular method to a binary one. In as much as this disruption is needed, it need not be limited to these binary choices or to the MOOC-ization of higher education (MOOC: massive open online courses). By contrast, those who resist disruptive change long for a return to a supposed Golden Era as imagined by Wilhelm von Humboldt [33] or John Henry Newman [71]. A workable vision for the university of the future would preserve the traditional values of human dignity, freedom, and excellence, take into consideration the diversity of the learner pool, exploit the technological advances at hand, and reshape higher education with a focus on the learner's needs.

Established colleges and universities are facing escalating operational challenges, including reduced funding, changing student demographics, questions regarding quality and value, and increased competition. Their success—or more bleakly, their survival—requires a transformative change to enable new teaching and learning approaches, keep up with the evolution of knowledge, stay ahead of the development curve rather than trying to catch up with it, diversify the modes of knowledge exchange to focus on the needs of the learner, and finally, shift the focus from the image of the university and its market reputation (trivial metrics like ranking schemes, number of publications, impact factors, etc.) to the quality of its main product: the graduate.

As we navigate the fundamentally altered educational landscape of the new era, we need to constantly update our definition of the future university. Below are five models of innovative approaches to higher education in the twenty-first century that should expand our idea of the university. They focus on the learner's experience as the primary goal of a university's mission, taking into consideration the different learning needs of the diverse pools of students. The models require an entrepreneurial spirit capable of imagining and putting to test a transformation of an existing, or a start-up, university different from what we currently have. This new university is grounded in a deep philosophy of higher education that puts the learner at the center of its mission and harnesses our technological advancement to diversify the venues for the exchange of knowledge.

In many aspects, this is an exercise in speculative design [72]. It contemplates designs that critique existing norms, but also suggests possibilities for alternatives. These designs may not all be practical, but they call for a new philosophy of higher education that contemplates the student's identity in this enterprise; is the student a customer of the university or a product in the making, with the graduate being the ultimate product? Is there a university customer—maybe the tuition payer: society, parents, student, etc.—and what would customer satisfaction entail? The exercise below provides proposals for five new institutional models that focus, mainly, on the learner, the student, and the graduate.

4.1 The Polymath

A polymath is someone with multiple interests. Polymath learners are "renaissance" people who exhibit a signature trait, namely curiosity, like the prototypical polymath Leonardo Da Vinci. In traditional universities, the educational needs of the polymath are largely ignored as the focus of the educational mission is oriented toward the average generic student, the median of a bell-shaped curve. Special attention is often paid to students falling below average, to the left of that curve, but rarely to the right end of that spectrum. High performers, although celebrated by their institutions, rarely receive any special education that meets their competitive needs. In the polymath mode of knowledge exchange, the university's emphasis is shifted toward the high performers, as these are more likely to push the envelope of knowledge. The polymath program offers its students a "menu" of three majors in three broad domains: (1) the professions, (2) the sciences and social sciences, and (3) the arts and humanities. To matriculate, every student must commit to these three distinct majors. The faculty in such a program is carefully selected in such a way that members are competent in at least three distinct disciplines with the ability to teach, research, create, and think in the areas between those disciplines. The current university has all but paid lip service to true interdisciplinary and multidisciplinary pursuits. Bringing together people from different disciplines but with singular proficiency often fails to generate the desired multidisciplinary outcome as it falls short of integrating their expertise into a meaningful pursuit. A major barrier is communication between experts across disciplines and a clear understanding of what every other expert is doing. A polymath program brings down these barriers. The true multidisciplinary makeup of the individual faculty and students enables the mashing-up of distinct ideas and facilitates communication between constituents. This empowers the students to make connections between disparate concepts, thus unleashing their creativity and innovative thinking.

Academic disciplines have been described as idea-spaces. An idea-space is "*a domain or world viewed from the perspective of the intelligence embedded in it, intelligence that we can use… both to solve our everyday problems and to make the creative leaps that lead to breakthrough*" [73]. In that regard, academic disciplines "*embed collective intelligence about the most effective way to carry out research, typically providing an overarching framework of established theory, principles, practices, heuristics, methodological assumptions, lab techniques, and so forth*" [73]. Therefore, the majors at a polymath program would be designed in such a way that students are required to take sufficient credits in each discipline as to demonstrate mastery of this collective intelligence. As Richard Ogle noted, "*Creative leaps arise from the imaginative and insightful transfer of powerful, externally embedded intelligence from one idea-space to another*." He described the experiences of scientists, artists, and other creative individuals who advanced new ideas or solved intractable problems, namely because they could "*leap from one-idea-space to another without getting trapped in a single one*." Polymath programs induce such creative potential in students by inviting them to explore three different idea-spaces in depth. Whereas the idea of a polymath program may have been far-fetched a few years ago, a few classical higher education institutions have started to explore it. One example is the Polymathic Scholars Honors Program in the College of Natural Sciences at the University of Texas in Austin. It is open for science majors with multidisciplinary interests beyond or within the sciences [74]

4.2 The Nomad

The nomad learner does not require a fixed physical location for the exchange of knowledge, as such a nomad program is not necessarily tied to a campus. The spot where learning occurs shifts around the globe, with professors and students seeking out problems and experiences anywhere in the world, a match with the global economy of knowledge. Industrialization in the eighteenth–twentieth centuries required people to settle in one physical location, to perform a very specific task, or function, and become very adept at this one function. However, the jobs associated with the knowledge and information economy of the twenty-first century have dispensed with the requirements of specific tasks and locations and paved the way for an itinerant—nomadic—worker who is "creative, imaginative, and innovative" and who can work with almost anybody, anytime, and anywhere. The emerging online university that many traditional schools are adopting is but one aspect of this concept. Nomad programs transcend the fixed physical campus and are not limited simply to online teaching.

Courses in nomad programs are organized each around a specific problem. Faculty mentors identify the problem, maybe a research question. Then, through a virtual network, students and professors decide on the nature of the problem and the outcomes for completion (standard for success). They come together around a schedule at a predetermined physical location, where they will work on the problem or the research question for a given period. The question can be related to a current challenge facing a given society or community anywhere around the globe. It may involve finding solutions to an engineering infrastructure problem in sub-Saharan Africa, or mediating conflict and clashes resolutions between the police force and an ethnic community in an American urban center, or addressing the problem of refugees on the Lebanese–Syrian border, or designing a software solution for a global multinational challenge. The evaluation of success involves an assessment of the outcomes based on the standard for completion set in advance. It takes into consideration the perspectives of students, faculty, and representatives of community stakeholders. When an acceptable equilibrium (solution) has been achieved, the student–faculty group gathered for the course disassembles until a new problem is selected in a different location.

There is today a Nomad University in existence [75]. It is an international network of outstanding teachers allied with an open global community of self-directed students. Additionally, several established US institutions have started similar programs—for example, the American University in Washington DC [76], Purdue University Global [77], and others.

4.3 Learning with Computers

In this mode of knowledge exchange, the learning experience involves an interface between the learner and the computer. The interface centers on the notion that machines will not—and indeed cannot—supplant human cognition. Many futurists and ethicists are concerned that computers and algorithms will gradually replace human beings in a wide range of cognitive tasks once believed to be impervious to automation [78]. Industry leaders and several commentators foresee a near future where computer skills have replaced human skills, in the same way that mechanical labor displaced human labor during the industrial revolution [79, 80]. That is why at these interface programs, students will learn how to "think with computers."

The curriculum presumes that humans and computers thinking together are better than humans or computers thinking alone, and that thinking with machines will allow students and trainees to engage in a level of cognition not possible with the human brain alone. This requires more than just giving students laptops, tablets, or unrestricted access to computers. Rather, it necessitates an environment that can enhance the quality of the interface between the computer and the individual brain. This interface is a "*form of relation that obtains between two or more distinct entities, conditions, or states such that it only comes into being as these distinct entities enter into an active relation with one another… and such that its overall activity brings about the production of a unified condition or system that is mutually defined through the regulated and specified interrelations of these distinct entities*" [81]. An aspect of the interface mode of knowledge exchange may be a customized holographic experience that provides learners with access to theory and practice tailored to their individual needs. The Mirror Lab at the University of Arizona is an early model of an interface university program [82]. Other institutions of higher education are developing interface programs with the help of IBM's Watson [83], Google's Deep Mind [84], or other artificial intelligence resources.

4.4 *The Skillfully Competent*

In this mode of knowledge exchange, the learner focuses on mastering a set of skills rather than enrolling in predetermined courses that require a set amount of time to complete. These are offered through competency-based degree programs that allow students to master specific skills in their field of study at a pace that works best for them. Students can use the learning resources provided by faculty and apply knowledge acquired through work, life experiences, or prior education. Better yet, they can complete as many competencies as they desire during a specific term, giving them the opportunity to lower tuition costs by finishing their degree faster. Once they have proven proficiency in all the competencies in their field, they earn their degree.

Several US-based institutions currently offer such programs. They include the University of Michigan, Purdue University, Capella University, and many others. These competency-based programs provide students with diverse reasoning and practical skills that prepare them for the needs of work in the modern world. There are no specific majors or electives. Rather, a degree from such a program indicates competence in a number of skills, in which students have developed fluency. Ten work skills have been identified by the Institute of the Future report as "*proficiencies and abilities required across different jobs and work settings*" [85]:

1. **Sense-making**: determine the deeper significance of what is being expressed.
2. **Social intelligence**: connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions.
3. **Novel and adaptive thinking**: proficiency at thinking and coming up with solutions and responses beyond that which is routine or rule based.
4. **Cross-cultural competency**: operate in different cultural settings.
5. **Computational thinking**: translate data into abstract concepts and understand data-based reasoning.
6. **New-media literacy**: critically assess and develop content that uses new media forms, and leverage these media for persuasive communication.
7. **Transdisciplinarity**: literacy in and understanding of concepts across multiple disciplines.
8. **Design mindset**: represent and develop tasks and work processes for desired outcomes.
9. **Cognitive load management**: differentiate and filter information for importance, and learn how to maximize cognitive functioning using a variety of tools and techniques.
10. **Virtual collaboration**: work productively, drive engagement, and demonstrate presence as a member of a virtual team.

For a more detailed description of these skills and their role in work settings, see the Future Work Skills Report [86].

Several studies have found that most employers look for college graduates with broadly applicable skills rather than specific college degrees. These skills include, for example, oral and written communications, critical thinking, solving complex problems, taking responsibility, and innovation, as well as ethical judgment and integrity

[87, 88]. Current undergraduate colleges do not teach these skills. Instead, they teach subjects and disciplines (history, philosophy, psychology, languages, physics, etc.). If, by chance, a student acquires these skills, it is a byproduct of subject-based education where students can major in or concentrate on only one or two subjects. By contrast, the skillfully competent graduate is equipped with a broad-based skills experience that aligns with workforce development needs: the skills prioritized by employers become the subjects of a liberal arts education. Thus, instead of the limited options of history, chemistry, or other arts and sciences disciplines, students study sense-making and complex problem solving, for example, with formal courses organized around each skill. This also requires a new type of faculty, one experienced, or retrained, in these skills rather than just in academic disciplines.

4.5 The Gamer

This mode of knowledge exchange makes play the highest form of learning, well above the acquisition and production of knowledge. "*The ability to play may be the single most important skill to develop for the twenty-first century*." Play, in this context, is defined as "*the tension between the rules of the game and the freedom to act within those rules*" [89]. The activities of the gamer learner look much like the activities that artists engage in. If the conference room and the laboratory define the modern research university, then the studio defines the learning arena for these ludic programs. The program has no set curriculum and no preset courses to take. Instead, students are encouraged to follow their curiosity and explore subjects necessary to satisfy that curiosity [90]. Students explore novelty and engage in reproductive creation: imagining that which does not exist and bringing the "new" into existence.

During their intellectual development, children reach a stage when "*they are able to envision a state of affairs contrary to the one that is apprehended by their senses, to capture that imaginative activity in public symbolic form, and to continue to elaborate upon that imaginative capacity*" [91]. As Gardner noted in his book [91], play and imagination are closely linked. A key epistemological tenet of learning through playing would be that play and imagination define higher learning, and so the program's mission is first and foremost to cultivate the imagination. "*Capturing the imaginative creativity in public symbolic form*" defines the central activity of the program or the university.

The ontological terrain on which learning through games operates is that students enact play not within the actual world but in possible worlds. "*The most fundamental characteristic of the imagination is its ability to let us free ourselves from the grip of present reality.... [T]his characteristic enables us to construct and play with alternative ways of seeing, understanding, and acting in the world that allow something new, interesting, and useful to emerge.... The imagination frees us from the mesmerizing grip of reality, allowing us to invent, play with, and even try out alternative worlds*" [73, pp. 69 and 73]. "*The work of the imagination does not represent 'what* *is absent.' It also posits objects that otherwise would not exist*" [92]. To play means to imagine that which would not otherwise exist.

While there may be real-world applications of the results of play—for example a new way to organize the economy—creations that act upon the world are not the primary outcomes sought at these programs. Play is an end unto itself.

5 Conclusion

The quest for knowledge existed long before the university came about, or higher education became a household commodity, and it will likely continue taking many shapes and forms and in a variety of venues. Yet, one cannot discount the role of the university in shaping our modern society. In this chapter, we offered a brief historic review of the origins of the university, going back to ancient higher education and advancing forward to the evolution of the Western-style university. In the nineteenth and twentieth centuries, the university evolved to meet the needs of an industrial economy and serve the aspirations of nation-states, industrial production, and corporate management. This role spilled over into the early twenty-first century but is rapidly changing in trying to keep with knowledge-based economies and the demands of the times, compelling structural and functional changes of the contemporary university. As the notion of the nation-state started to give way to that of a global tribe and the nature of the workforce started to morph, universities are increasingly turning into transnational corporations, pitching a discourse of "excellence" driven more by global market forces and profit margins than thought and thought processes. This change was further escalated by the coronavirus pandemic, which has compelled a great reset [93] and, in many instances, appears to have gutted higher education of its traditional elements. Several colleges and universities across the world were forced to downsize or close their doors totally by the end of 2020. Others have adapted rather quickly and made emergency investments in online technology to keep up with the mandates of the pandemic.

The chapter also touched upon the origins of academic freedom as a crucial element for the health of the modern university. Academic freedom, in the twenty-first century, has become such an elusive concept that defining it must take into consideration the interests of society, institutions, students, and faculty, rather than purely the ideals of freedom of thought, exploration, and speech. These special interests, allied with the evolving need to comply with social and cultural policies and regulations, and to fit with a complacent research environment driven largely by money, have further shackled academic freedom. Several examples from around the world show that modern academia appears to stunt creativity when it needs to nurture it. This calls for an open debate about the definition of academic freedom and its scope and begs the question whether there is any real freedom left in twenty-first-century academic settings.

It is undeniable that the long-term interests of a society are best served when the educational process leads to the advancement of knowledge. The hybridization of higher education with remote online teaching, precipitated by COVID-19, may have been a step in the direction of modernizing higher education, but it is not enough. The job market is changing. The number of jobs involving routine skills—both physical and cognitive—is shrinking over time. Increasing automation is rapidly replacing workers at factories, even in low-wage countries like China. Artificial intelligence technologies, like machine learning and computer vision, are permanently eliminating high-skill jobs in offices, too. Many world economies—including in the USA—are turning from manufacturing to service, in which most new jobs do not require advanced education. This necessitates a change in the university model and its role in society: from a competitive model to a more cooperative one, where several institutions could come together and join efforts to maximize the use of resources in the delivery of knowledge; from institutions that cater to the elite to ones responsive to the public square and societal needs for knowledge, advancement, and growth; from institutions that pitch a brand, promote generic interests, or market education as a product for sale, to ones that deliver knowledge as a global utility, focus on the student and the graduate as the primary product, and attend to local issues and problems in the global context. Five different programs are proposed; each one of them has the potential to be a stand-alone university.

The proposed models offer a transformative vision that will challenge our existing dogma vis-à-vis the role of the university in society. It would require the university of the twenty-first century to be open yet shielded from interference by government, financial sponsors, or other economic interests, for it to afford its faculties and students the freedom needed to think, explore, debate, create, innovate, and change.

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Distance Education: Is It Any Longer a Paradigm of Choice? The University of Jordan; A Case Study

Nathir M. Obeidat, Rida A. Shibli, Mohammed A. Khasawneh, and Nael H. Thaher

Abstract Traditionally, lecture-based learning has prevailed for centuries resulting in a conventional academic system that has become the paradigm for education adopted in various countries around the world. Over the years, however, especially with advancements in science and technology, this paradigm has gradually started to fade in the wake of a need to accommodate the role of the primary constituent of such an educational paradigm, paving the way for a newer paradigm that allows for a more pronounced role, with improved learning outcomes, for its constituents. Hence, a new system of learning, a student-centric paradigm, otherwise known as an outcome-based paradigm of education, started to emerge to allow recipients to have a more active role in the educational lifecycle. Here, although this new system became more appealing to many, it was only adopted by academic institutions that were seeking to stand out in delivering to the job market a product with more-pronounced and well-defined roles for learners. In the interim, the providers of all existing paradigms were also keen to make their learning material available to recipients well beyond the boundaries of the classroom and the hosting institution/s involved. In this, many academic institutions of higher learning had already started to leverage the ubiquity of the World Wide Web and the underlying digital solutions that were evolving to produce teaching material in electronic format and make it readily available to the recipients anywhere and anytime. Soon after, the revolution that had impacted all ongoing developments to the internet and the evolving speeds in data

N. M. Obeidat
School of Medicine, The University of Jordan, Amman, Jordan
e-mail: nobeidat@ju.edu.jo; president@ju.edu.jo

R. A. Shibli (✉)
Faculty of Agricultural Technology, Al-Ahliyya Amman University, Amman, Jordan
e-mail: r.shibli@ammanu.edu.jo

R. A. Shibli · N. H. Thaher
School of Agriculture, The University of Jordan, Amman, Jordan
e-mail: n.thaher@ju.edu.jo

M. A. Khasawneh
School of Engineering, The University of Jordan, Amman, Jordan
e-mail: m.khasawneh@ju.edu.jo

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transfer were inherently the primary drivers for software developers and technology-fostering companies to initiate more far-reaching advancements in the educational arena. As a result, these market players started to develop a multitude of platforms that enabled various recipients of the learning paradigms not only to have access to the learning materials, rendered in electronic format, from across the web, but also to avail themselves of synchronous interactive learning paradigms that brought classroom activities to places convenient to learners irrespective of their physical localities. In this chapter, we analyze the differences between conventional learning paradigms, on the one hand, and those that were being supported by the evolution of the internet and the underlying electronic infrastructure, on the other. The latter systems made distance learning a more appealing option towards the end of the twentieth century and they then assumed a more concrete role in the early twenty-first century as a new era of pandemics started to evolve. The role of each learning paradigm under consideration, and how it evolved, is assessed, including opportunities and challenges for digital transformation at academic institutions in general, but more specifically those pertaining at the University of Jordan as a model example, and the impacts that were fostered along the way. Furthermore, a rundown of the various educational paradigms involved in this case study is presented, outlining the ensuing levels of associated governance that went into play at the University, reaching ultimately to one that is setting the stage for the University to transform its educational infrastructure and academic offerings into a system that is fully digitized, smartly presented, readily available to its various constituents, and commensurate with the 4th industrial revolution in the twenty-first century.

Keywords E-learning · Educational technology · Learning management systems · Online learning · Hybrid learning · Higher education

1 Introduction

The origins of online learning can be traced back to the 1900s, where the universities of Pennsylvania and Chicago in the United States were the first to utilize the U.S. postal service to introduce universal free delivery of educational resources to their beneficiaries [1]. However, today's online paradigms of education, as most people view them, have evolved to encompass any form of distance or non-centralized education, including but not limited to, independent study, computer-based instruction, computer-assisted instruction, video courses, videoconferencing, web-based instruction, and online learning [2].

Thus, with the advent of the World Wide Web and web-based learning, higher education institutions have come to experience unprecedented growth in online learning during the past two decades. Over the past two years, this growth has increased exponentially due to the COVID-19 pandemic to around 1.3 billion online learners world-wide [3], causing a global shift towards working from home and a bonus for online education. Accordingly, most higher education institutions around the world primarily catered for online learning provisions in lieu of the prevailing traditional in-person (in-class) educational paradigms. It also appears that educators in all types of institution recognized that a structural shift was forthcoming, and that online information delivery and learning will, to a high degree, be the mainstay of higher education in the future [4]. Therefore, it was necessary for educational institutions to adopt new methods of delivering courses and assessments to students. An example of such a standardized approach is the Learning Management System (LMS) [5]. This was described by Alias and Zainuddin [6] as a web-based technology developed to enhance the learning process at educational institutions through proper preparation, implementation, and evaluation. The use of an LMS in the learning process aids the e-learning process by providing instructional content without regard to time or location [7], allowing students and teachers to connect via the internet, and facilitating the sharing of course-related knowledge and resources [5].

In the days following the outbreak of the COVID-19 pandemic, the imminent adoption of technology for classroom use, as the primary source to disseminate teaching material to students remotely, became an opportunity that could not possibly be overlooked. Since the COVID-19 outbreak in late 2019, and into the early months of 2020, governments around the world, at the recommendation of the WHO, found themselves compelled to stage various levels of lockdown to curb the spread of the disease. Schools and institutions of higher learning had no option but to yield to government directives in staging these imperatives. Various businesses and government offices found themselves in a position where employees could no longer report to the office and were immediately instructed to work from home. At this point, students at all levels, like employees and other workers, found themselves having to cope with a suddenly changing environment and, as such, had to seek other ways to make substitutions for the workplace environment. Luckily, the technology industry had already been working on systems that were primarily meant for teleconferencing and tele-class applications. Indeed, technology giants like Microsoft, Google, and Cisco had programs already in place that were being updated to stage team and group work meetings across the internet, while participants remained in the convenience of their living rooms, home offices, and their official workplaces, traversing geopolitical boundaries with ease. With a little tweaking of existing technologies, these technology giants were soon ready to help the rest of the world surmount the consequences of the global lockdowns. In the months and immediate years that followed, governments, businesses, and the educational sectors involved were able to gradually cope with the evolving situation. Despite the reduced efficiency compared with the original workplace and actual classroom environments within universities and school systems, people across the globe were readily coping with the situation while, at the same time, exploring every other possible alternative to achieve best practices under the prevailing pandemic circumstances.

In the wake of the COVID-19 pandemic and the three years that followed, the University of Jordan, being a leading academic institution in Jordan and a renowned academic institution region-wide, found itself in a dire situation which required immediate attention from its upper administration. The University of Jordan, having been hit by the handicap of the COVID-19 pandemic, compounded by existing dire economic hardship, was forced to explore various viable options to cope with the situation, keeping in mind existing constraints when it came to the networking infrastructure that would be needed to deliver a suitable remote-learning course. Moreover, save for a few buildings that were established during the past two decades, these problems were exacerbated by the structural constraints imposed by existing buildings and by financial constraints to the campus-wide academic building regime.

2 The Evolution of Remote Learning Paradigms over the Past Five Decades

Following the mid-1970s and early 1980s, several universities in the developed world already had preliminary plans to target students across other communities, particularly in places where academic institutions possessed more than just a single campus across large geographical stretches. This aimed to leverage existing forms of crude technologies to disseminate the teaching materials across larger geographical areas. As they did that, they realized that they needed to find ways to replicate another classroom environment set at some remote location. In so doing, academic institutions with sufficient financial means were able to replicate the classroom that existed at the primary location (original) and establish the copied classroom at a secondary location, using the same class instructor to lecture across two classrooms at totally different geographical locations. Furthermore, these universities had also to leverage very early forms of TV broadcast technologies to transfer the teaching material from one place to another and make it available to the beneficiaries who might be spaced out across hundreds or thousands of miles. With the use of such teleconferencing capabilities, people across various organizations (public and private) now had the means to have daily meetings without the burdens and expenses of long-haul travel. Towards the late 1980s and into the early 1990s, various institutions (both industrial and academic) started to have at their disposal enhanced legacy broadcast systems, some newly introduced technologies, and the very early versions of packet switched networks (PSNs), like the integrated service digital network (ISDN). That is when academic institutions started to see the benefits of the new era that carried with it great potential for the dissemination of teaching materials across distant geographical areas. Nonetheless, the content of such paradigms was still being targeted at groups of assembled people as opposed to targeting individual clients.

Around the middle to late 1990s, people started looking into empowering the instructor by providing additional classroom capabilities. The trend was primarily focused on broadcasting the taught material to spatially separated remote groups of beneficiaries that could be assembled virtually under the umbrella of powerful software, together with the supporting networking protocols, but from the educator's viewpoint taking the form of a single client. This placed more emphasis on what enablers could be harnessed by an educator to bolster effectiveness and impact in delivering teaching material to the recipients in the same classroom and beyond.

With this new focus, people started exploring ways of introducing viable forms of technology that would make it possible for individuals to reach out to academic institutions and to acquire knowledge from the convenience of their living rooms or workplaces, or from a disk space within a proper office operating environment [8]. In the mid-1990s, the term e-learning began to spread across the world of education [9] by bringing together evolutions in the fields of learning and technology, a process that inherently culminated in the birth of the distance-learning concept [10]. Distance-learning paradigms that entailed the use of computers, internet, and data shows, together with various electronic resources, also offered asynchronous and synchronous tools such as e-mails, forums, chats, and video conferencing [11, 12], thus facilitating better communication between students and lecturers, and altogether enhancing the learning process for students [13].

By the early days of the 3rd millennium, many types of e-learning system had evolved with various online platforms beginning to emerge, giving rise to robust information and communication technology (ICT) infrastructures, such as Skype, Moodle, and Blackboard. These had to be supported by the availability of high-end communication technologies that, in turn, relied on the internet and upscale wireless technologies for their operation [8]. With an ongoing effort to advance the state-of-the-art in communications gear, supported by a more reliable and capable internet, the trend again was shifting to a new regime of distance learning, all culminating in what has become known as Online Learning. This included synchronous lecture broadcasts, sturdy electronic resources, more user-friendly interfaces, as well as readily accessed recordings of lecture materials made available to recipients at their convenience. Here, the COVID-19 pandemic inherently played its part in bringing about further developments to this education regime when various technology-developing companies, including Microsoft Teams, Google Classroom, Zoom Meetings, Cisco's Webex, Go-to-Webinar and Go-to-Meeting, among others, started to introduce more enablers to the scene [8]. The most important functions of these innovative platforms were to allow effective synchronous student–lecturer communication and to render an alternative mode of collaboration asynchronously, while assisting lecturers in managing lectures and courses, evaluating and monitoring student progress, and keeping records of grades and student attendance/interactions.

3 Learning Paradigms for Holistic Development

Various learning paradigms had emerged to bolster the efforts of an educator, both in the classroom and beyond the set boundaries of a traditional classroom. For instance, educational resources that leveraged learning, teaching, and research materials to render the taught materials and stage them to recipients were constantly coming through. Many of these were in the public domain or were under open licenses that allowed users to have free access, re-use, re-purpose, and make them amenable to adaptation, and redistribution. Such educational resources can be deployed in the service of distance learning, online learning, as well as in-person learning scenarios.

In this context, we are addressing distance learning or educational paradigms that entail acquisition of information by non-conventional means to gain knowledge from attending institutions. Under such paradigms, advanced technological regimes are deployed throughout the development of the taught material, which is then delivered across vast geographical stretches to the student recipients. The paradigms included recorded videos, electronic class notes, etc., all of which can be accessed at the convenience of the learners, and at their own pace. The material offered is also augmented with various assessment methodologies which often harness artificial intelligence to ensure that students are exposed to adequate levels of the curricular offerings and can be adapted to various levels of difficulty commensurate with the student's learning capabilities. The online learning paradigm in which a taught material leverages a synchronous mode of faculty lecturing (in real time), in addition to information from other sources, has proven to be rather effective in the case of shy, easily intimidated, and slow-learning students who usually are not confident enough to speak-up freely in a regular classroom setting [14]. There are no space and time limitations under such a flexible educational paradigm, which allows access to a wide range of information whereby students can learn at their own rhythm, interact in peer discussions, and easily exchange points of view and ideas [15].

In contrast, under the conventional in-person learning scenario, a student receives the lecture material in a traditional classroom setting. Through the injection of contemporary technological enhancements, this mode of learning is commonly supplemented with technology-in-the-classroom enablers that an educator can use to enrich the learning experiences of the students. A hybrid learning paradigm allows students to have the benefit of both worlds, a combination of online and in-person classes. This mode of education also fosters instruction in which the classroom time is augmented by offline internet-based student–faculty interactions allowing students to network with one another. This is, in fact, the de facto norm at many higher education institutions. In the online learning paradigm, teaching is always online but student learning can be augmented by the availability of other educational resources in an electronic form.

Distance education and e-learning depend heavily on ubiquitous forms of technology, including computers, which students may, at times, not have access to, and the internet, which may suffer interruptions and/or other associated system errors during course deliveries. Nonetheless, there are important support aspects that constitute the basis for distance education and e-learning, including the proper design and management of the supporting network infrastructure to help avoid interruptions, especially during video-conferencing; the availability of user-friendly tools that help students assimilate and understand transmitted information; the provisioning of reliable, interactive and diverse electronic gear to shore up compatibility of deployed resources; a reliable leverage of social networks to build online communities for students to reduce incidents of feelings of isolation; the use of various effective educational techniques such as a leverage of debates and, where possible, learning based on experience; and the provision of services that help students and lecturers be aware of the latest policies adopted by universities and the government, while encouraging collaboration between the various institutions involved [16]. The effectiveness of distance education and e-learning is determined by three primary elements, namely, awareness of how to use the tools and enhance the learning process, the ability to proficiently interact with students and create a comfortable learning environment, and the ability to creatively capture students' attention and bring them ever closer to a productive learning environment [17].

Nowadays, higher education systems throughout the world are in a continuous process of change associated with rapid advances in information and communication technologies; this presents challenges for the institutions to keep pace with the needs, desires, and requirements of students, and to expand students' access to technology and improve their academic experiences. Information technologies are continuing to advance at an accelerating rate and e-learning systems are seen as essential factors in carrying out the various activities of academic institutions. These institutions are therefore investing more and more in online systems and devices [18]. However, in the technology era, one of the main challenges for universities is the integration of innovative e-learning systems to reinforce and support both teaching and learning [19]. Due to its complexity, multiple definitions are proposed for the concept of e-learning. Put simply, e-learning uses information and computer technologies and systems to build and design learning strategies [20]. In short, e-learning refers to transferring knowledge and education by utilizing various electronic devices [21], and the concept can be better understood when it is integrated into a context in which technology is used to meet people's needs to learn and evolve [22]. Jordan was one of the first countries in the region to respond to the COVID-19 pandemic by enforcing a lockdown and national closure of higher education institutions. To date, the University of Jordan has successfully shown progress—and admirable ingenuity given its resource constraints—in sustaining learning during the pandemic and making the move to online learning possible. Transforming the educational system by harnessing a paradigm shift is ongoing and comprises a core component of the educational cycle at the University of Jordan. This shift helps sustain educational continuity and supports crucial interactions by scaling-up quality instruction, fostering outstanding instruction, while expanding opportunities for student practice and increasing student engagement in the educational process.

4 The Right Choice for Technology Deployment in the Classroom: the University of Jordan Case

The University of Jordan was established in 1962 as the first public university in the country and was a milestone in the socio-economic development of Jordan. The impressive rapid expansion in establishing diverse colleges and schools, deanships, scientific centers, units and service departments and the establishment of educational programs within the University of Jordan were essential contributions to the economic development of the country. Now, the University has around 50,000 students (graduates and undergraduates) from all over the world; 24 colleges and schools offer more than 250 academic programs in various natural and social sciences and scientific disciplines including, engineering, medical, agricultural, and health sciences. There are also 38 PhD programs, 111 MSc and MA programs, and 16 academic programs related to higher specializations in medicine and dentistry. The University of Jordan, through its strategic and action plans, continues to lead the higher education sector in Jordan, the provision of high-quality education being at the forefront of its priorities.

The educational system in the first decade of the University of Jordan was based on the annual (British) system of education. In 1970, with the exception of medical schools, the University of Jordan switched to the American credit-hour system, which was seen as the first structural change at the University. In the late 1990s and early 2000s, there was great interest in e-learning and distance education and the University administration was eager to embed these programs in the educational cycle within the University of Jordan, but this process was largely vague and undefined.

Meanwhile, blended learning at the University of Jordan had been in place since 2016. Against the evolving backdrop of the COVID-19 pandemic, the University of Jordan, as a leading academic institution in Jordan, and a renowned academic institution in the region, found itself in a dire situation that required immediate attention from its upper administration, which took it upon itself to implement an educational cycle commensurate with present-day learning regimes. Here, the University placed student learning at the forefront of the process where it ensured that the various relevant components were assembled including the workforce (academic and supporting staff), management at all levels, and assessment procedures, together with the supporting technological and information infrastructures, all closely coordinated (Fig. 1). The technical teams presented the University administration with several viable technological options that would help the University cope better with the evolving COVID-19 situation. The options provided were diverse enough to give the administration the required flexibility to arrive at one or more solutions to suite the varying needs of an academic institution and the size of the University of Jordan, with a faculty body of 2,000 people.

In delivering these viable options (Table 1), limitations in the financial resources of the University were considered, as were the varying needs of the academic faculty in receiving some acceptable level of training to cope with a new teaching regime and to deliver the various courses remotely. With each option, the local technical experts also presented the administration with the necessary technical details to help the different faculties pick the option that would be most suitable for the level of academic operation/s required by each college.

Moreover, the local University experts also gave their opinion of various technical features to help decision makers in various colleges and schools pick the right option for their academic needs. To allow the various academic entities to make viable comparisons of the suitable options, the relevant technical details were summarized as shown in Table 2. In the last line of Table 2, the local experts also offered recommendations of their own to help the administrative staff and non-technical teams arrive at a suitable choice from amongst the options. These recommendations were

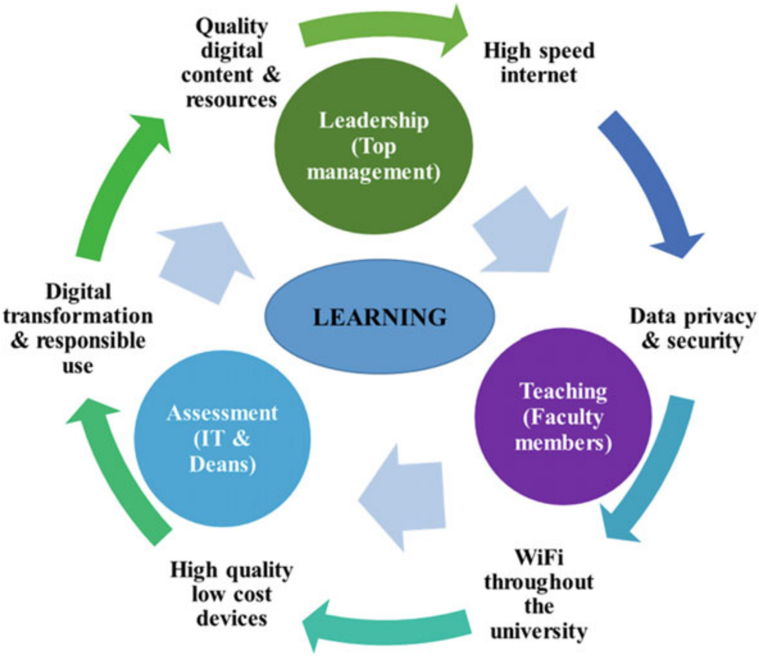

Fig. 1 Infrastructure to support transformative learning and to fulfill the needs of students for their holistic development within the University of Jordan

Table 1 Explanation of viable options for technology deployment in the classroom at the University of Jordan

Option number	Option description
Option 0	Entails a standard computer + writing pad (dull) + standard type overhead projector
Option 1	Entails a standard computer + smart writing pad (graphics screen) + standard type overhead project
Option 2	Entails a good computer + smart board + suitable overhead projector + audio accessories
Option 3	A good computer + smart board + suitable overhead projector + audio accessories + TV type screen
Option 4	Good-specifications computer + smart TV type screen + audio system
Option 5	Two good-specifications computers + smart TV type screen + tracking camera/s + audio system
Option 6	Two good-specifications computers + smart TV type screen + tracking cameras (2) + audio system + mixing system

made after consideration of factors such as complexity, price range, technical capabilities, and performance, as measured against budgeting constraints experienced by the University. All things considered, options 2, 3, and 4 were the most likely to be chosen given the cost ranges and the advantages offered, but resorting to options 5 and 6, when needed, was not totally ruled out. In fact colleges and schools planning to produce their own educational materials for classroom or commercial purposes in the future were advised to ensure that they had the facilities to do so, which would mean purchasing some equipment listed in options 5 or 6.

Deans of colleges and schools at the University of Jordan inherently have a good understanding about the existing educational technologies, infrastructure and the project needs of each college. However, without a broadly shared vision of transforming the education system, any attempt at such transformation will have a dim chance of success. Therefore, to help the deans of various colleges and schools arrive at the most suitable option for their colleges, the technical team also prepared two different questionnaires to be completed by the colleges and schools to help the technical team come forward with further recommendations. The questionnaires involved information that was solicited on the existing educational technologies and infrastructure for each college or school. Overall, the first questionnaire, regarding existing educational technologies, focused on: the number of classrooms; the percentages of theoretical and practical teaching; the number of college laboratories; the need for educational technologies in the classrooms and laboratories and whether any were already suitably equipped; the most appropriate option and additional options for deans from the previous report; the types of equipment available to colleges and schools; the nature of existing network support and the internet speeds at which classrooms are served; the need for technical support; and the number of classrooms that needed to be equipped with educational technologies in the short, medium and long terms. Commensurate with the option list (Table 1), action plans were put together in accordance with options 5 and 6 for future educational provision, particularly addressing the number of classrooms that needed to be prepared for this purpose.

The second questionnaire was designed and circulated to the college deans to solicit further information on the compatibility and readiness of the existing building infrastructures campus-wide, to enable the administration to determine imminent structural needs and any associated upgrades that were necessary. This questionnaire focused on the prevailing general situation of classrooms and the construction work needed to renovate any deteriorating infrastructure, including the placement of contemporary seating arrangements in the classrooms and the need to repair or replace existing student seats; the condition of floors, walls and ceilings in the classrooms; the status of windows, curtains and doors; the placement of luminaires; the status of fans, air conditioning and heating units; any issues related to moisture or water leakage in the classrooms; and what was direly needed or immediately required to fix the situation. Analysis of the second round of questionnaires readily pointed to the extent of the need for maintenance work in the classrooms, and the appropriate time frame to meet college and school needs.

These two different questionnaires were circulated to the various colleges and school deans who were asked to furnish any information that the technical teams

Table 2 Comparative assessment of the various options under consideration

Option number	Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Features							
Ease of use	Least convenient	Mildly convenient	Convenient	More convenient	Convenient +	Convenient ++	Most convenient
Adaptability	Poor	Low to moderate	Good	Pretty good	Very good	Extremely good	Superior
Scalability	Poor	Low	Good	Good	Pretty good	Moderate to high	Very high
Productivity	Poor	Low	Moderate to good	Good	Pretty good	Very good	Superior
Performability	Poor	Low	Moderate to good	Good	Pretty good	Very good	Superior
Bandwidth requirement	Low to moderate	Low to moderate	Moderate	Moderate	Moderate +	High	High
Investment level	Low	Low to moderate	Acceptable	Moderate +	Moderate to high	Pretty high	Very high
Recommendations for selections	Low to mild price range Not recommended or for worst-case scenario		Moderate to lower-high price range Recommended range choice			High to more expensive Recommended for future or for limited use for present needs	

may have missed, thereby providing an overall indication of educational technologies already in use campus-wide, and infrastructure conditions at the University of Jordan. Each college dean, in turn, responded by completing the questionnaire and returning it to the technical team presiding over the subject matter. The notion behind this was that the University of Jordan wanted to take the time to exchange meaningful ideas, views, and information with diverse deans about the implementation of an appropriate online learning system. By so doing, the University paved the way for an all-out successful transformation of the educational system at the University.

As the outcomes commensurate with the questionnaires began to surface, great disparities in the needs of the various programs fostered by the University of Jordan started to emerge. Such disparities would readily have imposed huge budgetary burdens on earmarked programs brought forward by the University's upper administration. Further, as things unfolded, this would also have imposed huge overheads when it came to maintainability and serviceability. As a result, it was mutually agreed between the University administration, on the one hand, and the team overlooking the technical undertakings, on the other, to put forward some common options that would by necessity attend to the divergent requirements ensuing from the needs of the different colleges and schools.

Working together with the University administration, the technical teams were able to bring forward two possible options for colleges and schools to choose from. Under the first common option, shown in Table 3, colleges and schools would uniformly make their choices commensurate with possibly a mix of options 2 and 3, as presented in Table 2, which would yield a more economically viable option for most of the lecturing needs campus-wide.

Under the second mutually agreeable option, a limited number of colleges and schools would be looking at an option that would be more compatible with a mix of the choices encompassing options 5 and 6 (see Table 2). Under this second option, the costs involved in equipping most lecture rooms would be prohibitively large

Table 3 Standard common lecturing equipment for model classrooms

Internet (wired and wireless)
Desktop computer (all-in-one touch screen with controlled access using UJ username, password, and hardware security key or automated ID swipe option)
Computer desk with lockable drawers/cabinet
Professional audio system (speakers and wireless microphone)
Writing pad
Data show ($\geq$ 3500 lm brightness for regular size rooms and $\geq$ 5000 lm for large rooms)
Presentation remotes (PPT clicker + laser pointer)
Projection screen
HD livestreaming camera (non-tracking, wide-angle capable of capturing lectures including writing on white board)
White board (already available in majority of classrooms but can be replaced with permanently painted wall board)

Table 4 Lecturing equipment encompassing production gear; distinguished lecture rooms only

Internet (wired and wireless)
Desktop computer (all-in-one touch screen with controlled access using UJ username, password, and hardware security key or automated ID swipe option)
Computer desk with lockable drawers/cabinet
Professional audio system (speakers and wireless microphone)
Writing pad
Data show–smart board integrated system or Interactive LCD display (with spotlight presentation remote)
Presentation remotes (PPT clicker + laser pointer)
White board (already available in majority of classrooms but can be replaced with permanently painted wall board)
FHD tracking livestreaming camera (could be more than one)
Possibility of mixing system (only for high quality lecture capturing needs)

for a university with limited overall budgetary allocations. Therefore, it was agreed between the parties that most academic colleges and schools would get a set of equipment as shown in Table 3 for most lecture classrooms. However, there were colleges and schools that needed special equipment to allow for the possibility of producing academic materials for local institutional consumption and/or for commercial distribution. For those colleges and schools, the University administration gave permission for a small percentage of lecture rooms to be equipped with special equipment to fulfill specific academic requirements, as shown in Table 4.

5 Induction of Academic Governance to Legislate Online Learning at the University of Jordan

In 2020, the Higher Education Council at the Ministry of Higher Education in Jordan formed a national committee headed by the Vice President of the University of Jordan to contrive a plan for embedding online learning in the higher education system. In 2021, with major contributions from all higher education institutions, the proposed plan was approved, and later that year an official bill was passed into law, via a royal decree, which constituted a milestone development in the higher education system in Jordan. Accordingly, the Higher Education Council issued its bylaws for embedding online learning in the higher education system. In 2022, the relevant criteria for embedding online learning were, in turn, issued by the Accreditation and Quality Assurance Commission for Higher Education Institutions. Recently, the University of Jordan ratified its own local bylaws and procedures for online learning and distance education.

Following the choices to which the University of Jordan had committed, the deans' council instated sets of bylaws commensurate with the learning paradigms currently in place at many academic institutions around the world. In doing that, the upper administration adopted governance that fosters distance-education paradigms commensurate with:

i) *In-person learning*; here the University adopted a paradigm of education whereby all academic activities are executed via in-person learning, fostering the presence of both the instructor and students in a classroom environment. In this option, no mix with other educational paradigms was allowed.
ii) *Online learning;* here the University fostered a paradigm of learning wherein students and instructors would commit to a 2:1 ratio of synchronous to asynchronous learning. This meant that, out of three weekly lectures of a given course, students would attend synchronously administered lectures twice a week but the third lecture would be delivered in recorded unattended electronic form, so that students would subscribe to such lectures in a manner that would be commensurate with their own pace and time allowance.
iii) *Hybrid-mode learning;* under this learning paradigm, half the students registered to any course would attend class activity in-person, while the other half would simultaneously subscribe to the online mode of learning; students would then alternate their learning modes from one class to the next throughout the course.

The University bylaws regarded technically oriented (scientific, engineering, medical colleges) programs and humanities-oriented (all other colleges) programs rather differently. In the former, the various colleges were allowed to deliver their course syllabi, as spread across a student's duration of study, according to the following schedule: of the entire curricular offering under a given specialty 10% would be delivered electronically (online), 30% would be delivered under the hybrid mode of learning, and the remaining 60% would be administered in-class. The deans' council left the choice of the courses offered by each college, under the three categories, to be undertaken by the academic departments concerned in coordination with the deans of the colleges and schools involved. However, in the humanities-oriented programs, the University administration (deans' council) recommended the following schedule of the entire curricular offering under a given specialty, as spread across a student's duration of study, 10% would be delivered electronically (online), 40% would be delivered under the hybrid mode of learning, and the remaining 50% would be administered in-class.

6 Infrastructure Considerations in Support of Online Learning at the University of Jordan

Just prior to COVID-19, the University of Jordan, like many other academic institutions, had been ill-prepared for, and lacked a proper infrastructure that would stand in support of, any form of distance education. Such a situation readily placed academic institutions at a disadvantage and immediate measures were needed to mitigate the ensuing effects. Regular operations of many academic institutions around the world were disrupted, if not halted altogether. Exceptions did exist, of course, especially in academic institutions that were originally partially geared towards some level of online delivery of academic programs as part of their regular standard procedures; even here, academic institutions that were deemed to be ahead of the crowd in their preparedness still had to reorient their programs to offer total distance education. In the wake of COVID-19, the University of Jordan was awakened by the realities of:

- A lack of proper institutional network infrastructure in terms of adequate access to the world wide web;
- A lack of internet speeds that were sufficient to support the imminent needs of the situation, even when network access was supported;
- A lack of the ability of faculty members to deliver the teaching materials from their homes, during lockdown times, due to lack of infrastructure, readiness, and preparedness;
- A lack of infrastructure preparedness on the part of the University;
- Issues associated with securely administering course assessments remotely.

6.1 Measures Undertaken by the University of Jordan to Remedy the Situation

As the world was recovering from COVID-19 and the world population was preparing to resume activities, academic institutions that had fallen behind during the lockdown years started, despite future uncertainty, to develop their strategic plans. Universities that had been ill-prepared at the times of COVID-19 made serious efforts to undertake multiple upgrades to their building, technical, and connectivity infrastructures; this included the University of Jordan and also came at a time when it was undergoing change in the upper administration. The incoming top management of the University assumed its leadership at a time of economic hardship that was not particularly associated with the COVID-19 era but was also predominant pre-pandemic. The processes that were followed to induce the much-needed measures are illustrated in Fig. 2.

Following ample discussions at the University Administration and Deans' Council levels, and to meet the needs of in-person, online, blended and hybrid (concurrent) learning and teaching paradigms, and in support of the University's endeavors to be part of the movement of global open educational resources, it was concluded that long-term investment into the future of e-learning at the University of Jordan was inevitable despite financial challenges. Therefore, it was decided to equip all classrooms with state-of-the-art smart systems that allow lecture capturing and full interactivity between lecturers and students within the classroom realm or outside. Adopting the same smart systems for all classrooms, regardless of school type, inherently guarantees major advantages, including ease of maintenance and cost-effective procurement of spare parts, efficient training of teaching staff on the utilization of the systems, and hassle-free mobility for teaching staff in different classrooms across

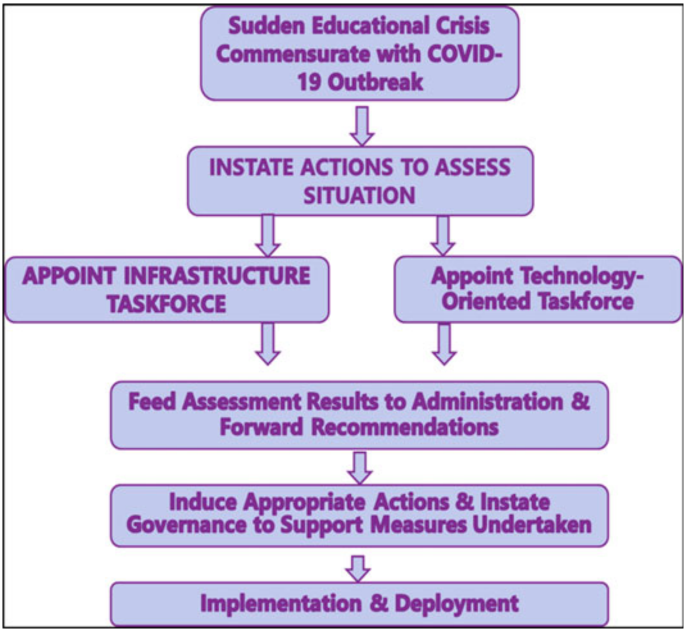

Fig. 2 Illustration of the sequence of events that was undertaken to induce the necessary changes in support of online learning at the University of Jordan

different buildings. Furthermore, this would also allow a minimum level of system compatibility for teaching staff irrespective of the physical teaching spaces they are assigned to teach in. The smart classroom system to be adopted was consequently based on a digital podium with a touch-sensitive display; a regular or an interactive projector, depending on the classroom size; an external non-tracking FHD camera for livestreaming and lecture capturing; an audio system with wireless microphones for lecturers and students; and an audio–video mixer. Furthermore, it was agreed that each school would be provided with at least one smart multi-purpose venue that can accommodate virtual meetings, seminars, workshops, and some graduate level courses. In addition to the features mentioned previously, these venues would be equipped with tracking cameras and interactive displays.

In the process, the University of Jordan found itself having, as a result, to cope with:

- Revamping an already deteriorating building infrastructure campus-wide,
- Retooling and retraining of the faculty body on distance education,
- Reassessing and revising University accessibility to the internet,
- Gearing the classroom space with the needed educational technologies in support of the educators involved.

To commit itself to such strategies, the University of Jordan entrusted the tasks involved to two taskforces:

1. A taskforce charged with feeding in recommendations pertaining to:
   a. Overall building infrastructure of the academic buildings,
   b. Classroom furniture infrastructure,
   c. Surveying imminent needs for academic undertakings.
2. A taskforce charged with feeding in recommendations on technology-related matters in the academic process, which included:
   a. Assessing the various technology-related requirements of the colleges and schools,
   b. Reviewing the various options available to equip the classroom with the needed educational technologies.

The first task force included experts from the colleges and schools of engineering and fine arts and design, together with employees representing the physical plant and the engineering and maintenance departments. The second task force involved experts from several colleges and schools and a high-level representation from the Computer Center and School of Information and Technology. In brief, the University of Jordan committed to restructuring academic programs and course plans in line with the requirements of distance education and e-learning, taking into consideration the requirements of existing diversities in its program offerings. The University incorporated blended learning materials with a percentage not exceeding 60% but not less than 40% for humanities and social fields, while this percentage did not exceed 50% and did not fall below 30% for scientific, health and medical fields for the entirety of any program as compared to the conventional face-to-face (in-person) programs.

7 Conclusions

Prior to the outbreak of COVID-19, several universities from around the world were already in the business of delivering their academic programs in the distance-education mode, either as a fully fledged business model or as a part-time undertaking. Many universities that had adopted distance education as their sole mode of operation were not fully recognized by official accreditation organizations nor were they receiving the same attention and ranking amongst more renowned academic institutions. In fact, many countries in the third world refrained from recognizing such institutions for lack of conviction, the opposite of their impact on the audiences involved, or due to the prevailing attitudes dealing with the quality of delivered product to the relevant job markets. Nonetheless, a number of world-class, well established academic institutions in the United States and Europe had already partially adopted distance education, which was primarily intended to serving the imminent needs of recipients that resided in widely spaced geographical stretches but genuinely wanted to attend such distinguished academic institutions, and also those private sector employees who were in pursuit of graduate studies but did not want to quit their already rewarding job careers.

When the COVID-19 pandemic broke out, the large bulk of academic institutions who never were in the business of delivering teaching material from a distance readily found it in their best interest to start considering suitable options to cope with the imminent needs of their constituents. In this sense, the academic world suddenly woke up to a new reality! Many universities found themselves handicapped by being unable to cope with the prevailing lockdown times. The University of Jordan was one such institution that found it incumbent upon itself to promptly venture into the new realm of distance education. The University was obliged to design and approve educational contents appropriate for interactive e-learning materials with regard to intellectual property rights (copyrights) and the use of modern learning methods consistent with e-learning. It was emphasized that digital tools could only complement, and not offer an alternative, to the effectiveness of face-to-face learning. Nonetheless, the University of Jordan is continuing its efforts to promote the use of electronic alternatives for teaching, assessment, examinations, breaking out of stereotypes, and developing teaching dossiers and course curricula in accordance with modern concepts, as well as digitizing all academic, administrative and financial procedures and making provisions for the multitude of infrastructural changes involved.

Distance education and online learning provide an opportunity to reduce certain overheads and reach out to larger audiences, especially for those who are unable to attend academic activities on campus. This also may become a new source of income for the University by attracting students from outside the country and for students who are unable to enroll on a full-time basis. The University of Jordan is committing itself to providing an integrated learning management system, security, protection, and a capable information technology environment, as well as to qualifying the academic, administrative staff and students through professional training environments. Such commitment is rapidly helping the University venture into the new realm of distance education and e-learning via the processes and remedial actions fully delineated in this chapter. In the meantime, the question: "**Distance Education: Is it any Longer a Paradigm of Choice?**" will still be foremost in the thinking of any academic institution.

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Delivery of Online and Blended-Learning Higher Education Programs in the Arab world—A Case Study from Sohar University in Oman

Hamdan Al-Fazari

Abstract Not very long ago, online and blended learning (a combination of face-to-face and online) were regarded with considerable suspicion in Oman, and the Ministry of Higher Education, Research and Innovation (MoHERI; formerly the Ministry of Higher Education, MoHE) refused to recognize any online and distance-taught programs. Omani students wishing to benefit from online and distance-learning study abroad were refused permission, and they had to travel abroad to study conventionally taught programs. Yet, although this was the case in Oman, online and blended delivery of higher education (HE) programs was practiced to a limited extent in some Arab states. Since the start of the coronavirus pandemic (COVID-19) in the academic year 2019–2020, however, there has been a massive shift to online and blended learning, not just in Oman and at Sohar University (SU) but across all the Arab states. Online and distance learning are now accepted as convenient pathways to learning for busy or remotely located students and they have proved to offer an exceptionally productive opportunity for sharpening research and independent thinking skills (Fazza H, Mahgoub M (2021) Student engagement in online and blended learning in a higher education institution in the Middle East: challenges and solutions. Studies in Technology Enhanced Learning. https://stel.pubpub.org/pub/01-02-fazza-mahgoub-2021/release/1). Even so, it must be stressed that Higher Education Institutions (HEIs) in Oman, and particularly SU, only recently adopted the blended learning system (in the academic year 2019–2020) due to suspension of classes because of COVID-19. Accordingly, blended learning has been delivered by different educational and communication platforms. For example, SU used the educational platform Sohar University Learning Management System (SULMS) for uploading the teaching materials and Microsoft Teams platform for communication with online classes. The discussion forum on SULMS was another important tool to promote knowledge transfer among teachers and students (Sohar University. https://www.su.edu.om/index.php/en/). Online, distance learning and blended learning have also allowed for the hosting of programs from foreign universities, and for elective courses, while those courses which are university requirements,

H. Al-Fazari (✉)
Sohar University, Sohar, Oman
e-mail: HFazari@su.edu.om

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and courses with large student numbers have also been found to benefit from the online delivery approach. Of course, HEIs that wish to implement online and blended learning delivery require well-designed websites, learning management and communication platforms, and appropriate assessment procedures that meet the programs' learning outcomes and ensure the academic integrity of such delivery. In conclusion, online and blended learning programs are now welcome in Oman. There are obviously both advantages and disadvantages to the approach. The perceptions around online learning in Oman and SU are now positive, as recent experience suggests that they are able to provide students with final learning outcomes that reflect the level of knowledge and skills expected of graduates. However, in order for these approaches to be the most effective educational model, they need to ensure that academic quality and integrity reach the highest standards in the most appropriate learning and teaching environments.

Keywords Online and blended learning delivery · Effective distance learning · Blended learning and teaching environment · Hybrid learning · Learning environment

1 Introduction

The term "online learning" is not new, as the first attempts at online learning can be traced back to 1924, when Professor Sidney Pressey at Ohio State University invented the first electronic learning machine, the machine tutor. After that, the most important invention in the history of online learning technology was called "PLATO". This was a computer system designed by Donald Bitzer in the 1960s. The PLATO network hosted thousands of users, and it allowed the creation of many of the greatest educational programs of the century, across multiple educational disciplines, but the PLATO network was very expensive at the time [3]. Online learning depends on various factors such as digital infrastructure, availability of internet connection, as well as the cost of obtaining this connection, which are the reasons for the delay in online education in many Arab countries. In most Arab countries, people began to learn by using books written by Arab scholars. Due to different economic levels, the implementation of online learning could not be the same in all countries. Some Arab states made significant positive steps while others did not. Furthermore, online and distance learning education were not widely used until the coronavirus pandemic (COVID-19), which forced most Arab countries to start online and blended learning delivery. Even after the pandemic, most Arab countries have continued to apply a mixed mode of traditional and blended education.

In Oman, higher education is relatively young. Sultan Qaboos University was only founded in 1986 to complete the education of those students who had obtained a high school diploma [4]. Online and blended learning are even newer to Oman, and they were mainly introduced during the coronavirus pandemic, at which time most universities, colleges and schools in Oman moved to online learning. Online and blended learning can be contrasted by looking at some of the features outlined below:

- Online is new whereas distance learning is not
- There is an ongoing debate about online and distance learning in comparison with traditional education
- Online and distance learning support lifelong learning and offer benefits for students studying part-time or at a distance
- Online platforms or learning management systems allow for collaboration between students and lecturers
- Online and distance learning are becoming more firmly established every year

2 Why Online and Blended Learning are Preferred

Online and blended learning are preferred for some of the following reasons:

- They offer more flexibility
- They offer multi-channel delivery and customized learning resources
- They enable learning to take place through social interaction
- They are cost-effective; there is less need for large premises
- They provide access to multiple courses, wider choices and different learning resources
- Students can revisit the classes they miss at any time, or rewind to ensure full understanding
- They save time and travel and permit Working From Home (WFH)

A study carried out by KITABOO regarding why students prefer digital content [5] revealed that 97% found adaptive learning technology helpful, 84% students say that digital learning will enhance knowledge and that 79% students prefer online quizzes, adaptive learning and e-textbooks in learning. This is reflected in Fig. 1.

3 Why Online & Blended Learning may Become the Future of Education

The twenty-first century will depend on knowledge and economic and technological competition between countries, requiring the preparation of generations of learners who can master the skills of the modern technologies that have become obligatory in their use, development, and in the dissemination of culture between the generations. This will only be achieved through educational institutions, researchers and other interested stakeholders. Technology has already become the most important pillar of change in the field of education, within a system governed by small screens that draw from websites and interactive platforms, and which can operate within a

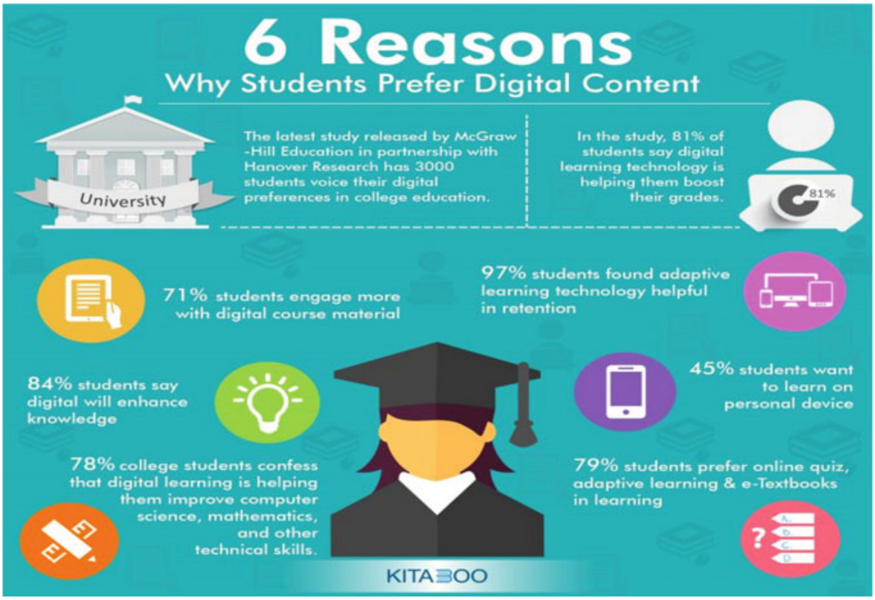

Fig. 1 KITABOO—top 6 reasons why students prefer digital content [5]

virtual world. It is therefore necessary to focus on disciplines and applications that are commensurate with the acceleration of knowledge that we are witnessing today. This, in turn, requires those in charge of the education sector to review the strategies and the plans of teaching and learning, together with their curricula, assessment methods and the characteristics of the learners to be in line with these on-going developments.

Online learning and distance learning may become the future of education for the following reasons:

- Digital transformation through the adoption of technology. Technology is playing an increasing role in everyday life
- The rapid growth in knowledge
- Changing expectations of education as a result of the creation of a knowledge-based society
- Pandemics, crises and diseases

4 Online and Blended Learning in the Arab States

Online learning depends on various factors such as digital infrastructure, availability of internet connection, and the cost of obtaining this connection. These are all reasons for the delay in the adoption of online education in many Arab countries. In most Arab countries, people begin to learn by using books written by Arab scholars, but as a result of different economic levels, the implementation of online learning is not the same in all countries. Some of the wealthier societies have made significant and positive steps while others have not. Initiatives with online education began when the Syrian Virtual University was established in 2002. This institution collaborates with foreign universities that have strong experience in online education. Online programs in the field of corporate training have also been implemented and have generated great interest in the Arabian Gulf region. In 2003, the League of Arab States endorsed online learning as an approved means to help eliminate illiteracy and improve teacher training. Recent efforts in the field of online education in the Arab world can be divided into the following categories: governmental efforts to create structures for complete programs; online programs of professional development and training for employees; and higher education efforts, both individual projects and collective exchange efforts [6]. Despite this, distance education was not widely spread until the coronavirus pandemic, which forced most Arab countries to start online and blended learning delivery. Now some Arab states are leaders in this approach to educational delivery.

5 Online and Blended Learning Initiatives at Sohar University

Before COVID-19, Sohar University used online delivery simply as a tool to facilitate learning. During the COVID-19 pandemic, however, Sohar University adopted two learning strategies. These were Directed Remote Learning (DRL) and Blended Learning/Hybrid Learning.

In the Academic Year 2019/2020, for DRL, Sohar University decided not to simply teach in front of a computer. Sohar University created a new learning model and called it SUDRL. The main philosophy of this model was based on the fact that just converting lecturing online will not help learners but using the online approach as a tool to guide students on how to learn is more effective. The DRL program consisted of:

- Teaching instructions
- Short PowerPoint presentations with voiceover and graphics objects
- Supportive reading material and virtual books
- Online forums, Microsoft (MS) Teams, WhatsApp groups and online office hours

In the second semester of the academic year 2019–2020, all courses were delivered using DRL in order to respond to the COVID-19 pandemic. The number of direct contact hours was changed, and students were given a range of activities and materials to study remotely while supported by online study materials, pre-recorded lectures, practice exercises, assignments and tests, scheduled live synchronous sessions, and meetings on SULMS discussion forums and on the MS Teams platform. Lectures were delivered as interactive slides, and the tutorials and lab sessions were delivered to the student using the MS Teams application and SU portal discussion forums.

Through DRL, SU continues to deliver course content to the students using advanced technologies and safe learning methods that satisfy the course and program learning outcomes and university generic skills. Sohar University provides students with a mix of live synchronous sessions and core course notes and materials (reading materials/case studies etc.) as lectures. The tutorials and the lab sessions are delivered to the students using the MS Teams application and the SU portal discussion forum. Furthermore, live sessions are conducted to provide interactivity and engagement with students. Tutorials are provided to students online and extra support is provided using live sessions.

The DRL approach was a new experience that yielded many positive directions and outputs, but also presented challenges and risks. Through the new learning method in SU (DRL), Sohar staff and students have realized that DRL offers the following advantages:

- Staff learning opportunities (SULMS, content development) were improved
- Student learning opportunities (IT skills, SULMS, communication) were expanded
- Live sessions can be conducted for students to provide extra help
- Student engagement is increased with each task
- Staff have shown that they can adapt to circumstances and to switch to DRL delivery
- Students have demonstrated positive cooperation.

Nevertheless, SU staff and students were faced with many challenges when using DRL and these included the following:

- Difficulty in delivering practical components in many courses
- Low student participation in live sessions
- Changing guidelines for DRL framework for staff

Using DRL as a teaching model at the University involves lectures being given to large groups of students, accompanied by tutorials and labs, with some workshops. However, as a response to the COVID-19 pandemic over the last two years, the University developed a comprehensive portfolio of courses taught using the DRL approach. In this approach, the courses were delivered online through four modules, all of which are aligned with the respective learning outcomes approved by the MoHERI. The main advantage of DRL is that students can download the materials from the University's learning management system and work remotely at any time and in any place. A description of one of the courses delivered through DRL at the University in the second semester of 2019–2020 is shown in Fig. 2.

In the Academic Year 2021–2022, blending learning/hybrid learning consisted of:

- Face-to-face elements (60–70%), such as lectures, tutorials and lab sessions
- Directed learning elements (30–40%) such as videos, live sessions and online to support the face-to-face learning

Task: INSERT TASK No. and TITLE/DESCRIPTION

Task Objective Edit to suit your course

The objective of this task is to ……......

Learning Outcomes Edit to suit your course

1.

2.

Assessment Edit to suit your course

Assessment Type	MCQs or Report or Quiz or Comprehension or Analysis of Data
Assessment Weightage	%

Task Guidelines Edit to suit your course

- Study the PowerPoint slides (**Task 1 Materials folder**)
- Watch the supplementary video (**Task 1 Materials folder**)
- Read the texts given (**Task 1 Recommended Reading folder**)
- Try some sample exercises (**Task 1 Sample Exercises folder**)
- Use SULMS Discussion Forum to discuss the task with students and faculty

Task Resources (on SULMS)

- All resources to help students complete the task are available in **Task 1 Folder** on SULMS

Key Dates Edit to suit your course

- Task start date: Sunday 19 April 2020
- Task submission date: Thursday, 30 April 2020

Contacts Edit to suit your course

- SULMS Discussion Forum
- Course Lecturers Email:
- Microsoft Teams (Join the team using code sqmp3fb, and channel Task 1 – World Wide Web)

Fig. 2 Course description delivered through DRL

A description of course delivery for blended learning for the Academic Year 2021–2022 is given in Fig. 3.

Sohar University listed a set of guidelines for blended learning. The guidelines are set to help both students and staff. Figure 4 presents the list of the guidelines used for blended learning at the university.

Course Delivery Mode (Blended Learning) for Academic Year 2021-22			
Teaching and Learning Activities	Delivery Mode	Contact Time in Hours	Study Materials
Lecture	Face-to-Face	2	Lecture Notes
Tutorial	Face-to-Face	1	Instructor-led Exercises
Tutorial-Directed Learning	Directed Learning	1	Directed Exercises
Lab	Face-to-Face	1	Instructor-led Practices
Lab-Directed Learning	Directed Learning	1	Directed Practices
Supportive Teaching and Learning Activities			
Lecture-Directed Learning	Directed Learning	1	Walk-Through Case Study
Course Consultation	Live Session	1	MS-Teams Platform

Outline Course Assessment for Academic Year 2021-2022				
Assessment Type	Assessment Description	Weighting (%)	Due Date	Delivery Mode
Quiz	Formative	0%	Week 5	Open/Closed Book
Mid-Term	Summative	30%	Week 7	Open Book (Online)
Lab reports or Essay / Assignment	Summative	20%	Week 12	Open-Book (Online)
Final Exam	Summative	50%	Exam Week	Closed Book (Sit-Exam)

Fig. 3 Course delivery mode—blended learning in the academic year 2021–2022

6 Recommendations

Building effective online blended and distance learning programs for higher education requires consideration of many factors and therefore, the following is recommended:

- **Government approval**—To have government approval for this type of education. This will promote a more flexible approach and will foster open learning education.
- **Updating current education strategies**—To prepare future generations for changing circumstances.
- **The learners' needs**—Grant control to students and delegate the responsibility of maximizing their learning outcomes to them.
- **Faculty and lecturers**—Grant them the role of facilitators of learning and as guides, supervising and tracking student actions. In addition, more focus should be given to faculty members' professional development.
- **Personalized learning**—Make use of learning platforms that are built specifically for the purpose of online and blended education.
- **Diversified content**—Make better use of technology and digitalization by using videos, imagery, and other resources from the websites to make classes more interesting and engaging, and to facilitate student understanding.
- **Collaborative and social learning**—Develop a better infrastructure for student collaboration, e.g., presentations, sharing screens, commenting on media, taking quizzes and assessments, organizing discussions can all be conducted more effectively using the online mode of learning.

Semester 1 Schedule	A full schedule has been developed to ensure students are given a general induction to SU and faculty induction. Induction week: Sept 27 - 1 October. Classes begin – Oct 4 Student study week – Nov 15 Revision Week – Jan 3 Final Assessment week – Jan 10
Planning Course Delivery	Student Engagement is the key to success. All courses must include a mix of activities to keep students engaged and to meet all the learning outcomes and graduate attributes. **REMEMBER**: There are 3 semesters to deliver your course, so you need to ensure that you are using a variety of activities to suit the delivery mode, and to keep students interested and engaged. If on campus is not possible in week xxx, replace this component of the course in those weeks with another activity that can help students meet the learning outcomes. The practical component can be inserted at a later stage of the year if necessary. Choose from a combination of activities to achieve the learning outcomes, such as: • live (synchronous) interactive teaching and discussion sessions on MS Teams • pre-recorded short lectures • online labs or practical work (and on-campus once approved) • online workshops / tutorials • self-study / research / field work (for projects) • homework • preparation for assessment (practice exercises, mock tests, MCQs to test understanding) • assignments • Etc.
Assessment	**Maximum 2 - 3 summative** assessments (including 1 final exam) Some formative assessment to be included to measure student understanding of course objectives and learning outcomes. Projects/assignments must only be submitted online through Turnitin in SULMS (no. of Turnitin licenses has been increased to 6500 to allow all students use Turnitin, students must submit through Turnitin in SULMS). Consider how to have assessments on campus – what resources would be required and what the assessment type will be.
	Review assessment plan across levels within faculty to ensure students are not overloaded with assessment on 1 day. **SULMS Gradebook** should be used to manage the grading of all assessment tasks. **Rubric/Marking Criteria must be available to students.**
Topics and Course Profile on SULMS	4 topics of 3 weeks duration during the semester. All course leaning outcomes must be covered across the 4 topics. Use standard course profile provided, and place approve course profile on SULMS by 24 September for students to access.

SULMS Interactivity*	As mentioned in planning course delivery above, within each topic, design a number of activities for students to interact or engage with materials.
	• Embed activities into the teaching and learning process (see SULMS functions such as Choice, Glossary, Workshop, Wikipage etc.)
	  ○ Journaling, postcard writing
	  ○ Building, designing, analyzing
	  ○ Observing, collecting data, predicting
	  ○ Interviewing, storytelling
	• Invite student collaboration (collecting data/giving feedback on research or case studies etc.)
	• Arrange a number of weekly tutorials
	• Have students participate or even host Questions and Answers sessions via MS Teams
	• Encourage students to set up discussion forums or "break out rooms" with each other to support each other and develop team working skills
	N.B. Any staff not familiar with MS Teams and other SULMS functions to contact Staff Development for Training.

Teaching and Learning engagement with students on MS Teams	MS Teams is the preferred channel for communicating with students. MS Teams can cater to large numbers of students at any time without creating bandwidth problems, and allows for sessions to be recorded. MS teams was tested during DRL and proved very effective. Plan to include some **short** synchronous (live) interactive sessions with students each week through MS Teams. **For blended learning, the focus should be more on tutorials rather than lectures for live sessions.** Pre-recorded short lectures can also be used and uploaded for students on SULMS. Pre-recorded lectures should be followed by online discussion sessions on MS Teams. In order to support students, course teams should be prepared to: • **draft schedule** for live sessions and discussion sessions on MS Teams across levels to ensure no overlap between courses • **be available** between 8 am - 6 pm Sunday to Thursday (faculty to consider shifts for academic staff to ensure no overtime is

Fig. 4 Blended learning guidelines at Sohar University

- **Implementation of hybrid education**—This approach to be fundamental for the future of education.

7 Conclusion

The debate regarding traditional education vs. online and blended education raises many questions about the education system and suggests that one-size does not fit all and that we need to acknowledge diversity but, if technology is used wisely, it can play a powerful role in education. Traditional education has its own benefits, such as face-to-face interaction and developing interpersonal skills and group learning, which are essential skills for the overall development of a student. Even so, online education is fundamental for the future, but it is still an evolving process and needs more time to develop its full potential.

At Sohar University, we believe in continuous change in the growth of knowledge and in the advancement of technology that leads to changes in the delivery of education. We look forward to a future full of changes and accelerations of knowledge, so we are witnessing developments in all fields, in the quality of programs and the development of new ones commensurate with scientific and technological development, and in promoting scientific research and innovation. We are encouraging entrepreneurship, providing the appropriate science and learning environment, providing multiple and advanced laboratories, and employing distinguished academic and research staff while linking all of this to modern techniques and technology.

Today, online and distance learning have become cornerstones of education and they allowed education to continue during the COVID-19 pandemic. Technology has made online and distance education accessible to people of different cultural and economic backgrounds all over the world. In the Arab States, it is suggested that instead of attempting to replace formal education with online education, the two approaches can be merged to create more effective, efficient, and interactive learning experiences. This is due to technological development, the entry of robots into the business line, the spread of high-speed internet, artificial intelligence, and changing patterns of employment. This calls for updating current education strategies to prepare future generations for changing circumstances. It is therefore suggested that the two approaches should be mixed and that blended or hybrid education might become fundamental for the future of education.

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A Flexible Blended Approach to Learning

Quintin McKellar and Karen Barton

Abstract In 2004 the University of Hertfordshire became a Centre for Excellence in Teaching and Learning (CETL), with a specific remit to develop Blended Learning (BL) as part of a UK government initiative to enhance teaching and learning in UK universities. This was built on the strong foundation of an excellent virtual learning environment, one of the first developed in the UK (StudyNet), which had been established and developed in-house by the University over the previous decade.

Over the next four-year period the University invested in specialist teaching rooms, a near-universal wireless network and the provision of laptop computers for all academics. Academic staff were offered secondments to become BL teachers, a curriculum design toolkit was produced, and a 10-week Continuing Professional Development module 'Blended Learning in Higher Education' delivered. An electronic journal 'Blended Learning in Practice' was established, and annual international conferences on BL held at the University, bringing the international community of pedagogical scholars together to learn and disseminate best practice in blended learning. The support funding for CETLs stopped in 2008; however, the University was able to further promote the BL approach through its own Learning and Teaching Innovation Centre. Between 2008 and 2020 the approach to BL was enhanced though the redevelopment of the Virtual Learning Environment, from the original in-house-developed system (StudyNet), to a commercially developed system (Canvas), and by the evolution of the curriculum design toolkit to a 'Guided Learner Journey' (GLJ). Although the degree of blended approach to learning was variable, according to subject or professional body constraints, all modules had universally followed the GLJ principles, and by 2020 it was very widely adopted and was supported by electronic assessment methods, a substantial library of recordings, and extensive use of flipped classrooms. When lockdowns were imposed in response to the COVID-19 pandemic, this material and methodology allowed a rapid transition to full online delivery, which exploited some excellent online resources that had already been

Q. McKellar (✉) · K. Barton
University of Hertfordshire, Hatfield, Hertfordshire, England
e-mail: q.mckellar@herts.ac.uk

K. Barton
e-mail: k.barton@herts.ac.uk

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produced, but also relied on the rapid adaption of more traditional learning material. While the universal requirement for online delivery was counter to the philosophy of a quality blended approach, it did require all academics to deliver material online and shift their approach to teaching and necessitated the whole community to embrace some of the technologies used in the blended approach in different ways.

Over the two-year pandemic period academics were able to improve the quality of online teaching, learning and assessment material, and as their ability to engage face-to-face with students was re-established, this material formed part of the blended approach. As we began to emerge from the pandemic our Pro Vice Chancellor for Education and Student Experience, and her team, determined to emerge with a better learning experience for our students than when we had entered. In the UK, an unhelpful political and media narrative that online delivery was bad and that face-to-face was good accompanied our emergence from COVID-19. This was in part fuelled by the selective use of survey data from post-lockdown students suggesting that 92% preferred face-to-face engagement. Not all surveys came back with such universal disapproval, including our own end-of-module surveys, which were much more positive. Michael Barber's Gravity assist report quotes 67% of students as satisfied with their digital teaching during the pandemic. The subtleties of a flexible blended approach, embracing some online and technology-enhanced material, passed our politicians by and indeed the terminology caused confusion with our students. Through our extensive experience in BL, we know it can have enormous benefits, but it must be done well. As a consequence, and after a university-wide extensive consultation with staff and students, we have introduced a set of community-led principles which are self-explanatory and avoid ambiguous terms. These will guide a universal approach to teaching across the institution. The Herts Learning Principles: Prioritise student learning, Ensure coherent design, Offer opportunities for personalization, Harness technology and Build community, and provide the basis for revalidation of all courses at the University over the next three years.

Keywords Blended learning · Digitally enhanced learning · Virtual learning environments

1 Introduction

The almost 8 billion people on earth are all unique. Some genetic characteristics are common to all—the general structure of the neurone or nerve cell and the operation of interneuronal synapses or junctions—yet when assembled as organisms we are all different with our own preferences, behaviours, and abilities. It is not surprising therefore that we have different approaches, attitudes, and aptitudes to learning. The Socratean academic performance in an amphitheatre of hungry disciples appeals to some—and it is impossible to deny the interest and excitement imparted by David Attenborough as he describes the intricate lives in our natural surroundings in a traditional didactic classroom. Nevertheless, the didactic approach does not appeal to all, nor is it the most effective in all circumstances. Learners may prefer debate, discussion, and interaction, may like to relive the event, or may wish reflective solitude. They may like the written word, a radio recording, a film or television production, or the interaction offered by their computer or telephone, or the immersive learning that a practical, laboratory or clinical course can bring. Attenborough is of course the master and just as we all differ in our learning abilities, so too do our teachers in their proficiency, preferences, and expertise to deliver and ability to excite, delight and ignite their students. The same could be said about the quality of well or poorly prepared lecture notes, or books, or practicals, laboratories, or demonstrations or almost any learning aid.

2 Blended Learning

Blending different forms of teaching is likely, therefore, to spread the risk and reward to a diverse population of students, learning from equally diverse educators, and to play to individual preference at least some of the time. This no doubt applies to conventional (pre-electronic) forms of teaching, just as it does to teaching in the digital age. Technology has, however, dramatically increased the range of options and opportunity for mechanisms and modes of delivery and engagement, and indeed 'Blended Learning' is now broadly accepted to apply to technology (usually digitally)-enhanced learning. There are many examples which demonstrate that specific technology-enhanced interventions can improve student engagement and success; however, taken overall there is little information to suggest that BL approaches significantly improve outcomes compared to face-to-face learning [1–3]. Nevertheless, a blended approach can be utilized to cater more effectively for different learning preferences and, used wisely, can deliver in ways best suited to the subject or discipline being taught and can play to the strengths of the teacher or the teaching team. In 1987 Chickering and Gamson identified seven principles of good pedagogy for undergraduate education, which have been widely used in educational development and curriculum design [4]. These were adopted at the University of Hertfordshire as part of our approach to curriculum design which: (1) encourages contact between students and faculty, (2) develops reciprocity and cooperation among students, (3) uses active learning techniques, (4) gives prompt feedback, (5) emphasises time on task, (6) communicates high expectations, and (7) respects diverse talents and ways of learning. These principles have not changed fundamentally as a result of the expansion and utilization of a greater range and depth of technological modes of delivery. Indeed, technology has been demonstrated to lever the implementation and embrace of the seven principles in supportive and enhancing ways [5]. Since the blend of learning comprises both technology-enhanced delivery and face-to-face interaction, it is unlikely that a well-constructed blended approach will offer substantial 'cost' efficiencies when compared to a conventional programme. Indeed, as material is being devised and prepared it may be more expensive. Nevertheless, the utilization of film or recordings to replace some of the more didactic forms of face-to-face learning may free up time to enhance smaller group interactions and thus greater learner engagement. It is also axiomatic that today's students will use many of the technologies encountered in a blended approach to teaching when they enter the workplace, and having exposure to them is going to enhance their employability and is likely to make them more productive. It is also likely that as technologies improve, they will be utilized in a blended approach ever more effectively, with adaptive technology allowing greater personalisation of the education experience. Artificial intelligence will enhance assessment and support adaptive teaching, data analysis will improve student support, and haptics technology will create more realistic simulated activities.

3 Flexible Learning

Technology has also supported greater flexibility in undergraduate education for some time. Through the medium of television, the Open University has championed flexibility in learning since 1969, and more recently Massive Open Online Courses (MOOCs) have made educational material available at a grand scale. Both are constrained with regards to some of the Chickering and Gamson's principles; for instance, contact with faculty, reciprocity and feedback, and MOOCs have struggled to provide sustainable business models in their own right [6] and suffer from a lack of financial return and value to the participant by way of academic credit gained. Nevertheless, technologies now offer a variety of modes of delivery and permit flexibility of place, pace, and time of learning. The place of study may be at home, in the workplace or at university, in residencies, libraries, learning resource centres, social learning spaces or in corridors or on the grass. The University of Hertfordshire has its own bus service, widely used by its students and the general public, and providing Wi-Fi on the buses has become an essential requirement for students who work and socialize while in transit. The pace of delivery is also now flexible; we offer law degrees that can be completed in two or three years, and we offer flexible credit frameworks as well as part-time, online distance learning and apprenticeship degrees. The pace of learning will also be impacted by artificial intelligence systems, permitting adaptive processes whereby the rate of learning can be accelerated or decelerated depending upon the capacity and success of the individual student. The mode of teaching will become more flexible with face-to-face, distance, and BL, and with the use of technology enhancements, film, audio recordings, simulations, practical labs, and work experience. The opportunity for flexibility of place does challenge the established cultural concept of the physical university campus, and although place will still be important for practical, laboratory, studio-based and some simulated experience, and for work-based placements, it is also likely that the social, cultural, sporting and counselling framework of a university campus will retain its value and attraction. Furthermore, surveys of students during the COVID19 pandemic, when all teaching had moved online, suggest that up to 90% still value a face-to-face experience, which substantially constrains the flexibility of place, pace, and time. Furthermore, where universities have tried to offer greater flexibility in the past through, for instance, modularization, it has quickly become apparent that there are resource limits to the extent that flexibility can be delivered. Within the constraints of the Chickering and Gamson's principles this will also be true, utilizing current and likely future technology. Nevertheless, for the commuting student or those constrained by part-time work, or those with disabilities or caring responsibilities or, indeed, for those studying from the workplace, and for those who simply enjoy its convenience, flexibility in learning is a win–win outcome [1]. Online approaches provide the backbone of much flexible learning, and while flexibility of place can be accorded by both synchronous and asynchronous online delivery, a more flexible approach to time can best be achieved utilizing asynchronous methods. Adaptive technologies will undoubtedly enhance our approach to pace, allowing and encouraging students to progress at a pace best suited to their own ability. Hybrid or hi-flex delivery will also enhance the flexibility of place, where synchronous delivery is important. Flexibility is most often currently constrained for those subjects that demand a substantive content of practical and laboratory instruction. These are often also under constraints from professional bodies, which often stall progress in the name of quality.

4 Background

Technological evolution has been master and servant to the revolution that has occurred in higher education. Laptops and Wi-Fi emerged as the exception, quickly became common then pervasive, then an expectation, and now offer the benchmark below which we recognized digital poverty and indeed now often offer the limiting factor for greater uptake of digital or electronic delivery. The evolution of Virtual Learning Environments (VLEs) also brought together many structured and operational facilities in a digital format and could act as a repository for teaching materials and provide platforms for engagement. The University of Hertfordshire developed its own VLE called StudyNet during the early 1990s and this provided an excellent starting point to develop and utilize digital technologies. The VLE was used for online discussion groups and to continue engagement and discussion of key topics and concepts, asynchronously, outside of the formal tutorial setting. It acted as a signpost to, and facility for, student support, both academic and pastoral. It provided access to electronic resources for student education and acted as an archive for recorded lectures which were produced and deposited as podcasts [7]. It also put the University in a very strong position to lead on the development of a blended approach to learning. This was further enhanced when the then Higher Education Funding Council (HEFC) of the UK funded a competition within the HE sector to develop Centres for Excellence in Teaching and Learning (CETL), one of which was won by the University of Hertfordshire.

5 Centre for Excellence in Teaching and Learning

The University established a Blended Learning Unit (BLU) in 2005/2006. In order to kick-start the blended approach to learning, the University utilized capital funding which had been made available, to extend its wireless network to 300 teaching rooms, many of which were upgraded with interactive whiteboards and audio-visual connectivity. All academic staff were provided with laptop computers, thus enhancing their digital teaching toolkit, as well as incentivizing them to invest in the digital elements of a blended approach to teaching. Many utilized their laptops to facilitate electronic voting for formative assessment, and podcasting either as a supplementary teaching resource or for revision and reflection on face-to-face activity. During the four years of support for CETL, 25 academic staff received substantive secondments within the unit and became BLU teachers. They were subsequently expected to lead on the evolution of the blended approach to learning but were also expected to disseminate their outcomes and champion the methodology within their faculty/academic school. A Curriculum Design Toolkit was produced as an important resource for academics wishing to adapt and develop the curricula for their subject in a more blended way. Dissemination was also enhanced by an internal workshop series open to all academics and access to relevant external seminars through virtual classroom technology. Within the overall programme, groups undertook more-specific projects: researching the learner experience, developing multimedia, determining best practice in assessment, and utilizing audio support for learning. Special-interest groups were established to progress podcasting for pedagogy, evaluation of the learner experience, engagement of students through in-class technology, and enhancing and assuring quality. Each year an internal conference was held to assimilate and disseminate the learning across the institution.

The CETL had goals to develop, evaluate, communicate, and sustain the outputs and outcomes of the project. The developmental goal was achieved by identifying excellence as it emerged, providing short-term secondments where academic staff could learn and embrace methodology, and embedding a more structured approach to the outcomes within the academic schools and where specific developmental projects could be undertaken. The project was evaluated using Higher Education Academy (HEA, a precursor to Advance HE) benchmarking methods. This demonstrated that 82% of all academic staff had benefitted in one way or another from the project, and of those actively participating 91% expressed an improvement in their use and appreciation of learning technologies, teaching styles and educational culture. Furthermore, 85% of all staff indicated that they were more confident to utilize the technologies associated with a blended approach to learning. During the evaluation of the BLU there was a substantial increase in the utilization of the University's VLE, StudyNet, with logins rising from 4.8 million (2004/2005) to 9.3 million (2008/2009). While this could represent the evolution of student digital engagement, independent of a BL approach, it is highly likely that much of the traffic was encouraged by the changed methods of teaching. Within the BLU the teachers shared their outcomes through direct contact with their colleagues and more structurally through an internal workshop series. The BLU also developed an online journal dedicated to the subject called 'Blended Learning in Practice' (BLiP). This acted as a repository for the research outcomes of the project and received external submissions of relevant material, thus enhancing both internal and external communication. External communication was no doubt supported through the BLiP journal articles, which are included in the 332 peer-reviewed outputs relating to the work of the BLU. It was also enhanced through an annual International Blended Learning Conference, which hosted leading international figures to deliver keynote papers on the topic, and which attracted delegates in person and virtually from around the world. The sustainability of the blended approach to teaching was supported by the enhanced physical infrastructure within the University, and by revised policies and procedures relating to the production, dissemination and protection of digital material resulting from the project. More substantively, the sustainability was ensured by the cultural change associated with colleagues who became disciples of the approach, and whose behaviours and success encouraged others.

6 Evolution of a Blended Approach to Learning

The outcomes of the CETL provided an excellent platform for further evolution of blended (and other) approaches to teaching and pedagogy within the University of Hertfordshire, and four specific developments bear mention in the pre-pandemic years. Firstly, the evolution of StudyNet, our VLE, became unsustainable. By all measures StudyNet was a good platform and was ahead of its time; nevertheless, the resources required to maintain and upgrade a unique and institution-specific VLE were untenable. Furthermore, the commercially available alternatives were improving faster, becoming relatively more affordable and acquiring greater connectivity with other existing and essential academic and business platforms and systems. Following a consultation and evaluation process, the University moved its VLE onto the Canvas platform, which now forms the anchor for its BL pedagogy.

The second major evolution was to develop a roadmap and directed approach to BL design, to guide learners in their journey through the University, from registration to graduation. The Guided Learner Journey is founded on a number of principles which: (1) embrace the consistency of delivery of learning activity and resources, (2) provide a timeline for learning activities and assessment points, (3) enhance a student's ability to supplement and comment on the resources and learning activities available, (4) deliver an effective search function, (5) simplify links to journals, e-books and other external resources, and (6) personalise their module website, for instance by topic or timeline.

A third development was the introduction of a set of graduate attributes to which it was hoped that our students would aspire, and against which it was agreed that curricula should be developed. The attributes identified in 2013 were: (1) professionalism, employability and enterprise, which embraced communication, team working, problem solving and digital literacy; (2) learning and research skills, which fostered curiosity and an ethos of lifelong learning; (3) intellectual adaptability, encouraging analysis, application, synthesis, evaluation and criticality; (4) respect for others, prioritising cultural awareness and mutual respect; (5) social responsibility, encouraging ethical behaviour and sustainable activities; and (6) global awareness, whereby our students become aware of evolving world issues. As a consequence of changing global priorities, technology, and individual behaviours, and following extensive consultation, the University of Hertfordshire graduate attributes were revised in 2022 and adapted into a more student-focused statement that pledges, in addition to their subject expertise and proficiency, as a University of Hertfordshire graduate, they will be: (1) professionally focused, (2) global minded, (3) sustainably driven, (4) digitally confident, (5) inclusive and collaborative, and (6) evidence-based and ethical. It is interesting to note that the major changes relate to the rising prioritisation of sustainability in our student and graduate behaviour and the sharp focus—no doubt enhanced by distance delivery during COVID-19-related lockdowns—of digital confidence.

The final significant evolution which began in the years following the CETL initiative was the development of electronic assessment methods. Formative assessment throughout a course can be very effectively undertaken by digital methods, as can some forms of authentic assessment, whereas traditional summative end-of-course examinations, often considered the gold standard by professional bodies, provide a more substantive challenge.

There is no denying the challenges of systems that rely on access to appropriate computing hardware and software as well as fast broadband. They are also potentially subject to academic misconduct (plagiarism) since even the most robust systems are not foolproof [8, 9]. It is likely that software preventing 'cut and paste,' and biometric identification methods will help, but it is the design of the assessment, and support during preparation of the students undertaking the assessment, which is likely to most substantially enhance the security and validity of the methodology.

The period between the completion of the CETL and the outbreak of the COVID-19 pandemic did not result in a universal adoption of a blended approach to learning at the University, nor were all academics or programmes embracing the available technology to its greatest potential. This was likely a feature of individual intransigence or insecurity associated with lack of confidence or competence to use available tools and methods. In a sector-wide survey in the early period of COVID-19 restrictions, only 21% of teachers were very confident that they had the skills to design and deliver digital teaching and learning [10]. There were also obstacles associated with the many professional body accreditations, whereby the accrediting bodies often demanded specific in-contact or in-person teaching, where the flexibility to utilize technology-enhanced learning is limited.

Nevertheless, the substantive amount of work toward a blended approach, the creation of a large library of recorded material and the utilization of electronic assessments, even in a limited way, did place the University in a positive position when COVID-19 struck and lockdowns were announced. The Guided Learner Journey (GLJ) and design of all module sites to the principles outlined above, and generally higher confidence and competence of staff at the University of Hertfordshire due to recent support and training through GLJ implementation, was also important. We also had a team in our Learning and Teaching Innovation Centre, and a set of extensive resources in place, ready to support staff to shift to fully online methods quickly. In the JISC Digital Insights Survey of Academic staff in 2019/20, which overlapped with the start of the pandemic, University of Hertfordshire staff rated the quality of digital teaching and learning at 71% good, which compared to 57% across the sector.

7 Lockdowns in 2020

The University of Hertfordshire was typical of most universities in the UK. It had identified disease outbreaks as a risk in its risk register and was also very conscious of the danger associated with a highly infectious coronavirus in a globally interconnected world. It had noted the risk and followed the spread of the disease after its emergence in China. Despite all these warnings and a three-month ‘lead-in’ period, it had not radically changed its teaching provision, a substantial proportion of which was delivered in conventional face-to-face classrooms or practical settings, before the first lockdown. The reasons that direct action, in relation to teaching methods, was not taken earlier are many. Academics were mid-semester, dedicating all their time to actual teaching and with no headroom to start developing new approaches to material. The Government response was unknown and the potential for a full lockdown uncertain until the scale, pace, and hospital capacity (incapacity) became apparent, and there was a sense that if the worst came to the worst and we had to respond we would be no worse off than all our competitors who were in the same position. When the first lockdown was imposed, the University gave all the students a ‘reading week’ in order to give staff an opportunity to transform teaching methods to an online approach. The imposition of ‘emergency’ online provision was of course radically different from a pedagogically motivated blended approach. In some cases, sessions primarily planned as didactic in nature, were re-produced as asynchronous recordings with accompanying slides. In other cases, they were replaced by live or synchronous sessions as originally timetabled. Small-group tutorial-type sessions were, in every case, replaced by synchronous online equivalent versions using Teams or Zoom. Practical sessions were adapted and provided, where possible, with remote access to labs and computers using specialist software so that students could continue with coursework under supervision. The use of online classroom-engagement tools exploded. Meetings with tutors moved fully online. Enhanced access to reading materials was provided through digital formats and all assessment was adapted to allow digital formats where these were not already in place. The effort required to continue to teach 562 programmes to more than 30,000 students should not be underestimated, nor the success of the transition. That this was largely replicated in all 140 HE institutions in the UK (and many more worldwide) is truly remarkable. In the HE sector in the UK at the time of the lockdowns, 58% of students and 47% of teaching staff had no experience of digital teaching yet by December 2020 92% of students were learning mostly online [10].

There is no doubt that the evolution towards a blended approach to learning at the University of Hertfordshire placed us in a very favourable position when the lockdowns occurred. The large library of recordings was instantly available, and a great number of academics were able to adapt to recording or conducting online-only sessions relatively easily. They were supported by our Learning and Teaching Innovation colleagues, together with a team of trained student technology mentors, who were able to support their technically less engaged colleagues as well as staff. Furthermore, the technology, and the Guided Learner Journey approach through the Virtual Learning Environment was well tried and tested and proved very effective for delivery. It was also a pleasant surprise that many colleagues were able, through necessity, to overcome their apprehensions about the technologies and methodologies required for online delivery. Full online delivery has its limitations beyond the pedagogical—many subjects depend on practicals and laboratories to develop skills, enhance knowledge, and encourage imagination and creativity. Indeed, many accrediting professional bodies demand them as part of their professional education programme. It was greatly impressive to see how our academic colleagues produced opportunities for our students to have practical experiences from their home environments—some developing simulated activities, others producing practical kits that were sent to students who could experiment from home. The learning experience following the first lockdown was not ideal; however, internal surveys and feedback from focus groups and from committees with student representation at the University of Hertfordshire suggested that 73% (October 2020) were satisfied with the online experience compared to 50% in May, at the start of the lockdown. In a broader survey of students in UK universities, 67% were content with their digital teaching [10]. During the primary two years of the COVID-19 pandemic the opportunities for face-to-face teaching varied as the waves of infection waxed and waned, from full lockdown with all students learning online to COVID-19-'safer 'environments, with greater (1.5–2.0 m) spacing between students, inter-cohort cleaning and disinfection, enhanced ventilation and mask wearing, to variations on this theme and finally back to 'normal.' During this period academics were able to improve and develop the online material that they were using, and to adapt and enhance their own skills at digital delivery. The University of Hertfordshire, like many others, saw the opportunity for a step change in its pedagogic approach and decided to move to a universal, high-quality, blended flexible pedagogy for all programmes by 2025. Sadly, during this period politicians and the media chose to make political gains at the expense of educational progress. As we emerged from the pandemic, our Secretaries of State for Education and Ministers for Higher Education encouraged students to demand compensation if they were not receiving the face-to-face teaching that they had anticipated on application to university. Not surprisingly, this had the effect of stimulating discontent among students across the sector. It was a surprising and disappointing volte-face on the part of our political masters, who had been demanding that we utilize technology more effectively in the years preceding the pandemic. Their rationale was that universities were utilizing online delivery as a 'cheap' alternative to returning to face-to-face, and that students were not receiving good value for money. This fails to acknowledge that high-quality blended learning offers many opportunities for face-to-face engagement and is not cheaper than conventional, didactic teaching. Indeed, as outlined above in terms of the skills and resource required to do this well, it is likely to result in engagement with smaller student cohort sizes, thus making it more expensive. It also fails to acknowledge the evidence, which has shown that a reduction in classroom time, substituted with online learning of between 30 and 79%, did not adversely affect learning outcomes [11] and that blended approaches are at least as effective in terms of outcomes as face-to-face teaching [12, 13]. For some students, the blended approach allows for better outcomes, for example our own Black, Asian and Minority Ethnic (BAME) awarding gap reduced significantly over the period. Commuting students, carers and disabled students especially welcomed the increased flexibility and accessibility it offers them. Furthermore, the myopic view of our political luddites failed to appreciate that the pandemic had merely accelerated the embrace of digital technology in education, which had been evolving over the previous two decades.

Despite the political intransigence, the University of Hertfordshire is continuing to progress towards a high-quality blended flexible pedagogy. History suggests that it is difficult to stop progress, and it has been argued that flexible BL is now an inevitable reality [14]. The political and media debate on BL methodology made it clear that the descriptors and technologies were poorly understood, and definitions and descriptors often misinterpreted. It also polarised a subject which was in reality much more subtle, graduated, and integrated. Rather than describing the University of Hertfordshire approach as blended flexible pedagogy, the University consulted with academic and professional staff, and with students, and crafted and adopted curriculum design principles which are being embraced through a whole-campus curriculum review programme and will undoubtedly progress a blended flexible approach. The principles are to prioritise student learning, ensure coherent design, offer opportunities for personalization, harness technology and build community. They will do so offering a Guided Learner Journey from registration to graduation and beyond and are supported by our refreshed Graduate Attributes and universal personal tutor provision. The objectives of the change programme are to develop employability, global perspectives, digital capability and learning skills for life. The curricula will be informed by industry and professional engagement and will be created in partnership with our students; they will cultivate active learning and critical thinking and embrace a personalised approach to learning and wellbeing, with more flexible options for mode and subject of study, and potential exit qualifications at levels 4 and 5, and will embrace more-authentic assessments. In the broader context of the campus university, there will be an increased range and quality of extracurricular and sporting activities, and opportunities to enhance the university and local community. There will be opportunities for students to gain a credential called a 'Go Herts' award, at gold, silver, or bronze level, for active and positive engagement outwith the curriculum, but fully aligned with our new graduate attributes. The inclusion of employability in our graduate attributes, the embrace of industry in the development of curricula and the focus on employment in the objectives associated with our learning principles, highlight the importance placed on successful outcomes as far as the graduate is concerned. This is enhanced by the active and enthusiastic use of work placements (some compulsory, e.g., nursing and teaching) during educational programmes, and also the now substantive number of apprentices progressing to level 6 and often within integrated degree programmes. The principles of Herts Learning are the same for apprenticeship learners as they are for conventional full-time, part-time, postgraduate, and undergraduate students. The evolution of the curricula at the University of Hertfordshire has been guided by Advance HE's Flexible Learning Framework and by our own desired graduate attributes and Guided Learner Journey. The Advance HE framework has four dimensions covering technology-enhanced learning, pedagogic approach (an integrated and balanced approach), employment and institutional systems and structure [15, 16]. Flexible learning approaches may appeal to any student but are likely to be most attractive to those who have part-time employment, or caring responsibilities, are more mature, or have a commute to get to their university campus [17]. Successful outcomes of any flexible approach to learning have been highlighted by Barnett [18] and include acquiring a qualification, embracing self-directedness, interacting with other students and tutors, receiving prompt and informative feedback, having access to counselling and careers advice, being inclusive and academically sound, offering a ladder of progression, being cost effective, challenging, and allowing students to complete their programmes. Many studies have demonstrated the learner benefits of a flexible approach to learning [19–22], reviewed by Loon [3], and it will be interesting to see if the evolving UK assessment of teaching quality will reflect these benefits.

The assessment of the quality of educational delivery is being radically changed in the UK. The system which historically existed relied on internal processes of programme review and revalidation, embracing best practice, and focusing on quality enhancement with external validation assured through the oversight of external (to the institution) examiners and Quality Assurance Agency (QAA) visitations. With the creation of a regulatory agency, the Office for Students (OfS), a "voluntary" outcomes-based approach to assessing educational excellence in HE, the Teaching Excellence Framework (TEF) was introduced in 2017. This used data on student satisfaction, employment outcomes and student continuation, together with a statement from the institution. It was judged by an independent panel and institutions awarded bronze, silver or gold awards. This system is likely to be replaced by a regulatory framework of quality indicators of student outcomes for: continuation and completion; degree outcomes, including differential outcomes for students with different characteristics; and graduate employment, in particular, progression to professional jobs and postgraduate study. The national baselines set for these indicators are now the minimum standards expected for all providers of HE in the UK. The TEF is also being reviewed and participation will become a requirement for all HE providers under the new quality regime, to indicate institutional 'excellence above the baseline'.

It remains to be seen whether a blended approach to learning or more flexible learning provision will enhance the quality as measured by the outcomes data above. It is likely though that the quality of the provision, whether conventional, blended, or flexible will have greatest impact.

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E-Learning at the University of Petra During the COVID-19 Pandemic: Lessons and Recommendations

Rami A. Abdel-Rahem and Nuha El-Khalili

Abstract The fear of COVID-19 spreading in 2019 led many governments over the world to close down their institutions, including schools and universities. Such a decision was challenging as the education sector in Jordan was not ready to offer the uncommonly used e-learning. On the other hand, this challenge was converted into an opportunity following the rich experience gained by both students and instructors in the education sector. The opinions of the stakeholders in the education sector were diverse, with some encouraging e-learning, and others believing that the traditional learning style is more fruitful. Many investigators have studied the advantages and disadvantages of this form of learning. Such studies focused on solving e-learning issues related to student support, assessment, course development, course structure, infrastructure and institutional support, faculty support, the use of technology, and course interaction. These previous studies, however, did not consider the computer skills of instructors or the academic level of the students, both of which play a major role in their satisfaction with the new e-learning experience. By the end of the COVID-19 pandemic, many governments have embraced e-learning in their academic curricula. It seems that e-learning is a must as whole aspects of life are converting to digital formats; but such a conversion has to be accompanied by offering new policies and infrastructures that make such learning more attractive. The opinions of instructors and students from the University of Petra (UOP) regarding their satisfaction with e-learning during the COVID-19 pandemic are presented and analyzed.

Keywords E-learning · Learner satisfaction · Teacher satisfaction · Blended learning · Online learning · COVID-19

R. A. Abdel-Rahem (✉)
Department of Chemistry, Faculty of Arts and Sciences, University of Petra, Amman 11196, Jordan
e-mail: rabdelrahem@uop.edu.jo

N. El-Khalili
Department of Software Engineering, Faculty of Information Technology, University of Petra, Amman 11196, Jordan
e-mail: nuhak@uop.edu.jo

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1 Introduction

E-learning refers to all forms of the learning process that include digital material and can be delivered through digitally supported media, and it can take two forms: online or blended learning [1]. Online learning is characterized by the existence of physical separation between the teacher and students, and their communication is facilitated by digital learning platforms. Blended learning, on the other hand, combines traditional face-to-face learning with digital methods during the teaching and learning process. Although blended learning was used at Jordanian universities long before the pandemic, supported by some learning management systems (LMS) such as Moodle and Blackboard, it was limited and highly resisted. During the COVID-19 pandemic, specifically from March 2020 till May 2020, the Jordanian government suddenly concluded that the spread of the virus could be inhibited by social distancing, and a decision was made to convert teaching and learning in schools and universities into distance online learning. Because of these sudden closures, universities were forced to use online learning, regardless of students' and teachers' levels of expertise in technology and preparedness; this decision was crucially challenging.

Within a very short period of time, the University of Petra took the necessary measures, which included upgrading of the infrastructure, providing new synchronous digital platforms such as Zoom and Microsoft (MS) Teams, and training instructors on how to use the platforms. Student/instructor support was offered by the e-learning center staff around the clock in order to facilitate the new e-learning and teaching process. Initially, some instructors communicated with their students by sending videos and presentations and received students' feedback through Moodle and Blackboard platforms and forums. Later, the Microsoft Teams platform was chosen as an official tool for instructor/student communication in most Jordanian universities. Even after the total closure was removed by the end of May 2020, teaching continued mostly online for the summer semester. The new challenge was to re-structure courses, as well as the assessment methods, to suit online distance learning. Among the challenges at that time was how to motivate students' interactions during lectures. In face-to-face learning, computer skills are generally not essential for the instructors, and all students can be observed directly by the instructor, to capture their feedback, motivate them, and enhance their interaction during the lecture. This was lost during online learning, since opening cameras was not enforced during lectures due to technical and social reasons. In order to increase students' participation during the synchronous lecture, it was necessary for the instructor to learn to use digital tools such as pole, forums, breakout rooms, etc. This required digital competencies. Traditional assessment methods and exam preparation are simple routine paperwork, while designing a digital assessment method that is robust and rigorous involves a lot of effort and requires many digital skills.

Regardless of the obstacles that this trend poses, the benefits of e-learning are substantial. An e-learning environment allows students and universities to easily exchange and receive learning information at any time and from any location, as well as linking students and instructors to the global body of knowledge. The Jordanian Ministry of Higher Education (MoHE) envisions keeping the e-learning trend in Jordanian universities, by approving new regulations to re-structure all higher education programs into "hybrid programs", which incorporate regulated percentages of online, blended, and face-to-face courses. The MoHE published a two-year action plan to implement this target. Jordanian higher educational institutes changed their regulations and devised new procedures accordingly. During the academic year 2020–2021, the University of Petra continued to enhance the professional development of instructors, but included more training related to teaching methodologies, instructional design processes, intellectual rights and using open access resources, and e-learning tools. The goal was to increase the instructor's awareness and competencies in utilizing teaching methodologies such as flipped learning and project-based learning, and to re-structure the online and blended courses to ensure their effectiveness in achieving the intended learning outcomes.

In order to maintain high-level e-learning, many countries have developed specific quality assurance criteria for e-learning through their local higher education agencies. When evaluating e-learning, these standards and benchmarks differ slightly in the criteria used for evaluation; however, there are five common criteria used to measure e-learning quality, namely: Institutional Support, Course Design, Student Support, Faculty Support, and Technology Support [2]. In this study, we concentrate on evaluating the student and faculty support criteria through investigating some of the factors that affect their satisfaction with the e-learning system at our university.

After one year of implementing "hybrid programs" at the University of Petra, the aim of this study is threefold: (1) to evaluate the student and instructor satisfaction of online and blended courses; (2) to investigate whether the computer skills background of instructors and the academic level of students influence their satisfaction with e-learning; (3) to propose recommendations to improve the efficacy of e-learning process at universities. The study conducted two surveys for instructors and students at the University of Petra.

The rest of this chapter is organized as follows: Sect. 2 presents the relevant literature; Sect. 3 provides the methodology followed in the study; Sect. 4 provides the research results; Sect. 5 provides discussions of the results; Sect. 6 concludes the research and provides some recommendations.

2 Literature Review

The definition of e-learning adopted in this study, as a type of learning facilitated by computer and network technology, has gone through three eras. The first era lasted from the mid-1980s until the 1990s, when the information and network technology matured and e-learning took the form of educational software disseminated on CDs. With the spread of the Internet, e-learning took the form of two-way communication between the student and the teacher, through asynchronous tools such as email.

Teaching material also took different formats such as videos, images, and multiple text formats.

During a later era from the mid-1990s until the mid-2010s, the high bandwidth of networks and the high capacity of computer technology enabled videoconferencing between students and instructors, as well as live streaming of audio and video classes. Learning management systems became powerful. In this era, synchronous communication between the instructor and students, and collaboration among students were now possible within e-learning.

The third era from 2008 until 2019 can be characterized by the development of Massive Open Online Courses (MOOCs), and mobile learning paradigms. Many universities offer fully online programs and courses. Social media platforms serve as additional tools to support e-learning. However, utilization of e-learning varied greatly among educational institutions and countries [3]. The COVID-19 pandemic pushed online learning to be part of the educational process worldwide. The literature is abundant with studies evaluating the effect of the online and e-learning processes that were adopted during the pandemic in many countries around the world (e.g., [4–6]). The question is: Will the COVID-19 pandemic form the start of a new e-learning era? And what will be the characteristics of this era?

In Sects. 2.1 and 2.2, we will review the literature relating to the students' and the instructors' satisfaction with e-learning, respectively.

2.1 Student Satisfaction

Reviewing the literature documenting the students' satisfaction with e-learning and online learning shows that there are many factors influencing their satisfaction. These can be grouped into four main categories: interaction and communication, course quality, characteristics of learners, and instructor facilitation and characteristics [7–9]. Studies show that sources of student dissatisfaction with online learning environments are the lack of personal contact and feedback, technical problems, and overloading of students with self-learning [10]; however, they tend to be more satisfied with blended learning, since they can achieve effective learning and teaching outcomes [11, 12]. Interaction between the lecturer and the student is a decisive factor in online learning, as shown in a study by Hettiarachchi et al. [13] in which 75% of students preferred live sessions facilitating student–lecturer interaction over pre-recorded video lectures, pre-recorded audio lectures, or education via lecture notes and handouts.

Other studies show that characteristics of learners, such as possession of computer skills, affect their satisfaction with e-learning. Thus, students with average and high computer skills are better able to manage their online learning and to cope with any technical problems than those with low computer skills [14]. A study by Ke and Kwak [15] shows that students with a higher level of education tend to feel less satisfied with online education, because they have different expectations of the nature of learning; however, they also showed higher time commitment for online learning participation and demanded more peer-communication. On the other hand, students with lower education levels (e.g., undergraduate students) described online learning as "assignment-test-oriented" and reported a weaker sense of the need for online interactions. Student motivation is another characteristic that has been shown to affect satisfaction with online learning in a study by Hettiarachchi et al. [13]. This study concludes that students require constant guidance, encouragement, and training during online courses. Al-Bazar et al. show that students with higher technical skills can use e-learning resources more easily in blended courses in comparison with those possessing lower technical skills [11]. Many studies show that gender has no effect on satisfaction or attitude toward e-learning [16–18].

Course design and course quality have a strong effect on satisfaction in online learning [19–21]. Kumar et al. recommend that instructors should incorporate tools showing effective learning content such as infographics, video clips, forums, assignments, and quizzes, which provide the student with interactions with the content, along with providing quality in e-learning [19]. Ghaderizefreh and Hoover show that students who experienced less boredom and frustration are more satisfied with online courses. They also found that the following factors, when present, led to increased student satisfaction with the online learning experience: the level of expectation and difficulty are not too high, the pace of the course is not too fast, and online instructions are clear [22].

An empirical analysis of e-learning quality that was done in 10 countries during the pandemic showed that the teacher's active role in the process of online education has a major effect on overall quality. The teachers' responsiveness to students' questions and timely feedback seem crucial for the students' satisfaction with online learning. The diversity in learning formats has a significant impact on quality, while having a suitable infrastructure is not so important. The study also showed that results are not influenced by gender or fields of study of students [5].

Psychological distress during this pandemic was another area that many studies investigated to determine its effect on learning and teaching from the perspective of students [23, 24] and teachers [25].

2.2 Instructor Satisfaction

Research around e-learning has typically been focused on student satisfaction, and less research has focused on instructor satisfaction.

Many studies investigating the satisfaction of instructors with e-learning compare the level of satisfaction with the instructor's skills and training. These studies differ in the definition of "required skills" necessary for e-learning. Basic digital skills required for instructors can be defined as the "ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace, and in society" [26, 27].

However, the TPACK model introduced by the Mishras [28] emphasizes that there are other types of knowledge necessary for using technology effectively while teaching, namely: content knowledge, pedagogical knowledge, and technological knowledge. From the perspective of the K19 model, technology-related teaching skills include a knowledge base for technology use in classrooms as well as skills to engage in planning, implementing, evaluating, and sharing of technology-related teaching scenarios. These technology-related teaching skills of teachers are supposed to be the core drivers of composing lessons that employ several types of learning activity in effective and efficient sequences, thus providing good quality e-learning [29].

An early study [30] investigated the factors significant in explaining teachers' e-learning satisfaction, including three main areas: teacher characteristics, learning environment characteristics, and organization characteristics. The results show that teacher characteristics, such as computer anxiety and computer attitude, as well as the ease of use of the learning environment, and training and technical support are among the factors that increase teacher satisfaction.

Liu and Zhang [18] investigated the effect of gender and years of experience of teachers on five factors related to online learning: expectation, loyalty, complaints, perceived quality, and satisfaction. The results of the study show no influence of gender on any of these factors; moreover, they show that years of experience affect expectations only. Teachers with less experience have higher expectations of online learning. It also shows that teacher complaints in online learning mainly concern two topics: platform management and platform content. Thus, it is important to raise the expectation of teachers with more teaching experience to improve their satisfaction with online learning, and to maintain the expectation of less experienced teachers. This study recommends improving the design of online learning platforms to achieve the following:

- Enhance instructor interactions, by providing modules that allow instructors to prepare lessons collaboratively.
- Enhance the instructor's ability for instructional design, since teaching quality largely depends on making the right pedagogical and technological decisions, i.e., provide relevant instructional design videos made by experts, and a discussion community for instructors to review each other's teaching designs and engage in mutual discussions.

These recommendations would improve instructor preparedness for e-learning requirements [18].

Graham et al. argue that there is no linear relationship between a teacher's years of experience and the quality of teaching and satisfaction, but rather that experience is one of many factors influencing the quality of teaching [31].

An earlier study at UOP that investigated the satisfaction of instructors with e-learning during COVID-19 considered five areas of satisfaction: infrastructure, training, assessment methods, teaching methods, and laws and regulations. The results show that instructors experienced difficulty in increasing the interactions of students during online classes, and that they needed more training on techniques to create and manage e-content. They also had concerns about the integrity of online assessment methods that took place during the COVID-19 lockdown [32].

Sailer et al. investigated the factors relating to technology use in teaching, including basic digital skills, technology-related teaching skills, and availability of digital technology resources. Their results show that there is a threshold level of digital technology resources at which the use of technology does not increase even if the resources increase beyond this level. Instead, teachers' basic digital skills seem more important for the frequency and effectiveness of utilization of technology in learning. Therefore, they recommend focusing on equipping teachers with skills for using technologies effectively to improve the quality of e-learning [33].

A survey done for Harvard faculty members showed that the most-mentioned benefits of e-learning were synchronous tools such as chats, breakout rooms, and polls, which allow interactions between students and instructors, and among students. The study also mentions the flipped learning technique that was adopted by many instructors to benefit from pre-recorded theoretical classes, to create a more personalized learning environment for the students, where they can learn at their own pace while utilizing classes for discussions. The study reports on the effect of the improved infrastructure that Harvard University adapted in 2015 called the "HBS Live Online Classroom", which provided a real-time, interactive online classroom for 60 learners on multi-screens. This was in addition to the "HELIX Classroom", where students attended classes remotely. Both facilities provided an environment similar to face-to-face classes, thus achieving high learner engagement in class, student satisfaction, and technology-burden relief for the instructor [34].

3 Methodology

Two surveys were conducted for students and instructors, which included all the university faculties. A total of 197 instructors responded. Eight faculties at UOP participated in the two questionnaires, namely the faculties of: Information Technology (FIT), Architecture & Design Architecture (FAD), Administrative & Financial Sciences (FAFS), Arts & Sciences (FAS), Law (FL), Pharmacy & Medical Sciences (FPMS), Mass Communication (FMC), and Engineering (FE). The FIT has five departments including: Software Engineering, Computer Science, Data Science & Artificial Intelligence, Information Security, and Virtual and Augmented Reality. The FAD has five departments: Architecture, Interior Design, Graphic Design, Animation & Multimedia, and Digital Film Design Technology. The FAFS has seven bachelor programs: Business Administration, Banking & Finance, Accounting, Marketing, E-Business & Commerce, Business Intelligence & Data Analytics, and Financial Technology. The FAS has six bachelor programs: Arabic Language & Literature, English Language & Literature, Chemistry, Mathematics, Educational Sciences, Modern Languages, and French and English Language & Literature. The FL awards only a Bachelor of Law. The FPMS offers two bachelor programs, one for Pharmacy and the other for Nutrition. The FMC offers four bachelor programs: Journalism and Digital Media, Digital Promotional Media, Radio & Television, and Master of Media & Journalism, whereas the FE offers one program in Civil Engineering. Civil engineering and Architecture were classified as Engineering. Software Engineering, Computer Science, Data Science & Artificial Intelligence, Information Security, and Virtual and Augmented Reality were classified as information technology (IT). Chemistry, Mathematics, Pharmacy, and Nutrition were classified as Science and Medical Science, and the remaining departments were classified as Humanities and Social Science. The instructors participating in the survey were categorized according to the number of years of teaching, which is an indication of their ages and computer skills background. In addition, 539 students from different study levels also participated in the survey. Students were categorized by their academic general point average (GPA) as: fair, good, very good, and excellent.

The surveys were created using the Moodle Learning management system and were distributed in October 2022. Questions in the survey were all given five answer options, allowing the participants to choose their agreement level through the scale: (1) Strongly disagree, (2) Disagree (3) Neutral, (4) Agree, and (5) Strongly agree.

4 Results

Two surveys with similar questions were sent to instructors and students. At the beginning the instructors were asked about their area of speciality and their years of experience in teaching. The years of experience were categorized as five intervals, namely: 1–4, 5–9, 10–14, 15–20, and more than 20 years of experience. The students were asked about their academic levels and their GPA, which were classified into four intervals, namely: excellent (GPA: 3.67/4–4/4), very good (GPA: 3/4–3.66/4), good (GPA: 2.99/4–2.33/4), and fair (GPA: 2.32/4–2.00/4).

Ten questions were submitted to instructors and students in order to measure their satisfactions with online and blended learning, seven were common to both audiences. The questions in common were:

- Are you satisfied with the e-learning experience of the blended courses?
- Are you satisfied with the e-learning experience of the online courses?
- Do you agree that the infrastructure at UOP is suitable for e-learning?
- Do you agree that students feel bored during online lectures?
- Do you agree that the quality of e-learning provision could be improved?
- Do you agree that it is necessary to have a deanship of e-learning at the UOP?
- Do you agree that the global trend will be toward e-learning?

4.1 Instructors' Responses

The respondents of the survey covered different faculties and areas of speciality. Figure 1 shows the distribution of the 197 respondents according to their area of speciality, while Fig. 2 shows their distribution according to years of experience.

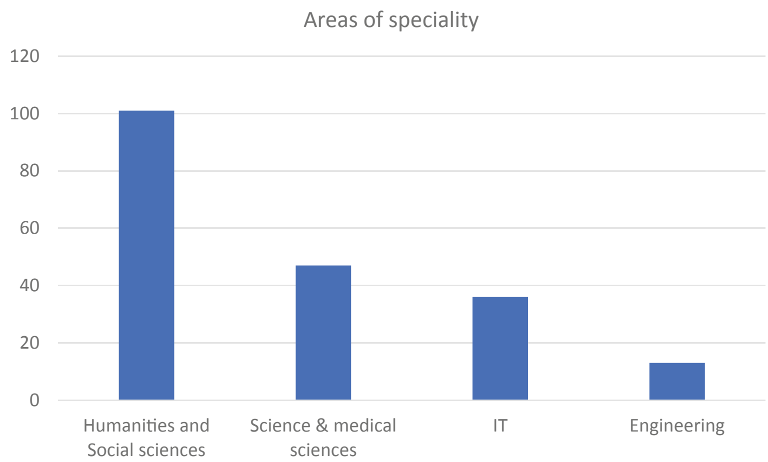

Fig. 1 Distribution of respondents according to their area of speciality

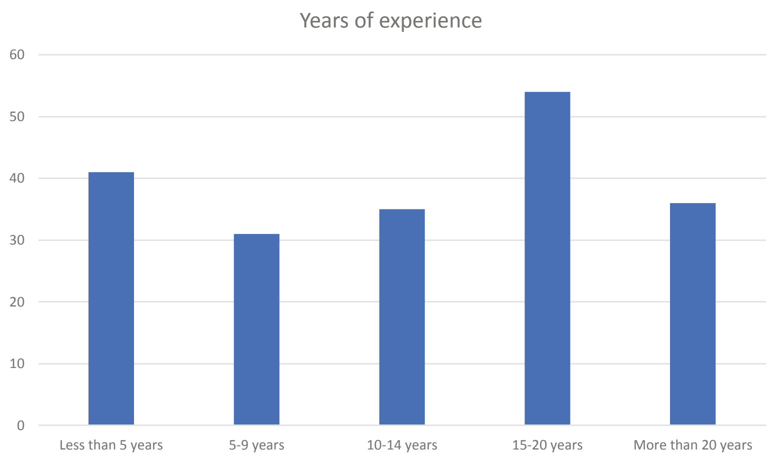

Fig. 2 Distribution of respondents according to their years of experience

4.1.1 Q1: Are You Satisfied with the E-Learning Experience of the Blended Courses?

The instructors who answered with strongly agree and agree, (1) and (2) on the scale, were considered as satisfied, whereas those who responded with strongly disagree and disagree, (4) and (5) on the scale, were considered as not satisfied. Neutral responses were number (3) on the scale. At UOP, blended courses combine both synchronous lectures and asynchronous activities. UOP has chosen the system of (2:1) which, for a three-credit-hours course means: 2 h of two synchronous lectures

Table 1 Satisfaction of instructors with blended courses according to their years of experience

Instructor years of experience	Satisfied (%)	Neutral (%)	Not satisfied (%)
1–4	59	17	24
5–9	58	13	29
10–14	43	23	34
15–20	59	11	30
More than 20	36	19	44
Average	**51**	**16.6**	**32.2**

held at the university campus, and a 1 h asynchronous lecture, including some activities that contain some interactive materials, videos, and homework to be studied and answered by the students in the absence of the instructor. Table 1 shows the response of instructors to question 1, according to their years of experience.

It is obvious from Table 1 that 51% of instructors were satisfied with blended learning, 16.6% were neutral and 32.2% were dissatisfied. Moreover, the new instructors had the highest level of satisfaction compared to those with long teaching experiences (~more than 20 years), who were the least satisfied (44%). Generally, as the years of experience increase, the instructors somehow become less satisfied with blended learning.

4.1.2 Q2: Are You Satisfied with the E-Learning Experience of the Online Courses?

The response of UOP instructors to question 2 is documented in Table 2, which shows an increase in the dissatisfaction of instructors with this type of learning compared to blended learning (Table 1). The averages of responses are 38.6%, 17.2%, and 44.2% for satisfied, neutral, and not satisfied, respectively. At UOP, online courses include 2 h of online synchronous lectures, where the instructor and the students meet through Microsoft Teams (MT), and one lecture of asynchronous activities that are similar to those mentioned in question 1. The activities of the asynchronous lecture are uploaded to the Moodle Platform (MP) by the instructor and the students are required to learn the material on their own. Generally, there is higher dissatisfaction with online learning (~44.2%) compared to blended learning (~32.2%). The dissatisfaction with online learning becomes more pronounced as the instructors' years of experience increase.

Table 2 Satisfaction of instructors with online courses according to their years of teaching experience

Instructor years of experience	Satisfied (%)	Neutral (%)	Not satisfied (%)
1–4	41	24	34
5–9	42	19	39
10–14	34	20	46
15–20	43	17	41
More than 20	33	6	61
Average	**38.6**	**17.2**	**44.2**

4.1.3 Q3: Do You Agree That the Infrastructure at UOP Is Suitable for E-Learning?

Table 3 indicates the response of UOP instructors to question 3. The results indicate high agreement on the suitability of the infrastructure at UOP. The averages are 84.0%, 12.2%, and 3.6% for agreement, neutrality, and disagreement responses, respectively. At UOP, two internet lines from two providers work together to prevent any possible disconnection. Each line provides a speed of 1.0 gigabyte per second (GBPS) fiber with internet backup of 200 megabytes per second (MBPS). Instructors communicate with students from their offices at UOP. Each instructor's office at UOP has a new computer, camera, and microphone to facilitate the e-learning process. Additionally, all classrooms are supported with cameras, speakers, and microphones so the instructor can provide live lectures to students outside the campus in some few cases. Instructors with more than 20 years of teaching experience were less likely to agree that the infrastructure at UOP is suitable for e-learning (~72%) than those with less experience (~88%). In 2021–2022, the university equipped two e-learning studios to allow users to record and edit their e-learning contents in a variety of ways using either light board or green screen. The university also provided 10 Wacom tablets for instructors who prefer to explain courses using them. All editing tools, voice recording tools, and a teleprompter are available for use.

Table 3 Responses of instructors to question 3: "Do you agree that the infrastructure at UOP is suitable for e-learning?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	88	5	7
5–9	87	6	6
10–14	86	14	0
15–20	87	11	2
More than 20	72	25	3
Average	**84.0**	**12.2**	**3.6**

Table 4 Responses of instructors to question 4: "Do you agree that students feel bored during online lectures?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	71	22	7
5–9	68	16	16
10–14	77	20	3
15–20	70	19	11
More than 20	81	14	6
Average	**73.4**	**18.2**	**8.6**

4.1.4 Q4: Do You Agree That Students Feel Bored During Online Lectures?

Table 4 indicates the response of UOP instructors to question 4. Overall, 73.4% of instructors agreed that students feel bored during online lectures with a notably higher percentage agreement (~81.0%) from instructors with long teaching experience. The averages are 73.4%, 18.2%, and 8.6% for agreement, neutrality, and disagreement responses, respectively. It was a matter of observation that at the beginning of the COVID-19 pandemic, the interaction of students with instructors was, for some reason, better than it was later on. The online lectures at UOP are recorded and the students have access to them at any time. Clearly, the instructors' opinion that students "feel bored" during online lectures has to be verified by the opinion of the students themselves, which will be presented in the second section of these results.

4.1.5 Q5: Do You Agree That the Quality of E-Learning Provision Could Be Improved?

The response of instructors to question 5 is shown in Table 5. The averages of responses to question 5 are 73.0%, 18.8%, and 8.6% for agreement, neutrality, and disagreement, respectively. The results follow the same trend obtained in the response of instructors to question 3.

Table 5 Responses of instructors to question 5: "Do you agree that the quality of e-learning provision could be improved?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	73	15	12
5–9	68	23	10
10–14	80	11	9
15–20	69	26	6
More than 20	75	19	6
Average	**73.0**	**18.8**	**8.6**

Table 6 Responses of instructors to question 6: "Do you agree that preparation of electronic exams and attractive electronic material is difficult?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	49	20	32
5–9	52	13	35
10–14	54	17	29
15–20	44	15	41
More than 20	61	11	28
Average	**52.0**	**15.2**	**33.0**

4.1.6 Q6: Do You Agree That Preparation of Electronic Exams and Attractive Electronic Material is Difficult?

As mentioned earlier, in this study, we adapt the definition of e-learning content to mean any document file, presentation file, audio file, or video file that may be used to deliver e-learning [19]. There was pronounced agreement on the difficulty of preparing electronic exams and attractive electronic material (~52.0%), and this difficulty increased as the instructors' years of experience increased. The response averages are 52.0%, 15.2%, and 33.0% for agreement, neutrality, and disagreement, respectively (Table 6).

At UOP, preparing electronic exams includes dividing the scientific materials into categories, and multiple questions have to be included under each category so that random questions can be provided by the learning management system (LMS) to students. Such action increases the reliability of the electronic exam and its accuracy. Two LMSs are used for electronic exams at UOP: Blackboard and Moodle. As for electronic content, instructors usually use different methods such as pre-recorded Microsoft Teams videos, followed by homework related to the videos, or interactive presentations, or interactive videos. Interactive material is usually prepared using H5P (an abbreviation for HTML5 Package) tools. Intensive training workshops were provided to UOP staff in order to embrace these e-learning tools in the academic programs' curricula. Nevertheless, the most experienced instructors still think that preparing such interactive materials requires a long time and still face challenges in using and preparing these materials.

4.1.7 Q7: Do You Agree That You Need Training to Develop More Attractive Online Courses?

Averages of 59.2%, 17.6%, and 23.2% of instructors agreed, were neutral, or disagreed with question 7, respectively (Table 7). These results indicate the need for UOP faculties to provide more training, especially for those with the longest teaching experience (~64%).

Training courses are regularly offered by the academic development center (ADC) at UOP, and intensive training courses are offered for new staff at the start of every

Table 7 Responses of instructors to question 7: "Do you agree that you need training to develop more attractive online courses?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	59	12	29
5–9	68	16	16
10–14	57	20	23
15–20	48	26	26
More than 20	64	14	22
Average	**59.2**	**17.6**	**23.2**

academic semester. At the beginning of the pandemic, training courses were focused on using the learning management systems and synchronous interaction platforms (such as Zoom and MS Teams). Basic tasks such as how to upload material files, assignments, and how to prepare exams were covered. Later training courses covered instructional design processes to re-design courses into e-courses, interaction tools (such as H5P, and discussion forums), and teaching methodologies. Training courses elevated the skills of instructors, as defined in the K19 model [29], from basic digital skills and technology-related teaching skills, to the four different phases of technology usage in classrooms: planning, implementing, evaluating, and sharing technology-related teaching scenarios [33].

4.1.8 Q8: Do You Agree That You Need Additional Tools to Develop More Attractive Online Courses?

Altogether, 68.8% of the instructors agreed that they need additional tools, Average responses of 68.8%, 13.6%, and 18.0% for agreement, neutrality, and disagreement were given by instructors, respectively (Table 8). Responses were similar regardless of instructor experience. The other tools specified by the instructors in this question were mainly laptops or desktop computers, and drawing tablets for architecture (DTA), virtual reality (VR) tools, and additional training courses for interactive tools.

Table 8 Responses of instructors to question 8: "Do you agree that that you need additional tools to develop more attractive online courses?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	59	15	27
5–9	81	10	10
10–14	77	9	14
15–20	63	20	17
More than 20	64	14	22
Average	**68.8**	**13.6**	**18.0**

Table 9 Responses of instructors to question 9: "Do you agree that it is necessary to have a deanship of e-learning at the University of Petra?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	46	12	41
5–9	55	19	26
10–14	43	26	31
15–20	46	22	31
More than 20	33	25	42
Average	**44.6**	**20.8**	**34.2**

4.1.9 Q9: Do You Agree That It Is Necessary to Have a Deanship of E-Learning at the University of Petra?

The responses of instructors to question 9 are documented in Table 9. The average responses are 44.6%, 20.8%, and 34.2% for agreement, neutrality, and disagreement, respectively. Disagreement somehow increases as the teaching experience increases, with the highest percentage (~42.0%) for instructors with more than 20 years of experience, indicating greater rejection of e-learning by them. Fresh instructors, on the other hand, were more in favor of establishing a deanship of e-learning at UOP.

4.1.10 Q10: Do You Agree That the Global Trend Will Be Toward E-Learning?

The responses of UOP instructors to question 10 are given in Table 10. The average responses are 54.0%, 23.2%, and 22.8% for agreement, neutrality, and disagreement, respectively. Generally, all instructors believed that e-learning is going to be a global trend. New instructors with less than 10 years of teaching experience agreed more with this trend than other instructors.

Table 10 Responses of instructors to question 10: "Do you agree that the global trend will be toward e-learning?"

Instructor years of experience	Agree (%)	Neutral (%)	Disagree (%)
1–4	63	15	22
5–9	65	19	16
10–14	37	26	37
15–20	52	31	17
More than 20	53	25	22
Average	**54**	**23.2**	**22.8**

4.2 Students' Responses

The 539 students who responded to the survey represented different study levels and GPA performances. Figure 3 shows the distribution of respondents by study levels, while Fig. 4 shows the distribution of students by GPA. Figure 4 shows a normal (Boltzmann) distribution of student GPA which is usual for such large sample. The distribution is, however, shifted toward excellent GPAs rather than fair GPAs, which could indicate that low-academic-level students were less interested in responding to the questionnaire. The students' responses to survey questions are listed below.

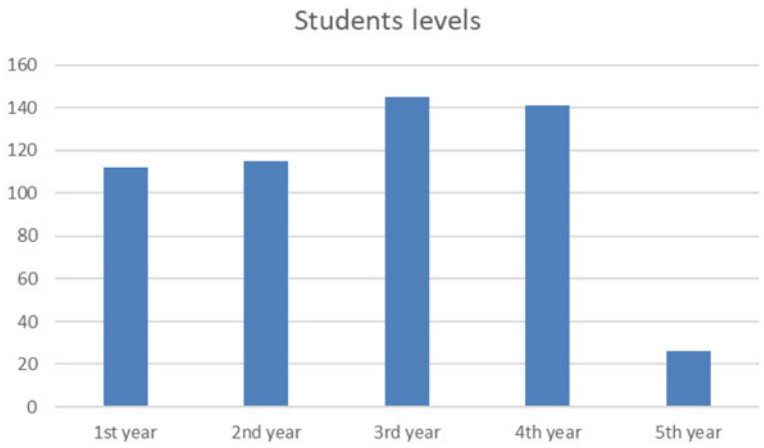

Fig. 3 Distribution of students by study levels

Fig. 4 Distribution of students by GPA

Table 11 Satisfaction of students with blended courses according to their GPA

GPA	Not satisfied (%)	Neutral (%)	Satisfied (%)
Excellent (3.67–4)	16	20	64
Very good (3.00–3.66)	17	20	63
Good (2.33–2.99)	18	22	60
Fair (2.00–2.32)	24	24	52
Average	**19**	**21**	**60**

4.2.1 Q1: Are You Satisfied with the E-Learning Experience of the Blended Courses?

Table 11 shows the response of students to question 1, according to their GPA. It shows that, on average, 60% of students are satisfied with blended learning, 21% are neutral and 19% are dissatisfied. It is also obvious that students with low GPA are the least satisfied with blended learning compared to other students.

4.2.2 Q2: Are You Satisfied with the E-Learning Experience of the Online Courses?

The responses of students to question 2 were similar to those of instructors and show higher dissatisfaction in general with online courses compared with blended courses. Table 12 shows the response of students to question 2, according to their GPA, where we can see that, on average, 56% of students are satisfied with online learning, 19.5% are neutral, and 24.5% are dissatisfied. Again, the percentage of students dissatisfied is highest for students with low GPA (Fair), followed by students with good GPA.

Table 12 Satisfaction of students with online courses according to their GPA

GPA	Not satisfied (%)	Neutral (%)	Satisfied (%)
Excellent (3.67–4)	23	13	64
Very good (3.00–3.66)	22	22	56
Good (2.33–2.99)	26	25	50
Fair (2.00–2.32)	27	18	55
Average	**24.5**	**19.5**	**56**

Table 13 Satisfaction of students with university infrastructure according to their GPA

GPA	Not satisfied (%)	Neutral (%)	Satisfied (%)
Excellent (3.67–4)	12	15	73
Very good (3.00–3.66)	7	11	81
Good (2.33–2.99)	11	20	69
Fair (2.00—2.32)	18	24	58
Average	**12**	**17.5**	**70.5**

4.2.3 Q3: Is the Infrastructure at UOP Suitable for E-Learning?

Students at UOP can utilize all the internet lines available on campus, in addition to free WiFi internet on university buses. The ratio of computers to students on campus is 1:20. Students, on average, show a high level of satisfaction (70%) with the available infrastructure (Table 13). Only 12% are dissatisfied, and 17.5 are neutral. It also shows that students with a low GPA are the least satisfied with the infrastructure (58%), and 18% are dissatisfied.

4.2.4 Q4: Do You Have the Hardware You Need for E-Learning?

A high percentage of students (85%) considered that they had adequate hardware for e-learning (Table 14). The result of a similar question asked in 2020 (during the pandemic) was 42%; this percentage increased to 80% in 2021. Most students use their smart phones, and personal PCs to access learning management systems. Table 14 also shows that students with only a fair GPA are the least likely to agree (79%), and most likely (9%) to disagree that they have the necessary hardware. This may indicate that the unavailability of proper hardware might be a factor for their low satisfaction rate with the blended and online learning courses (Tables 1, 2).

4.2.5 Q5: Do You Agree That the Quality of E-Learning Provision Could Be Improved?

Table 15 shows the response of students to question 5, according to their GPA. It shows that, on average, 62.5% of students agree that better quality e-learning could be provided, 25.5% are neutral, and 12% disagree. It also shows that students with a low GPA are the least likely to agree that better quality e-learning can be provided (52%) and the most likely to disagree (15%).

Table 14 Satisfaction of students with the availability of hardware according to their GPA

GPA	Not satisfied (%)	Neutral (%)	Satisfied (%)
Excellent (3.67–4)	5	8	87
Very good (3.00–3.66)	4	7	89
Good (2.33–2.99)	8	8	84
Fair (2.00–2.32)	9	12	79
Average	**6.5**	**8.75**	**84.75**

Table 15 Students' responses to the question: "Do you agree that the quality of e-learning provision could be improved?", according to their GPA

GPA	Agree (%)	Neutral (%)	Disagree (%)
Excellent (3.67–4)	11	19	69
Very good (3.00–3.66)	12	20	68
Good (2.33–2.99)	10	29	61
Fair (2.00–2.32)	15	33	52
Average	**12**	**25.5**	**62.5**

4.2.6 Q6: Do You Agree That It Is Necessary to Have a Deanship of E-Learning at the University of Petra?

On average 72% of students agreed that a deanship of e-learning was necessary, a higher percentage than for instructors (44.6%) when asked the same question (Sect. 4.1.9). Table 16 shows that students with a low GPA are the least likely to agree with this question (67%).

Table 16 Students' responses to the question: "Do you agree that it is necessary to have a deanship of e-learning at the University of Petra?", according to their GPA

GPA	Disagree (%)	Neutral (%)	Agree (%)
Excellent (3.67–4)	10	12	78
Very good (3.00–3.66)	8	20	72
Good (2.33–2.99)	9	20	71
Fair (2.00–2.32)	9	24	67
Average	**9**	**19**	**72**

Table 17 Students' responses to the question: "Do you agree that the global trend will be toward e-learning?", according to their GPA

GPA	Disagree (%)	Neutral (%)	Agree (%)
Excellent (3.67–4)	11	16	73
Very good (3.00–3.66)	19	13	68
Good (2.33–2.99)	18	17	65
Fair (2.00–2.32)	21	15	64
Average	**17.25**	**15.25**	**67.5**

Table 18 Students' responses to the question: "Do you agree that you feel bored during online lectures?", according to their GPA

GPA	Disagree (%)	Neutral (%)	Agree (%)
Excellent (3.67–4)	27	23	50
Very good (3.00–3.66)	21	26	52
Good (2.33–2.99)	25	27	48
Fair (2.00–2.32)	30	18	52
Average	**26**	**23.5**	**50.5**

4.2.7 Q7: Do You Agree That the Global Trend Will Be Toward E-Learning?

Students' average agreement with this question (67.5%) was higher than that of instructors (54%; see Sect. 4.1.10). Table 17 shows the responses of students to this question. Here, we can see that students with an excellent GPA had the highest level of agreement (73%), while the students with fair GPA had the lowest (64%).

4.2.8 Q8: Do You Agree That You Feel Bored During Online Lectures?

Table 18 shows the responses of students to this question, with averages of 50.5%, 23.5%, and 26% for agreement, neutral opinion, and disagreement, respectively. Students had similar opinions regardless of their GPA, which indicates that most students feel bored during online lectures, thus supporting the instructors' opinions when asked this question (73% in agreement; Sect. 4.1.4).

4.2.9 Q9: Do You Agree That Electronic Exams Are Better Than Paper Exams?

Electronic exams were used at UOP before the pandemic but were performed on campus under supervision of staff members. The percentage of students taking electronic exams varied according to the faculty and the nature of the course. During the shutdown period of the pandemic, all exams were taken online with no supervision by staff members. Many methods were adopted to increase the integrity of exams under these circumstances, such as one-way-direction exams, and a huge bank of questions

Table 19 Students' responses to the question: "Do you agree that electronic exams are better than paper exams?", according to their GPA

GPA	Disagree (%)	Neutral (%)	Agree (%)
Excellent (3.67–4)	13	18	69
Very good (3.00–3.66)	11	16	72
Good (2.33–2.99)	14	12	74
Fair (2.00–2.32)	6	18	76
Average	**11**	**16**	**73**

from which random questions could be chosen. During 2021–2022, all exams were conducted on campus whether electronic or paper exams. Generally, the questions in electronic exams tend to be of a multiple choice nature rather than essay questions. Table 19 shows the responses of students to this question. On average, 73% of students agree that electronic exams are better, 16% are neutral, while 11% disagree. The distribution shows that the percentage agreement increases as the student GPA decreases, i.e., students with a fair GPA are the most likely to agree that electronic exams are better (76%).

4.2.10 Q10: Do You Agree That You Interact with the Instructor in Online Courses?

As mentioned previously, synchronous classes in online courses occur on MS Teams. However, students are not required to open their cameras during online classes, which reduces the interactivity between the students and the instructor. On average, 55% of students agreed that they interacted with instructors, 22% were neutral, while 23% disagreed. Table 20 shows the distribution classified by GPA. We notice that students with an excellent GPA are the most likely to interact (62%).

Table 20 Students' responses to the question: "Do you agree that you interact with the instructor in online courses?"

GPA	Disagree (%)	Neutral (%)	Agree (%)
Excellent (3.67–4)	22	16	62
Very good (3.00–3.66)	20	26	54
Good (2.33–2.99)	20	31	48
Fair (2.00–2.32)	30	15	55
Average	**23**	**22**	**55**

Table 21 Students' responses to the question: "Do you agree that the content presented in online courses is attractive?"

GPA	Disagree (%)	Neutral (%)	Agree (%)
Excellent (3.67–4)	18	19	64
Very good (3.00–3.66)	18	20	62
Good (2.33–2.99)	18	28	54
Fair (2.00–2.32)	27	24	48
Average	**20**	**23**	**57**

4.2.11 Q11: Do You Agree That the Content Presented in Online Courses is Attractive?

On average, 57% of students agreed that the content of online courses is attractive, 23% were neutral, while 20% disagreed. Table 21 documents the distribution classified by GPA, which shows that the percentage agreement increases as the student GPA increases. Students with an excellent GPA have the highest percentage agreement (64%).

5 Discussion

Tables 1 and 2 show that, for instructors, there is a higher overall dissatisfaction with online learning (~44.2%) than with blended learning (~32.2%), and this becomes more pronounced as instructors become more experienced. Such a trend is probably due to the fact that the more-experienced instructors have gained, through time, competitive teaching skills that enable them to handle traditional class lectures easily. Additionally, in such lectures, the instructor can easily observe the students, focus on individual students, and evaluate their satisfaction according to their feedback and their body language. In the classical lecture, several teaching styles can easily be used by instructors, including: deduction, induction, description, discussion and dialog, story presentation, problem-solving, and brainstorming among others. Implementing these teaching styles in an online course seems to be a challenge, especially when the interaction with students is poor. Furthermore, the computer skills of instructors with long teaching experiences (more than ~20 years) are expected to be lower than for new instructors. Blended courses were preferred over online courses by experienced instructors because, in blended (or hybrid) learning, face-to-face lectures with students are still available, which enable the instructor to easily interact with students synchronously. Overall, there is a hidden resistance from the most experienced instructors and hence their satisfaction with the infrastructure at UOP is the lowest (~72%) of all the groups, as indicated in Table 3. Overall, 73.4% of instructors agree that students feel bored during online lectures, with a higher percentage agreement (~81.0%) among instructors with the longest teaching experience, as indicated in Table 4. With the new trend of e-learning, preparing appropriate electronic exams to enable accurate student assessment is also a challenge compared to paper exams.

Classical exams can be done in less time and oversight of students is easy because they can be observed directly. Preparing attractive electronic material is difficult as it takes a very long time to prepare relatively little scientific material; this explains why 61% of very experienced instructors thought that it was difficult to prepare electronic material (Table 6). Such difficulty was in accordance with the instructors' response (Table 7) indicating their need for additional training, especially for those with the longest teaching experience (~64%). Instructors thought that provision of laptops by the university would support their online teaching work (Table 8). Moreover, the instructors, especially those with long teaching experiences, were not enthusiastic about establishing a deanship of e-learning at UOP (Table 9), probably because this would somehow force them to go ahead with their online teaching work. However, more than half of the instructors (54%) agreed that the global trend will be toward e-learning (Table 10).

Similar to instructors, students indicated that they were more satisfied with blended learning (60% on average) than with online learning (56% on average). This concurs with results from previous studies [10, 11] because personal contact and feedback from instructors are greater in blended learning. Psychological distress from isolation in online learning is another reason for this lower percentage [35]. Even if the asynchronous online part of a blended course is of low quality, the face-to-face part compensates for this, thereby achieving better learning outcomes than in wholly online courses.

In both cases, students with a fair GPA are the least satisfied. This might be due to multiple factors. One factor is evident in the answers to questions 3 and 4, where students with a fair GPA indicated that they do not have the required hardware for e-learning. They also think that the university did not have a suitable infrastructure for e-learning. The lack of equipment may be a key reason for this dissatisfaction. Lack of suitable equipment may cause technical problems, which the literature shows causes dissatisfaction [10]. Furthermore, it could also be the reason that students with fair GPAs do not interact as much with instructors in online classes (as in question 10) and are least satisfied with the e-learning content (as in question 11). This requires a further detailed investigation to study if there is a direct relationship between suitability of e-learning equipment, technical problems, and e-learning satisfaction.

Students with a fair GPA are more satisfied than others with electronic exams, since they are mostly multiple choice questions; this concurs with studies showing that students facing learning difficulties struggle with written exams and think that multiple choice (MC) exams are easier. Their preference for MC exams is due to the fact that they just have to choose an answer, and do not have to show what they have learned or to construct their own solutions. By contrast, students who prefer open-ended questions in exams do so because they think that these questions give them the freedom to express their knowledge and skills better than multiple choice questions [36, 37].

The results of questions 10 and 11 are as expected because students with excellent GPAs are keener to make the effort required, so they interact with the instructors in online courses and they explore the course content provided online. But, in general, all students regardless of their GPA levels feel bored during online lectures. This might be due to the fact that most instructors moved face-to-face teaching methods onto digital platforms, with very little utilization of interaction tools (such as polls, breakout rooms, discussion forums, etc.) during online classes.

Students are keener than instructors when it comes to agreeing that e-learning is the global trend; the average agreement of students was 67.5%, while only 54% of instructors agreed. Similarly, students agreed more with the idea of the need for deanship of e-learning than instructors. This is not surprising since the current students are mostly Generation Z, who are familiar with the use of digital technology and social media from very young ages; therefore, they believe in e-learning.

To bridge the gap between the two elements of the educational process (namely the student and the instructor), UOP has to improve its infrastructure and technology in order make e-learning an attractive prospect. Overall, e-learning has to be similar to, or even better than, traditional education in order to go along with the global trend toward e-learning and to achieve appropriate learning outcomes from the academic programs. The transition toward e-learning will have high economic impact on universities and learners. The experience of Harvard University seems to be promising [34]. The Live Online Classroom that was established at Harvard University allowed the instructors to provide an interactive online classroom for students on clear multi-screens. Such classrooms allow the instructors to observe and monitor the students and evaluate their interactions and body language [34]. We expect that offering such classrooms will bridge the gap between traditional and e-learning as the instructors will be able to practice their teaching skills and shift from teaching to learning whenever they think it is necessary. Additionally, such classrooms will be monitored by technical staff who will support the instructors, especially those with little computer experience, to conduct their lectures. Other teaching and learning tools have to be available, including internet access, smart boards, and other requirements. Such tools allow the shift from teaching to learning to be achieved. It is expected that the hidden resistance of instructors will be reduced in the presence of such classroom studios, since the infrastructure arrangement will let them feel as if they are in a traditional lecture theater. A deanship of e-learning has to be established at UOP to cope with the huge increase in e-learning demand and to set the policies and procedures needed for this future form of learning.

6 Conclusions

The following conclusions can be drawn from this study:

1. Instructors and students expressed higher overall dissatisfaction with online learning compared with blended learning and this becomes more pronounced as an instructor's years of experience increases and as the student's GPA decreases.
2. Overall, there is a hidden resistance for implementing online and blended courses from the most experienced instructors.

3. Instructors think that students feel bored during online lectures, and the students confirmed this observation.
4. The quality of e-learning at UOP could be improved, which requires more training to be given to the instructors.
5. Overall, instructors think that preparing electronic material and exams is difficult compared to the requirements for classical lectures and think that UOP needs to offer laptops to them to support their online lectures. Additionally, students with only a fair GPA indicated that they do not have the required hardware for e-learning.
6. Students believe, more so than the instructors, that e-learning is going to be a global trend and hence students were more in favor of the idea of a deanship of e-learning than instructors.

The current investigation aimed to assess instructors' and students' satisfactions with the blended and online learning approaches that they experienced at the University of Petra after implementation of the hybrid programs according the new MoHE regulations after the COVID-19 pandemic. In conclusion, e-learning is a trend in education, but the transition from classical teaching methods still needs more improvements. Among the pressing issues is the training of instructors in teaching methods suitable for e-learning in order to develop good quality materials that hold the attention of students. Additionally, the Harvard University experience of adapting Live Online Classroom to provide a teaching/learning environment that is similar to face-to-face classes seems to be a good choice for UOP.

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Interactive and Collaborative Distance Learning Approaches: A Decision-Making Framework for Higher Education in Developing Countries

Wael Mualla and Karim J. Mualla

Abstract Distance learning in higher education has come a long way since the introduction of the World Wide Web in 1990. Today, world-leading universities rely on distance learning as a major source of income and a significant platform from which to deliver an equivalent standard of teaching and assessment to that of physical on-campus education. Recent advancements in information and communication technologies have drastically shifted distance learning toward being a more desirable option. In particular, following the COVID-19 pandemic, unprecedented types of remote and dual-teaching innovations were introduced and, for selected disciplines, even became noticeable competitors to traditional on-campus education. In developing countries, internet-based distance learning is still in its early stages as many countries are facing challenges and obstacles regarding its various aspects, including the level of infrastructures, the availability of electricity, power outages, lack of internet coverage, differences in network coverage between cities and remote areas, etc. Another matter of concern is the availability of skilled technical support staff to follow and manage the process of distance learning. Furthermore, many developing countries still do not recognize qualifications obtained through distance education programs, which is often essential for admission to further study, or for employment.

In this chapter, the status of distance education programs in higher education institutes (HEIs) in developed and developing countries is presented and discussed, with special focus on Syrian HEIs. The impact of the COVID-19 pandemic on the Syrian higher education system is also outlined, as well as the main challenges faced by HEIs in assuring teaching and learning continuity. The findings of a small survey on how selected HEIs in the region and in Europe performed during the pandemic, the challenges they faced in assuring teaching continuity, and their future plans regarding

W. Mualla (✉)
Damascus University, Damascus, Syria
e-mail: wmualla@gmail.com

K. J. Mualla
School of Computing and Mathematical Sciences, University of Leicester, Leicester, UK
e-mail: kjm49@leicester.ac.uk

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course delivery in the post-pandemic era are also presented. Finally, a decision-making framework for higher education management in developing countries to design and implement effective distance learning processes is outlined, while taking into account the various academic and technological capabilities available to these institutions.

Keywords Developing countries · Syria · War · COVID-19 · Higher education · Distance education

1 Introduction

Distance learning in higher education (HE) has come a long way since the introduction of the World Wide Web in 1990. Today, world-leading universities rely on distance learning as a major source of income and a significant platform from which to deliver an equivalent standard of teaching and assessment to that for physical on-campus education.

The challenges surrounding distance learning consist of lack of student engagement, lower appetite to learn, and other interactive and collaborative concerns regarding technologies and infrastructure. While this is mainly due to the remote nature of the learning process and delivery methods, which in most cases amount to asynchronous events, recent advancements in information and communication technologies have drastically shifted distance learning toward a more desirable option. In particular, following the COVID-19 pandemic, unprecedented types of remote and dual-teaching innovations were introduced, and for selected disciples, even became noticeable competitors to traditional on-campus education.

In developing countries, the situation is considerably different from that in developed countries. Internet-based distance learning is still in its early stages as many countries are facing challenges and obstacles regarding infrastructure, the availability of electricity, power outages, lack of internet coverage, differences in network coverage between cities and remote areas, etc. Another matter of concerns is the availability of skilled technical support staff to follow and manage the process of distance learning.

Furthermore, in many developing countries, the recognition of qualifications awarded through distance learning, which is often essential for admission to further study or for employment, is still a complex issue. Many developing countries still do not recognize qualifications obtained through distance education programs, or they are only recognized provided they meet certain conditions [1].

In this chapter, the status of distance education programs in HEIs in developed and developing countries is presented and discussed, with special focus on Syrian HEIs. The impact of the COVID-19 pandemic on the Syrian HE System is also outlined, as well as the main challenges faced by HEIs in assuring teaching and learning continuity. The findings of a small survey on how selected HEIs in the region and in Europe performed during the pandemic, the challenges they faced in assuring teaching continuity, and their future plans regarding courses delivery in the post-pandemic era are also presented.

Finally, a decision-making framework for higher education management in developing countries to design and implement effective distance learning processes is outlined, while taking into account the various academic and technological capabilities available to these institutions.

2 Distance Learning in Higher Education Before COVID-19

According to U-Multirank data, some 60% of universities reported online learning provisions in their strategic planning prior to COVID-19, while only one-third appeared to provide full online courses in some form [2].

Before the pandemic, the evidence indicated that universities with a greater focus on the fields of education, business studies and economics, as well as larger institutions and those with a broad disciplinary scope, were more likely to offer online programs [2]. Although the majority of universities have recognized the strategic importance of online teaching, only a few have developed fully online educational programs. It is noticeable that, in the fields of engineering and science, the percentage of programs available entirely online is less than 3%, whereas it is much higher in subjects such as business studies (12%) and economics (7%). Furthermore, U-Multirank data show that the availability of interactive learning tools and digital exams is low, indicating that widespread online support has proven difficult for many universities [2].

3 Distance Learning in Higher Education in Developing Countries

Many developing countries still do not recognize qualifications obtained through distance education programs or only recognize them provided they meet certain conditions [1]. For example, in Saudi Arabia, overseas degrees studied through distance learning are not recognized; only qualifications that are studied on a full-time basis and delivered on-campus are recognized. However, in Malaysia, overseas degrees studied through distance learning are accepted if they are recognized in the home state [1].

In India, overseas degrees studied through distance or blended learning are not recognized by the Association of Indian Universities (AIU). In Qatar, overseas degrees studied via distance learning are generally only recognized when awarded by selected universities in Australia, New Zealand, the UK, and the USA. In Oman, distance learning is only recognized for certain MA and PhD programs, and only when awarded by selected UK, Australian, New Zealand, and US institutions. Students wishing to study at non-Omani institutions are advised to seek written approval from the Omani Ministry of Higher Education, Research, and Innovation prior to enrollment. Only 49 UK universities currently appear on the list of recommended institutes for distance learning [1].

In the UAE, overseas degrees studied through distance learning are recognized if they meet certain criteria. Students are recommended to apply to the Ministry of Education prior to enrolling in an overseas degree program to ensure that the program is recognized and will be granted equivalency upon completion. Distance learning programs in scientific and applied fields may not be recognized in the UAE [1].

4 Distance Education in Higher Education Institutions in Syria

Distance education (DE) in HEIs in Syria exists only in traditional public universities and in the Syrian Virtual University (SVU). In traditional public universities, DE programs are not internet-based; students come to campus on weekends only if they wish to consult with staff. Some digital contents are provided to students (in the form of CDs) to cover certain subjects. For example, DE programs in Damascus University consist of seven programs mainly in humanities (Table 1). The SVU is the only University in Syria that provides online DE programs (undergraduate and postgraduate).

Table 1 Distance education programs in Damascus University

No	Program title	Faculty	Year established	Year of graduation of 1st cohort
1	BSc in Media	Faculty of Media	2001–2002	2004–2005
2	BSc in Translation	Faculty of Literature and Human Sciences	2001–2002	2004–2005
3	BSc in Accounting	Faculty of Economics	2003–2004	2006–2007
4	BSc in Legal Studies	Faculty of Law	2003–2004	2006–2007
5	BSc in Kindergarten	Faculty of Pedagogy	2003–2004	2006–2007
6	BSc in International Studies and Diplomacy	Faculty of Political Sciences	2006–2007	2010–2011
7	BSc in Management of Small and Medium Enterprises	Faculty of Economics	2006–2007	2010–2011

5 Impact of the Pandemic on the Syrian Higher Education System

The COVID-19 pandemic has caused the largest disruption of education in history worldwide, impacting HEIs whether in terms of teaching and learning access, student recruitment, student mobility, and academic and non-academic staff or university operations. The Syrian higher education system was not an exception. In fact, the impact of the pandemic was more severe in Syria because the country was slowly emerging from a prolonged war [3–5].

The main impact of the pandemic was on teaching and learning, and on academic and non-academic staff. No significant impact was reported on student access, student recruitment, or on drop-out rates.

The most important effect was the temporary cessation of face-to-face teaching in all Syrian HEIs for a period that lasted more than two months. Many HEIs tried to switch to distance education (synchronous or asynchronous) during the lockdown with variable degrees of success.

The success of Syrian HEIs in implementing distance education varied considerably, according to the size of the institution and its e-readiness [5]. Public universities with diversified programs and huge numbers of students had considerable difficulties in implementing online programs. Higher institutes and some private universities that had relatively small number of students managed to implement successfully some e-learning courses on their platforms [5].

6 Main Challenges in Moving to Online Education and Assuring Teaching and Learning Continuity

Low connectivity and poor infrastructure as a result of the prolonged crisis, and difficult access to internet and digital devices by many students proved to be major obstacles to implementing viable distant e-learning programs by many HEIs in Syria. The preparedness of academic staff was also an issue of concern as many staff members did not possess the ability or the experience to continue teaching in a virtual modality.

Furthermore, the teaching of subjects that included the development of professional competences through practice (clinics, design, engineering, etc.) was a source of greater uncertainty as universities were not sure how to deal with the online delivery of these subjects.

7 Success Stories in Assuring Teaching and Learning Continuity During the Pandemic

The experiences of two Syrian HEIs who succeeded in assuring teaching continuity during the pandemic, namely the Higher Institute for Applied Sciences and Technology (HIAST), and the Syrian Virtual University (SVU), are described here.

7.1 The Higher Institute for Applied Sciences and Technology (HIAST)

The Higher Institute for Applied Sciences and Technology is an elite institute that accommodates about 350 students spread over 5 years. The very strict admission requirements imposed by the institute mean that only high-achieving students in the Syrian secondary education certificate are admitted to the institute [5, 6].

E-learning was established in HIAST in 2003 long before the COVID-19 crisis. An e-learning platform, called "*e-class*", had been created on the institute's network and servers. It was based on the open-source software *Moodle*. Distance learning was not offered at that time at HIAST, but the platform was used to explore blended learning, and to conduct training courses for workers in remote places.

With the emergence of the COVID-19 pandemic and the start of the implementation of "social distancing" measures, HIAST found in the *e-class's* platform a suitable and familiar alternative to ensure the continuity of the teaching and learning processes.

Factors that contributed to HIAST's success in switching to online education are [5, 7]:

- The familiarity with the e-learning platform that was installed more than 15 years before the pandemic.
- The small number of students in the institute.
- The high quality of the students and student's excellence in technology-related subjects.
- Staff highly trained on the use of technology.
- Provision of continuous technical support for both staff and students.

7.2 The Syrian Virtual University (SVU)

The SVU was established in 2002 by special law and offers distance learning courses delivered entirely online. The SVU consists of three faculties: the Faculty of Information Technology and Communications, the Faculty of Management Sciences, and the Faculty of Humanities. Each faculty provides a number of Bachelor's and Master's programs [8].

The SVU uses its own University Information System (SVUIS) which has been built and developed internally. The e-learning platform is based on LMS Moodle, which was adapted to SVU needs. Distance tutoring is provided in a number of ways including synchronous lectures, recorded lectures, videos, etc. Final exams are not carried out online but rather in certified national and international telecentres [5–10]. National centers are spread throughout Syria and international centers are based in certain locations in the Arab region and Europe [8].

The impact of both the war and the pandemic on the SVU was different compared with other Syrian universities. The war, which began in 2011, had a huge impact on traditional HEIs in general. The damage inflicted on the institutions was huge, including losses of infrastructure, disruption to the academic year, and limited higher education funding. In the case of the SVU, because all its courses are delivered remotely, the impact of the war was significantly less compared with other universities (public or private). In fact, in the early years of the war (2011–2014), many students considered studying at the SVU to be a safe mode of higher education study, which resulted in a significant rise in the total number of enrolled students [5, 12].

The pandemic did not affect the teaching and learning processes at the SVU. Lectures in all programs continued in a normal way. Only final exams (which are usually carried out in certified telecentres) were postponed for a period of two months in Spring 2020 [11]. Regarding admissions and student recruitment, a steep rise in the number of enrolled students at the SVU was observed in the academic years 2019–2020 and 2020–2021 [12]. This significant increase was an expected impact of the pandemic as many students considered studying at the SVU to be a safe mode of study during the pandemic as well.

The most important factor in the success of the SVU during the pandemic was its extensive experience in remote teaching, with instructors having the necessary qualifications, and degrees specifically designed to be taught online.

It is clear from the previous two success stories that HEIs that had their own platforms and digital teaching resources were successful in shifting to online delivery and assuring teaching continuity during the pandemic.

8 Survey of How Universities Performed During the Pandemic, and Their Plans Post-pandemic

A small survey was conducted by the author on how HEIs performed during the pandemic, and the challenges they faced in ensuring teaching continuity. The survey included 15 HEIs in the Middle East region and in Europe. The future plans of HEIs regarding teaching and learning processes post-pandemic were also surveyed.

The study showed that, prior to the pandemic, none of the 12 surveyed HEIs in the Middle East had DE programs and only two of those in Europe had DE programs. All HEIs moved to DE during the pandemic, the majority synchronous; only a few used mixed deliveries (synchronous and asynchronous).

8.1 Main Challenges Faced During the Pandemic

The survey revealed that the main challenges faced by academic staff in moving to DE during the pandemic and the subsequent lockdown were the availability of the necessary digital equipment, staff competencies and the required level of IT skills, access to a reliable and fast internet service, a convenient place to attend the sessions, and being abroad in a different time zone.

The survey also revealed that the main challenges the institutions had to deal with during the online delivery were maintaining student engagement, feedbacks and communicating with students, courses that require practical work (e.g., labs), designing and conducting online exams, and student assessment (course work and exams).

It is interesting to note the diverse methods the surveyed HEIs employed in conducting online student assessments and exams. Some institutions used multiple-choice questions (MCQs) with a limited time to select a choice, whereas other institutions used MCQs with a different set of questions for each student.

Some institutions used open-book exams giving a 48-h window for submission of the exam papers, other institutions opened the exam for a 24-h period and allowed students to stay only for a specified allocated time for each exam.

Only one of the surveyed HEIs reported that exams were canceled and other methods used to assess students.

Most of the surveyed HEIs reported that plagiarism was a real concern and a major challenge that they had to deal with.

8.2 E-Learning Post-pandemic

Regarding the post-pandemic period, the HEIs surveyed had different plans for continuing to deliver some courses remotely.

While some institutions opted for integrating e-learning with face-to-face learning (20% of taught courses totally online, 20–30% blended learning, 50–60% face-to-face), other institutions chose hybrid learning, where all teaching sessions would be available on-campus and online, and students could choose what is suitable for them.

Some institutions allowed staff members to change their modules and include elements delivered online as long as they did not exceed a set limit (30%, synchronous or asynchronous).

Moreover, some institutions left the choice entirely to students so that every student had the option to register as an online student or as an on-campus student.

8.3 Blended Learning

When HEIs were asked specifically whether blended learning will be an option in the post-pandemic period, most of the institutions surveyed indicated that blended learning will stay because technology will help substantially in shaping the future of education. Some institutions revealed that all their developed materials are kept at the disposal of students, and all sessions are available to attend in person, or online (synchronous and asynchronous). Students can mix and match a way that suits their needs as learners.

Although one HEI reported that blended learning had already been implemented, and that hybrid teaching was already used for most courses, one other institution reported that no blended learning was planned as it is not suitable for natural science and engineering courses that include lots of laboratory work.

8.4 Main Challenges to Adopting E-Learning and Distance Education in Developing Countries

When the HEIs were asked about the main challenges hindering the adoption of e-learning and distance education in universities in developing countries, most institutions raised the issues of the availability of adequate infrastructure such as electricity and telephone lines, as well as access to the digital equipment and internet connections necessary to support online learning. Some institutions focused their attention on the lack of technological expertise by teaching staff to produce e-learning and e-content and stressed the need for staff training, not only on how to use online tools but also on how to design modules, assessment methods and exercises that are suitable for an online environment.

Surprisingly, only one institution raised the issue of getting the regulatory authorities to recognize that distance learning is important and will significantly help in talent development and in access to higher education.

8.5 Comparison with the Findings of the UNESCO Report

The findings of this small survey are consistent with those of a UNESCO report published on July 2021 on the “Response of Arab Countries to Educational Needs during the COVID-19 Pandemic” [13]. The report included a survey conducted by UNESCO and addressed the governmental/formal educational institutions in schools, high schools, institutes, and universities, during the period between the 2nd of June and the 12th of June 2020. Several Arab countries responded to the questionnaire in which a total of 13,483 participants submitted responses.

The UNESCO report showed that the weakness of the infrastructure caused a serious obstacle that prevented some learners from pursuing their education and following up with their classes. It also showed that, in some Arab countries, at least half of learners were unable to pursue distance learning due to power outages or lack of internet coverage. Responses to questionnaires also indicated major differences in network coverage among cities and remote areas [13].

Regarding staff competencies, the UNESCO report revealed that many teaching staff members did not have the required digital skills to keep in pace with the distance learning process, and many of them did not have an appropriate home environment for distance learning.

The UNESCO questionnaires also showed that the process of assessment and evaluation of student achievements was a challenge in the distance learning process, in terms of ensuring transparency and promotion standards. Teaching staff used various forms for assessment, some adopted direct evaluation during the educational process, and others used electronic assessments through available electronic applications. Only a very small portion (6%) indicated that no assessment was done [13].

The results also showed that more than half of the sample included in the questionnaire (13,483 participants) supported the integration between traditional learning and distance learning.

9 Effective Approaches to Distance-Learning by UK-Based World-Leading Universities

This section reviews the latest distance-learning practices that were reshaped and adopted during the COVID-19 pandemic by several UK-based Universities. The University of Leicester is presented as an example of how a world-class university designed and employed a hybrid, embedded, and blended learning approach during the pandemic across different distance learning programs. In 2022, the University of Leicester was ranked 23rd out of 766 universities in the world, and 4th in the UK according to the Times Higher Education Impact Ranking [14]. The University also received positive feedback and recognition from both students and other HE institutions regarding the way distance learning strategies were administered and delivered [15].

The following review covers a high-level analysis of the pedagogical pillars of distance learning. This paper considered the following areas essential to ensure an optimal implementation and delivery processes for distance-based teaching, assessment, instructions, and management strategies.

9.1 Teaching Approaches and Assessment Strategies

In a previous paper [5], key approaches to remote formative and summative assessment were discussed in terms of dual (on-campus and off-site) delivery and management. This paper builds on these aspects by highlighting a decision-making framework for distance learning assessment delivery, feedback, and administrative process. The framework covers the following areas:

- Learning:
  - Helping students to work more efficiently online, by constructing a bespoke learners Guide to Digital Learning.
  - Engaging with students as partners to improve learning processes through various semester-long Q&As and dedicated feedback sessions.
  - Supporting students to adequately transition to higher education by developing a remotely accessed transitions toolkit.
  - Ensuring distance-learning students are aware of all additional academic skills and online support available through the dedicated operations team.
  - Enabling students to choose guidance-related personal, careers, and placement tutors, and others involved in pastoral support related to learning.
  - Ensuring students effectively utilize the wide range of remote learning features to facilitate different teaching styles and opportunities [16].
- Teaching:
  - Module convenors teaching practice:

    Creating a platform for distance learning module leaders to prepare to teach online through a self-study site for an introduction to distance learning in HE.

    Developing teaching strategies with program directors through the university-available and approved online methods.

    Designing an effective research-inspired, innovative, and adaptive curriculum which is scalable to accommodate the requirements of students from different parts of the world and with different backgrounds.

    Utilizing and making the most of the available digital learning environments, such as Blackboard, Top Hat and Reflect, which support distance learning [17].

    Evaluating and improving module leaders' practice through peer-enhancement exercises.

    Drawing on successful case studies, from on-campus learning practices, that are considered applicable and beneficial to distance learning.

    Ensuring that distance learning learning materials are designed for an inclusive, compassionate, and accessible curriculum [18].

  - Module convenors professional development:

    Ensuring that all academic staff are taking the next step to gain HEA fellowships and the appropriate teaching certificates in their region for education excellence.
    Reflecting on previous teaching and learning experiences through the support and development of creative online practices.
    Identifying the optimal and scalable approaches to employ in large distance classrooms, in what is referred to as MOOC (Massive Open Online Courses) [19].

- Assessment and Feedback:

  - Employing a bespoke catalogue of assessments to support the development of students' skills, engagement, and confidence.
  - Selecting appropriate assessment and feedback strategies as set by program directors and the education committee for on-campus processes.
  - Adapting the same assessments for online delivery and feedback release and follow-up procedures [20].
  - Ensuring all assessments align with the university assessment strategy for on-campus programs.
  - Ensuring both convenors and students fully comprehend the feedback charter principles and allow frequent Q&A sessions to address any shortcoming [21].

9.2 Instructions, Administrative Operations, and Streamlined Processes

One example of a multi-option and fluid process to manage distance learning programs, is a popular DL course at the University of Leicester, titled: "Advanced Computer Science MSc, PGCert, by distance learning". This degree includes six modules and a dissertation project, which can be completed in two years. Students can decide to study over two terms by selecting three modules each semester. Alternatively, students can select the same number of modules over three terms by taking two modules each semester [22].

In addition, students can follow another path which allows them to study four courses without a project over one academic year, and then attain a Postgraduate Certificate (PGCert) at the end. Students can also upgrade from the PGCert to the former MSc either during or after the course.

It is important to mention here that the admission process for this program allows students to align their interests via pre-defined paths if their educational needs are very specific. For instance, if students are not certain whether distance learning is right for them, another option is available to study any individual module as a CPD course (short course) and attain a certificate of completion afterward. This will contribute toward an MSc or PGCert if students start their course within two years of enrolling.

9.3 Supervision, Personal Tutoring, and Accessibility of Projects

One of the key educational aspects of any program, whether at a distance or on-campus, is the completion of larger projects in the final year, or one other year. These activities normally include groups of students working together, which involves dedicated and frequent supervision by an academic member of staff, scheduling of meetings, and the provision of feedback throughout the project's different milestones.

In reference to distance learning, these activities become more critical given that the only method of delivery is through the internet, which must take place strictly through the licensed platforms that are available to the university. This is considered mandatory and essential in order to abide by data protection laws and other legal procedures [23]. Other similar meetings such as personal tutoring and accessibility support, must follow a similar approach, which could cause a challenge for universities when delivering distance learning programs. On this account, solutions and recommendations are outlined as follows:

- Communicating and connecting with students on a personal level from different time zones, using available technologies to overcome potential barriers for disadvantaged parts of the world that are located in a different time zone.
- Building a relationship, understanding expectations, and undertaking each project or tutoring session as an isolated case to shed light on different student skills and knowledge levels.
- Producing regular and frequent formative exercises that are designed to specifically act as a replacement for conventional face-to-face learning and instant feedback and feedforward communication.
- Addressing isolation in all types and formats of supervision meetings and collaborative activities to give students the feeling of an on-campus community.
- Encouraging informal and formal conversations between students themselves through personal tutoring techniques such as virtual office-door knock, whiteboard collaboration, and other creative tools to incentivize engagement as outlined in the teaching section.

Prestigious international university rankings normally avoid publishing specific rankings regarding distance learning studies [24]. Therefore, prospective students from around the world are left without a concrete reference with which to find the leading online programs available in relation to a particular subject of interest.

According to research by StudyPortals, in which data were collected and analyzed from several high-level international rankings (Times Higher Education, and QS Rankings), the outcome identified which UK universities offer students effective and popular remote degrees [24]. Furthermore, these institutions provide different types of program from Bachelors, Masters and PhDs to a range of other bespoke programs in some cases, as previously described.

In 2022, StudyPortals identified the top four universities for offering UK-leading distance-learning degrees. These were University College London, the University of

Edinburgh, the University of Manchester, and King's College London. Other universities, such as the University of Warwick and the University of Glasgow, were also recognized for high-level distance learning delivery and degree options. These universities offer a range of distance learning study levels including MSc., M.A., and MBA degrees. Moreover, the most popular distance learning subjects were Neurology, Education, Security, Sports, Business Management, Food Science, History, Law, and Philosophy [25].

The key advantage that these universities have over other institutions offering similar online degrees is their strong collaborative links with industry and both private and public services, which is not considered an easy process to adopt when delivering a fully remote mode of study.

10 Conclusion

Some higher education experts described the COVID-19 pandemic as "a blessing in disguise" because it has thrust universities almost overnight into digital education [26]. It is true that the pandemic has made everybody more open to digital education, including regulators, students and faculties; however, in developing countries, significant challenges remain to be overcome before viable digital education programs can be implemented.

Achieving equality among all learners and achieving learning opportunities for all remains the main challenge for educational systems in developing countries, especially in light of the crises and conflicts that these countries are experiencing. Moreover, low incomes in some developing countries, poor technical capabilities and electricity infrastructure, availability of devices for learners, poor internet networks and different internet coverage between cities and rural areas are all among the challenges faced.

In light of the survey results and the feedback received from many HEIs, it can be concluded that, in the post-pandemic period, most institutions are planning to benefit from the experience gained during the lockdown by integrating in-class traditional learning with distance learning. Blended learning seems to be the option adopted by many HEIs although they differed in the ways of implementing it.

It is of paramount importance for HEIs in developing countries to address the issue of the lack of technological expertise in e-learning and e-content production by teaching staff, and the need for staff training, not only on how to use online tools but also on how to design modules, assessments, and exercises that are suitable for an online environment. Within this context, HEIs in developing countries can benefit from the experience of universities in developed countries, such as the University of Leicester, which has received positive feedback and recognition from both students and other HEIs following the way distance learning strategies were administered and delivered during the pandemic.

The issue of getting the regulatory authorities, in developing countries, to recognize that distance learning is important and will significantly help in talent development and in access to higher education is also of paramount importance and needs to be addressed as well.

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Bridging the Digital Divide in Higher Education: North African Challenges and Initiatives

Wail Benjelloun

Abstract The digital divide refers to the uneven access to information and communication technologies (ICT) and therefore to the advantages of digital transformation (DT). The divide may concern differences in the availability of technology and/or human capacity that create inequities between nations, social strata within a nation, educational and training institutions and economic entities and enterprises in accessing information. Such inequities obviously create unfair advantages for the "haves", giving them a competitive edge over the "have nots". Over the past few decades North African (NA) educational systems have been heavily solicited by a rapidly expanding youth population, requiring increased investment in infrastructure and staff, and creating pressure on the fragile economies of developing nations. An initially timid interest in distance education during the first two decades of the century was reinforced by the pressing needs resulting from the COVID-19 pandemic. At the higher education (HE) level, the fact that such distance education worked more or less effectively to prevent the loss of two academic years during the pandemic suggested to decision-makers interesting possibilities to deal with the pressure. With the pandemic, the Virtual University of Tunis (founded in 2002), as well as more modest programs like the Cadi Ayad University (Marrakesh, Morocco) MOOC development effort, became national priorities. Several NA HE ministries and universities undertook initiatives to facilitate access to ICTs in general, and particularly to internet and learning platforms. The challenge, however, was not just related to access to technology but also to working to bridge the digital divide to provide equal access for underprivileged students as well as for those in remote geographical areas. It also meant training faculty to create content and to take advantage of available platforms. There is a growing awareness that the future of NA HE is linked to the ability to marshal diverse learning resources and paradigms to ensure a quality education that fosters innovation, research and competitivity. Beyond contributing to facing the challenges of increasing student numbers, the mix of independent, blended, e-learning, distance education, in class coursework, and the resulting multiple hybrid formats create opportunities encouraging students to express their full potential, thus improving prospects for employability in a region

W. Benjelloun (✉)
Mohammed V University, Rabat, Morocco
e-mail: wbenjelloun@gmail.com

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where the higher the diploma the greater the chance of unemployment. They also allow for internationalization, regional cooperation and curriculum sharing at the national level. The resulting changes in the role of faculty, in learning techniques, in institutional investments and in job market preparation are reviewed in the light of policies to bridge the digital divide, and their impact on NA HE is assessed.

Keywords Digital transformation · Digital divide · Internet penetration · Distance education · Innovation and research · Employability

1 Introduction

North Africa is home to some of the oldest and most famous universities in the world, such as Al Qarawiyine of Fez, Ez-Zitouna in Tunis and Al Azhar in Cairo. Yet, most NA modern universities, established immediately after independence (Morocco, Tunisia, Libya and Mauritania) or left behind by the departing colonial powers (Egypt and Algeria), suffered from insufficient academic and administrative staff, equipment and appropriate curricula. In spite of that they successfully trained the initial administrative cadre for their nations, who assured the construction of modern sovereign states.

Over the years, these universities served an important role as agents of social mobility, allowing the disadvantaged to aspire to better employment and a better life. In North Africa, a seat in the public tuition-free universities thus became the objective of all holders of the Secondary School (Baccalaureate) Certificate. As the numbers of students (and consequent pressure) increased, the load was oriented toward "open access" faculties that welcomed eligible holders of the secondary certificate, whereas a limited series of higher institutes, constituting highly selective centers of excellence (e.g., faculties of medicine or engineering) were open only to those students with the best grades.

For some NA countries, the increase in the number of students over the years has been dramatic and has continued into this century. Morocco's HE student population increased from 100,000 at the end of the 1980s to 420,000 in 2011 and 1.2 million in 2021–2022 [1]. Algeria's increased from 1.7 million in 2018 to over 2 million in 2021–2022 [2], while in Egypt the HE student population grew from 2.99 million in 2017–2018 to 3.1 million in 2018–2019 [3]. Thus "massification" continues to be a major challenge for NA universities. Of the more densely populated NA countries, only Tunisia has seen its public tertiary student population stabilize and actually slightly decrease over the past decade; in 2018–2019, it stood at 254,526 [4]. Libya reported 200,000 students in 2004 [5] and 400,000 in 2022. Mauritania stood at 21,664 university students in 2018 [6]. This means that today there are more than seven million students in NA HE, set to hit the job market within the next few years.

Another challenge relates to adapting university curricular programs in NA countries to fit the needs of the job market. This inadequacy of university programs has become even more pronounced in recent years in spite of repeated attempts at reform.

Moreover, economic growth in the region did not develop at a pace that would allow the absorption of ever-increasing numbers of under-equipped university graduates into the job market [7].

In recent years, as the Fourth Industrial Revolution (4IR) set in, with the accent on HE moving from the amount of knowledge absorbed to the nature of skills acquired, the situation may become even more critical if the needed transformations are not adopted. Advances in artificial intelligence, cognitive computing and automation are expected to replace nearly half of current jobs on the market. Critical thinking skills thus become a prized commodity. A recent report shows that in technology, media and telecom companies, the high innovators are developing critical thinking skills in employees as a major tool for 4IR success [8].

The volatile combination of massification, uncertain quality and socio-economic pressures has contributed to a level of youth unemployment in the region that is among the highest in the world today: 27.2% in Morocco, 38.3% in Tunisia and 31.9% in Algeria [9].

This was the situation in the NA universities as the COVID-19 pandemic hit, in early 2020, further complicating the fundamental challenges they faced. The university system was required to adapt to the conditions created by the pandemic, teaching their students in spite of campus closures coupled with confinement of students, faculty and staff. Hence, NA universities were quickly forced into distance learning mode in spite of the fact that they were for the most part unequipped to undertake an immediate transfer.

2 COVID-19 and North African Higher Education

2.1 Tertiary Education

The effect of COVID-19 on education was almost immediate. In Morocco, for example, all educational institutions, public or private, at all levels of instruction, were shut down on 16 March 2020 [10]. The Ministry of Education insisted that interruption of classes should not be considered as a vacation, but rather as a strategy meant to limit the spread of the virus, and an opportunity to replace classroom teaching by distance pedagogy. For this purpose, teachers were given a special dispensation from confinement regulations to register their courses in university facilities.

Courses were aired initially from the studios of several national television stations, before moving to university sites and platforms on the web. Multimedia studios were installed in universities and schools that did not already have them. Initially courses were static, with little interactivity. Neither faculty nor students had received any training in the pedagogy of distance learning.

Algeria proceeded to close all schools and universities following the spread of the COVID-19 pandemic. Full or partial closures of administrative services and educational institutions were announced on 12 March 2020. Algerian universities thus interrupted all teaching and other in-class activities based on a decision of the Ministry of Higher Education and Scientific Research. On 2 April 2020, another decision from the same ministry instructed universities and higher institutions to switch to distance education (DE), thus placing the majority of faculty and students on unfamiliar ground [11].

As all NA countries moved to distance learning, the early studies and questionnaires [12–14] showed the reluctance of many faculties and students to adopt the system, principally because of the perceived lack of human contact. With the exception of a few universities in the region that had made some headway with DE prior to the spread of the epidemic (UVT-Université Virtuelle de Tunis, Université Cadi Ayad of Marrakech, CERIST [Center for Scientific and Technical Information Research] in Algeria and the Egyptian Knowledge Bank in Egypt), faculty and students were initially generally resistant to DE.

In fact, web-based DE was perceived as having several drawbacks, not least of which was the lack of human contact. Faculty and students were convinced that distance learning could not replace face-to-face instruction and in fact "dehumanized" the learning experience. At best, DE could be a complement to classroom teaching but could not completely replace it. Other reported drawbacks of DE included its supposed limited usefulness in laboratory or tutorial settings, the difficulty for faculty to judge students' assimilation of the curriculum, the inability of students to benefit from peer support and exchanges and difficulties in testing.

In fairness though, respondents to questionnaires, both faculty and staff, recognized the flexibility offered by DE and realized that without it they would have been unable to continue their studies normally during the rest of the year. Classes were programmed at different times of day and could be recorded by students for later consultation.

As confinement progressed, universities in all NA countries were equipped with electronic platforms that allowed professors to render courses and lessons available to students, with progressively growing sophistication. The combination of television broadcasts, social networks, university platforms and printed material eventually ensured a better coverage rate which, in Morocco for example, attained 80% in some cases [15]. The legal framework was also addressed since up until COVID-19, online and distance programs were not recognized as being equivalent to in-class instruction.

The fact that such distance education worked more or less effectively to prevent the loss of the academic year during the pandemic suggested to decision-makers interesting possibilities to deal with the pressure of massification through digital transformation (DT). It also became clear that the success of distance HE was intimately related to the degree of DT in the country as a whole.

2.2 *Professional Training for Entrepreneurship*

A special case was that of young entrepreneurs and the challenges posed by COVID-19. As the pandemic ran its course, training programs for young entrepreneurs also became an issue since they suffered from the lack of support for their often fragile businesses and startup operations. An interesting initiative was undertaken by the Moroccan Office for Professional Training (OFPPT), which launched a distance training system which enabled the creation of a total of 8,836 virtual classes and provided 83,356 distance training sessions, totaling 228,946 h completed by April 2020.

To support this dynamic, more than 2,600 educational tools (documents, videos and software) were selected and made available to trainees via the various electronic channels and sharing platforms. A content-production operation continues to be maintained by the OFPPT (Moroccan Office of Professional Training and Employment). In addition, the Office launched, in April 2020, an e-learning platform dedicated to the learning of foreign languages (French, English and Spanish) which is expected to benefit up to 280,000 trainees [16].

3 The Fourth Industrial Revolution and DT

The term "industrial revolution" (IR) refers to development phenomena that have impacted the entire planet. The first industrial revolution is related to the steam engine, while the second is related to the advances in transportation made possible by the internal combustion engine and the introduction of new sources of energy. The third industrial revolution was characterized by advances in electronics, telecommunications and computers, as well as nuclear energy. The fourth industrial revolution (4IR), currently underway, is based on the internet and the advances being made possible in terms of the internet of things, with intelligent machines, robotics, virtual reality and health applications [17]. In addition to the use of intelligent machines, 4IR integrates digitalization, facilitating the sharing of information, significantly impacting expenses and eventual investments, thereby creating new possibilities for industrial units. This means that a DT needs to take place at all levels in order to take advantage of the new technologies and processes, indeed to survive and remain competitive.

In response to 4IR, the past quarter century has encompassed a significant generalization of digital technologies. They have in fact become indispensable to many facets of human endeavor, from business to education. Modern-day institutions have had to evolve in order to keep up with the changing preferences of today's consumers. Digital transformation refers to the integration of digital technologies in the activities of entrepreneurs, government services and educational institutions, with a view to improve service to citizens, facilitate business transactions and support the learning process.

The expressions DT or digitalization appeared at the beginning of the century, but have in fact expanded to include other concepts such as technological innovation and human strategic input. With the advent of faster and wider sharing and exchange of information on the web, as well as new tools and applications to facilitate this exchange, many government, business, educational, health and energy institutions, to name but a few, turned to DT in their relationship with citizens, clients and students. E-commerce, e-government, distance learning and distance health consultations are all manifestations of this transformation around the world. These transformations are reported by most companies to be difficult, requiring initially a degree of introspection. In a recent McKinsey survey [18], the highest success ratios were reported for companies working in the areas of web technologies, cloud-based services and mobile technologies.

4 National DT Initiatives in North Africa

With the advent of DT, NA governments set about improving DT capabilities. As COVID-19 set in, it was estimated that 3.3 billion of the world's population had mobile devices, a number expected to rise to 5.5 billion in 2025. Smartphones currently account for 57% of connections to the internet, expected to rise to 77% by 2025 [19].

North African users access internet primarily through their smartphones, followed by computers and finally tablets. It is expected that phones will in large measure replace the computer as a personal means to access the internet. Like other users in Europe, North America and Southeast Asia, NA consumers thus prefer the smartphone for the associated mobility, and are progressively moving away from fixed phone lines and desk computers.

4.1 Internet Penetration in NA Countries

The dynamism of the telecoms industry has had a palpable effect on NA societies and on the overall economy. In Morocco, for example, during the period between 2000 and 2015 mobile telephone penetration rates rose from 8 to 128%, according to the regulatory agency (Agence Nationale de Réglementation des Télécommunications, ANRT) [20]. In the region as a whole, mobile phone subscribers, in millions, were as follows in 2022: Egypt 95.36, Morocco 49.42, Algeria 45.56, Tunisia 14.85, Mauritania 4.93 and Libya 2.92. It should be noted that the actual number of individual subscribers in Africa and Asia is difficult to determine with precision due to widespread usage of multiple SIM phones [21].

Internet penetration in NA countries in 2022 is variable, ranging from 21.5% for a current population of 4.9 million in Mauritania to Libya's 94.8% for a population of 7 million. The more densely populated Maghreb countries tend to have more or less similar penetration rates: 83.3% for Algeria's population of 45.2 million, 79.4% for Morocco's 37.6 million and 69.4% in Tunisia for a population of 12 million. Egypt brings up the rear for this group of countries, with 59.1% for 105.5 million people (this represents a concerted effort on the part of the Egyptian government since in 2016 internet penetration was only 33% for a population of 93.4 million) [22].

To place these numbers in perspective, the average penetration for the different African regions have been reported as follows: Southern Africa 66%, North Africa 63%, West Africa 42%, Central Africa 24% and East Africa 26% [23].

Similarly, according to the Digital Evolution Index of 2017, the only stand-out in the MENA region is the United Arab Emirates. Breakouts (making good progress) are Morocco, followed by Jordan then Algeria, with Egypt in the Watch Out (facing challenges) category [24].

It thus became obvious in NA universities that ensuring DT and overcoming the digital divide was not simply an HE problem that could be solved independently of the socio-economic environment and government initiatives. All of the region's governments have in fact adopted successive DT plans that frequently either failed to materialize or are significantly behind schedule. For all of the region's countries, productive participation in the digital economy represents a complex challenge. Without proper institutional support, policies and strategies, pursuing digital economic integration can lead to job losses and increased inequality.

4.2 Morocco

As adopted by government, the Moroccan strategic plan for DT is based on three pillars. The first concerns initiatives to digitalize the national administration and economy through the development of a master plan to modernize government IT platforms and the establishment of shared data centers. This pillar also includes an initiative to promote bridging the digital gap for the benefit of citizens and businesses, by providing connectivity for all, for secondary and higher education, for small and medium enterprises and for disadvantaged regions. The key indicators for the first pillar are 5–10% annual growth of offshoring, and placing Morocco as the number one digital hub in francophone Africa and the number two digital hub in Africa [25].

Other interesting initiatives from the second and third pillars include development of infrastructure and physical networks and the attraction of African talent to join Moroccan firms; guaranteeing access to high-speed and very high-speed broadband and universal access to mobile data; training and skills development in ICT; and creation of a digital legal and regulatory framework. This plan has yet to enter the implementation phase.

A Digital Development Agency (ADD) [26] was announced in 2016 and has just recently been set up, in order to upgrade the governance and regulation of the digital sector. Its mandate is to execute Morocco's Digital Strategy for government services (generalization of e-government to facilitate users' access), for the private sector (digitalization of companies) and for citizens' access to social services, medicine and education. Objectives include upgrading of ICT regulations, setting up a national training program in digital literacy, upgrading existing technology as well as promoting advanced infrastructure (national data center, sovereign cloud), and developing digital trust (cybersecurity and data protection).

4.3 Tunisia

The Tunisian Strategic Plan [27] was developed to guarantee a certain number of results by 2020 to reinforce social inclusion and reduce the digital divide, encouraging digital culture through the use of ICTs in education. It was also designed to develop an e-administration, to create opportunities for employment for graduates with digital skills and to accompany national enterprises in the creation of added value and stimulate innovation, thus improving entrepreneurial competitivity. Finally, the Plan included the development of a legal framework and appropriate security precautions to allow Tunisia's entry into the digital sphere. Among its objectives was rendering Tunisia a regional technology hub. With this in mind, Tunisian authorities reserved a budget of 5.5 billion dinars (1/3 public, 2/3 private funds) for "Digital Tunisia 2020", to extend over the 2014–2020 period.

The plan was also meant to leverage ICT as an essential driver for the country's socio-economic development, with an expected creation of 95,000 jobs, and an increase in exports from 1 billion dinars to 6 billion in 2020. According to the Minister of Technologies and Communication, the strategic objectives were to place Tunisia first in Africa and 4th in the Arab world in the Network Readiness Index (NRI). However, in the NRI 2020 report [28], Tunisia is ranked 10 among Arab countries and 91 out of the 134 countries included in the survey. According to the report, Tunisia's advantage remains its human potential and it has made the most DT progress in the area of governance.

According to a COVID-19 impact study published in 26 November 2020 by the National Statistics Institute (INS) [29], companies have increased their use of digital platforms mainly for administrative tasks (48.6%) and for distance work (43.2%). The use of ICT for payments and sales has increased, respectively, from 19.5% and 10.1% in the second trimester to 26.3% and 23.1% in the third trimester of 2020. Investments in DT and direct and indirect funding have, however, remained minimal in Tunisia compared to those furnished to other sectors of the economy. Nonetheless, the expectations in terms of development of digitalization remain optimistic, especially since COVID-19 experience pointed to the need for such development.

The 2020 Plan was finally only partially implemented due to financial difficulties faced by the Tunisian government. The outgoing minister for ICT and Digital Economy, Mohammed Maarouf, complained on 7 December 2019 to a group of businessmen that the DT budget had not been a government priority and it ended up in fact covering the deficits of the Ministry of Finance. A new plan laying out the objectives for 2025 (fundamentally similar to the preceding version) was adopted in 2020 [30].

4.4 Algeria

Digitalization of the economy in Algeria was initiated by Law 200-03 of 5/8/2000, which concerned the organization of telecommunication services, introducing competitivity in the sector. This law was modified in 2018 by Law 18-04. The digital strategic program "e-Algérie 2013" included measures to develop DT. These included a fund "FAUDTIC" [31] to support both public and private institutions in efforts to adopt ICTs. Among the national committees set up in 2017 was the Technical Support Committee which provided guidance for public service organizations as they introduced digitalization. A National Electronic Certification Authority was also set up to monitor government and economic initiatives and encourage electronic commerce. In parallel, techno parks were launched to support startups in the digital field. Because of its strategic interest and the speed of innovation in the field, statistics related to digitalization are closely followed by the Ministry of Post and Communication as well as the Regulatory Authority for Electronic Post and Communication [32].

The Algerian electronic commerce market has developed significantly thanks to 3G and 4G mobile internet and the high smartphone penetration. In 2019, Algeria was classed 17 in Africa and 111 worldwide [33]. Electronic commerce was launched in Algeria by the multinational Jumia, which reported between 15,000 and 17,000 orders per month in 2017. The supervisory body GIE Monétique Algérien reported around 454,204 electronic online payment operations [34].

Law 18-05 defined the general legal framework for electronic commerce of services and goods and defined the rights and responsibilities of electronic commerce providers and consumers. It set up a listing of e-commerce providers in the national commerce registry, readily available to consumers. Providers must communicate all transactions to the Ministry of Commerce. This eventually allows close statistical surveillance of the sector and is an indicator of how closely the sector is being regulated.

While the government has put an emphasis on digitalization with heavy investment in the ICT sector, progress has been slow. The ICT sector is in fact an important pillar of the country's DT program and has benefited from an investment of $4 billion in infrastructure and $22bn in equipment imports. Algeria still lags behind other African countries; it is not placed in the top ten African countries and shares the last place in the MENA region alongside Mauritania [35]. Public investment has led to an increase in internet penetration but without significant economic impact. Small and medium enterprises do not in fact use ICT in more than 30–40% of their activities. Additionally, there seems to be some resistance to the adoption of methods that can increase transparency in economic transactions, given that a significant part of the sector is informal [36]. Similarly, the use of mobile money is very low. According to a 2021 World Bank report, only 16% of Algerian adults and 11% of women used digital payments. For comparison purposes, the average in the MENA region is 23% of adults and 18% of women. As with the other NA countries, ICT has the potential to provide new solutions to Algeria's development challenges.

4.5 Mauritania

Mauritania has recently created a Ministry of Digital Transition, Innovation and Public Sector Modernization (MTNIMA) [37] to ensure that DT contributes to development outcomes. Internet usage in the country is low (21%), and the cost of fixed broadband is prohibitively high for most of the population. It is important that DT does not become an instrument exacerbating social or regional inequalities. Digital technology and smartphones are not readily available in rural areas, thus rural dwellers would not be able to benefit from government services as they transferred online.

Leveraging the potential of digital technology and innovations for development is a key priority in Mauritania's national development strategy. Accelerated by the COVID-19 pandemic, the government has created a set of institutions to provide leadership for Mauritania's DT and to ensure a whole-of-society approach. Guided by a High-Level Digital Council (HCN) [38], a strategic council chaired by the Prime Minister and including private sector representatives, MTNIMA is driving DT across a range of strategic pillars including regulations, infrastructure, e-government, digital business, sectoral transformation and human capital. Moreover, MTNIMA will also work on improving transparency and accessibility of public services, as well as bringing the government closer to the Mauritanian people.

The United Nations Development programme (UNDP) has collaborated closely with MTNIMA since its inception, advising on digital inclusion and governance of public-sector transformation and leveraging its integrator role in the UN system to identify strategic partners for implementation. As MTNIMA is currently in the process of sharing Mauritania's DT agenda, there is an exceptional opportunity to embed an inclusive approach in MTNIMA's strategy, institutional design and approaches from the start. So far, UNDP and MTNIMA have been working together on establishing a set of digital foundations. A new State Digital Agency (ANETA) is thus being established to serve as the implementation arm of MTNIMA. One of the key areas of work in ANETA's mission statement is accelerating digital inclusion. This includes strategies that should be adopted to change public service work habits to favor digitalization [39].

4.6 Egypt

Egypt's DT is managed through the Digital Egypt strategy, which was developed to strengthen and diversify the nation's economy by fostering technological knowledge and innovation, and rests on three pillars: DT, digital skills and jobs and digital innovation [40, 41]. The ultimate goal of the program is to transition the nation to a digital knowledge economy based on information-intensive activity. Thus, the effort devoted to the development of technology hubs to provide training for IT professionals, the support for startups and the development of emerging technology. Startups, which have traditionally been in e-commerce and online business, are now expanding to fintech and Artificial Intelligence [42]. Government has thus far been the leading investor to advance the project, including $1.6bn to improve fixed broadband speed. The private sector is called upon to be an effective contributor. A new national fiber network to meet the needs of digital government services is being put in place, as is the upgrading of digital infrastructure to meet the needs of the national strategy. Cloud computing is also an important part of the government's transformation. A legislative framework, including a data protection law, was put in place to ensure the security of the system.

4.7 Libya

In spite of its high internet penetration rate, Libya is ranked 169 in the EGDI, due to a great extent to the economic and technology disruptions it has known over the past decade. To overcome this situation, the country has looked to its neighbors for cooperation. For example, a set of agreements was signed between Egypt and Libya in 2021 [43]. These agreements provide for cooperation in all facets of ICT development, including interconnectivity with Egyptian cable services and access to the Egyptian international cable network as well as the construction of smart cities in Libya. The agreement also sets the stage for joint investment in ICT development and training in both countries and for close cooperation between Telecom Egypt and Hatif Libya.

5 The Digital Divide

Average access to internet in the Arab states in general is 76% in urban zones against 39% in rural areas. These are roughly the averages of the world at large, but are significantly less than the European averages (87% and 80%) [44].

A primary concern in all NA countries is to ensure that increased integration in 4IR does not exacerbate inequality by making large numbers of people unemployed while enriching those with access to advanced technologies. The UN (UNCTAD) digital economy report [45] warns against the emergence of a digital divide in access to data, as the digital economy develops. Many developing nations are in fact becoming simple providers of raw data to the world digital platforms, and yet end up paying for the digital intelligence developed from their own data.

Arab Barometer has presented exhaustive statistics concerning the digital divide in the Arab world. A survey of internet use in 12 Arab countries in 2020 showed the existence of significant digital demographic and socio-economic inequalities. In spite of increasing smartphone penetration, women, the elderly, the less educated and lower-income individuals are less likely to use the internet [46]. As society has grown reliant on technology and the internet, those lacking digital literacy and access to ICTs face greater challenges and even outright exclusion from integrating into an increasingly digitally dependent economy and society.

The statistics vary from one NA country to another, although there are overall similarities. When the question concerns use of internet, with any frequency, NA nations are clustered toward the lower end, with positive responses from 58% (Egypt), 59% (Tunisia), 67% (Morocco), 68% (Algeria) to a high of 74% for Libya. The highest percentages for Arab users are reported for Kuwait (97%) and Lebanon (88%).

Age reduces internet use. Those over 60 use the internet less than younger (18–29) respondents: Egypt (9%, 90%, respectively), Morocco (16%, 93%), Algeria (21%, 93%), Tunisia (23%, 91%), Libya (32%, 88%). Women generally use the internet less than men: Egypt (47%, 69%), Tunisia (44%, 73%), Morocco (56%, 79%), Algeria (64%, 72%), Libya (76%, 71%). Geographically, rural dwellers use the internet less than urban residents: Tunisia (49%, 63%), Egypt (52%, 67%), Algeria (59%, 70%), Morocco (55%, 76%), Libya (67%, 74%).

The severity of these inequalities creates a significant digital divide and compromises the socio-economic inclusion of important sectors of society. While the race for the advanced positions in technological developments takes place as countries position themselves to gain ever more economic and strategic advances, the world's digital platforms continue to expand their own data ecosystems and progressively take control of all the steps in the world data-value chain. In fact, all NA countries suffer from the effects of the digital divide, with differences in the availability of technology and/or human capacity that create inequities in accessing information through ICT between nations, but also between social strata, regions (e.g., urban vs. rural, central vs. remote), educational and training institutions or businesses within a nation. The challenge was thus not just related to access to technology, but also of working to bridge the digital divide to provide equal access for all students.

6 Initiatives to Bridge the Digital Divide in HE

In parallel with these national initiatives, the NA HE sectors also developed their own digitalization initiatives, which took into account the particular situation in each country. In general, such actions addressed accessibility, as well as pedagogical and governance issues.

As we have seen, all NA countries suffer from the effects of the digital divide, with differences in the availability of technology and/or human capacity that create inequities in accessing information through ICT between nations, but also between social strata, regions (e.g., urban vs. rural, central vs. remote), gender, educational and training institutions or businesses within a nation. The challenge was thus not just related to access to technology, but also of working to bridge the digital divide to provide equal access for all students.

As with the national level, universities also face the challenges of qualified human resources, pedagogical tools, infrastructure, technology and access. Many of the pedagogical shortcomings may be attributed to an unfamiliarity with the distance-teaching strategies and the available technology, as well as the lack of sufficient training for both faculty and students. In addition, a fundamental issue that faced distance education (DE) in NA was the difficulty in accessing the web and appropriate platforms, for technical and/or financial reasons.

North African educators need to define clear learning goals and employ technology to explore new pedagogical strategies. These strategies can be incorporated into classroom, online and blended courses to provide students with learning experiences that maintain quality and at the same time respond to personal needs.

6.1 Morocco

The Moroccan Universal Telecom Service Fund (UTSF) was mandated in 1997 [47] to support the generalization and modernization of ICT access and equipment, the financing of research and the reduction of the social ICT divide. In 2005, the UTSF was in fact created as a special budgetary account to which all telecom operators contributed 2% of their annual turnover after taxes and infrastructure investments. Thus, the fund was able to collect 2.25 billion Moroccan Dirhams (roughly 250 million US$) from 2005 to 2013.

In Morocco, several initiatives with educational impact were programmed through this fund. Perhaps, the most important was the E-Sup program which involved three action areas and was budgeted at roughly 21 million US$. The first, program Area 1, dealt with improving digital work environments in universities through the acquisition and installation of equipment and infrastructure. Program Area 2 reinforced ICT infrastructure in accredited research facilities. Program Area 3 concerned the acquisition and development of digital pedagogical resources.

Another initiative was MARWAN (Moroccan Academic and Research Wide Area Network), managed by the National Center for Scientific and Technical Research. MARWAN is a national non-profit computer network dedicated to education and research, and serving 130 HE Faculties and institutes. Additionally, it is connected to the calculation grid "MaGrid" for high-speed operations and data storage, as well as the European GEANT network.

The NET-U program was initiated to provide internet connectivity to all public universities and campuses (150 schools and campuses), facilitating internet access. The program was meant to generalize Wi-Fi throughout HE, supervise technical installation and internet connectivity, centralize management and access protocols and allow user mobility and access. This program was also financed through the UTSF with a provisional budget equivalent to about 12.5 million US$.

In November 2015 the program LAWHATI was launched, with the objective of providing electronic connected tablets to HE students. This was to encourage networking, to facilitate access to the internet, generalize ICTs in the Moroccan University, integrate ICT in the learning process, modernize learning pedagogies and facilitate interactions between faculty and students.

Several other programs have included Community Access Centers in regional administrative facilities to facilitate access of youth to ITC; the generalization of ITCs in pre-tertiary learning (GENIE); Nafida, a program to facilitate access to multimedia content in education; and INJAZ, to facilitate access to facilitate the purchase of tools to access ITCs.

While some of these programs have made major headway and have had a palpable impact on HE (e.g., MARWAN, LAWHATI, INJAZ), others are lagging due notably to inappropriate management [48].

6.2 Egypt

Egypt has launched a comprehensive education approach within the Egypt 2030 Vision, meant to drive DT in education and to overcome the digital divide. This approach, known as Education 2.0, covers the entire system in a progressive manner. Pre-school primary- and secondary-level classes benefit from an investment equal to 4% of gross domestic product. Education 2.0 prepares students for university studies and for the job market, and includes technical education, academic freedom, scientific research, the Arabic language, religious education and national history, as well as the eradication of illiteracy. The projects of Education Egypt 2.0 include automated tests, e-learning systems, university hospital automation and an international student portal [49].

Additionally, the COVID-19 pandemic brought new challenges. While it accelerated the application of certain parts of the education reform project—most importantly the use of technology, which became imperative—it underscored other problems. These issues include unequal internet access (coverage varies widely among the large and small cities and villages) and the need to provide tools and devices (such as tablets) to students, and train both teachers and students to use them. Some have also questioned political motives that may in fact determine some of the plan's orientations [50].

Egypt is applying an infrastructure and information system at all its public universities, technical institutes, research centers and university hospitals, at a cost of EGP 7.335bn. The entire program is bolstered by the recently launched Egyptian Knowledge Bank (EKB), an online library that provides high-quality peer-reviewed resources in three languages for HE teaching and research, through cooperation with Elsevier. The EKB underpins the DT of the Egyptian university system and contributes to bridging the digital divide in access to information. The system also contains portals for all pre-university stages, from kindergarten through 12th grade, with multimedia materials corresponding to the curricula. Access to EKB is freely available to all students in the country [51].

According to a ministry report, several projects have been implemented in the area of DT, including launching the Geographical Information Portal (GIS). This is in addition to the electronic payment system for various services in universities.

Egyptian universities resorted to distance learning in response to the COVID-19 pandemic, coupled with more than 700 training courses by the National E-Learning Center (NELC). No mention is made of the issue of equity of access [51].

6.3 Libya

For over a decade, the United Nations sanctions imposed on Libya strongly impacted the country's access to ICT, compromising socio-economic development at all levels and limiting competitivity. The combined effect of these sanctions (lifted in 2011) and the years of political unrest that followed are still felt today as access to advanced ICT remains fragile and ICT infrastructure remains limited. There is a pressing need for the country to develop its ICT capabilities in many fields of endeavor, including education, health, agriculture, banking, industry, services and government [52].

As the digital divide in Libya is still widening, there is a need to improve the current state of ICT infrastructure and provide coverage for the remaining population, which accounts for more than 56% specifically in the rural areas. There is also a need to introduce reliable and faster internet and to implement e-government nationwide. Moreover, the socio-economic impact of the digital divide must be reduced in order to guarantee better health, better quality of life and better education [53].

Elaiss [52] has considered the different digital divides in Libya. First, he identifies a content divide linked to non-mastery of the English language, which renders difficult benefiting from web content on the internet. Perhaps related is a social divide between rich and poor in terms of access to appropriate equipment. He then addresses a gender divide, with women enjoying less access than men, and a commercial divide with the virtual absence of e-commerce. Finally, educational disparities and differences in literacy issues further exacerbate the situation. Libya therefore needs to move rapidly to remedy these drawbacks. This is especially true given that greater investment in IT has been shown to favor economic growth and productivity. The European Union is supporting these efforts by investing €5 million to support Libya's DT through the 3-year "E-NABLE" project for a competitive and better-governed business environment [54]. No such effort has been reported in the field of education.

6.4 Algeria

In an effort to reinforce access to digital tools within universities, the Minister of Higher Education announced the multiplication of internet speed by 10 as of January 2023. Digitalization would also be extended to serve additional university pedagogical and organizational services through the extension of the generalized information system "Progrès" and the various digital platforms adopted to improve management of teaching, research, human resources, student life and social services in universities. The year 2023 will also see the launch of new institutes in technology, mathematics and artificial intelligence [36].

6.5 Tunisia

The Tunisian digital sector employs 100,000 persons and generates 7.5% of GDP (INS, 2018). Nevertheless, the pandemic has demonstrated the weaknesses inherent in the current system. Thus future priorities have included e-government, e-commerce and educational connectivity. The difficulty of achieving these priorities lies in the fact that household internet access presently stands at less than 50%.

COVID-19 bared the shortcomings of Tunisian HE in the area of DE. Two major problems were identified: unavailability of access to ICT for faculty and students, and unfamiliarity of faculty with DE tools. Thus during the first weeks of the introduction of DE, a significant number of HE institutions and students refused to adopt the system. It was recognized that DE in HE may in fact exacerbate the difficulties of those with limited access, exaggerating inequalities related to competences, accessibility, social strata and gender, among others [55].

This situation has led to the proposal of the following recommendations.

- Provide training for faculty unfamiliar with DE
- Generalize the use of a single interactive DE platform nationwide
- Assess faculty teaching methods
- DE courses should not initially be graded or contribute to failure or success
- Negotiate agreements with telecom operators for better and cheaper service
- Cooperate with European universities in improving DE capacity.

Not only will these measures improve Tunisian DE, they will also prepare the system for future crises and facilitate the internationalization of Tunisian universities.

6.6 Mauritania

In January 2023, the Mauritanian Ministry of DT, Innovation and Administrative Modernization launched consultations for the acquisition of a fiber-optic infrastructure to improve the quality of telecom service in the face of DT and a public demand for a high-speed internet service [56].

At the same time, an effort is being made by civil society and NGOs to extend internet use outside the major urban hubs through equipment, training and support. These programs, allow geographically disadvantaged youth to access the internet, to follow educational programs and, in general, to become more familiar with ICTs [57].

6.7 Impact of Digitalization on Employability

Digitalization is a driver of the transformation of employment. The degree of training of the digitalized labor market by groups of countries with different levels of per capita income has shown that the use of digital technologies simplifies the procedure of job creation, giving the opportunity to work via the internet within the so-called "on-demand economy". As a result of the implementation of digital information and communication technologies, the share of employees in the service sector is growing in most countries.

As in education and governance, the degree of digitalization of the labor market is uneven in the world. The introduction of modern technologies in high-income countries allows the population to fully realize intellectual and creative potential, finding a job in the most efficient sector of the economy—the high-tech and knowledge-intensive services. Despite the rapid spread of digital technologies and the rapid growth of employment in the service sector in the upper-middle-income countries, the level of DT of the labor market is much lower than in the high-income countries. According to the World Bank, only Libya in NA qualifies for upper-middle-income status. There is thus a digital divide between the two groups (high-income and upper-middle-income) of countries, although there is a high probability of high-middle-income countries eventually catching up with the high-income group. The trend of gradual digitalization of the services sector is also observed in the lower-middle-income countries (Mauritania, Morocco, Algeria, Tunisia, Egypt), though the low prevalence of information and communication technologies in these countries makes it impossible for their populations to join the global digitalized labor market [58].

7 Conclusions

North African universities and schools must benefit from the full potential of technology to engage and empower learning. They must focus on using technology to improve learning outcomes, create new types of transformative learning experiences and delivery systems that better serve students with different needs, and contribute to solutions for massification. Opportunities must be created for collaboration between institutions, both national and international, to ensure that system- and ecosystem-wide goals are achieved. Further, NA universities should collaborate in support of research by focusing on how technology can impact or enhance personalized educational approaches.

As DT in NA universities progresses unevenly and with varying success, the region's governments need to adopt credible DT plans which include tertiary education. Socio-economic progress hinges on the ability to take advantage of DT. At the same time the digital divides in the region must be effectively bridged. The initiatives adopted thus far are generally modest and, because of financial constraints, often unsustainable. Rather than subordinate DT and efforts to bridge the divide to budgetary restrictions, governments and universities should realize that these initiatives constitute effective means to create wealth and to overcome socio-economic difficulties.

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Hands-On E-Learning and Distance Education in Engineering: Wishful Thinking or a Practical Reality?

Isam Zabalawi, Helene Kordahji, Hassan Salti, and Fadi Alkhatib

Abstract Globalization and digitization are substantially changing the landscape of higher education institutions. Some universities, nowadays, are offering students flexible pathways to pursue their degrees via e-learning and/or distance education. When it comes to engineering education, and to the best of our knowledge, no thorough and detailed studies have been published showcasing how traditional engineering courses with laboratory components have been converted to online without compromising the quality of education. This chapter will attempt to answer two fundamental questions: is it possible to acquire hands-on practical skills in a distance/e-learning environment? How can engineering education be implemented remotely with virtual laboratories? E-learning and distance learning for engineering education can be successfully implemented without compromising the program learning outcomes and university graduate attributes if it is based on a solid foundation supported by a comprehensive governance framework. For this reason, this chapter will be putting forward a detailed governance framework for online engineering education along with metrics to measure its implementation. The Australian University (AU) in Kuwait is used as the case study for this chapter.

Keywords Engineering education · E-learning · Distance learning · Laboratory · Virtual laboratory · Education · Online · Governance · University · Australian University · AU

I. Zabalawi (✉) · H. Kordahji · H. Salti · F. Alkhatib
Australian University, West Mishref, 13015 Safat, Kuwait
e-mail: i.zabalawi@au.edu.kw

H. Kordahji
e-mail: h.kordahji@au.edu.kw

H. Salti
e-mail: h.salti@au.edu.kw

F. Alkhatib
e-mail: f.alkhatib@au.edu.kw

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1 Introduction

The term 'engineering' comes from the Latin word 'ingeniare' which implies to devise. Several words are derived from this, such as ingenuity which means inventiveness, and engine which can mean any machine of our devising. Therefore, an engineer is first and foremost a deviser of machines [1]. The term 'engineering' is believed to date back to 1325 [2].

To date, the Accreditation Board of Engineering and Technology (ABET) defines 'engineering' as "the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind" [3]. The fundamental purpose of engineering education is to "build a knowledge base and attributes to enable the graduate to continue learning and to proceed to formative development that will develop the competences required for independent practice" [4]. The graduate attributes of an engineer as per the Washington Accord, must be centered around engineering knowledge, problem analysis, design/development of solutions, investigation, tool usage, the engineer and the world, ethics, individual and collaborative teamwork, communication, project management and finance and lifelong learning [4].

According to Engineers Australia, a professional engineer is required to take responsibility for engineering projects in the most far-reaching sense. The work of professional engineers is also predominantly intellectual in nature even though the outcomes of engineering have many physical forms. This means that professional engineers are concerned with the development and advancement of research, governance, improvement and application of new technologies through innovation, creativity and change [5].

Engineering education is one of the STEM (Science, Technology, Engineering and Mathematics) fields that incorporates: educational content, lab-based work, design and simulation-oriented activities [6]. It is known to deliver hands-on, design-oriented, critical thinking, team building and collaborative problem-solving skills [7].

Active, student-centered, project-based, problem-based and research-based learning form the foundation of this education. These pedagogies refer to a broad range of teaching strategies that ensures students are actively participating in their learning process [8].

With education becoming more globalized, concepts of distance learning, e-learning, open universities and virtual laboratories are becoming more popular. Whereas online delivery of theoretical knowledge has been proven to be as effective as traditional face-to-face delivery, the effectiveness of conducting engineering education online, including laboratories, and achieving all its intended hands-on practical skills in an engineering education framework is still debatable because of the traditional need to directly use and operate instruments.

To teach engineering online successfully, three important factors need to be present: (1) the quality of online courses should be comparable or better than the traditional classroom; (2) the courses should be accessible from anywhere at any time; and (3) all topics of the discipline should be available. These attributes of quality, scale and breadth form the basis of the Sloan Consortium (Sloan-C) organization which is committed to making education available anywhere and at anytime. According to Sloan-C, quality online learning has explicit metrics that gauge the progress in online education. They are centered around the effectiveness of learning, student satisfaction, faculty satisfaction, access and cost-effectiveness [7].

Despite all the published literature on the pros and cons of online teaching and its challenges in engineering, to the best of our knowledge, no thorough and detailed studies have been published showcasing how traditional engineering courses with laboratory components have been converted to online without compromising the quality of education. This chapter will attempt to answer two fundamental questions: is it possible to acquire hands-on practical skills in a distance learning environment? How can engineering education be implemented remotely with virtual laboratories?

E-learning and distance learning for engineering education can be successfully implemented without compromising the program learning outcomes and university graduate attributes if the program is based on a solid foundation supported by a comprehensive governance framework. For this reason, this chapter will be putting forward a detailed governance framework for online engineering education along with metrics to measure its implementation. The Australian University (AU) in Kuwait, a private higher education institution, is used as the case study for this chapter. Through its College of Engineering, the university has successfully applied e-learning and distance education for all its diploma and bachelor programs.

2 Engineering at a Glance

2.1 The Development of Engineering Education

One can relate engineering to the first humankind inventions, traced back to 4000 years in the lands of Egypt [9].

One of the world's first engineers is believed to be Imhotep who was the chancellor for the Egyptian Pharaoh Djoser. Imhotep designed the Pyramid of Djoser which is in the Egyptian necropolis of Saqaara (2650–2600 BC). Archimedes (287–212 BC) is the founder of statics and hydrostatics. He lived in Sicily which at the time belonged to Greece and would later succumb to the Roman siege. He is known for inventing tools such as the Archimedes lever or screw and war machines such as the catapult [10]. His contributions have separated engineering science from technology and crafts and influenced the progression of engineering from the Byzantine period until today [11]. Then there was Heron of Alexandria (10–85 AD); he was a mathematician, a physicist and an engineer who lived in Alexandria, Egypt, which at the time was part of the Roman Empire. His most famous invention was the first steam turbine 'the Aelolopile' [12].

Since then, the engineering profession has kept evolving. Studies have shown that this evolution is linked to four industrial revolutions: the first is the invention of steam machines and their effects on transport and production; the second is related to chemistry and electricity and the discovery of new sources of energy; the third is the digital revolution; and the fourth, which is ongoing, is Industry 4.0 [13]. We are also moving toward Industry 5.0 which merges human inventions, collaboration and a sustainable focus using technology and automation processes resulting in a more holistic production model [14]. According to Livinuik [14], Industry 5.0 is based on a 4-point framework: people, collaboration, sustainability and technology which results in a harmonized operating paradigm capable of driving long-term project performance gains across industries.

Moving on to engineering education, the first batch of graduate engineers belonged to the nineteenth century and first half of the twentieth century. Post 1913, scientific and statistical fields were inserted into engineering education which led to understanding phenomena subject to variation and to predicting systems. This can be seen in the works of Henry Ford and Dr. Shuart for controlling the Six Sigma process. The quality of engineering witnessed a major progression after World War II. The 'Engineering Science' approach, which started in Europe, made its way to the United States post-World War II. Previously, scientists were able to face adversities and challenges in modern technologies better than engineers. Also, accreditation boards such as ABET required an engineering curriculum to include basic science and mathematics, in order to model, analyze, design and realize physical systems and prepare students to work professionally. Therefore, the scientific and mathematical content of engineering was increased, leading to the study of strength analysis, numerical analysis, test data and probabilistic risk assessment; but the time spent doing practical work was decreased [9].

As for internationalization, the foundation of the ERASMUS program in 1987 contributed to a shift to a more modern student-centered paradigm [13]. In the early 1990s, something more than science was required from an engineer and many engineering schools started emphasizing non-technical skills such as teamwork and communication. In particular, the Bologna Declaration in 1999 contributed to a change from a traditional teacher-centered to a learner-centered approach. This led to the rise of active methodologies, such as the Conceive–Design–Implement–Operate (CDIO) concept, which was formulated and deployed in 2000. The founders, MIT, KTH Chalmers and Linkoping universities established a global community of more than 120 universities working toward a common framework for implementing the learner-centered approach in engineering education [13]. The CDIO concept is an innovative educational framework that offers the CDIO Syllabus, which forms the basis for curriculum development and outcome-based assessment applicable to all engineering schools. Students graduate with an array of personal, interpersonal and system-building skills that allows them to work in real engineering teams and actively be part of new developments [15].

Nowadays, society demands that engineers should be capable of co-creating sustainable development. There are more expectations from today's and tomorrow's engineers in the sense that they are also required to be innovative and carry the entrepreneurial spirit. Digitalization also requires engineers to have a thorough understanding of systems and process skills. These expectations need to be inserted within the pedagogical methods of the higher education sector [16].

2.2 Where Are We Now?

The context of the engineering profession is shifting. Globalization, the knowledge economy, innovation, entrepreneurship, changing demography, internationalization and most importantly digital transformation are the drivers changing the profession of engineering and the existing models within the higher education sector.

Without a doubt, engineering education is now challenged by digital transformation where there is a fundamental need to change the existing delivery model of education. Through digital transformation, engineering education can shift from the formal teaching model to untraditional models such as e-learning and distance learning by using state-of-the-art technologies, implementing virtual laboratories and artificial intelligence, and applying digital tools fostering the use of platforms to improve the student experience. Such a transformation increases the efficiency of engineering education as it considers the changes in demographics within today's society and the needs of the workforces while offering educational solutions to students who prefer different modes of studying.

With that said, there are certain contextual elements that are not changing within the profession of engineering and they include: focusing on the customers' problems, delivering new products, processes and systems, inventing and applying new technologies, using a multidisciplinary approach to develop solutions, working in teams and communicating efficiently and working efficiently with limited resources.

The last few years have accelerated the application of e-learning and distance education across universities, especially with the onset of the COVID-19 pandemic. As such, many universities are nowadays implementing online learning and distance education or, if not, are including it as part of their strategic future planning. This certainly requires some pedagogical and infrastructural changes to ensure students still acquire and have a better experience and skills, as if they were on-site. On the pedagogical side, the curriculum taught online needs to be adapted to fit this type of learning. To ensure students grasp the conceptual knowledge, lecturers may adopt active learning styles such as case-study-based learning [17]. The instructor may also apply several techniques and competencies such as cross-questioning to engage students through virtual communication [18]. Some universities for instance, chose to introduce assistants with the instructors for the online sessions to ease the process and supervise students' activities. On the infrastructural side, classrooms must be adapted to the online delivery style using the most advanced technologies such as smartboards, tablets, connectivity, etc. The same applies to the virtual labs which need to imitate traditional labs and create similar experiences for students via the usage of the most advanced technologies such as virtual reality, 3D modeling, computer simulations and software, etc. [19].

2.3 Online Engineering Education Attributes

Online engineering education allows students to study at their own pace, access information easily in a relaxed environment, interact with their peers and teachers through a variety of online communication platforms, experience virtual labs and virtual realities and access a financially more affordable educational set-up. In addition to the personalized learning experience offered by e-learning and distance education, the engineering program's graduate attributes need to be aligned with the shift to digital education. As such, the following were listed by [20] as generic competencies for all engineering majors:

1. Ability to communicate in a second language.
2. Capacity to learn and stay up-to-date with learning.
3. Ability to communicate both orally and through the written word in their first language.
4. Ability to be critical and self-critical.
5. Ability to plan and manage time.
6. Ability to show awareness of equal opportunities and gender issues.
7. Capacity to generate new ideas (creativity).
8. Ability to search for, process and analyze information from a variety of sources.
9. Commitment to safety.
10. Ability to identify, pose and resolve problems.
11. Ability to apply knowledge in practical situations.
12. Ability to make reasoned decisions.
13. Ability to undertake research at an appropriate level.
14. Ability to work in a team.
15. Knowledge and understanding of the subject area and understanding of the profession.
16. Ability to work in an international context.
17. Ability to act based on ethical reasoning.
18. Ability to communicate with non-experts in one's field.
19. Ability for abstract thinking, analysis and synthesis.
20. Spirit of enterprise, ability to take initiative.
21. Interpersonal and interaction skills.
22. Ability to design and manage projects.
23. Ability to act with social responsibility and civic awareness.
24. Determination and perseverance in the tasks given and responsibilities taken.
25. Appreciation of and respect for diversity and multiculturality.
26. Ability to work autonomously.
27. Skills in the use of information and communications technologies.
28. Commitment to the conservation of the environment.
29. Ability to adapt to and act in new situations.
30. Ability to evaluate and maintain the quality of work produced.
31. Ability to motivate people and move toward common goals.

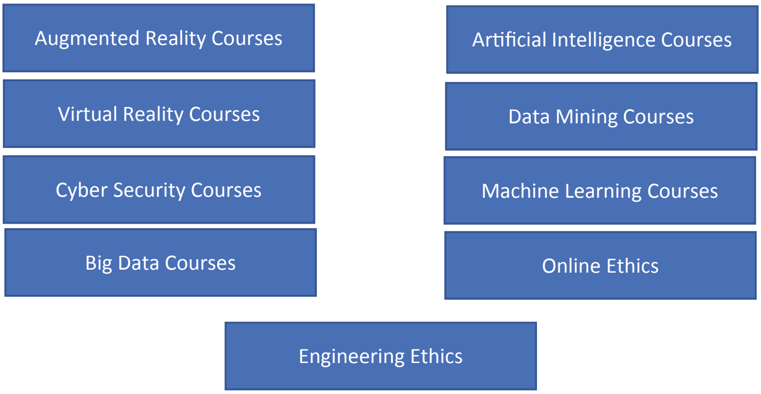

Fig. 1 Online engineering education courses

It is important to mention that in addition to the above generic competencies, each specialty within the field of engineering will have a set of complementary competences.

Furthermore, students should have access to a set of compulsory courses (as shown in Fig. 1) regardless of the program of study they are enrolled in. The courses should include but are not limited to those shown.

2.4 Challenges of Teaching Engineering Remotely

Several overarching challenges have been identified with respect to teaching engineering remotely. For instance, an observational study was performed at California State University, Long Beach to understand the challenges students experienced while studying online during the COVID-19 pandemic. The results yielded several issues that negatively impacted the education experience for students and faculty; these included logistical and technical problems, teaching and learning challenges, privacy and security concerns and lack of experience and hands-on training. The study also indicated that students were not engaged during the class and were having difficulties in focusing as well as suffering from Zoom fatigue [21]. It is also argued that cheating and plagiarism are difficult to control online; as a result, a major portion of the grades should be assigned to summative assessments that include task-based simulations, presentations, case-studies, group projects, open-book questions and online interviews [22].

Mahmood et al. [23] classified the challenges related to online engineering education into two categories: academic and psychological. The lack of student engagement and participation, the limited access to lab tools, the technical difficulties, the reduced students' creativity and the dearth of instructors are all classified under the academic category and lead to a weaker development of intended skills and achievement of learning objectives. As for the psychological category, we include the lack of student motivation and personal support, misinterpretation of non-verbal behaviors and instructors' resistance to change.

In the context of experimental work and labs, online delivery also presents several challenges. It is argued that the effectiveness of conducting labs and achieving all their intended hands-on practical skills in an engineering education framework is still debatable because of the traditional need for directly using instruments [24]. Some previous studies argued that certain disciplines cannot completely alter their lab experiences to become virtual. For instance, Potkonjak et al. [19] argued that conceptual knowledge gained from lecture-based classes can be built-on through virtual experiments and modeling but, as they advance in their course, major, authentic real-life hands-on learning is required to equip them for an engineering workspace.

Moreover, in a virtual lab context, simulation or remote labs using unfamiliar software makes the labs more difficult and frustrating to students. Home experimental kits suffer from a lack of supervision while performing the experiment and operating the kits. Lack of teamwork, group discussions and direct interaction with the mentor are also some of the challenges faced by virtual labs [25].

On the other hand, some practitioners, such as Yoho [26], believe that gaining theoretical knowledge is more important than any specific lab skill. Her view is that the benefits of accessing online labs outweighs the disadvantage of not being there physically. She argues that lab skills can be learned in internships or during job training. She also raises the point that most lab procedures are done once and never used again.

As such, we must properly reassess engineering education with a fresh lens and determine whether engineering courses, and those with laboratory components, can be taught online without compromising the quality of education.

3 Parameters of Distance Learning: Governance

3.1 Understanding Governance

The above section addressed the current landscape of engineering education and how it evolved. Over the next few paragraphs, oversight will be provided on the governance of engineering education for distance learning.

This chapter argues that engineering studies can be taught completely online. A balance between hands-on and hands-off learning is required for the transitional period and this is referred to as the blended learning approach. Blended learning is defined as a mix of online and traditional face-to-face classes. However, without a doubt, online is the future of education.

To the best of our knowledge, there seems to be a lack of research on the governance of online engineering education and the ways it is practiced. The reason behind that is attributed to universities still using their traditional governance models to implement e-learning for engineering. Therefore, we must look again at the nature and purpose of governance. The term governance is a Greek word known as 'Kubernaein' which means 'to steer'. This means that governance implies controlling and/or directing a group of people [27].

According to [28], the term 'governance' reflects a mixture of the legal dimension, attributes of institutions, allocated funds, as well as interactions between these components and the relevant stakeholders. In [29], governance is defined as "the structures, relationships, and processes through which, at both national and institutional levels, policies for tertiary education are developed, implemented, and reviewed". Governance is the quality assurance umbrella of all the areas within the higher education landscape.

Within the traditional higher education sector, governance has five dimensions at any given time [30]:

1. State regulation, with the traditional notion of top-down authority vested in the state and the government regulates directly by prescribing detailed behaviors;
2. Stakeholder guidance, which shifts the governance approach from direction to guidance and advice. Government remains an important stakeholder in universities but delegates certain powers to representatives on university boards;
3. Academic self-governance, relating to self-steering by professional communities within the university;
4. Managerial self-governance, referring to the critical role of hierarchies within universities through such functions as rectors, presidents and top management in decision-making and goal setting; and
5. Competition, recognizing scarce resources including money, personnel, prestige and demand pull from customers.

3.2 Sloan Consortium for Online Engineering Education

Administering online education requires a comprehensive governance structure. The concept of online learning in higher education is more than just implementing advanced technological infrastructure. It is no longer simply the use of a computer as an artifact in the learning process [31]. It also includes learning strategies and methods, content diffusion, policies with a special focus on flexible frameworks, innovative pedagogical models, up-to-date assessments linked with learning outcomes, as well as personalized learning. To better understand the concept of distance online learning, it can be classified as synchronous and asynchronous. Synchronous learning means that the course is live and all participants must be available online simultaneously. In asynchronous learning, the learner has the opportunity to access the course at their own pace [32]. However, this classification in no way limits the implementation of distance learning. Distance learning has many forms and may also be used as a supplement to traditional lectures through learning management systems, which is usually referred to as blended learning [33].

From an educational point of view, distance learning has several advantages, such as ease of access to information, interaction among learners and teachers, a student-centered e-learning paradigm, cost-effectiveness and a learning loop that improves course design and content over time [32, 34]. Furthermore, the changes in student demography are placing higher education institutions under intense pressure to accommodate their evolving needs and skill sets. Distance learning also offers students the chance to work and study at their own pace as lectures can be taken at any time that suits the students. It offers a relaxed environment with reduced pressure when compared to a typical classroom. Advancements in technology are forcing universities to become more flexible. Therefore, through effective implementation of distance learning, universities could cater to a larger number of students scattered in different geographical locations.

With regard to governance, according to the Sloan Consortium,[1] governing online education should be based on five pillars: learning effectiveness, access, faculty satisfaction, student satisfaction and cost-effectiveness. These pillars create clear metrics for online education and progressing the field [7]. In [35], Moore from the Sloan Consortium provides an in-depth explanation as illustrated in Table 1.

3.3 Proposed Governance Framework for Online Engineering Education

The Sloan-C quality framework gives institutions the flexibility to set their own standards against the pre-defined pillars. It covers a wide range of higher education practices and processes.

Taking inspiration from this framework, the following section proposes a quality governance framework catered to the needs of engineering education offered online. It can also be used separately for online learning and blended learning in other disciplines.

It also considers the barriers of online engineering which are centered around the lack of legislative directions, lack of use of technology, attitudes to technology, limited abilities in using these technologies, quality concerns, lack of motivation and academic skills in embedding technology within teaching and learning, external factors, cost, resistance to change and lack of user support.

The dimensions of the framework are based on 11 principles.

1. **Thoughtful Leadership**

    Description

    A thoughtful leader thinks about the impact of his/her decisions, is aware of the situations, notes different characteristics of his/her team members and

[1] The Sloan Consortium, known as Sloan-C, is a dedicated non-profit consortium for higher education institutions that offer online accredited programs.

Table 1 Governance pillars of the Sloan Consortium

Pillar	Goal	Process/practice	Metric (example)
Learning Effectiveness	The quality of learning online demonstrated to be at least as good as the institutional norm	Academic integrity and control reside with faculty in the same was as in traditional programs	• Faculty perception surveys or sampled interviews compare learning effectiveness in delivery modes • Learner/graduate/employer focus groups or interviews measure learning gains
Access	All learners who wish to learn online can access learning in a wide array of programs and courses	Program entry and support processes inform learners of opportunities and ensure that qualified learners have reliable access	• Administrative and technical infrastructure provides access to all prospective and enrolled learners • Quality metrics for information dissemination, learning resources delivery; tutoring services
Faculty Satisfaction	Faculty are pleased with teaching online, citing appreciation and happiness	Processes ensure faculty participation and support in online education	• Repeat teaching of online courses by individual faculty indicates approval • Addition of new faculty shows growing endorsement
Student Satisfaction	Students are pleased with their experiences in learning online, including interaction with instructors and peers, learning outcomes that match expectations, services, and orientation	• Faculty/learner interaction is timely and substantive • Adequate and fair systems assess course learning objectives, results are used for improved learning	• Metrics show growing satisfaction: • Surveys and/or interviews • Alumni surveys, referrals, testimonials • Outcomes measures • Focus groups • Faculty/Mentor/Advisor perceptions

(continued)

Table 1 (continued)

Pillar	Goal	Process/practice	Metric (example)
Cost-Effectiveness	The institution continuously improves services reducing costs	• The institution demonstrates financial and technical commitment to its online programs • Tuition rates provide a fair return to the institution and best value to learners	• Institutional stakeholders show support for participation in online education • Effective practices are identified and shared

shows empathy. He/she must have a clear vision and an in-depth understanding of the requirements to deliver online education and all that it entails.

<u>Rational</u>

The university must identify a champion to lead the changes from within the university's executive management and departments, experts from the field and/or external consultants. The leader must have agility and adaptability skills to match expectations and diffuse tensions that can arise. Thoughtful leaders are not the product of some marketing spin. Rather, they inspire and earn the support of their audiences. They make their community feel valued and appreciated.

<u>Metrics</u>

- Periodic self-assessments.
- External audit reports and findings.
- Successful delivery of plans and projects.
- Digital transformation strategies.
- Growth.
- Return on investment.
- Staff, faculty and student retention rates.

2. **Cost Implications**

<u>Description</u>

Delivering online education requires extensive remodeling of the university's infrastructure. The major cost incurred while developing distance education and e-learning is that of developing and implementing the learning management system (LMS). Further, hosting of any new learning platform requires a support and maintenance budget, to ensure smooth-running of courses portfolio.

<u>Rational</u>

Embedding online education requires sound financial planning. It is critical to have a roadmap with a budget for online services and ongoing monitoring is essential.

Metrics

- Well-defined budgets.
- Pre-planned funding.
- Variances of budget, actual costs and incomes.
- Compliance with the project plan and time frames.

3. **Change Management**

Description

Change management entails supporting the university's community during the transition process to e-learning and distance education. It requires a technical understanding of what is needed to influence and adopt the change.

Rational

The implementation of an e-learning framework is not a straightforward process. Universities can either adopt a moderate strategy or a more radical approach. A moderate strategy involves cautiously introducing well-rehearsed and easy-to-use technologies while a radical approach impacts an organizational structure in a transformational manner [36].

Regardless of the approach adopted, it is vital that universities rely on a combination of top-down and bottom-up approaches for implementation. The following principles could be used: conception and initiation, develop the plan and formulate the team, train and communicate, implement and enhance and finally evaluate and improve.

Metrics

- Return on digital transformation investments.
- Reliability and availability of used technologies.
- Revenue from digital transformation.
- Percentage of cloud deployment.

4. **Assessment Methodologies**

Description

There are various mechanisms by which assessments could be conducted. Assessments could be subjective or objective, written or oral, theory-based or practical. Assessment methods must have depth and coverage and must be directly linked with the learning outcomes of the course.

Rational

Faculty must develop assessments that are as rigorous as traditional face-to face exams while setting the right infrastructure to prevent cheating and plagiarism. Each department and the relevant course coordinator/instructor should determine fair and reasonable means of online assessment considering the individual nature of each course. Online assessments may include one more of the following assessment methods: exams, quizzes, assignments, projects, open-book exams and other activities. Faculty members should explain to students the method of delivery and assessments of their courses including lab or project components. This includes special arrangements, special software requirements and their user manuals, modalities of cheating prevention, special online assessment policies and procedures, online ethics, etc.

Metrics

- Ratio of face-to-face assessment to total or virtual assessments.
- Grade distribution analysis.
- Percentage of plagiarism/cheating cases detected each semester.
- Incident time to detect and response.
- Moderation of grades.
- Learning outcome analysis.
- Assessment types.

5. **Virtual Laboratories**

Description

A virtual lab is an on-screen simulator that allows students to conduct experiments virtually, test ideas and evaluate their results. Students use advanced technology to perform a series of experiments that mimic real-life experiments.

Rational

The university must have resources to emulate the practical experience that students get on campus while studying online. This requires proper allocation of resources and training. Virtual labs should allow students to actively explore and understand complex and abstract processes, and emulate real hands-on practice. The presence of an assistant or tutor to support the student doing the experiment online is essential, this could be synchronous or asynchronous. Embedding intelligent virtual tutors to emulate the role of lab assistants in a virtual lab scenario, for instance in the form of interactive guidance, may also be an alternative.

Metrics

- Student surveys and testimonials.
- Simulation-based exercises.
- Student performance in labs.
- Availability of tutors.

6. **Student Engagement**

Description

Student engagement is best described as the active participation and displayed interest of students during the class session. Faculty need to create an engaging classroom environment based on positive behavior interventions and evidence-based practices.

Rational

It is often difficult to keep a student engaged and implement a student-centered pedagogy while teaching online. Effective teaching and learning tools including communication are key here. Students can be provided with home lab tools that allow them to practice their skills and record their experiences.

Metrics

- Learning Management Systems (LMS).
- Track active users with LMS.
- Online discussions.
- Ease of course accessibility and availability.
- Course retention and attrition rates.

7. **Quality Faculty and Staff**

Description

Quality faculty must possess exceptional knowledge of industry and academic teaching, publish relevant research, be committed to their profession, be skilled in technology and continuously aim for knowledge development and personal growth.

Rational

Ongoing professional development is an essential action item in good governance to ensure that faculty and staff can keep up with the demands of digital education. Faculty members must also be active in research and focus on research-based learning.

Metrics

- Training in the e-learning systems.
- Percentage of faculty teaching online courses.
- Level of technical competence.
- Promotions.
- Research output.

8. **Resources, Facilities and Infrastructure**

Description

This includes the university's campus, computer resources, manpower, support utilities, storage, classroom space, security, maintenance, laboratories, buildings, technology, research centers, etc.

Rational

A thorough planning to identify the needs to deliver and implement online education is required. This implies thorough human resources' planning as well as special facilities and infrastructure requirements.

Metrics

- Quality and types of technology: availability, accessibility and security.

- Quality of the services and support offered to the users of the system.

9. **Classroom Management**

Description

Classroom management includes the theoretical and practical applications of classroom management principles which allow faculty to make professional decisions in areas related to classroom management concerns.

Rational

At the beginning of the semester, students must be provided with a clear and detailed syllabus that allows them to understand what is expected from them. Lectures must be broken down in shorter sessions with more breaks. During break time, students are encouraged to work in teams. Lectures must be recorded and made available to students.

Metrics

- Quality of instructional design: learning objectives, assessments and activities.
- Quality of learning resources in the online platform (content and activities).
- Student teamwork.

10. **Evidence-Based Decision-Making**

Description

Evidence-based decision-making is a method that emphasizes using data and collected information to make decisions.

Rational

Through a process of surveying faculty, staff and students, the university can get oversight on what is working and what is not working. In addition, classroom observations and focus groups are also helpful tools in gathering feedback, evaluating processes and enhancing implementation. A solid quality assurance framework is also required which is based on: external and internal audits, data analysis and dashboards, quality management systems and policies and procedures.

Metrics

- Internal and external audits.
- Classroom observation reports.
- Number of courses/degrees offered virtually.
- Periodic review of policies and procedures.
- Data monitoring.

11. **Degree Recognition**

Decision

Many countries still do not recognize degrees offered online or via distance learning. Universities need to ensure that their degrees offered online must be accepted by governing agencies locally and internationally.

Rational

When offering online degrees, the university has the responsibility to work closely with national quality assurance agencies to ensure that their degrees are recognized.

Metrics

- Number of students employed overseas who completed their degrees virtually.
- Number of students who completed their degrees virtually pursuing master's in foreign universities.

4 Professional Engineering Tools for the 2030 Engineer

4.1 Progression of Professional Engineering Tools

With the emergence of computer systems and their exponential growth during the past few decades, the engineering profession has witnessed a tremendous shift toward computer-aided professional tools. Nowadays, computers are essential and are an integral part of all engineering disciplines and engineers' daily routine. Their usage in the engineering discipline these days extends beyond collecting, processing and analyzing data to even designing, simulating, emulating, controlling and sometimes predicting. A quick glance at the history of professional engineering tools would help us understand where they are heading during the upcoming years.

In a seminal paper, L. D. Feisel and A. J. Rosa summarized the history of computers and their usage in engineering laboratories. Although electronic digital computers became operational in 1946, it was only in the 1970s that they became acceptably mature enough to be used in engineering laboratories, yet their usage was limited to basic computations to analyze data with greater speed and accuracy than using the traditional slide rule. Nevertheless, due to the lack of engineering software which was also related to the relatively low processing speed, using computers at that time required the engineer to have a deep understanding of the computer's architecture and its assembly language, which questioned its efficiency and limited engineers' productivity [37].

It is only with the emergence of personal computers (PCs) in the 1980s that the invasion of computer systems into the engineering profession and laboratories occurred. Subsequently, due to the computers' higher processing speeds and increased memory capacity, computerized measuring tools combined with basic analysis software tools started to appear. "Smart" data acquisition instruments were developed to collect data which were then fed into a computer for processing and analysis [38]. Without any doubt, this helped engineers to become much more productive as the time they used to spend on data collection was drastically reduced, giving them more time to focus on the analysis of data, and hence promote their creativity and design thinking.

On the other hand, the 1980s and 1990s witnessed the appearance of efficient "simulation" software, such as Simulation Program with IC Emphasis (SPICE) and finite element method (FEM)-based simulation programs, enabling engineers to investigate the efficiency and optimize their designs prior to implementing and testing them physically. The FEM-based simulation software allowed engineers to observe complex phenomena which are extremely challenging and costly to see in a laboratory setting and, accordingly, to model and analyze complex systems in various engineering fields such as electromagnetic fields, strains, stresses, etc. [39–41]. Without any doubt, this significantly decreased the products' design cost and time and therefore had a serious positive impact on the productivity of engineers in various engineering fields such as civil, mechanical, electrical, biomedical and aeronautical engineering. This era also witnessed the appearance of well-established 2D and 3D Computer Aided Design (CAD) software, such as SolidWorks, AutoCAD and 3D Studio replacing the old-fashioned paper and ink-based drawing design studios and workshops in the fields of civil and mechanical engineering.

Since then, and due to the continuous growth of computer performance as well as the wide emergence of the internet, web and their applications, professional engineering tools are becoming more and more computerized. They are continuously evolving, becoming more user-friendly and time-efficient, incorporating a wide range of well-established toolboxes, and more interconnected to an extent that we can hardly even differentiate between them. The LabVIEW software, a product of National Instruments, is a good example of such integration. Using such software, engineering students and professionals can simulate experiments, automate data acquisition, monitor experimental results and even control real instruments remotely. Another good example of such an integration is the software products of ANSYS by which most engineering students and professionals in various disciplines can create their own 3D designs, and simulate, analyze and optimize them on-site or remotely.

In one of its recent articles in Engineering Technology, Michigan State University differentiated the various computer-aided engineering tools of nowadays and classified them into three categories [42]: Computer Aided Design (CAD), Computer Aided Engineering (CAE) and Computer Aided Manufacturing (CAM). It is worth mentioning here that an engineering tool may fall under one or more of these categories, depending on its functionalities.

Software tools that fall under the CAD category are those used by engineers and draftsmen to draft, create and review designs in the form of 2D or 3D models. Depending on their priorities, they would use CAD software to either create designs and/or analyze and check them against conceptual errors. Examples of the most recent CAD software are AutoCAD, SolidWorks, Fusion 360, Revit, etc.

The CAE category, on the other hand, refers to software tools that are frequently used by engineers to "simulate" the designs under different conditions and constraints. Any software that involves simulation, data acquisition, processing and/or analysis falls under the CAE category. For instance, the FEM software and data acquisition/analysis software mentioned earlier are all categorized as CAE tools. Examples of widely used CAE software in the twenty-first century are ANSYS, Matlab, Simulink, HyperWorks, Excel, etc.

Finally, any software used to automate the manufacturing process or generate files to control the manufacturing process of a design is classified as CAM software. In other words, CAM software is used to translate CAD designs into machine languages that can be understood by manufacturing machines. Nowadays, most of the CAD software is enabled with this functionality, rendering it hard to differentiate between CAD and CAM software.

4.2 The Current Professional Engineering Tools

From what we have discussed above, one may conclude that most professional engineering tools are nowadays computer-aided and connectivity-enabled. As depicted in Fig. 2, an engineer creates designs in CAD software, simulates them and optimizes their performance in CAE software then, when satisfied with the simulation results, the final design is translated into machine language via CAM software to automate the production of a product/prototype that is then tested in a physical laboratory environment.

Engineers nowadays spend most of the design time behind computers and only when the product is optimized in simulation, is it then manufactured and tested. One would argue that such tools are still not sufficient, and that manual testing is also

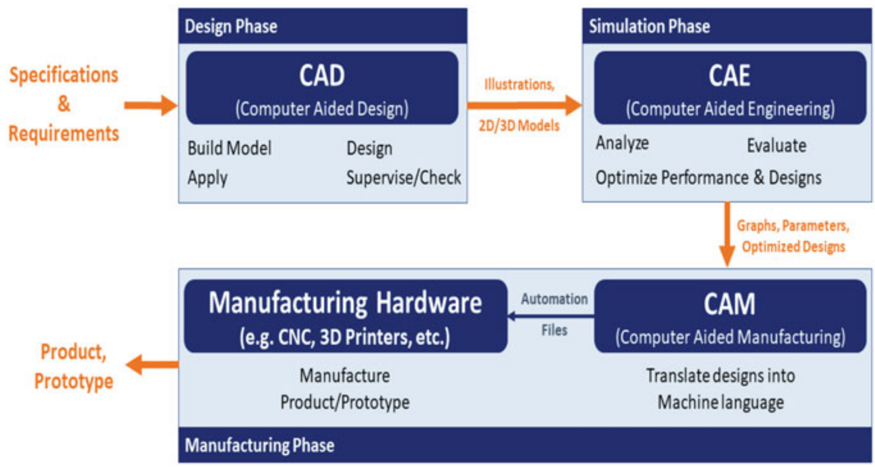

Fig. 2 Product/prototype development phases

required, which is a fact, yet no one can deny the capabilities of today's engineering software tools and their increased efficiency in emulating real-world conditions, which is strongly related to the increased communication and closed feedback loop between the various engineering software developers and their professional users [43, 44].

Furthermore, the testing of manufactured engineering products/prototypes prior to commercialization is nowadays computer-aided, and CAE software tools such as Simulink and LabVIEW, as well as many other examples are used to automate the testing of manufactured products and prototypes. Monitoring the performance of commercialized engineering products is also conducted remotely through computer-aided tools. It is hence the time to re-think the "practical" and "hands-on" competencies and skills that are required by the engineers of tomorrow.

5 Engineering E-Laboratories

A lot of experimentation is needed in the practical field of engineering. In fact, engineers have one of the most practical jobs in the world. Such practical skill development starts with the testing of theories in college labs. Students aspiring to be engineers must familiarize themselves with lab settings. Hence every branch of engineering demands the use of a controlled environment such as labs where the outcome of theories can be produced, tested and analyzed. Another important dimension in science education is interaction. According to the theory of distributed cognition, learners' performances and learning effects are significantly influenced by the interactions between the learner and the learning environment [45, 46]. There are four types of interaction, first, Student–Student interaction (S–S), second, Student–Instructor interaction (S–I), third, Student–Equipment interaction (S–E) and finally, Indirect Interaction (I-I) that are common in science labs [47]. In other words, the learner's interactions happen either directly or indirectly through the instructor, other students or equipment. Furthermore, students acquire *practical intelligence* in a laboratory scenario with the aim of *troubleshooting*. Troubleshooting is defined as the ability to detect and solve problems or diagnose faults in the apparatus. Engineering students must be exposed to computerized troubleshooting [48].

As illustrated in Fig. 3, in engineering education, simulation becomes crucial. Nowadays, many industries, including aviation, nuclear, chemical and many other engineering applications, significantly rely on simulation and simulators. The analysis tool for the finite element method (FEM) is an example of a simulation technique that transformed engineering software. It is used to depict difficult-to-visualize processes like electromagnetic fields, heat transfer and current flow. Computer-aided engineering software has emerged as a crucial tool for replacing the actual lab in engineering education, easing the difficulties for educators to convert real to virtual labs due to their portability, usability and affordability. Simulation environments can be used to teach and expose learners to practical experiences.

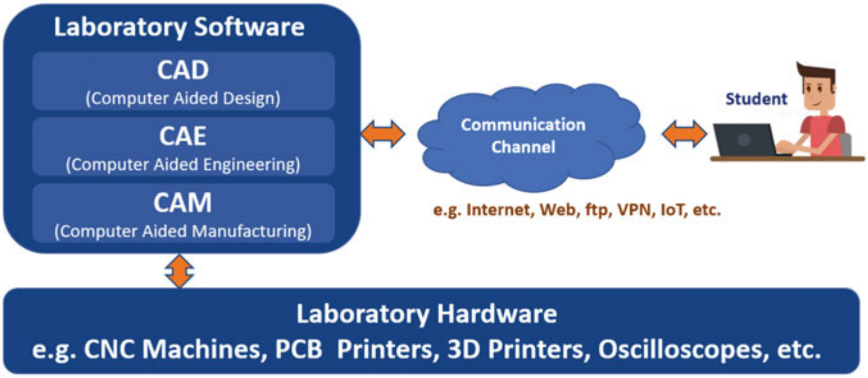

Fig. 3 Simulation and emulation of the lab environment

Three-dimensional (3D) simulation labs are also used nowadays thanks to the present advancement in programming and visual technologies (Virtual Reality). Some engineering colleges are implementing 3D technology in their simulation labs such as Geo-technical, Rock and Eater Resources Digital Library (GROW). In addition to testing soils, this virtual lab enables students to investigate other tests that are challenging to carry out in actual labs. This 3D virtual lab thus offers an improved learning environment. The students can also undertake several tests beyond the purview of actual labs, which actively encourages students to learn more. In a 3D simulation environment, the participant is not prevented from acting in a way that can potentially lead to failure in a particular learning scenario. Equally important, due to the 3D graphics, the students can view the equipment more realistically. Some experiments might not be available to teaching labs due to dealing with hazardous chemicals, lab accidents and health issues, which is made possible thanks to 3D simulations and virtual reality.

However, three main points are usually presented when arguing simulation-based labs. First, since the program is a mathematical representation of the actual system, it is argued that simulation cannot replace an actual experiment as it is not providing real results, which raises the following question: to what extent is an engineering student required to appreciate the differences between the simulation and measured results?

Second, the whole simulation package must be revised as experiments are changed or added in response to changes in the curriculum, but such a revision wouldn’t imply the same at a much higher cost in an experimental lab environment. Third, the fact that simulation-based labs do not have to take safety procedures and lab ethics into account, students might be discouraged to consider them, which also raises a new question, but as long as students are operating in a “safe” simulation environment, to what extent do students need to be exposed to the safety procedures of real workplaces?

Meanwhile, to address the claimed “deficiencies” of simulation-based labs, universities around the world are adopting various strategies which are summarized as follows.

5.1 Video Presentation by Faculty Members and Lab Technicians

Recording the experiments is one of the cutting-edge practices that some institutions have implemented to overcome the shortages of simulations. Students may connect synchronously online to a scheduled lab session during which the lecturer can show them the measurement part of an experiment. The students are involved in this process and are obliged to document their findings and comparisons between the simulation and practice. In addition, students can openly engage with their peers and ask questions to lab instructors at any time during the session.

Alternatively, students may either watch a pre-recorded video presenting the differences between simulations and practical measurements in an asynchronous mode, and then connect asynchronously with their peers and instructors to discuss and document their findings, or if needed, synchronous online meetings may be scheduled.

5.2 Shipping Modules to Students to Perform Experiments at Home

According to this strategy, university lab kits would be put together and distributed directly to the students so they could conduct experiments at home. With no defined time constraints on how long students can use the equipment to study, this offers the distinct advantage of giving students tactile lab experience. However, delivering equipment by mail is expensive; for instance, if equipment is accidentally damaged or lost in the mail. In addition, conducting tests without a qualified demonstrator on hand to supervise the process raises health and safety concerns.

5.3 Remote Laboratories Through Cloud or VPN

Thanks to the internet of things, Cloud Computing and Virtual Private Networks (VPN), and the availability of CAD, CAE and CAM tools, the real measurement of lab experiments is nowadays possible. The students can indeed have remote access to the CAM tools through the cloud or VPN, which are in turn linked to the lab devices in a pre-set experiment scenario. As such, the student would have access to the measuring devices to have real data from experimental measurements and compare the results with those obtained by simulation as depicted in the Fig. 3.

6 Case Study: The Australian University in Kuwait

The following section will outline the experience of the Australian University (AU) in Kuwait implementing distance education and e-learning for all its programs within the College of Engineering.

The University is an institute for learning and research that provides higher education in the State of Kuwait. Founded in 2004 with 228 students, our academic institution was among the country's first private higher education institutions. Today, AU has more than 3000 registered students and an excess of 13,000 alumni. It offers Diploma Programs (0–2 track) and Bachelor Programs (2 + 2 track) in Business and Engineering Technology, in addition to Aviation Diploma Programs.

The College of Engineering (COE) at AU has Diploma and Bachelors' programs in Mechanical, Petroleum, Civil and Electrical and Electronics Engineering. The Australian University's COE ensures that its students develop state-of-the-art skills by adopting the international CDIO (Conceive, Design, Implement, Operate) pedagogical framework which is based on experiential learning principles. Project-Based Learning (PBL) is also used at AU to develop CDIO skills.

In 2019, the COE implemented e-learning and distance education across all its programs. The application of this mode of learning was very accommodating to the students' needs as it permitted them to work and study at their own pace within the relaxed settings of their own homes. Students were able to take their lectures at any time suitable to them. In addition, they were able to view their lectures as many times as they needed as everything was recorded. This mode of learning boasted high retention rates and high satisfaction survey results as many students favored this type of learning.

6.1 The AU's E-Learning Plan

To properly launch e-learning, AU's COE designed and adopted an e-learning plan to transition to online. The plan included five phases as per Fig. 4.

The following is a breakdown of each phase and what it entailed:

Phase 1: Conception and Initiation

During the first phase, the COE performed extensive research, a gap analysis and needs assessments to understand and assess the requirements of e-learning. A feasibility study was conducted to identify the required costs and resource planning including cost-effectiveness and efficiency gains.

Phase 2: Develop the Plan and Form the Team

Fig. 4 The e-learning plan at the Australian University of Kuwait

During this phase, the COE set the parameters for implementation and selected the types of technology, delivery methods, content and designs.

Phase 3: Training and Communication

The COE proceeded to provide adequate training for faculty and staff by organizing workshops and raising awareness on e-learning. All communication platforms were utilized: emails, social media, press, meeting, AU portal and website. In addition, a preliminary survey for AU students was conducted to get insights on their views of e-learning.

Phase 4: Implementation and Enhancement

The COE integrated e-learning within all its operations. The necessary infrastructure was adapted as implemented proceeded for e-labs, PBL courses, online internships, graduation projects, exam invigilation and quizzes online.

Phase 5: Evaluation and Integration Within the Culture

The final phase included completing an overall assessment of the entire distance learning semester and developing a plan for enhancement.

According to AU's COE, it was important to view the online platform with the same lens as the traditional environment. It is engaging, student-centered and built around the same foundations. To implement e-learning, the COE adopted a set of 10 pillars as the basis of developing the e-environment and implementing the programs as shown in Fig. 5.

Pillar 1: E-learning Provision

The provision of e-learning must meet the needs and demands of AU students. The integration of e-learning must be embedded in the University's strategy.

Pillar 2: Equity of Opportunities

E-learning courses must provide the same equity of opportunities to those taking the courses in more traditional settings.

Pillar 3: Individualized Learning

COE ensured that the systems used for e-learning were efficient and effective in order to provide AU's students with an individualized learning experience.

Pillar 4: Technologies used in E-learning

Several technologies were mobilized to support the growth of AU's independent lifelong learners.

Pillar 5: Resources for faculty, staff and students

AU's resources were made available such as e-learning course materials, online tutoring and e-library.

Pillar 6: Standards expected by the Stakeholders

AU's quality processes ensured that the provision of e-learning meets the standards expected by the University's leadership, stakeholders and legislative bodies.

Pillar 7: Pedagogy and assessment for E-learning

COE ensured that the implementation of e-learning innovates the teaching and learning process and meets the needs of an increasingly diverse range of students and disciplines.

Pillar 8: Remove barriers that impede or restrict effective e-learning

Monitoring and evaluating systems and practices were implemented by the COE and contributed to the success of e-learning.

Pillar 9: Level of Service

COE designed processes that support all aspects of implementing e-learning (human, technical and infrastructure).

Pillar 10: Cost model

By using an effectively designed cost model system along with in-depth market research, the pricing of e-learning offerings was competitive and appropriate to the target population.

Fig. 5 Ten e-learning pillars

6.2 AU's E-Learning Implementation for Engineering Programs

The COE utilized Microsoft (MS) Teams as the platform of choice to deliver their online course materials which were uploaded to the learning management system "myLMS". The COE developed and trained its faculty on the three methods for recording and delivering lectures and tutorials:

1. Faculty post their lecture in the form of PowerPoint slides with a pre-recording of their voice explaining the material using the "Narration" and/or MS Teams functions.
2. Live presentation of the lecture via MS Teams and the whiteboard and electronic pen/tablet embedded within MS Teams are used to explain the lecture material. Besides, the live lecture can be recorded for future use by students.
3. Recording of lectures in AU's studios and posting them online for students to review through Microsoft Stream. These studios can broadcast live lectures or tutorial if needed.

For every e-learning course, the supervising faculty members communicated directly with students regarding the method of distance learning as well as the means of online assessments, marking schemes and any group activities.

Many of the COE courses have lab elements. Others have project or practical components such as PBL courses and graduation projects. Their learning and assessment methods were designed to ensure that they can be completed without the need for face-to-face communication. Projects were modified using simulation/theoretical-based methods for assessment. All the technical and simulation labs were recorded and delivered either in a live broadcasting or pre-recording setting through MS Teams. Students were introduced to the lab problem sheet, demonstration of the different apparatus and the lab set-up. Then, the instructor conducted a live presentation of the measurement methods and discussed with them the basic calculations, measuring principles and the filling of the lab sheet. Later, the students worked on their lab sheets and submitted them online with their lab reports for assessments.

Each department within the COE considered different types of assessment based on the nature and requirements of each course. The COE had multiple assessment schemes to suite different courses. For instance, one assessment framework was implemented for courses with labs and another for courses without labs; the same was applied for PBL courses and graduation projects. All the new online methods of assessment and marking schemes were approved by the Heads of Departments, Dean of College and later by the University's Academic Council. Therefore, for any plan, a flexible, reasonable and fair approach was required. The assessment options depended on the different courses' needs and nature; they were:

- Take-home exam;
- Open-book exam with limited time by Moodle or any other LMS platform;
- Course final project or several mini-projects to replace the final exam;

- A series of weekly or biweekly online quizzes through Moodle to be conducted at a certain time for all the class to decide the final mark;
- Full online exam with invigilation (Moodle using lockdown browser and online monitor, etc.), this option needs the student to have his/her PC connected to a camera and with internet access;
- Multiple choice final exam through Moodle (myLMS);
- Oral and/or presentation exam for group projects by MS Teams or Moodle; and
- Other activities as appropriate for individual course requirements.

To ensure academic integrity, the COE introduced three methods of invigilating online exams or quizzes. They are MyLMS, MS Teams and the Respondus lockdown browser and its monitor. Control measures for enhancing the integrity of online assessments were developed and shared with faculty to help them design online assessments and maintain the integrity of AU's academic programs and reputation. A typical example of such measures is the creation of parameterized online assessment questions using "formulas" or "wild cards" features in Moodle.

In terms of training faculty, a structured training program was developed and implemented to provide faculty and staff with dedicated training on key areas of e-learning. The goal for the training programs was to integrate e-learning into AU's community. The program focused mainly on four principles:

- How to plan and create an effective online lecture and lab, deliver it online and engage the students;
- Creating an efficient online assessment with different methodologies and subjects;
- Online platforms and invigilating tools, especially MS Teams and Respondus lock down browser and monitor; and
- E-learning philosophy and approach on delivering and assessing the courses' material.

From an internal governance perspective, AU introduced several specialized online committees and assigned online champions to support faculty, staff and students at all stages. It was only natural for faculty to have different levels of concern when the time came to implement e-learning. Through surveys, open communication and team meetings, the COE was able to consolidate their concerns and address them. Concerns varied from pedagogical, logistical and IT problems to design of online assessments. All these concerns were addressed either through training or advising sessions. As for students, two areas of concern were identified: some students were facing internet issues at home in relation to speed and reliability of the connection, and others felt overwhelmed by e-learning despite all the support provided by the AU from an academic, technical and mental perspective.

From an external governance perspective, the Private Universities Council in Kuwait, (PUC), the governmental body that oversees the private higher education sector in Kuwait, established a set of rules and regulations for e-learning that were adhered to by AU. They were as follows:

1. Utilizing world-renowned applications and tools for the provision of e-learning while ensuring faculty receive the necessary guidance and training to properly implement and utilize them.
2. Preparing a detailed manual for faculty and students that explains how to use and implement e-learning.
3. Applying all approved educational materials to ensure that students are engaged and interact during the learning process.
4. Committing to the approved set of teaching hours for universities and colleges.
5. Utilizing distance learning systems as the needs dictates.
6. Providing platforms to enable students to directly communicate and interact through the implemented applications and tools.
7. Conducting pilot implementation tests for the applications and tools a week before launching them.
8. Giving lectures in accordance with the abovementioned control measures while ensuring adherence to proper etiquette of communication with students.
9. Ensuring students attend lectures and participate.
10. Urging faculty and students to commit to professional and appropriate dress code and physical appearance during lectures.
11. Respecting the ethics of intellectual property while ensuring the educational materials used are not breaching any intellectual property laws.
12. Preparing a modified academic calendar.
13. Applying approved assessment methods while ensuring learning outcomes are met.
14. Providing additional hours for students who require assistance and advice.
15. Ensuring the principles of transparency are applied for distance learning evaluations.
16. Providing electronic and scientific resources relevant to teaching materials.
17. Adopting internal control and monitoring mechanisms to ensure the effectiveness of the teaching and learning process for distance learning.
18. Ensuring universities have the proper infrastructure and technological set-ups such as high-speed internet and secure browsers.
19. Providing technical guidance and support for students during university hours.

7 Recommendations and Conclusion

Embracing the shift to online engineering education requires a fundamental shift in the strategy of the university. It requires thorough planning and having the right people placed in the right positions. Governance is at the center of this process. That is why this chapter has put forward a comprehensive governance structure along with metrics that will assist universities to implement engineering education online. In addition, it can be used for any major of online study.

Beyond that, we are also proposing a set of recommendations to other universities. They are derived from our experience at the Australian University in Kuwait. They formed part of the lessons learned for the College of Engineering and were used to further enhance the online education experience. They are summarized as follows:

1. Online learning offers a solid platform and opportunity for the University to benefit from the international experience of worldwide universities, its international partners and world-renowned experts.
2. Online delivery experience should become embedded in the selection criteria for the recruitment and appointment of faculty, administrators and supporting staff.
3. The IT infrastructure is critical for the success of online education. To this end, IT facilities should undergo continuous and regular updates to ensure they remain up-to-date and offer state-of-the-art services. This will enhance the virtual reality platform and all its broadcasting facilities.
4. Online education should become embedded within all the University's educational programs; this includes continuous development programs.
5. Library materials are a critical pillar of education. The budget should have a special allocation for the e-library system and resources.
6. Many newly admitted students might not have experience in online education. Targeted training programs should be developed to support these students and familiarize them with this type of learning.
7. Faculty are always encouraged and supported to engage with national and international peers on research and development. With online education, this is no different. As the University seeks to embed online education permanently into its systems and offerings, it will continue to provide support for faculty to pursue research internationally.
8. Key performance indicators should be introduced to ensure the efficiency and efficacy of online education. They should be continuously monitored and evaluated.
9. The provision of online education should include all subjects including Medicine and Engineering.
10. The practical part of certain programs can also be done by using the online environment and the latest technologies.
11. Applying digital transformation ensures that graduates possess a new set of skills, competencies and attributes that are part of online education.
12. The name of the game is to change to remain relevant. It has reached the point where if we do not change, we will be changed.

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Enhancing Collaborative and Self-Paced Learning in Traditional and Distance Education Settings

Emad Ebbini

Abstract Online learning management system (LMS) platforms such as Canvas could be used to provide learning materials and activities that may supplement a face-to-face or blended course or deliver a fully online experience. In particular, assessment tools such as assignments and quizzes could be used to provide instructors and learners with instant feedback to assess individual and classroom performances in real time. Textbook publishers have also provided learning and assessment tools that can be integrated with LMS platforms to enhance self-paced learning. Another important feature of LMS platforms is their ability to foster discussion and collaborative learning opportunities for students by supporting discussion boards and shared-document applications such as Google Docs.

While the above LMS features have existed for years, the move to online and hybrid learning has increased adoption to the point where educators can incorporate them fully going forward. This applies equally to institutions in the Arab world, given that our institutions have the necessary infrastructure, and our students are well-equipped with the skills to take full advantage of the learning opportunities provided by modern LMS platforms. However, anecdotal evidence suggests that we need to encourage and nurture a new culture of learning based on strong ethical standards and a positive attitude toward collaborative learning. It should be emphasized that such values are needed at all institutions worldwide and are not limited to one region or culture. For example, even among the leading universities in the United States, there is significant variation in the adoption of these values.

Together with ethical and collaborative educational values, modern LMS platforms provide the tools to take full advantage of accessibility of information to encourage students to be lifelong learners. This changes the dynamics of the teaching and learning processes, especially in terms of the role of the educator as a sage, providing sound judgment rather than being solely an authority in the field of study. While there is no conflict between the two roles, the balance between them is a skill that every educator needs to aspire to achieve in light of the students' needs and their abilities in a given setting.

E. Ebbini (✉)
University of Minnesota Twin Cities, Minneapolis, MN, USA
e-mail: emad@umn.edu

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In this chapter, we describe experiences with the abovementioned LMS features and their incorporation into face-to-face, hybrid, and distance-learning settings. Their applicability to higher education in the Arab world is discussed with examples from leading institutions in the region.

Keywords Blended learning · Learning management systems · Engineering education · Remote learning · Abstraction · Undergraduate education · Instructor-learner collaboration · Active learning

1 Introduction

For decades, engineering education at leading institutions of higher education has been transforming from a traditional model that emphasizes individual work to models that encourage student collaboration. However, many programs limit collaboration opportunities to a few designated courses such as the Senior Design course [1]. New engineering curricula need to be designed to foster students' collaboration throughout the degree program in order to reap the full benefits of this key aspect of modern engineering education. The incorporation of collaborative learning into engineering programs has become more feasible due to the wide adoption of remote learning technologies and advances in learning management systems (LMSs) such as Canvas. These systems have been developing at a fast pace and have powerful features that enable the design of modern curricula that support new learning paradigms based on collaboration in the broadest sense. To be specific, fostering collaborative efforts between the faculty and students are just as fundamental as collaboration among students.

Science, technology, engineering, and mathematics (STEM) fields are characterized by a continuously changing landscape that mandates revision of the curricula from time to time. Since the 1970s, these revisions have taken place at a slow pace in response to major technological innovations such as the introduction of the transistor and integrated circuits. The pace of change has increased during the last two decades, especially with the advent of integrated design environments (IDEs) that could provide students with realistic design experiences on par with what they are expected to use in the workplace. For example, consider the introduction of the microcontroller, which was initially taught in Electrical and Computer Engineering departments. The availability of intuitive, easy-to-use IDEs has allowed physics and mechanical engineering departments to incorporate microcontrollers in their courses. The success of these courses is a testament to the power of abstraction in STEM engineering, which allows curriculum designers to focus on the fundamental knowledge necessary for their learners while providing them with hands-on skills that are relevant for their future work experience.

The availability of mature LMS IDEs allows for the design of new curricula based on collaborative efforts among students, as well as between students and instructors, to improve the learning outcomes. Furthermore, both tools can be used to provide students with self-paced learning opportunities to cover gaps in knowledge and/or skills without being left behind. In today's multidisciplinary world where the student population can be quite heterogeneous, collaboration and self-paced learning have become key components of modern curricula, especially in the delivery of STEM education. This applies to traditional and remote-learning settings. In fact, they are key to supporting the reemergence of hybrid learning methods combining traditional and distance-learning methods.

This chapter describes the early experience of a redesigned curriculum in Electrical and Computer Engineering (ECE) that was based on fostering collaborations, the use of abstraction, and the incorporation of self-paced learning. Both lecture and laboratory courses are designed to support a blended learning model that is helpful to on-campus and remote learners [1, 2]. While focused on modern ECE education, it is hoped that readers will find it applicable to other STEM educational settings in the Arab world.

2 Continuously Changing Landscape of Electrical and Computer Engineering Education

Electrical and Computer Engineering continues to undergo rapid changes that will have profound effects on ECE education, both in the classroom and in the workplace. Since the late 1960s, transformative changes in ECE curricula were mandated by the move from (fixed) analog to (programmable) digital approaches in computing, signal processing, communication, and control. Several leading universities (e.g., Illinois, Georgia Tech, MIT, Berkeley, and CMU) responded by redesigning their curricula based on introductory courses with greater emphasis on the information-processing aspects of circuits and electronics [3–6].

The dawn of the twenty-first century has witnessed the emergence of the analog mixed signal (AMS) as a driver for innovations in sensing and actuation, as well as information processing. Analog and digital signals are remerging at the forefront of most sensing and information-processing systems in remarkable ways. These apply to circuit and electronic implementations, processor architectures, signal processing, and systems analysis and design. Innovation and leadership in this environment require electrical and computer engineers with competencies in circuits and electronics as well as in signals and systems. In today's multidisciplinary work environment, the core curricula for ECE should not create an artificial separation between specializations within the discipline.

The ECE department at Minnesota responded to the analog to digital transformation in a more traditional manner where signals and systems courses evolved separately from those for circuits and electronics. This approach served us well in the past, but it needs to be revised if we are to continue to graduate electrical and computer engineers who go on to become leaders and innovators or distinguished researchers in their chosen specializations.

This chapter describes early experience with a new ECE curriculum that was introduced in the Fall 2019 semester. The guiding principles of the curriculum redesign were to enrich and enhance the learning experience for a new generation of students without compromising the fundamentals that stood the test of time in engineering education. The new curriculum adopts a top-down approach to teaching core ECE courses emphasizing the role of circuits as signal processing and computing systems. The goal is to increase the students' motivation by integrating real-life applications with the most basic concepts, especially in the introductory circuits and electronics courses of the core curriculum. This is accomplished by designing core courses with integrated design experience, building on the appropriate level of abstraction of the underlying complexity in both circuit theory and mathematical methods. Abstraction allows for a timelier introduction of key mathematical tools such as the Fourier series with circuit theory, which allows the students to design systems such as audio filters and amplifiers. The early purposeful design experience will help the students acquire and retain important system-level concepts such as bandwidth, dynamic range, noise figure, and gain-bandwidth product. Subsequent junior-level courses in signals and systems, and electronics, elaborate on these concepts using the appropriate mathematical and computational tools for analysis and design. It is important to note that the introductory sophomore courses do not compromise on the fundamental concepts in circuit theory such as KVL (Kirchhoff's voltage law), KCL (Kirchhoff's current law), and Thevenin and Norton equivalents. These concepts are introduced, defined, and elaborated upon to equip the students with the ability to analyze the steady-state and transient responses using the appropriate transforms.

The proposed curriculum is designed to better utilize modern software and hardware design platforms for electrical engineering systems. We propose an approach that allows for integrating theory, applications, implementation, and hands-on experience. For example, MATLAB's SIMULINK and Xilinx Vivado allow for FPGA (field programmable gate array) implementation of digital designs with elevated levels of abstraction. Excellent system-on-chip (SoC) platforms such as the Zedboard® can be used in educational setting for implementing complete system designs, e.g., software-defined radio (SDR). The adoption of such a platform will allow the students to choose the level of abstraction appropriate for their experience and design goals. Consequently, this will enhance the learning opportunities for our students by allowing them to see the "big picture" even as they tackle the most rigorous mathematical problems encountered in our core courses.

Even though the curriculum was introduced just before the COVID-19 epidemic, it was designed with blended learning as a key element to help students at all levels to achieve their learning objectives [1, 2, 7–9]. This stemmed from the realization that a curriculum based on a top-down approach to learning utilizing modern hardware and software design environments cannot succeed without providing the students with self-paced and collaborative learning opportunities. Not only are these important as lifelong learning skills, but they also provide students with opportunities to overcome gaps in their knowledge while continuing to progress through the curriculum in a timely manner, i.e., not falling through the cracks [10]. Collaborative and self-learning also helps the instructors accommodate advanced learners who are ready for the next level and/or asking for more. Therefore, these learning opportunities need to be designed with care and with the students' needs in mind [11, 12].

Finally, while this document describes experiences from one institution in the United States, this experience applies to institutions of higher education in many parts of the world, including the Arab world. The globalization era ushered in by the end of the Cold War has accelerated the transfer of knowledge and technology to many parts of the world in unprecedented ways. The profiles of the students/learners in different parts of the world have a lot in common at this time compared to decades past. Students are more likely to gain knowledge through internet resources such as YouTube, Coursera, Course Hero, etc. With proper guidance, these resources can enhance their learning while they are pursuing their degrees within the traditional brick-and-mortar institutions of higher education. These institutions, in turn, are already evolving to adjust to the changes brought about by online learning options currently available. If anything, the element of higher education most resistant to change has been the instructor. While not the majority, there are many who still blame the students' attitudes toward learning, are holding outdated views about collaboration, and believe that they are teaching for the "average student". These instructors cannot be characterized by any ethnic, geographical, or age standards. The embrace of collaborative and self-paced learning tools described in this document can be beneficial for both instructors and learners by bringing the sense of shared responsibility to the teaching and learning process in higher education.

3 Foundations of the Proposed Curriculum

As with many curriculum efforts undertaken by specific programs at major universities, a faculty committee was formed to define the foundations and learning outcomes, in addition to deciding on the mathematical and software/hardware tools used in instruction. A seven-member committee was formed in September 2018 to deliberate these issues and present a proposal to the faculty. The faculty approved the following as the foundations of the proposed curriculum:

1. The use of appropriate levels of abstraction, together with the just-in-time principle, in the introduction of new mathematical tools for signals and systems. Abstraction is a key concept in engineering education because it allows students to understand complex systems and processes by breaking them down into simpler, more manageable parts. This helps students to develop a deeper understanding of the underlying principles and concepts, and to apply that understanding to new and unfamiliar situations. More importantly in the age of multidisciplinary education, abstraction enables students to see the connections between different fields of engineering and to apply the knowledge from one area to another.
2. Tighter coupling between some of the key mathematical tools such as the Fourier series and the Laplace Transform with circuits and electronics during the sophomore year. This aspect of the curriculum design is becoming increasingly critical

for keeping students motivated and giving them the opportunity to absorb and internalize these fundamental mathematical tools. Today's engineering students are just as bright as previous generations, but they learn differently, and their preparation varies greatly.

3. Theme-based approach with real-life demonstrations in the classroom and the laboratory. For example, an audio theme to enforce time and frequency domain concepts with tangible measurements and purposeful laboratory experience. Audio engineering systems provide a rich theme that provides motivating examples in signals, systems, circuits, and electronics.
4. The use of software and hardware abstraction provided by modern design tools to allow for increased design experience in the laboratory starting in the sophomore year. This would be extremely challenging to accomplish using the old bottom-up laboratory learning model. For example, abstraction allows us to design sophisticated amplifier circuits using packaged solutions in the form of monolithic integrated circuits even before teaching the students the basic operation of discrete components such as diodes and transistors.

It should be noted that the proposed curriculum redesign does not compromise the fundamentals of ECE that form the basis of our current curriculum. The redesigned core courses are better integrated to provide healthy repetition of fundamental concepts such as filtering, modulation, feedback, and stability. Collectively, the redesigned core courses should serve as more effective prerequisites for the advanced technical electives in all areas of Electrical and Computer Engineering.

4 Goals of the Proposed Curriculum

The overall goal of the curriculum redesign is to better prepare our students who will go on to engage in careers as design engineers or domain experts. The lecture, recitation, and laboratory experiences in several core courses should instill system design concepts based on the appropriate models of abstraction as part of the engineering education at Minnesota. Other courses provide elaboration on fundamental concepts with appropriate mathematical analysis tools. All core courses are horizontally and vertically integrated while keeping an eye on flexibility. If successful, the proposed curriculum will have the following advantages over the current curriculum:

1. Remove the artificial separation between circuits and electronics on the one hand and signals and systems on the other. Currently, many students consider courses like EE 3015 (Signals and Systems) and EE 3025 (Probability and Random Variables) to be disconnected from the "real electrical engineering" courses.
2. Better prepare our students to understand and delve into analog mixed signal (AMS) engineering; AMS is not a fad and students mastering this aspect of Electrical and Computer Engineering can be expected to thrive as designers and/or domain experts.

3. Create a program where design is encouraged and practiced at every level in a timely manner with the timely introduction of new concepts and mathematical tools.
4. Instill confidence in students by providing them with many opportunities to see how the theory connects with the real world.
5. Minimize the frustration of mismatched expectations on the part of both faculty and students by abandoning the silo-approach to a number of courses that currently do not meet their stated objectives.

To achieve these goals, especially the last one, it was deemed that collaborative and self-learning strategies must be part and parcel of the teaching and learning processes. As a simple and common example, instructors often complain that students are not prepared to take their courses, while students complain they were not taught prerequisite material. With the advent of modern LMSs such as Canvas and Blackboard, together with collaborative tools such as Google Docs and Microsoft 365, it is possible to design and implement models of collaborations that will help *every student* to achieve their learning goals. As described below, collaborative learning is not limited to collaboration among the students, but can be extended to collaboration between the instructors and students to improve the learning materials such as lecture notes, laboratory manuals, self-guided tutorials, etc.

5 Specific Reasons for Changes in Instructional Pedagogies

5.1 Continuously Changing Landscape

The continuous change in the ECE landscape is a compelling reason for continuous review of any curriculum at a leading university such as Minnesota. We need to equip our graduating students with the tools to become leaders and innovators in their industries and/or chosen fields of specialization. *Design and communications skills* are paramount, but they must build on thorough understanding of *fundamental concepts* that define ECE as a discipline. Over the last two decades, our curriculum evolved slowly by tweaking some core courses while others remained the same for years. The shift from analog to digital in the 1980s and 1990s triggered several efforts at leading institutions such as CMU [6], Berkeley [3], Illinois [4], and Michigan to redesign their curricula for both EE and CompE majors. In this age of embedded systems, IoT, robotics and data science, analog and digital are merging again. Similarly, software and hardware implementations are being continuously redefined. The new curriculum must be redesigned to provide the students/graduates with the design and communication skills for this age while not compromising on the fundamental knowledge in ECE.

5.2 *Some Students Find It Hard to Grasp the Relevance of Some of Our "Math-Heavy" Core Courses*

One can argue about the reasons for this, but one obvious reason is that students do not get to see how some of the mathematical tools are applied in real life. They may learn the mathematical tools introduced in EE3015 (Signals and Systems) or EE3025 (Probability and Random Variables), but they tend to forget them quickly after completing the course because of the weak connection with real-life experience. This has a negative impact on the quality of some of our advanced technical electives due to high variability in student preparation. Our curriculum needs to be redesigned to allow the average student to develop meaningful lifelong retention of key concepts to prepare them for advanced technical electives and beyond. Our curriculum needs to be redesigned with larger emphasis on introducing concepts early using a top-down approach with appropriate levels of abstraction. A healthy repetition of these concepts provides the students with adequate opportunity to achieve secure understanding of these concepts. This will help them cope with the mathematical rigor of the discipline. Better yet, proper motivation combined with the appropriate level of abstraction may encourage students to embrace this mathematical rigor.

5.3 *New Design Tools Offer Opportunities for Effective Top-Down Approach to Teaching ECE*

Over the last decade, we have witnessed a revolutionary change in software and hardware platforms for modeling, design, and evaluation of electrical engineering systems. In particular, system-on-chip (SoC) evaluation boards and supporting software design suites provide extremely powerful prototyping and, in many cases, full design evaluation. A modern SoC contains processing elements such as the ARM processor and FPGA with high-level synthesis (HLS) design suites allowing hardware designers to approach their projects with the highest levels of abstraction. Under the hood, the user can drill down to analyze the design components whether implemented in HDL, assembly, C, or any supported programming language, e.g., Python. In many cases, the hardware design tools are integrated with MATLAB/SIMULINK allowing hardware-in-the-loop verification of sophisticated designs employing filtering, control, and modulation.

With the proper use of the design platforms, we have an opportunity to enhance student learning through a top-down approach to teaching fundamental ECE concepts with full real-life demonstration in a timely manner; no more "*trust me, you'll see this later*"! Realistic in-class and laboratory demos can be designed to allow the students to focus on specific circuits or circuit elements in the context of larger systems-applicable real-life situations, e.g., processing real-life audio signals.

It is important to note that the real-life examples and demos should be utilized on multiple occasions and in multiple courses with appropriate levels of abstraction.

Designing key courses around themes allows for repeated use of examples to help students focus on understanding newly introduced concepts in more familiar settings. This provides the students with more opportunities to reflect on previously introduced concepts with the benefit of an expanded set of acquired tools or acquired mathematical skills. It will help them deepen their understanding, overcome misconceptions, and improve their intellectual engagement.

Another major benefit of abstraction is that it allows for the use of real-life design problems early and often with an eye on ethical issues. In teaching ethics, abstraction can be used to simplify complex ethical concepts and make them more manageable for students to understand. For example, abstraction can be used in teaching ethics in one or more of the following ways:

1. *Identifying general ethical principles.* By identifying and generalizing key ethical principles, such as respect for human rights or importance for fairness and justice, students can better understand and apply these principles in different ethical situations.
2. *Simplifying ethical dilemmas.* By simplifying ethical dilemmas, such as those related to emerging technologies or engineering designs, students can better understand how these principles apply in practice and can better prepare for ethical challenges they may face in their future careers.
3. *Utilizing thought experiments.* By providing hypothetical scenarios and asking students to consider how they would handle the situation, students can practice applying ethical challenges that they may face in their future careers.
4. *Understanding different perspectives.* Abstraction can also help students to understand different perspectives and cultural diversity, as it allows them to see the big picture and how the issues are connected.

It should be noted that abstraction can potentially lead to the oversimplification of complex issues, which could lead to misunderstandings and oversights. Therefore, abstraction should be used with caution and forethought, together with adaptivity in real time when such issues arise. Above all, it is important to provide enough context and detail to support the abstraction.

6 Benefits of Collaborative Learning

Collaborative learning has been traditionally practiced and understood as collaboration among students. In many programs, collaborative learning is experienced in special courses such as Senior Design Project courses. It is well established through research and practice that collaborative learning has many benefits, including [8]:

1. Increased engagement and motivation among students.
2. Development of social skills such as communication, cooperation, and problem-solving.
3. Increased opportunities for students to learn from and teach each other.

4. Greater depth and breadth of understanding of the material.
5. Development of a sense of community and belonging in the classroom, laboratory, or field experiment.
6. Improved academic performance as students are more likely to retain information when they actively participate in the learning process.

Of these stated benefits, the first and the last one can be considered the most significant in terms of the teaching and learning process for enrolled students. The other benefits are significant in terms of preparing the students to become lifelong learners as they move on beyond the classroom settings.

In addition to collaboration among students, it is important to understand collaboration in the broadest sense, i.e., between the instructor(s) and the students. A simple approach for doing this is to engage the students in the notetaking and editing process on a regular basis. This approach has been employed in several classes at the sophomore, senior and introductory graduate levels. Students are asked to volunteer their handwritten notes during lectures to be shared with their classmates, together with annotations from the instructor. This simple collaborative process provides several benefits to the teaching and learning experience in several ways, including:

1. The instructors gain a more accurate perspective on what was perceived by the students, which allows for addressing misperceptions in a timely manner.
2. Students gain immediate (on a weekly or even lecture-by-lecture basis) feedback regarding their understanding of lecture materials.
3. Annotations provide opportunities to highlight noteworthy results and provide links to additional learning resources.
4. Students' notes with instructor annotation provide an excellent learning resource for students with learning disabilities that need to have peer notetakers, as mandated by institutional policies at most colleges and universities.

In the age of artificial intelligence (AI) taking shape at the time of writing, we stand to benefit from another form of collaboration. For example, the newly introduced ChatGPT® can provide an excellent learning tool if used properly. While many educators are understandably concerned about using this tool for cheating, this is a misplaced fear. It is not difficult to design many assignments that allow or even encourage students to use such tools to obtain an answer that may provide a starting point for a more complete answer based on classroom, textbook, or other learning resources. In other words, the chatbot can provide an effective collaborative learning tool for the active learner, who questions and seeks to validate answers, regardless of the source. An important goal of collaborative learning experiences in general is to prepare learners to practice a healthy critique of information sources in terms of accuracy, completeness, and clarity.

7 Self-Paced Learning in Engineering Education

Self-paced learning allows students to work at their own pace, which can be especially beneficial for students who have different learning styles or who are working through the material at various levels [7, 10, 12–16]. This type of learning is often used in online or distance education [15], where students have access to the course material 24/7, and can complete the coursework whenever it is convenient. Self-paced learning can also be used in traditional classroom settings [7], where students are given the opportunity to work independently on specific assignments or projects. Regardless of the setting, self-paced learning can help to build independence and self-motivation in students, which can be beneficial for their future academic and professional endeavors.

It is important to state that collaborative and self-paced learning techniques can be combined to create an effective learning environment. By combining the two, students can work together to achieve a common goal, but also have the flexibility to work independently at their own pace. For example, educators can create a blended learning environment, where students take advantage of both face-to-face instruction and online resources. In this way, students can work together in a traditional classroom setting, but also have access to course material online, which allows them to pursue their individual learning goals [2].

Most of the widely available LMSs have the capabilities needed to support collaborative and self-based learning. Canvas, for example, can be used to provide students with access to the course material and to facilitate communication and collaboration among students, with various levels of participation by the course instructor. This particular LMS allows for the use of third-party software to enhance its native capabilities. For example, students can collaborate using Google Docs, or other Google Apps, from within Canvas. Of course, software tools such as Google Docs, Microsoft 365, or Overleaf allow students to work together on documents and projects in real time.

In summary, collaborative and self-paced learning are two important approaches that can be used to create an effective learning environment. By combining the two approaches, educators can create a flexible and engaging learning experience that allows students to work together and to work independently. Modern LMSs, such as Canvas or Blackboard, and software tools such as Google Docs and Microsoft 365, allow students to work together on documents and projects in real time.

8 Infrastructure Supporting the Latest Instructional Pedagogies

Collaborative and self-paced learning require a modern physical infrastructure that supports the latest instructional pedagogies. Some of the key components of the physical infrastructure that supports modern teaching and learning methods include:

1. *Technology-enabled classrooms*. These classrooms are equipped with advanced technologies such as interactive whiteboards and projection systems, which allow educators to use multimedia resources, conduct virtual class discussions, and collaborate with students in real time.
2. *High-speed internet and wireless networks*. Reliable internet connectivity and wireless networks are essential for students to access online resources and participate in virtual learning activities.
3. *Mobile devices*. The availability of mobile devices, such as tablets and laptops, to most if not all students, allows them to access digital materials, collaborate with classmates, and complete assignments outside the classroom.
4. *Flexible spaces*. Creating flexible learning spaces that can be easily reconfigured to support different learning methods and activities is crucial for modern pedagogy.
5. *Audio and visual equipment*. Having proper audio and visual equipment such as microphones, speakers, and cameras in the classrooms allows recording and streaming of lectures. This, in turn, allows for better communication and engagement in synchronous and asynchronous classes.
6. *Maintenance and support*. Regular maintenance and technical support are crucial to ensure that the physical infrastructure remains in good working order and that any issues are addressed promptly.

In addition to the above list, some programs have incorporated virtual-reality (VR) and augmented-reality technologies, which can create an immersive learning experience that allows students to explore and interact with a virtual environment. These pedagogies are still evolving at the time of writing and has not been part of the author's experience to the level that warrants reporting. However, it is clear that VR will be an important part of education on all levels and in all fields, STEM fields being no exception.

At the author's institution, the College of Science and Engineering (formerly the Institute of Technology) has long supported a pioneering program for distance and blended learning. Since 1971, the UNITE program served engineers and scientists from the Twin Cities metropolitan area and around the USA to complete graduate degree requirements by taking courses along with on-campus students and meeting the same standards. In addition, all lecture rooms on campus are maintained and upgraded regularly to provide some or all of the features listed above. This level of support for the physical infrastructure must be a high priority for every institution of higher education.

Blended learning models such as the UNITE model are now available in one form or another around the world. With the increased number of public and private institutions in many Arab countries, blended learning might be a necessity to provide learners with access to the best instruction in any one country or in the region. Not only will this allow institutions to collaborate to make more efficient use of distributed resources, but it may also improve the level of satisfaction experienced by instructors and learners. In fact, blended learning, with properly designed collaborative and self-paced learning experiences, could be essential to the survival of many institutions of higher education in the Arab world.

9 Integration of Outcomes and Assessment

The design of modern engineering curricula based on the latest instructional pedagogies, with adequate supporting physical infrastructure, must allow for the integration of outcomes and assessment methods. The cognitive, affective, and psycho-motor dimensions of learning need to be brought into as many of the tasks performed by students as possible. It is important to recognize (see Fig. 1) that learning needs to be conceived of holistically, rather than discretely (broken into parts). For cumulative and relevant learning to occur, students must be engaged on more than one level in teaching, learning, and assessment, as well as evaluation.

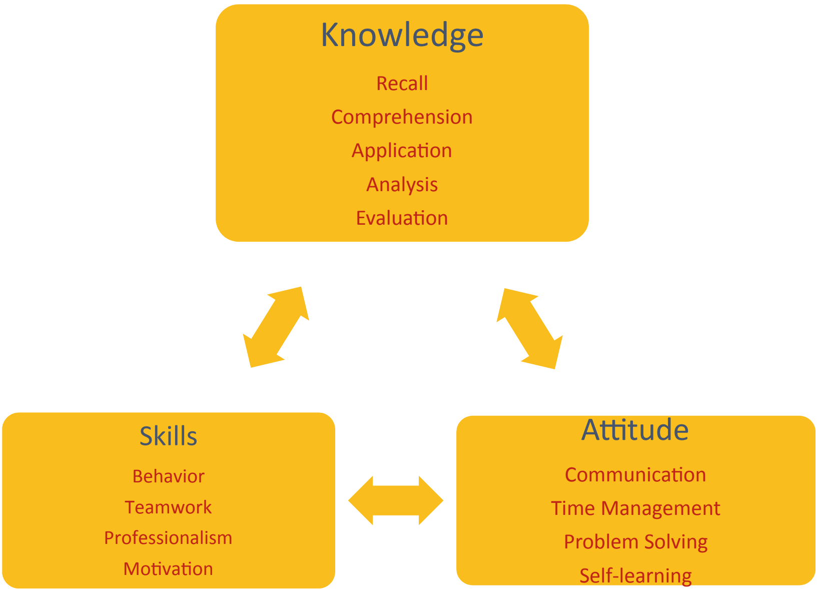

Fig. 1 Integration of outcomes and assessment in a holistic learning paradigm

Modern learning pedagogy based on the integration of outcomes and assessment emphasizes the use of formative and summative assessments to measure student progress and evaluate learning outcomes. Some key elements of this approach include:

1. *Outcome-based education.* This approach focuses on identifying and communicating clear measurable learning outcomes to students and aligning instruction and assessment with these outcomes. This is now becoming standard in most engineering curricula, especially with the wide acceptance of accreditation programs such as ABET.
2. *Formative assessment*. This type of assessment is used to provide ongoing feedback to students throughout their learning process, allowing them to identify areas of strength and weakness and make necessary adjustments to their learning.
3. *Summative assessment*. This type of assessment is used to evaluate student learning at the end of a unit or course and is typically used to assign a grade or measure progress against learning outcomes.
4. *Authentic assessment*. This type of assessment involves assessing students' ability to apply knowledge and skills to real-world tasks, rather than traditional methods such as multiple-choice tests.
5. *Self-assessment*. This entails encouraging students to reflect on their own learning and assess their own progress and is a key aspect of modern learning pedagogy.
6. *Collaborative assessment*. This involves students working together to assess their own and their peers' learning, which can foster a sense of community and shared responsibility for learning.
7. *Technology-enhanced assessment*. The integration of technology in the assessment process allows for more diverse and efficient ways of assessing student learning, such as using online quizzes, e-portfolios, and interactive assignments.
8. *Alignment of assessment and instruction.* To ensure that students are learning what they are supposed to be learning, the assessments should be aligned with the instruction, which means that what is being assessed is what is being taught and vice versa.

Several of the elements listed above are directly relevant to the collaborative and self-learning foundations of modern engineering curricula. In particular, the self- and collaborative-assessments are enabled by modern LMS programs such as Canvas. However, more can be done with creative thinking to engage the students and bringing them into the self-evaluation process in a stress-free manner. One key aspect of this collaborative process is to encourage an environment where the instructor(s) and learners collaborate toward improving the learning material to address gaps in students' backgrounds as well as to provide advanced learners with the opportunity to deepen their understanding of the lecture material and/or laboratory experience. Examples of such collaborative efforts are given next.

10 Example: A model for Collaborations Between Instructor and Learners

Modern LMS programs such as Canvas provide a plethora of tools that enable educators to engage their learners in ways that improve the flow of information and, consequently, improve the learning outcomes. When used properly, these systems can enhance traditional classroom learning models, such as whiteboard-based discussions of lecture materials, examples, and case studies. Based on the author's personal experience, a majority of students still prefer the whiteboard model over projection of prepared slides using Microsoft Power Point, Beamer, or other software programs. Students report that the pace of whiteboard discussions allows them to take more meaningful notes and get a good sense of the instructor's emphasis on specific concepts, mathematical tools, or analysis and design skills.

In this section, we present an example of an instructor–learner collaboration that helps students to benefit from classroom discussions with understanding of the context, even when they miss classes and/or get distracted for one reason or another. The setting is a graduate-level course in probability, random variables, and stochastic processes taught in the Fall 2022 semester at the University of Minnesota. Students enrolled were primarily graduate students in electrical engineering, but the course attracted students from mechanical engineering, data science, and robotics.

Another aspect of the course is that 30% of the students elected to take it online through University of Minnesota's UNITE system. Therefore, the course represents a form of blended learning involving traditional classroom and online delivery, both synchronous and asynchronous. It is interesting to note that some of the students who elected to take the online section of the course were regular graduate students, who would otherwise have been forced to take the traditional classroom section. This option became available to students as a result of the COVID-19 adjustments, whereby a number of students attended courses remotely for a variety of reasons. The College of Science and Engineering decided to keep this option open even after resuming in-person teaching in the Fall 2021 semester.

In some ways, the course may represent the future of teaching and learning at brick-and-mortar institutions, where blended learning may be the norm, not the exception. In addition, in today's multidisciplinary environment, even traditional core courses may attract learners from other disciplines with gaps in their backgrounds. This model represents new challenges to the traditional models of delivery and forces new forms of collaboration between instructors and learners to improve the course outcomes. In particular, this course represented a challenge in terms of trying to teach the "average student"; there was no such thing as the average student!

In response to the above challenges, two forms of instructor–learner collaboration were implemented. The first form was by engaging the students in the development of a record of the covered material and reconciling prepared instructor notes and whiteboard discussions in the classroom. This was intended to benefit all students in the class, but more so the asynchronous online learners. It involved the following steps:

1. Instructor provides weekly typeset notes in PDF with active internal and external links. These notes read like class notes, but function like an electronic book.
2. Student volunteers provide their own notes based on actual coverage in the classroom, including whiteboard work. Instructor reviews student notes, makes annotations as needed, and posts the annotated student notes on Canvas. Instructor annotations include:
   a. Corrections of any typos or misstatements;
   b. Additional references to specific contents in typeset instructor notes, e.g., equations, figure, and section numbers.
3. Instructor revises and updates typeset class notes based on what is learned from the student notes. This is done on a weekly basis, or as soon as student notes are received and reviewed.
4. Class syllabus is updated weekly to reflect actual coverage, e.g., skipped sections or examples.
5. Instructor provides a summary of covered material in each individual lecture and students provide feedback regarding their level of comfort with covered materials. If needed, topics are revisited to clarify the issues.

The collaborative process described above allowed the instructor to develop real-time responses to students' needs. The process allowed both instructor and students to develop a level of comfort with the use of both projection and whiteboard exposition of lecture materials, as appropriate. In other words, the use of typeset-note presentations continued to be part of the classroom delivery, but the option to enhance this mode with whiteboard discussion was used immediately when needed.

Another form of collaboration was the use of self-assessment on assignments and exams, together with data analytics from grading tools such as Gradescope, which is integrated within Canvas.

1. Instructor assigns biweekly assignments with 7–9 problems each.
2. Students are asked to give the assignment an initial reading and ask any clarifying question within 5 days of posting.
3. Corrections and/or hints are made, and the assignment is updated within a week of posting.
4. Students submit their solutions using Gradescope.
5. Instructor provides the answer key and launches an anonymous self-assessment quiz (voluntary).
6. Based on self-assessment, any gaps are addressed in class at the earliest opportunity.

Figure 2 shows an example of the self-assessment process described by the above steps for a particular problem on a given assignment. The upper panel shows the statistics of the students' scores on the problem in Gradescope, while the lower panel shows the summary of student's assessment of their performance based on their understanding of the answer key. In this case, the two measurements agree that about 50% of the students did not do well on this problem, which warranted a detailed whiteboard discussion of the problem in class. Students appreciated this aspect of the course in their anonymous evaluation of instructor and the course (University of Minnesota Student Rating of Teaching, SRT). One student wrote "Another thing I really appreciated was the feedback for each assignment, it again shows that the emphasis of the course was on learning the material not going through the motions". Other students commented on how this and other collaborative processes with the instructor contributed to their learning, and the sense that no one was left behind "He made sure that nobody was left behind and tried to accommodate the plethora of majors that were present in the course". This particular statement was particularly gratifying, as this was a major motivation behind the design and implementation of the above-described collaborations.

An unintended benefit from the forms of instructor-learner collaborations described in this section is that they provided an indirect assessment of the students' formative and summative learning of the course material. The students' comments and suggestions on the class notes grew more confident and elaborate as the semester went on. For example, many comments from the students on random processes invoked fundamental results from probability and random variables rather than relying on a derived formula. Of course, both arguments are meaningful and acceptable, but integrating the fundamental with more-developed results provides an example of more-comprehensive understanding by a lifelong learner. In the future, instructors should plan to use these indirect tools in a more-measurable way that is amenable to analytics.

11 Example: An LMS-Based Self-Paced Learning Model

The evolution of engineering curricula has been incremental, with the most common mode of change led by individual faculties introducing changes in their own courses, sometimes without regard to the rest of the curriculum. Of course, several leading programs in the United States have occasionally introduced major changes to their curricula in response to major changes in the field, as discussed with regard to the Electrical and Computer Engineering (ECE) curricula above. It is safe to say that most of today's ECE curricula are designed based on typical trajectories planned for students entering the program as first-year students and progressing by taking a set of core and elective courses governed by prerequisite courses. This works for most students, but may leave several groups of students behind:

1. Students who may have experienced deficiencies in learning prerequisite courses such as calculus or physics in their freshman year, but still met the requirements to pass these courses.
2. Students who transferred to the program from community colleges or other programs within the same university.

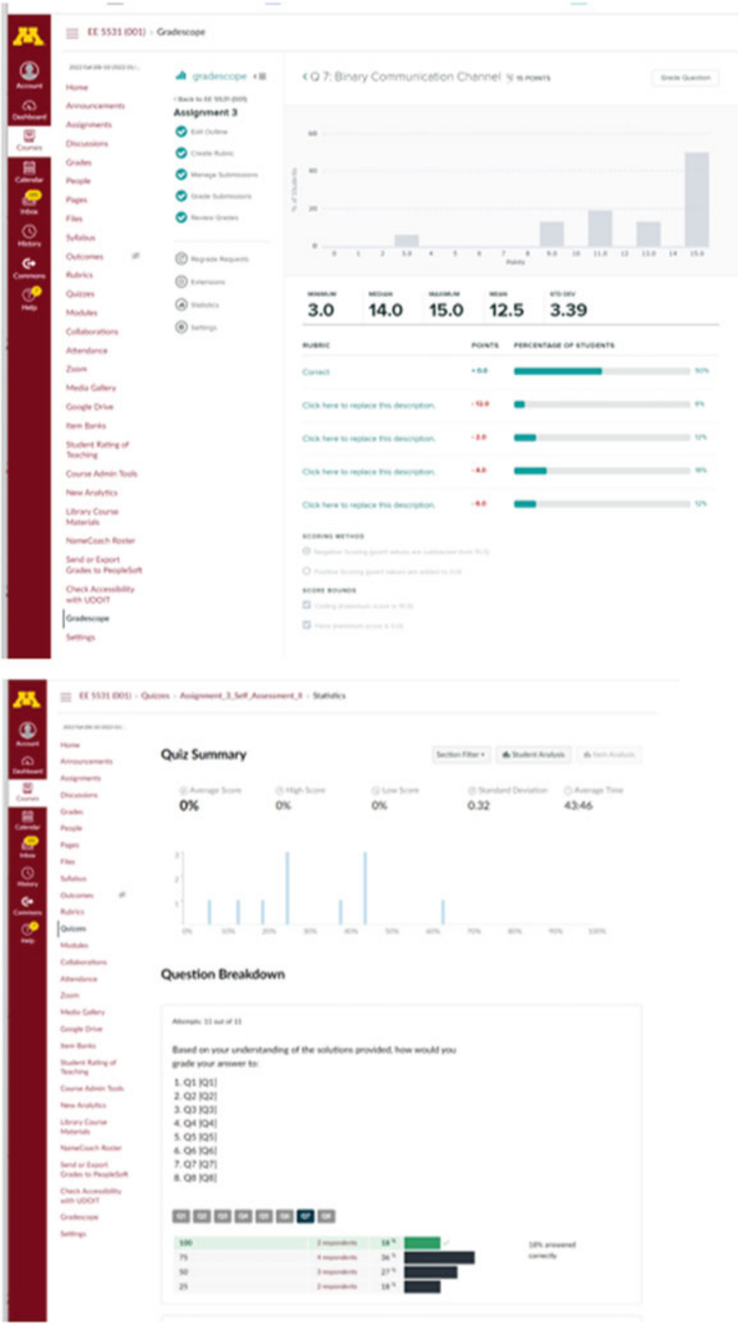

Fig. 2 Gradescope results (upper panel) and self-assessment (lower panel) for Q7 Assignment 3 in a graduate level course on probability, random variables, and stochastic processes. Both forms of feedback indicated that approximately 50% of the students did not do well on this problem, which was subsequently discussed in class to address these gaps

3. Students who have inadequate skills due to a lack of training in courses for no fault of their own, e.g., different instructors may put different emphasis on certain mathematical skills in covering freshman and sophomore-level courses.

Among other factors, the above factors have contributed to the creation of groups of students who struggled to keep up with certain core or foundational courses. These students typically seek help from tutors provided by student chapters of professional engineering societies such as the IEEE or other student organizations such as HKN.

The new ECE curriculum at the University of Minnesota was based on three foundational courses designed to integrate laboratory experience with timely introduction of key mathematical tools. In order to help students see the big picture even in the early stages of the program, abstraction is used to provide a top-down systems approach to engineering concepts, especially in the laboratory. Furthermore, a just-in-time approach is used to introduce key mathematical tools such as Fourier series and Laplace transform in the sophomore year. For this approach to work for the majority of students, or ideally for every student, in the program, it was immediately clear to the faculty that students with lacking mathematical skills needed more help than is traditionally available by tutoring.

In this section, we provide a specific example of self-paced learning that enabled students to bridge the gap(s) in their background with regard to the core courses in the ECE curriculum at the University of Minnesota. While the example is specific to one program and one area of engineering, it should be easy to see that it can be generalized to a variety of programs in engineering and other technical fields with rigorous requirements in core or foundational courses.

The redesigned curriculum is based on two foundational courses to be taken in the sophomore year. These courses cover the fundamentals of ECE in terms of circuits and electronics, but employ a motivating theme of audio signals and systems. In the first course, EE 2015, fundamental steady-state analysis is covered, which includes DC and sinusoidal responses of both simple circuits and amplifier-based filters. The latter is taught with the benefit of abstraction, where the students are taught how to characterize the frequency response of amplifier/filter circuits with only a basic understanding of their internal structure. Besides the fundamental laws of circuit theory, the students learn a powerful frequency domain concept of phasor analysis and are introduced to the Fourier series as a mathematical tool for performing frequency domain analysis of periodic signals, which is the next step above sinusoidal analysis. Both of these mathematical tools require working knowledge of complex numbers.

In the second course, EE 2115 (Analog and Digital Electronics), fundamental transient analysis is taught with a focus on digital switching circuits in modern electronics. In addition, transistor circuits as amplifiers and switches are introduced. The Laplace transform is introduced as a mathematical tool for transient analysis, which also requires knowledge of complex numbers. In addition, its relation to steady-state phasor analysis is discussed. The connection between steady-state and transient analyses serves to highlight the importance of continuity of understanding concepts and recognizing the appropriate mathematical tools for analysis in different domains and applications.

For reasons outside the scope of this report, many students tend to struggle with complex numbers and, therefore, phasor analysis, even when these concepts are taught well. To make matters worse, these topics are sometimes covered poorly or not covered at all, leaving a sizable group of students feeling uneasy about these concepts throughout the curriculum. To address this challenge, a Canvas-based bridging course was made available to students who continue to struggle with these concepts to complete at their own pace. This was especially useful to students taking the second course in the sequence, who either did not learn these concepts well or transfer students who had little or no exposure to these concepts but have a good understanding of the fundamentals of circuit theory.

The bridging course contains five modules on complex numbers and phasors, power in sinusoidal signals, frequency response and Fourier series, cascade filters and buffered cascades, and operational amplifier circuits. The contents include video lecture recordings from previous offerings and quizzes to assess student understanding. At the time of writing, 33 students have used this course from Fall 2021 till January 2023, with some of these students using the modules long after they have completed the second course in the sequence. This is a sizable minority of our students, who would have had little or no help to address these deficiencies in the past.

12 Ethical Considerations

The design of modern engineering curricula based on a collaborative and self-paced learning paradigm can present several ethical considerations:

1. *Cheating and plagiarism.* Collaborative learning can create opportunities for students to cheat and plagiarize each other's work. To prevent this, clear guidelines and expectations for collaboration should be established and plagiarism detection tools should be used to detect instances of cheating.
2. *Privacy and security.* Collaborative learning often involves sharing personal information or data, so it is important to have clear policies in place to protect students' privacy and to ensure the security of their data.
3. *Inclusion and accessibility.* Collaborative learning can be challenging for students with disabilities, so it is important to ensure that all students have equal access to the learning materials and activities.
4. *Bias and discrimination.* Collaborative learning can also create opportunities for bias and discrimination, particularly if the group is not diverse and inclusive. It is important that educators establish clear guidelines for respectful and inclusive communication.
5. Self-paced learning may lead to *isolation and lack of motivation* as the student will not have the same level of interaction and feedback that is available in traditional classes. To mitigate this, it is important to provide opportunities for interaction and feedback and to encourage self-reflection and self-evaluation.

6. *Time management and procrastination.* Self-paced learning can be challenging for students who struggle with time management and procrastination. To prevent this, it is important to provide guidance and resources on time management and to establish clear deadlines and milestones.
7. Self-paced learning can be challenging for students who are not self-motivated and need some *external structure or guidance.* Clear guidance is necessary to mitigate this, together with clear expectations and regular check-ins to ensure students are on track.

The cheating and plagiarism consideration deserves a special attention. While it is a legitimate concern, especially in professional fields such as engineering, the solution cannot be simply to employ tools of detection. These tools have a role to play, but only to the extent of determining the size of the problem in any one program. This problem should be addressed by educating students on the value of engineering ethics and encouraging them to see themselves as practicing engineers, with consequences to their decisions or work outcome. Incorporating more real-life design problems, including cost and failure analyses, might be a key part of the solution to this societal problem.

13 Conclusions

Advances in software and hardware design environments for engineering systems, together with the increased availability of remote and blended learning, have changed the educational landscape in fundamental ways. Engineering curricula at major institutions of higher education are being redesigned to adjust to these changes with a focus on arming the students with the tools to become lifelong learners, in addition to engaging them in efforts to improve the contents and delivery of lecture and laboratory experiences.

In this chapter, we described a new curriculum in Electrical and Computer Engineering that was designed to address the changes by embracing abstraction and timely introduction of mathematical tools to maximize student engagement. Abstraction is essential to allow for the introduction of modern software and hardware environments that students are likely to use in the workplace after graduation. However, in order for this approach to succeed, collaborative and self-paced learning must be baked into the curriculum in order to help students at all levels to achieve their learning objectives. In addition, self-assessment tools have to be developed in order to help instructors adjust the content and delivery of courses to help all students, and not just try to teach the illusive “average student”. We have presented examples of these teaching and learning tools from recently taught courses as part of the new ECE curriculum at the University of Minnesota. The examples emphasized instructor–learner collaboration to improve the content and pace of delivery to accommodate at-risk students as well as advanced students who are asking for more.

While the examples and curriculum design considerations were based on one institution in the United States, they are applicable to any higher education institution around the world due to the worldwide availability of learning management systems and the wide use of internet learning resources.

Perhaps one of the most important adjustments that need to be made is the increased emphasis on ethical issues in the new engineering curricula. Plagiarism is an important problem to address, but more important is to instill a sense of pride among the students that encourages them to guard against plagiarism in the first place. This has been successfully implemented at institutions such as the College of Engineering at Michigan and at the California Institute of Technology. While these long-standing models cannot be replicated everywhere, we can put more focus on ethics through the introduction of real-life design problems that emphasize the cost of failure in terms of health, capital, and other societal impacts. While these issues have always been important, they are essential in the twenty-first century where access to information from illegitimate sources is only a click away in most cases.

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The Impact of Online Learning on Career Performance Among Practitioner Engineers

Hoda Baytiyeh

Abstract Information and communication technologies have reduced the distance between students, professors, and companies, increasing opportunities for employment and collaboration among professionals. However, this open-world approach has also increased the pressure on fresh employees to meet global demands. One of the main challenges for contemporary education is to equip students with the requisite skills for career performance and sustainability. This study explores employed engineers' perceptions of how an online professional diploma impacted their career performance. The program in question is a joint online diploma in Green Technologies offered by three universities—two in Lebanon and one in Egypt. Ninety-two working engineers who have earned the online diploma responded to an online survey based on the ABET criteria for technical, interpersonal, and personal skills. Exploratory factor analysis identified four factors that were highly correlated with impact on career performance: independent learning, self-efficacy, social awareness, and transformational leadership. Among these professionals, the most valued of these factors was independent learning.

Keywords Distance learning · Career performance · Independent learning · Middle East

1 Introduction

The origins of online learning can be traced back to the early eighteenth century [1] and it is generally considered that it has gone through at least three generations [2]. The oldest form of online learning known as "distance education," and recognized as the first generation, had the form of a correspondence-study where students received paper-based materials from instructors using the postal service and then, as instructed, returned their written assignments for evaluation. The primary disadvantage of this learning approach was related to the lack of communication between

H. Baytiyeh (✉)
Department of Education, American University of Beirut, Beirut, Lebanon
e-mail: hb36@aub.edu.lb

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instructors and students as well as lack of interaction among students [3]. The most significant milestone in the history of online education was the development of digital computing technologies. The use of email, web-based resources, learning management systems, and online discussion boards are some of the primary technologies supporting interactive and flexible forms of online learning [4].

In terms of pedagogy, all forms of online learning were characterized by the behaviorist and cognitivist models of learning. Students primarily learned individually as the interaction among learners was still limited and not incorporated into learning activities. Those pedagogical models were successful, particularly for training objectives [2]. Novel pedagogical approaches, based on social-constructivist views of learning, were pioneered by Dewey [5], Piaget [6], and Vygotsky [7], who view learning as a process of knowledge construction by learners through interactions.

The continued evolution and growth of the online learning market is reflected in the spread of e-learning programs and disruptive technologies and tools that support the global learning and development industry. Using tools that facilitate remote communications, intra-organizational, and inter-organizational virtual teams of engineering professionals can perform critical tasks, such as product design and quality control; moreover, up to 52% of engineering employers are known to accommodate this approach [8]. Beyond work-related tasks, virtual teams are also increasingly used for online professional development, as engineers are expected to develop lifelong learning strategies to keep up to date with the latest knowledge in their field. As rapid advances in information and communications technology (ICT) applications provide opportunities for online professional development while continuing to work, the corporate e-learning market is expected to witness further growth. As such, it was revealed that occupational therapists embraced new ways to engage with continuing professional development while embracing positive attitudes toward the use of Twitter [9]. To facilitate this continuous learning and development, employees can access a wide range of advanced digital learning and teaching tools. In revenue terms, the predicted growth of the e-learning market share from 2021 to 2026 is $1.72 trillion (USD) at a progressing compound annual growth rate (CAGR) of 16.35% [10]. More specifically, online universities around the world are expected to bring in more than $86 billion in 2022 with a steep growth of more than $152 billion as soon as 2026 [11].

In educational institutions, new strategies for course delivery supported by online tools and learning platforms enable professors and students to access content and resources, share information, collaborate on projects, and discuss educational-related issues. As well as augmenting academic learning, network technologies that can transfer information at any time to any location promote new forms of identity construction, meaning-making, and social interaction [12, 13]. By eliminating spatial and temporal constraints, highly scalable and reusable online courses can accommodate any number of students [14]. Consequently, the number and proportion of college and university students taking classes online grew in 2017, and one-third of all students took at least one online course [15].

In developed Western countries, where it has been proven that computer-based classrooms are as effective as physical classrooms, online learning is now commonly accepted as an alternative to the traditional face-to-face approach [16] and offers a convenient alternative for professional development and lifelong learning [17]. Moreover, Butcher and Rose-Adams [18] argue that distance learning is an opportunity for the most vulnerable and hard-to-reach groups, providing them with a path to higher education by giving them access and flexibility while being employed. In the spring of 2020, when the coronavirus pandemic began to disrupt education in the United States, around 75% (11.8 million) of all undergraduate students were enrolled in at least one distance education course, and 44% (7.0 million) of all undergraduate students exclusively took distance education courses. According to the National Center for Education Statistics, the number of undergraduate students enrolled in at least one distance education course was 97% higher in 2020 than prior to the pandemic in the fall of 2019 (11.8 million vs. 6.0 million). The number of undergraduate students exclusively enrolled in distance education courses was 186% higher in 2020 than in 2019 (7.0 million vs. 2.4 million) [19].

In 2021, 27% of people aged 16–74 in the European Union reported that they did an online course or used online learning material, a 4% increase compared with 23% in 2020. Among all EU Member States, Ireland had the highest share (46%) of people aged 16–74 doing an online course or using online learning material. Finland and Sweden both registered a share of 45%, followed by the Netherlands with 44%. At the other end of the scale, doing online courses or using online learning material was not very common in Romania (10%), Bulgaria (12%), and Croatia (18%) [20].

However, online learning is less common in other global regions; in the Middle East, there are no available data on students enrolled in online courses or degrees, and the failure of governments to recognize online programs has discouraged academic institutions from offering online degrees [21]. As a result, online programs have lost credibility, leading to fewer competitive job opportunities than for graduates with comparable traditional degrees [22]. To combat this trend, some governments in the Middle East have initiated e-learning programs that are either completely virtual or jointly undertaken with higher education institutions elsewhere [23].

Knowles et al. [24] highlight specific characteristics that make the learning process of adults distinctively different from that of other learners. Adults can identify their learning needs and learning strategies and are able to take responsibility for their own learning. Also, adults tend to be selective, based on their own interests, and they perceive issues that are relevant to their immediate needs in their work environment. And most importantly, adult learning is based on learners' previous knowledge and experience where they use their own and previous resources, experiences, values, and beliefs in the learning process. Furthermore, Merriam and Baumgartner [25] believe that adults need to take control over their learning and to get involved in the planning of their own learning process, while having the option of selecting the learning approach that is more relevant to their work and experience. Therefore, diverse learning strategies are needed because adults have special characteristics. Pedagogical approaches should aim at actively engaging learners in open and interactive learning environments [26]. These learning strategies work best if they are tailored based on a constructivist approach. Constructivism is based on the interaction between previous knowledge and the knowledge acquired through new experiences and through interaction with others [27].

The spread of ICTs in higher education has created new opportunities, especially for the professional development of adults. Online learning includes different approaches of delivery and technology-enhanced options. These learning approaches integrate a growing number of tools to form online communities that help to improve the learning process. Such delivery modes provide adults with flexibility in learning through the opportunity to participate at their own convenience, following their own style and pace of learning in a dynamic learning environment that enhances active learner engagement [28]. Online learning provides a potential for a socio-constructivist approach for adult learning, by encouraging autonomous and independent learning as well as increasing the opportunities for collaboration and construction of new knowledge [29]. Based on authentic learning, such environments promote different thinking strategies with multiple perspectives and are especially suitable for the professional development of adults as they support self-directed learning, collaborative learning, and problem-oriented learning [29]. Consequently, online learning can provide adults with successful educational experience through constructivist pedagogies [30].

While engineering programs equip graduates with the necessary skills and knowledge to get their career underway, professional engineers are expected to constantly update their expertise to optimize their performance in an unstructured and multidimensional environment. Toward the end of the twentieth century, the Accreditation Board for Engineering and Technology (ABET) updated its accreditation criteria to include a set of soft skills that would prepare engineers for the challenges of the professional world. The plethora of concepts, tools, and applications pressurizes practitioners to remain updated and resilient in this highly competitive and challenging environment, and professional engineers are now encouraged to identify and pursue relevant career and performance goals that extend beyond technical skills to attitude, confidence, values, and leadership.

Based on the ABET criteria, the main objective of the present study was to investigate the career impact of an online diploma program on practicing engineers in the Middle East and to explore the relationship between the acquired skills and their career performance.

2 Engineers' Professional Development in the Workplace

While the decision to enroll in an engineering college is driven by several factors, personal interest in the subject matter is a key determinant, followed by other concerns such as financial concerns, social values, and personal growth in a satisfying job that provides opportunities for professional advancement [31]. Once employed, these graduates must cope with the realities of sustaining a full-time job while maintaining the necessary professional skills and knowledge to contribute to productivity and performance amid changing environmental constraints and administrative tasks [32].

Graduates need both specialized training and formal education to update and improve their professional knowledge, competences, skills, and effectiveness.

Engineering is sometimes characterized as a "design process" [33] or as technical problem solving [34]. However, evidence that recent graduates spend up to 64% of their time on written and oral communication [35] confirms that strong communication skills are a key component of engineers' professional development. For that reason, communication, teamwork, and interpersonal skills should be taught in the technical context of the workplace [36] as critical interdisciplinary skills for "global engineers" [37] who must update and develop their skills and knowledge throughout their career. In this global context, professionalism entails an ability to respond quickly and effectively to changes and challenges in technologies, organizations, markets, client requirements and government policies, as well as national and international regulations [38]. Therefore, a significant part of an engineer's professional development in the workplace results from engaging in the collective practices within professional work where the professional development of individual engineers and the development of the organization are co-produced in the workplace [39]. In fact, experience in the workplace provides a unique setting to assess the performance and competencies of engineering students while being engaged in the practice of engineering at the professional level [40]. Based on interviews with engineering faculty and students, Sheppard et al. [41] concluded that professional development is a "social process," affected by work context and environment. Trevelyan [42] argued that workplace coordination is a critical factor in the engineering field, involving discussion of project status and development of a network of contacts and supervising colleagues. Adams and Felder [43] believe that the professional development of engineers is a cycle that involves educators, students, academic institutions, and professional engineers and, therefore, educational institutions can be considered as learning organizations that must evolve not only to build a culture of innovation and continual learning but also to allow for reflective practice. Other researchers urge engineering educators to collaborate with employers to address the development of competencies for engineers and to establish a learning equilibrium between on-campus and work-based experiential studies using globally-based industries [44, 45] where mentoring and self-guiding situations can occur at the same time through on-campus educational practice and in the workplace [46].

Because engineering practice is characterized more by interpersonal and small-group interactions, engineering education should place greater emphasis on formal presentations and communication skills such as translation, clarity, negotiation, and listening [47]. Exploring how alumni perceived the impact of one in-service learning program to prepare engineers for the workplace, Huff, Zoltowski, and Oakes [48] reported that the most important career skills were seen to relate to leadership, interacting with customers, design, project management, oral presentations, and documentation of work processes. In a study investigating career preparation, 1,012 recent baccalaureate graduates identified internships, work experience related to career goals, advanced courses in communication, and participation in student organizations as key factors for learning and development [49].

With increasing interest over the last decade in soft skills for engineers, including communication, team coordination, and planning, higher education institutions have begun to embed these skills in their engineering programs. Stanford University was among the first to offer electronic instruction through its Center for Professional Development, with more than 250 technical and management courses that enabled about 5,000 working professionals to earn master's degrees or take short courses in various engineering fields. Stanford's school of engineering co-sponsored IEEE (Institute of Electrical and Electronic Engineers) graduate-level courses to provide applications-oriented skills upgrades for career development [50]. At the University of Wisconsin, the two-year part-time Master of Engineering degree taken during professional practice has attracted working engineers from several of America's top companies. Also, the MSc in Professional Engineering at Kingston University, London, was developed through the UK Government and the Engineering Council, as a method of recognizing and assessing learning at master's level alongside the monitoring of engineering-competence development in the workplace. This program entails the monitoring of professional development as well as competence evaluation and assessment of work-based learning by professional supervisors [51]. At the University of Missouri, Columbia, the Department of Electrical and Computer Engineering with the College of Education, developed a course for engineering graduate students emphasizing pedagogy and professional skills to introduce engineering students formally to professional skills through four topic categories: pedagogy and interpersonal communication skills, team-building and personal skills, proposal development skills, and globalization and gaining international experience. A pilot survey at the end of the course revealed the importance of raising awareness and knowledge of these skills because they were not covered in other courses in their undergraduate and graduate engineering curriculum [52].

According to Guest [38], continuing professional development (CPD) in the field of engineering is multi-faceted. While some firms prefer to work with external providers, others offer in-house professional development; with advances in ICT, employees at some firms are equipped with web-based tools for personal development and diary-based planning and recording systems. Other initiatives promoting project-based learning have used ICT in pilot and large-scale global projects, usually involving collaboration with the industry and university sectors [53]. In a recent assessment of the role of online training courses in promoting sustainable professional development strategies, Perez-Foguet et al. [54] investigated the implementation of the Global Dimension in Engineering Education program by a consortium of European technical universities and non-governmental organizations. Their findings confirmed the effectiveness of online training courses embedded in specialized online platforms for collaborative learning.

3 Context of the Study

In the spring of 2015, a joint professional postgraduate diploma in green technologies was launched by the American University of Beirut, the Lebanese American University, and the American University in Cairo. The ProGreen program offers three specializations: renewable energies, green buildings, and water resources. A cloud-based learning management system was implemented to enable students and instructors to access materials and to interact virtually.

The objective of this unique program is to support the professional development of practicing engineers and architects by enhancing their technical and decision-making skills in the area of green technologies. The diploma can be completed in 12–8 months, with a minimum requirement of 18 coursework credits in the chosen specialization (including a final project) to obtain the diploma. Additionally, students can opt for a double or triple specialization, requiring a minimum of 26 or 34 credit hours, respectively, including a minimum of eight credit hours of graduate coursework beyond their previous specialization(s). Admission requirements include a bachelor's degree in engineering, architecture, or science and a specified Test of English as a Foreign Language (TOEFL) score.

4 Research Questions

Academic institutions are expected to meet specific educational objectives as specified by the Accreditation Board for Engineering and Technology (ABET) criteria. While the present study does not evaluate the ProGreen diploma in terms of those criteria, it refers to them in exploring the impact of the program's online context on engineers' career performance, including technical, interpersonal, and personal skills. For present purposes, *technical* indicators include the hard skills and knowledge related to professional development and career advancement; *interpersonal* indicators are those related to interaction and communication skills; and *personal* indicators refer to management and planning capabilities.

Based on these three indicators, the study explores the skills acquired by engineers in an online learning context. Specifically, the study addresses the following questions:

- What skills do engineer practitioners acquire through the online diploma?
- How are the acquired skills interrelated?
- How do the acquired skills affect the engineers' career performance?

5 Theoretical Foundations

According to Moore and Kearsly [55], most distance education students are adults, ranging in age from 25 to 50 years; Guri-Rosenbilt [56] found that the median age of these students ranges from 30 to 34 years. For that reason, any exploration of distance learning requires some understanding of adult learning [55].

In relation to the workplace, Bandura's [57] social learning theory explains behaviors in terms of cognitive, behavioral, and environmental factors in "…a continuous reciprocal interaction of personal environmental determinants…virtually all learning phenomena resulting from direct experience occur on a vicarious basis by observing other people's behavior and its consequences for them" [57]. On this view, human behaviors are influenced by observation and direct experience of social interactions within a given environment [58]. Bandura's research focused on the relationship between human social experience and cognitive operations, and how these affect behavior and development. Bandura emphasized the role of cognition, abstraction, and integration—that is, how exposure to communication and interaction in various social situations affects human cognitive abilities, as well as response-outcome expectancies, perceived self-efficacy, and standards for self-evaluation.

For present purposes, the workplace is understood as the setting in which practitioner engineers acquire and transform experience. To assess how the online context of the ProGreen program has affected participants' professional development, this study examines the process of returning to learning during professional practice. Social learning theory informs this assessment of the interaction between cognitive, behavioral, and environmental factors in relation to the ABET criteria.

6 Method and Data Collection

A quantitative research design was used to assess the effect of an online learning context on the careers of practitioner engineers. Engineers enrolled in the ProGreen program were recruited by e-mail, and an online survey was sent to all graduated students ($N = 109$). Of those, 92 participated in the survey, and 92 completed it, yielding a response rate of 84%. The first section of the survey included demographic questions related to gender, age, and employment status. In the second section of the survey, participants were asked to rate 27 items indicating the effects of the online learning experience on a five-point Likert scale (1 = *poor*, 2 = *acceptable*, 3 = *good*, 4 = *very good*, 5 = *excellent*).

Based on previous quantitative and/or qualitative studies [59–61], the 27 survey items served as indicators of technical, interpersonal, and personal skills related to ABET criteria, and to industry needs and expectations. *Technical* indicators (9 items) related to the hard skills and knowledge required for professional development and career advancement, encompassing learning opportunities ranging from theoretical knowledge to creativity and innovation [62]. *Interpersonal* indicators of soft skills

(9 items) related to soft interaction skills that included the ability to work as part of a group or team, openness to new ideas, and verbal/nonverbal communication skills [63]. Finally, *personal* indicators (9 items) referred to management, negotiation, and conflict-resolution skills in contexts ranging from business policies to time management and planning [64]. For the purposes of this study, the cognitive skills component of social learning theory was related to ABET technical indicators; behavioral skills were related to ABET personal indicators, and environmental skills were related to ABET interpersonal indicators.

Exploratory factor analysis (EFA) was used to address the first research question. Factor analysis is a statistical method that seeks to explain the correlations among multiple outcomes as the result of one or more factors. The objective of using EFA was to explore how the ABET technical, personal, and environmental indicators can be understood in the context of online learning and social learning theory. The second research question was addressed through Pearson correlation analysis, and the third question was addressed through multiple regression analysis.

7 Results

The strongest motives for enrolling in the online diploma were *professional development* and *lifelong learning* (100% and 83% respectively) while *job promotion* and *required skills for the job* were rated least important (29% and 24%, respectively) (see Table 1). About 72% of respondents indicated that the online diploma's impact on their career performance was *good to excellent* while 23% considered it *satisfactory*. Table 1 also includes demographic information about respondents' gender, age, and employment status.

The 27 items in the second section of the survey, which related to technical, personal, and interpersonal indicators are considered reliable, with a Cronbach's alpha reliability of 0.91. To address the first research question, descriptive statistics were calculated to measure central tendency and variability for each item. Exploratory factor analysis (EFA) was performed to determine which of the 27 items formed related subsets, based on principal components extraction, eigenvalues greater than 1.00 and an absolute value greater than 0.40 [65]. The results of a Kaiser–Meyer–Olkin (KMO) measure of sampling (0.931) and Bartlett's test ($p < 0.0001$) confirmed the appropriateness of EFA here [66]. Although EFA is generally applied for large samples, previous studies have investigated the conditions under which EFA can yield good quality results for small samples. When applying EFA, ratios of sample size to number of variables are commonly recommended such as 5 or 10 observations per variable [67]. However, other recent researchers have found flaws in the ratio-based recommendations [68, 69]. It was found that sample size requirements are mostly dependent on characteristics of the data, such as the magnitude of the communalities, magnitudes of the loadings, the number of factors, and the number of variables per factors [70–72]. In fact, previous simulations have shown that, under conditions such as low number of factors, high loadings, and high number

Table 1 Participants' demographics and motives

		Frequency	Percent
Gender	Male	59	64
	Female	33	36
Age	20–30	44	48
	31–40	26	28
	41–50	16	17
	>50	6	7
Employed	Full time	68	74
	Part time	24	26
Motives to enroll in the diploma	Life-long learning	76	83
	Professional development	92	100
	Required skills for the job	22	24
	Personal fulfilment	46	50
	Job promotion	27	29
	Salary increase	33	36
Impact of the online learning experience on your career performance	Poor	5	5
	Satisfactory	21	23
	Good	32	35
	Very good	19	21
	Excellent	15	16

of variables; EFA can yield reliable results for small sample sizes [70, 73]. Given the small sample size resulting from the context of the current study and based on the recommendations offered by the recent researchers, the EFA revealed that the KMO value is above 0.60, the loadings of all variables are above 0.60, and the four factors that emerged have more than three variables, as shown in Table 2. And therefore, the uncovered factors are suggested to be favorable and reflect a valid structure of the applied EFA.

Exploratory factor analysis with principal components extraction yielded five factors that together accounted for 74.01% of the total variance. Table 2 shows the rotated factor loadings; the size of each loading reflects the extent of the relationship between a variable and a factor. For items loaded under two factors, only the highest loading was retained. The following variances were reported: factor 1, $\sigma^2 = 32.86\%$; factor 2, $\sigma^2 = 21.64\%$; factor 3, $\sigma^2 = 12.33\%$; factor 4, $\sigma^2 = 7.18\%$. Following this evaluation, factor 1 was labeled *independent learning*, factor 2 was labeled *self-efficacy*, factor 3 was labeled *social awareness*, and factor 4 was labeled *transformational leadership.*

These four factors reflect the skills acquired by professional engineers through the online diploma and were used to assess practicing engineers' perceptions of the online diploma's impact on their career performance. Four new variables were

Table 2 Rotated factor matrix with extraction method: principal component; rotation method: varimax with Kaiser Normalization (IL = Independent Learning, SE = Self Efficacy, SA = Social Awareness, TL = Transformational Leadership). Participants were asked to rate the various indicators on a scale of 5, to show how well the online diploma contributed to these skills (1 = poor, 5 = excellent)

Indicators	IL	SE	SA	TL
Preparedness for continued learning	0.902			
Transforming knowledge to product	0.873			
Learn a new subject on your own	0.825			
Conduct experiment on your own	0.783			
Theoretical knowledge	0.762			
Using technological tools		0.832		
Model and formulate problems		0.781		
Possessing computational skills		0.764		
Solving engineering problems		0.722		
Ability to work under pressure		0.683		
Ability to manage your time		0.677		
Presentation skills in foreign language			0.857	
Written communication in foreign language			0.821	
Oral communication in foreign language			0.788	
Confidence in dealing with others			0.735	
Knowledge of business and public policies			0.711	
Flexibility in dealing with others			0.692	
Ability to be goal oriented			0.659	
Possessing professional ethics			0.631	
Creativity and innovation skills				0.896
Make decision and accept responsibility				0.852
Ability to effectively work in a team				0.834
Openness to new ideas				0.776
Motivate others for a given task				0.762
Be willing to take risk				0.741
Leadership and managerial skills				0.735
Planning skills				0.702

calculated using the means of the indicators grouped under each factor by the EFA. Based on participants' mean ratings of the newly generated factors, *independent learning* was rated highest ($\mu = 4.20$), followed by *self-efficacy* ($\mu = 4.12$), *social awareness* ($\mu = 4.01$), and *transformational leadership* ($\mu = 3.77$).

Because of the limitations of Cronbach's alpha due to its sensitivity to the number of items in the scale and its tendency to underestimate the internal consistency reliability, composite reliability is a more suitable measure of internal consistency reliability. The internal consistency reliability was evaluated using Jöreskog's [74] composite reliability (CR) where higher values indicate higher levels of reliability. According to Hair et al. [75], values between 0.60 and 0.70 can be considered as "acceptable in exploratory research," and results between 0.70 and 0.95 represent "satisfactory to good" reliability levels. When applying the composite reliability formula to the items, the following values were observed: CR (independent learning) = 0.917; CR (self-efficacy) = 0.882; CR (social awareness) = 0.906; CR (transformational leadership) = 0.929. Since the composite reliability values are between 0.88 and 0.92, the condition of internal consistency is met. To answer the second research question, the relationship between the dependent variable (impact on career performance) and the predictor variables that emerged from the EFA (based on the ABET criteria) was determined using Pearson correlation analyses as shown in Table 3.

While all were correlated with the dependent variable, *independent learning* was most highly correlated ($p < 0.01$), confirming its strong impact on engineers' experience during the online journey and its added value for career performance. All factors were significantly correlated at the 0.01 level.

A one-way repeated-measures analysis of variance (ANOVA) indicated significant statistical differences among the four factor scores ($F_{3,\,123} = 99.02, p < 0.001$). *Independent learning* had the strongest impact, followed by *self-efficacy*, *social awareness*, and *transformational leadership*. In post-hoc tests using the Bonferroni correction, *independent learning* differed significantly from all the other factors ($p < 0.05$); no statistically significant differences were found among the remaining factors.

One objective of the statistical analysis was to provide an index of the relationship between two variables as shown in Table 3. A further objective was to address the third research question by providing an index that predicts impact on career performance from the other variables. Based on the multiple correlation coefficient R, this index established a weight for each predictor variable that measures its independent contribution to the perceived effect of the online program on career performance. To obtain regression weights representing the relative importance of the variables, the multiple correlation (R) and multiple regressions were performed for the four variables and the dependent variable as shown in Table 4.

Multiple R (0.726) represents the multiple correlation—in this case, the correlation between the dependent variable (impact on career performance) and the

Table 3 Pearson product-moment correlations for the factors for *independent learning, transformational leadership, self-efficacy, and social awareness*

	Impact on career	IL	SE	SA	TL
Impact on career performance	1	0.801*	0.690*	0.612*	0.554*
IL	0.801*	1	0.728*	0.839*	0.780*
SE	0.690*	0.728*	1	0.844*	0.949*
SA	0.612*	0.839*	0.844*	1	0.850*
TL	0.554*	0.780*	0.949*	0.850*	1

*The correlation is significant at the 0.01 level (2-tailed)

Table 4 Multiple regression of the criterion variable *Impact on career performance* with the predictor variables *independent learning, transformational leadership, self-efficacy, and social awareness*

Multiple *R*	0.726				
***R* square**	0.635				
Adjusted *R* square	0.627				
Analysis of variance					
	Sum of squares	*df*	*Mean square*	*F*	*Sig.*
Regression	57.160	4	12.540	61.125	0.000
Residual	21.673	87	0.586		
Coefficients					
Variables in equation	*B*	*Std. Error*	*Beta*	*t*	*Sig.*
(Constant)	–0.831	0.702		–1.184	0.244
IL	2.897	0.388	1.495	2.312	0.000
SE	2.319	0.529	1.145	4.384	0.000
SA	1.897	0.666	0.283	0.768	0.000
TL	1.512	0.681	0.236	0.612	0.000

weighted sum of the predictor variables (*independent learning*, *self-efficacy*, *social awareness,* and *transformational leadership*). The R square value (0.635) represents the variance of the dependent variable for all of the predictor variables combined. Adjusted R square (0.627) is an estimate of variance that takes account of error variance. Table 4 also shows F-statistics ($F_{4, 87} = 61.125$; $p < 0.000$) and the beta weights of the four predictor variables.

8 Discussion

The present study, using ABET criteria in combination with social learning theory, was an attempt to understand the interplay of practitioners' technical, personal, and interpersonal skills with cognitive factors (knowledge and expectations), behavioral factors (skills and practice) and environmental factors (social norms and community access), and to ascertain how this interplay affects their behavior in the professional work environment. The technical items captured theoretical knowledge and its transformation in the workplace, the interpersonal items focused on communications and decision-making, and the personal items sought to identify engineers' managerial ability and preparedness. Exploratory factor analysis (EFA) identified four underlying factors (*independent learning, self-efficacy, social awareness, and transformational leadership*) that exhibit the behaviors and skills acquired and promoted in this online journey that were valued by participants for their impact on career performance.

A majority (74%) of the participants had full-time jobs. While all cited *professional development* as a motive for enrolling in the online diploma, a sizable majority (83%) also cited *lifelong learning*. Knowles [76] identified five key characteristics of adult learners: (1) *self-concept* (maturing and transitioning from dependence to become a self-directed human being); (2) *adult learner experience* (accumulated experience as an increasing resource for learning); (3) *readiness to learn* (orientation to developmental tasks associated with social roles); (4) *orientation to learning* (shifting from subject-centered to problem-centered); and (5) *motivation to learn* (which becomes internalized).

In relation to the impact of the online learning experience on career performance, 57% of the engineers rated this as *satisfactory* while 31% rated their experience as *good to very good*. This confirms that online learning offers a practical solution for employers in supporting their engineers' career advancement. Because adults need to know the reasons for learning, effective professional development should focus on tasks to be performed rather than on memorizing content—in other words, instruction will be effective when it is of immediate use. In this regard, Akili [77] highlighted the gap between engineering education and practice in the Arab Gulf States, reflecting of a lack of collaboration between industry and colleges of engineering.

In terms of how online learning met the ABET criteria for career enhancement, the EFA of the 27 items provided a more comprehensive assessment of the four factors in terms of skills used in engineers' working environment.

Independent learning was rated highest ($\mu = 4.20$) by participants, reflecting participants' preparedness for continued learning and individual learning. More than half of the participants (52%) were mature independent adults aged 30 or more. There is evidence that most distance learning students are employed adults with past educational achievements [55]. Other studies have reported that adult students seek online degrees to apply what they learn as well as to acquire professional experiences and connections for career advancement [78]. Knowles [79] argued that learners become increasingly independent and self-directed as they mature because of their accumulated life experience, which they can use to direct their own learning.

Anderson [80] suggested that one model of independent online learning would include computer-assisted tutorials, drills, simulations, and virtual labs where students can complete laboratory experiments. However, independent learning does not mean that these students are alone. Previous research indicates that community learning promotes active and collaborative knowledge construction through interactions between students and with the instructor [81–84]. Havelock [85] suggested that interactions between learners can influence meaning-making and professional practices, and learner-to-content interaction is known to promote student satisfaction and performance [86]. This occurs mainly in workplaces where colleagues or family members provide significant support for learners engaged in independent study [87]. A recent study investigated the perceptions of graduates of a distance learning health and social-care program to identify the factors that contributed to completing their degree and showed that support from family, tutors, and employers enabled graduates to continue their studies [88]. It was revealed that the supportive feedback received from tutors helped to build students' knowledge and skills, as well as confidence. In his book *The World is Open*, Bonk [89] argued that people learn best together, with the help of peers and experts they have never met, often using resources generated in another country or culture.

The second most highly rated factor was *self-efficacy* ($\mu = 4.19$), which is defined as "the beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situation" [90]. In this case, a majority of participants were professional engineers with full-time jobs and other commitments to be met while completing the online program. For them, self-efficacy was about working under pressure and solving engineering problems. There is evidence that self-efficacy is a key competence for self-regulation control processes [91], influencing task choice, effort, persistence, academic motivation, learning, and achievement [92]. There is also evidence that self-regulation and self-directedness are enhanced by community learning, which involves sharing knowledge, experiences, and perspectives with others [21, 93, 94].

Social awareness, the third-rated factor ($\mu = 4.02$), relates to communication skills and confidence and flexibility in dealing with others in a professional context. Because online learning communities bring together people of different ages, locations, and backgrounds, *social awareness* plays an important role in online learning. Using social-media tools, students can now communicate easily beyond their learning platform to create a sense of participation and belonging without pressures or restrictions [21]. Using mobile technologies, students can build learning communities in which online social interactions support collaborative and cooperative learning and knowledge construction. Recent research in the Middle East shows that social-media-enabled devices now pervade Arab culture [95]. When investigating Iranian learners' identity construction in an online course, researchers revealed the importance of activities through virtual spaces in education to facilitate a self-reflective understanding of cultural issues as well as a more effective shaping of participants' real-life problems and issues in the relative comfort of the virtual space [96].

The lowest-rated factor was *transformational leadership* ($\mu = 3.77$), which relates to decision-making, assuming responsibility and motivating others within a team, as well as managerial and planning skills. Contemporary leadership requirements extend beyond control and planning to motivating and inspiring a team, and fostering positive attitudes and a sense of contribution [97]. According to Goleman [98], great leaders are not distinguished by their technical skills or by their IQs; instead, emotional intelligence enables them to maximize their own and their followers' performance. Emotional intelligence has five components: self-awareness, self-regulation, motivation, empathy, and social skills. According to a 2016 survey of employers, the most desirable skills in college graduates are leadership and teamwork skills [99]. In the present case, these skills seem to have been fostered by the engineers' constant interactions, both among themselves and with their professors.

Although there were significant statistical differences between *independent learning* and the other factors, those differences cannot be considered meaningful, as the means are similar (ranging from 3.7 to 4.2 on a scale of 5), indicating that participants' perceptions of these factors' impact on career performance were relatively similar.

The remaining question investigated any correlation between career performance (the dependent variable) and the skills acquired through online learning (the independent variables). As shown in Table 3, the highest correlation was observed between *independent learning* and *impact on career*, followed by *self-efficacy*, *social awareness,* and *transformational leadership.* Additionally, the R square and adjusted R square values in Table 4 indicate that the combined predictor variables contributed substantially to the explained variance in career performance. Finally, the F-statistics and beta weights show that *independent learning* and *self-efficacy* played a more important role than the other two variables in determining participants' career performance.

These findings call into question current approaches to teaching and learning and the impact of such practices on prospective students' career performance in the workplace. Previous research has described how traditional teaching methods predominate in the Arab world, as curricula in most Middle Eastern schools and universities typically focus on rote teaching and learning rather than on critical thinking, problem solving skills, or information analysis and synthesis [100–102]. However, there is evidence that a flipped classroom approach, emphasizing active learning, promotes a deeper and broader perspective on professional skills. Such skills include self-regulated learning, problem solving, self-confidence, teamwork and communication, as well as enjoyment and creativity based on enhanced problem solving and critical thinking [103, 104]. Previous studies have noted weaknesses in the actual practice of engineering. Particularly, it was shown that creativity and innovation, interpersonal and personal skills in leadership, management, and multidisciplinary teamwork were overlooked in college despite their importance in work settings [105]. While there is evidence that the Gulf States' prosperity means that while newly qualified engineers in the Middle East have no difficulty in securing jobs, they encounter critical issues during the transition in terms of taking on new responsibilities, performing under pressure, dealing with superiors, and communicating with people from diverse backgrounds [61].

Teaching methods must adapt to promote the requisite skills and competencies for career performance and professional development that will enable graduates to compete and survive in today's competitive global work environment. Some researchers have argued that the ABET professional skills should not be taught in the traditional lecture format but should instead be acquired through active and cooperative learning that acknowledges differences in learning styles [106]. The present study provides evidence that online learning promotes these key personal and interpersonal skills for career advancement.

Dewey [107] asserted that there are two types of learning: "learning about" (the given subject) and "learning to be" (a professional practitioner). This can be applied to the engineering field where there are two types of learning: learning the subject and learning to become a professional practitioner. In fact, solving classroom problems does not necessarily prepare engineering students to solve workplace problems because workplace engineering problems are significantly different from the types of problem that engineering students solve in the traditional classroom setting [27]. Because the professional development skills that are so crucial for success in industry are often neglected in education, they can be acquired through informal learning in workplace. Competence and expertise that are increasingly recognized as the most valuable resources of individuals, organizations, and societies in working life, become the main challenge in workplace professional development [28]. As technologies evolve, continuous professional development underpins career performance throughout the practitioner's working life. At the beginning of any career, each individual must take all available opportunities to advance their work-related skills. With advances in computer-mediated communication, Web 2.0 applications facilitate collaborative working while conversing online. Distance education can help to enhance team skills, including oral and written communication, through synchronous or asynchronous collaboration, either one-to-one or as a group. Distance learning promotes "a shared experience rather than an experience that is shared" [108]. Also, Dieleman and Duncan [109] stressed the benefits of being able to share information and experiences in a scattered geographical area. Interaction and involvement foster self-directedness, self-regulation, and self-awareness, all of which are essential for career performance. Eminent scholars including John Dewey, Kurt Lewin and Jean Piaget [110] viewed experience as central to human learning and development and stressed the importance of understanding learning in terms of process rather than outcome. In the workplace, all learning is relearning, moving between reflection, action, feeling, and thinking. Corporate e-learning can support employees' knowledge creation by integrating new experiences into existing concepts in a holistic process of adaptative interaction between person and environment.

The present findings support existing evidence that distance learning helps professionals to become active and recipients of knowledge [111–113]. This aligns with the andragogy theory of adult learning, which holds that adult learners must take control of their own learning to become self-directed, respecting individual differences and self-identity, and grasping the knowledge presented by real-world situations [24]. Social learning theory helps educators to frame their teaching practices to target cognitive, environmental, and behavioral factors. Distance learning helps in applying these principles to professional development and career performance. Advances in artificial intelligence mean that machines can perform an increasing range of routine tasks, freeing humans to focus on leadership, teamwork, and creativity [99]. In this changing environment, educational institutions must recalibrate teaching and learning practices to promote these skills.

9 Limitations and Implications

One of this study's limitations is that the number of respondents was relatively small, and the findings should be validated for a larger sample. Additionally, respondents were recruited from a single newly introduced online diploma in a region where such programs are not recognized or officially legislated by the higher education authorities. Although communities of professional engineers have established their own approach to professional development, it would be interesting to explore how higher educational institutions can engage with these professional bodies to enhance collaboration between education and industry for mutual benefit.

It would be useful to clarify how and whether profession (engineers, nurses, medical doctors, etc.) and years of experience might influence a student's decision to pursue online learning. A longitudinal study of identity development within a professional community would help to clarify the impact of online learning on career performance and practitioners' progress over time, and how and whether online learning can provide new or different skills as compared to other communities of learners.

It would also be interesting to explore the perceptions of professionals who enrolled in online programs but subsequently dropped out in order to determine whether online learning failed to support their lifelong learning process. Surveys or interviews would provide insights into the weaknesses and shortcomings of these online communities, helping educators, instructional designers, and researchers to better understand how online learning can support practitioners' professional development. Further investigations of other online programs for different professions would help to clarify the extent to which these findings are confined to the engineering profession and to the Middle East.

10 Conclusion and Recommendations

This study employed social learning theory to explore how practitioner engineers perceived the impact of online learning on their career performance. The results indicate that independent learning and self-efficacy contribute significantly to career advancement. Participants were satisfied with the impact of this online diploma on career performance and on their social awareness and leadership skills. These findings highlight a need for instruction that can bridge the gap between schooling and practice in terms of currently neglected key skills. To that end, academic and workplace environments should be linked to produce well-rounded practitioners by combining subject-related teaching with the soft skills increasingly required by professionals.

For that reason, education policy must reflect the increasing need for self-directed and lifelong learning in the context of professional development. Higher education institutions are urged to implement self-paced programs that exploit advances in ICT to enable practitioners with common interests to interact and collaborate, moving from individual to collective and collaborative working, especially in workplace contexts.

Political turmoil and late internet adoption in the Middle East have created a knowledge gap in which students and professors remain poorly informed about the benefits, barriers, and challenges of online degrees. Researchers can help to revolutionize teaching in the Arab world by building an evidence base that encourages universities in the region to develop online learning initiatives.

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The Implementation of Online Medical Education in the Arab World

Mayssoon Dashash

Abstract Researchers in the Arab world believe that online medical education is ineffective due to the current modest infrastructure, limited technical capabilities, problematical virtual learning environment, and weak technical skills. If certain factors are considered, however, online medical education, despite limited resources, can hold promise for health professionals in the Arab world, who have a heavy workload, daily commitments, and face various challenges while running their practices. It can update their theoretical knowledge, improve procedural skills, and support face-to-face training if it is designed, developed, and evaluated by local health educators who are familiar with community conditions and needs. This chapter reports several factors that can strengthen the quantity and quality of online medical education in Arab countries and improve its effectiveness despite limited resources. It will emphasize the critical roles of scientific content and educational material in the effectiveness and usefulness of online education, provided they reflect the needs, language, environment, and culture of the community of the participating health professionals. The chapter will also provide students, researchers, health professionals, academic members, course developers, and decision-makers with further insight about the best method for designing and delivery of online education in the Arab world. Qualitative and quantitative studies that explore the experience of some Arab health professionals during their participation in online medical courses will be presented. In addition, personal, technical, and country-specific challenges that can prevent the successful implementation of online education in Arab countries will also be discussed. Recommendations that can improve understanding and inform policies for raising the quality of Arabic contents and practices in online education are suggested.

Keywords Online education · Arab countries · Medical education · Educators · Students · Challenges · Learning · Contents

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M. Dashash (✉)
Faculty of Dentistry, Damascus University/Medical Education Program, Syrian Virtual University, Damascus, Syria
e-mail: mayssoon.dashash@damascusuniversity.edu.sy

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1 Introduction

The advent of online learning, smart mobile devices, and the explosion of social media and telecommunication technologies have provided opportunities for higher education institutions to utilize all types of technologies and make education a more transformative process, during which teachers and students can share information and experience in a collaborative environment that fosters critical thinking and the capacity for creativity [1]. Learners can create their own learning experience and teachers can have a guiding role that supports students to make effective use of technology [2]. As early as 1994, institutions around the world started to offer fully online or hybrid/blended courses to enable trainees to have easier access to a wide variety of resources [2].

A report, published by the American Society for Training and Development, indicated that 33% of training was delivered electronically in 2007 and more than 150,000 course enrolments were registered in the Florida Virtual School in 2008 [3]. In addition, statistics undertaken by the Pew Research Center in 2011 indicated that 89% of four-year colleges and universities offered some form of distance learning [1]. Several terms have been considered to refer to "online education", such as distance education, electronic learning (e-learning), online learning, blended learning, computer-based learning, web-based learning, virtual learning, internet-based learning, and massive open online courses, MOOCs [1, 4].

Distance learning is a learning process or system in which teachers are separated geographically or in time from their students who are also separated from each other [5]. Distance learning can be synchronous (happening at the same time) or asynchronous (self-paced) through adopting various technologies and by special institutional organization [6]. Online learning is education that takes place over the internet in which students can attend regular scheduled online lectures, access learning materials, communicate with peers, and submit assignments through a specific platform [6]. Blended learning refers to a combination of face-to-face learning and asynchronous or synchronous e-learning used to provide further understanding and more social interactions [6, 7]. Earlier work has defined e-learning as the use of various technological tools that can be web-based, web-distributed, or web-capable for education [8]. It is a pedagogical, aspiring, flexible, and engaging approach, learner-centred, which promotes communication, not a broadcasting of documents in electronic format to students through the internet [9]. A more comprehensive definition of e-learning has been described as an approach that utilizes the internet and digital technologies to deliver *mediated, well-designed, learner-centred, and interactive learning to anyone, any place, and anytime* according to instructional design principles [10].

Mechanisms that allow the distribution of information to a large group of learners, who are internationally distributed through an internet-based education, are called MOOCs [11]. They allow engagement in the virtual education and socialization experience without geographic bounds [11]. There are two distinct pedagogical forms of MOOC, the cMOOC, which is built around social and collaborative activities, and the xMOOC, which is more traditional and has a classroom structure that integrates short videos, lectures, learning activities, tests, and forums for students to discuss contents and solve problems with their peers [4]. Taking all previous terms and definitions into consideration, only the term *Online Education* will be considered in this chapter, to simplify issues and avoid any confusion.

In addition, it should be emphasized that the implementation, success, and sustainability of online education differs around the world and in Arab countries, and depends on several factors such as the resources, infrastructure, readiness for change, and socio-economic status of each country [12]. The TOE (Technology-Organization-Environment) framework, which was previously introduced by Tornatzky et al. (1990), can help identify factors that affect the success of online education [13, 14] based on environmental, organizational, and technological contexts (Fig. 1).

Through the *environmental context*, the investigators could identify the factors surrounding the organization's structure, decision-making, and performance, as well as the stakeholders who can support or prevent implementation of technology in education, such as governments, society, and industries. For instance, the regulations, policies, and strategies of governments in dealing with the student's score for recent semesters, during the COVID-19 pandemic, can affect technology adoption [14].

Understanding the *organizational context* would enable identifying factors related to an organization's culture and size, quality of human resources, management structure, degree of centralization and support. For instance, the rapid implementation of technology by professors and administrative staff in any institution depends on a decent management that can respond to unexpected changes, reduce the feeling of uncertainty, and support the continuous professional development of staff [14].

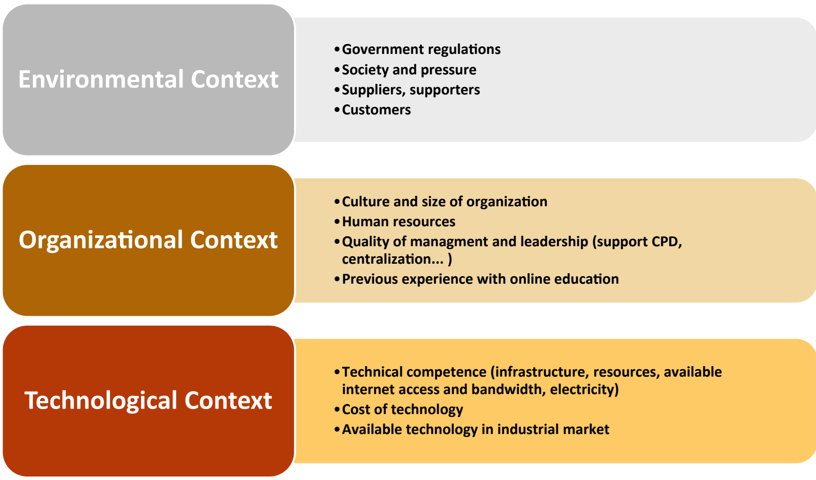

Fig. 1 The conceptual framework for adoption of online medical education in Arab universities. Adapted from Alshaikh et al. 2021 [14]

In addition, through the *technological context*, the investigators could identify factors that affect the capability of an institution to adopt available technologies. This would depend on the cost and competence of technologies that include infrastructure, resources, internet access, and bandwidth [14]. In fact, if we are going to discuss online learning in the Arab world, the different technical capabilities should be addressed. For instance, the statistics in 2015 indicated that 90% of the population in Qatar and UAE use the internet while in Somalia the proportion is less than 10% [15]. For this reason, the classification designed by UNESCO will be adopted, in which Arab countries are classified into those with advanced, intermediate, or minimal technical capabilities [16, 17].

Moreover, to understand online education and the chance of its success in a specific institution or country, it is essential to understand its components, including the contents, the process, and the system (Fig. 2). The *contents* include all materials that can be used by students such as references, study guides, slides, e-books, e-journals, research papers, images, animations, databases, e-library, and the internet [9]. The *process* refers to offline or online activities that are presented as schedules, protocols, participation in discussions, forms of conferencing, taking tests and assessments or completing web forms [9]. Third, the *system*, which is variously called a Learning Management System (LMS), a Course Management System (CMS), or a Virtual-Learning Environment (VLE), can integrate tools with services to deliver online courses through automating the administration, tracking, reporting of training sessions and delivery of online contents. It can be controlled based on date, time, role, or task and can be accessed online, after registration in a specific assigned role, free of charge or on a commercial basis, using standard web browsers [9, 18].

The system has several functions and tools that can be added to meet the needs of the learners, teachers, and managers [9]. It holds general information, including

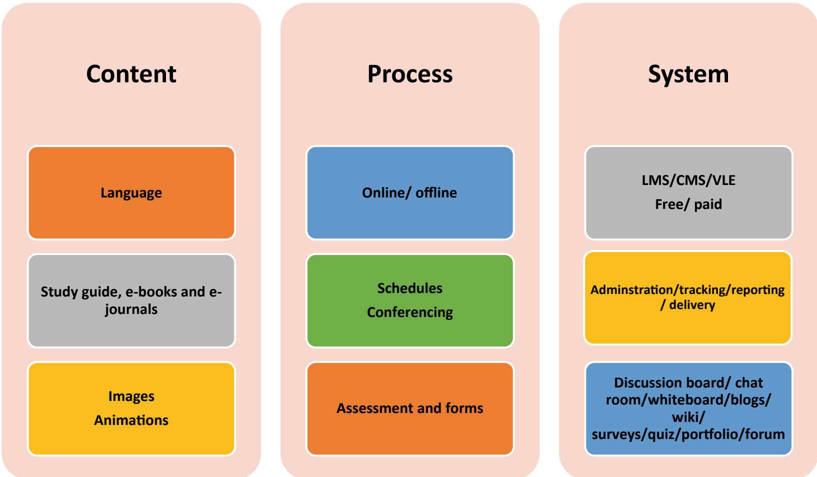

Fig. 2 Three components of online education that reflect its implementation and success

staff contacts, course details, timetables, announcements, links to resources, areas for uploading files, and tracking systems. It also includes areas for comments, forums, discussion boards, internal email systems, chat rooms, whiteboards, blogs, class and group allocations, wikis, online examination and testing tools, surveys and polls, a results section or grade book, and portfolio tools [9, 18].

Therefore, this chapter will discuss online medical education in Arab countries in the light of the components of online education. It will also categorize countries according to their technical capabilities and based on the TOE framework.

A closer look through qualitative and quantitative analyses that explore the experiences of some Arab health professionals during their participation in online medical courses will be presented together with methods for overcoming challenges.

Recommendations will also be presented to improve understanding and inform policies for improving the quality of design and practice of future Arab online medical education.

2 Online Education in Arab Countries During the COVID-19 Pandemic

Arab countries are facing daunting challenges such as limited and unequal access to education for 110 million students, the exacerbation of conflict, humanitarian crises, and increased societal disparities [19]. A report published by UNESCO has indicated that, during COVID-19, 86 million learners in Arab countries found themselves facing two options, either to select online education or to stop their educational process [17]. The report also indicated that more than 1.5 billion students from 190 countries have been forced to shift from face-to-face education to online learning [12]. Generally, the COVID-19 pandemic has led to several problems in education, such as loss of instructional time, loss of access to educational materials and peers, the inability to develop practical skills, and a lack of connection to the educational process [20]. However, the pandemic has been an opportunity for some Arab countries to change, implement online education and collaborate at local, national, and international levels [12].

Several digital solutions, in the Arab world, were boosted during the pandemic and different new approaches relating to education were adopted. For instance, in Morocco, the Ministry of Higher Education collaborated with state television networks to broadcast educational material across the nation, including in remote underserved communities. In Tunisia, the Virtual University of Tunis (VUT), which offers courses, made its platform, content, and IT and training capacity available to other universities in Tunisia to enable them to move their courses online. It was reported that 110,000 students signed onto the VUT online learning platform to take classes, and 18,000 professors were involved in online teaching activities [21].

The smart university of Hamdan Bin Mohammed is considered to be the first e-University in the UAE. Heriot-Watt University in Dubai has worked on “Vision”, a virtual-learning delivery tool, and the universities of Sharjah and the UAE have adopted another virtual-learning environment “Blackboard” to deliver online education during the pandemic [21].

In Jordan, “Darsak”, which is an educational portal that delivers classes for all grades, was created through a public–private partnership between the Ministry of Education, the Ministry of Digital Economy and Entrepreneurship (MoDEE), and private sector providers [21].

The development of home-grown education technologies and mobile applications such as “Rawy Kids” in Egypt and “Kitabi Book Reader” in Lebanon was also noted [21, 22].

3 Online Medical Education in Arab Countries During the COVID-19 Pandemic

The COVID-19 pandemic has had negative consequences for education and healthcare services in both the short and long term but these consequences can be reduced by tackling the crisis in medical education. In this case, medical education would extend beyond the teaching and learning of undergraduate and postgraduate students to become the heart of clinical practice. Medical education refers to the training that equips all medical students with the knowledge, skills and attitude that allows them to practice professionally and ethically, in which process doctors, teachers, institutions and governments share the responsibility for making sure that medical students are well prepared to provide the best health care to society [23].

In the last three decades, there has been a dramatic shift in medical education from traditional to unique student-centred approaches that adopt online learning, simulations, and virtual patients, and that also implement technology to deliver, support and improve teaching, improve the quality of explanation and modelling, and improve the quantity and quality of students’ practice, assessment, and feedback [24]. However, statistics and data indicate that online medical education was mainly the focus of high-income countries and was partially or fully ignored in developing and Arab countries until the advent of the COVID-19 pandemic in 2020. Moreover, researchers who investigated the preparedness of medical education in the light of the COVID-19 pandemic have reported insufficient emphasis on public health emergency preparedness, unsophisticated mechanisms for interdisciplinary cooperation, and inadequate guidance in medical ethics [25].

Therefore, utilization of online learning in medical education can result in opportunities for medical students. Several online learning modalities, such as simulation technology, synchronous learning delivery, and web-based or videoconferencing for standardized patient-based training [26], can improve clinical training. Online education can also enable globalization of medical education and life-long learning. However, this would depend on an adequate level of institutional readiness and infrastructure that is not always present in low- and middle-income countries [26].

In developed countries, several studies have demonstrated that online learning in the medical education field can provide students with easier and more-effective access to a wider variety and greater quantity of information at any time from any place [2, 27]. The use of several online virtual modalities that mimic the hospital environment such as tele-simulation and tele-health applications, which deliver immersive clinical simulation sessions, has permitted a more standardized and equitable educational experience [28]. In addition, active learning modalities, including live streaming or pre-recorded videos of surgical procedures, virtual case discussions, and remote adaptations of clinical visits, team meetings, and ward rounds, were found to increase interactivity [28]. A randomized controlled trial indicated that incorporating high-fidelity simulation, as a supplemental component of hands-on training, could enhance nursing students' clinical performance [20]. Similarly, clinical-immersion simulation was found to be effective in improving interdisciplinary knowledge and skills [20].

It was also stated that online learning could provide educators with new pedagogical methods, making learning more reliable, more efficient, and less stressful [2, 27].

In contrast, the major challenge in Arab countries, during the response to the pandemic, was teaching practical and clinical components of the curriculum such as laboratory sessions, anatomy demonstrations and professional clinical skills [29].

Several studies have noted that students that had disruptions in their clinical training have increased concerns about their preparedness for patient care [20, 29, 30]. Four major challenges related to medical education, during the COVID-19 pandemic, have been reported. These were health and wellbeing of faculty members and students, spatial constraints, time constraints, and access to resources [12].

The pandemic has highlighted the deep inequalities and demonstrated the saturation of a fragmented and outdated healthcare system. It was reported that one-third of Arab countries have fewer than 10 healthcare providers per 10,000 people, while the richest third have at least 50–70 providers per 10,000 population. In addition, it was stated that 77% of the population in Kuwait could access health services without suffering deep financial hardship, while this percentage decreased to 22% in Somalia [31]. Moreover, while some private universities within a particular country are well equipped for online education through earlier preparation of electronic platforms and contents, most public universities have been struggling with the sudden need to provide online education to many students. The main challenges that faced governments and universities were lack of access to the internet in many student households, and lack of tablets and laptops for student use at home. Additional challenges included the limited availability of online contents and platforms, and the limited digital skills of both instructors for teaching and assessment, and students to access, learn, and interact with instructors [21].

Researchers have addressed the critical role of scientific contents and educational materials in the effectiveness and usefulness of online education, as well as the importance of reflecting the needs, language, environment, and culture of the community of the health professionals who participate in the online education [32].

For instance, investigations of the experiences of early adopters of open online education, such as MOOCs, in healthcare education have shown that MOOCs are high-quality educational tools, which have been mainly created in high-income countries such as Australia, the USA and the UK to improve the knowledge, skills and attitudes of health professionals worldwide [32].

Chan et al. (2019) demonstrated that medical students who enrolled in a MOOC on health emergencies showed high levels of commitment and motivation to learn through different innovative educational resources, such as videos, learning activities, and interactive animations [4]. In addition, MOOCs that were developed to teach students the skills of interacting with patients, by using virtual patients, have shown that 90% of participants found the exercises useful and were more confident in using the methods learnt during everyday interactions with patients, friends, and family [33]. However, it was found that institutes and experts in Western developed countries, who developed the contents of most MOOCs, are focusing on the use of advanced technologies in disease prevention, diagnosis, and treatment in health systems rather than focusing on non-communicable and infectious diseases that are more prevalent in developing countries [32].

Researchers have addressed several challenges faced by students with different educational, cultural, and linguistic backgrounds and have advocated for online courses to offer content in native languages so increasing the diversity of students undertaking these courses [34]. They have argued for the necessity to develop specialized courses that can meet each country's needs, in terms of providing linguistic and cultural diversity [32]. They have also found that there was more success in attracting students from developing countries when the online platforms were translated into their native language such as Arabic [32]. When open online education and MOOCs were also investigated in Arab countries, it was found that that the participation of Arab universities is still very weak. It was noted that MOOCs, in the Arab world, are still oriented to the Arabs and there are no courses oriented towards non-Arabs. Researchers recommended the involvement of Arab universities in the MOOCs movement in the Arab world, and the establishment of MOOC platforms for the dissemination and teaching of Arabic to non-Arabs [15].

Internet connectivity and high English comprehension are critically important for completion of online courses. It has been emphasized that fast and reliable internet connections with appropriate bandwidths are essential for watching videos and loading the content properly. In addition, the translation of videos is very important for the learning process [26].

One conclusion that can be drawn from the above is that, provided certain factors are considered and despite limited resources, online medical education can hold promise to health professionals in the Arab world, who have a heavy workload, and daily commitments and challenges while running their practices. It can update their theoretical knowledge, improve procedural skills, and support face-to-face training if it is designed, developed, and evaluated by local health educators who are familiar with community conditions and needs. Medical education and clinical training in the virtual environment in Arab countries with different technical capabilities, therefore, should be emphasized and supported by recent research.

4 Online Medical Education in Arab Countries with Advanced Technical Capabilities

The implementation of online medical education in Arab countries with advanced technical capabilities (ACATCs) has been a response to the emergency and is not a set practice. It requires understanding, creativity, and adaptability to meet specific changing contexts [9]; ACATCs have had a rich experience of online education during the pandemic.

Based on the Technology-Organization-Environment (TOE) framework, the findings of investigations undertaken by Alshaikh et al. [14] about the effectiveness of online medical education in ACATCs during the COVID-19 pandemic indicated that the shift towards online education has been easy and smooth. Online education has been more flexible and efficient than traditional learning with no difficulties in communication. However, some obstacles have still been encountered by students. The ability to focus was less than during traditional education because of the students' environment, family circumstances and other social factors. In addition, practical training was not performed successfully [14].

It has been reported that, despite the adoption of a unified platform such as LMS during the pandemic, several social media platforms were successfully utilized for teaching and communication between teachers and students, and among students themselves, due to their easiness and speedy responses.

For instance, Saudi Arabia immediately started to deliver online education in all government and private educational institutions after the announcement of the COVID-19 pandemic and lockdown. It was reported that Saudi universities achieved unprecedented results with over 1,200,000 users attending 107,000 learning hours in over 7600 virtual classes [21].

A recent qualitative investigation, undertaken in Saudi Arabia to explore the effectiveness of synchronized online learning among medical students in the College of Medicine and Medical Sciences in Qassim University, has demonstrated satisfaction among participants about online learning. They also reported increased knowledge together with the ability to spend more time with their families and to improve their sleep pattern [35]. However, the students believed that nothing could replace seeing patients and interacting with them. They also reported some technical and behavioural challenges related to contents and exams and suggested regular evaluation of online education and the integration of online learning with other modalities such as virtual simulation technologies and computer-based models of real-life processes to facilitate diagnostic and therapeutic decision-making [35].

Another investigation, which was undertaken by the Pharmacy College at King Khalid University, indicated that instructors faced several challenges in order to engage students and evaluate them, and also addressed the need for training of instructors to enable them to provide virtual classrooms, record lectures and facilitate online discussions [36].

Hakami, in his quasi-experimental study that included 198 dental students at Jazan University in Saudi Arabia, found that virtual learning could be an effective alternative to traditional learning for teaching orthodontics to the dental students [37]. However, residents emphasized the need for a clearly structured curriculum, and for well-defined and clear training and learning objectives [25].

Other researchers at the College of Medicine of Alfaisal University in Saudi Arabia have provided evidence about the effectiveness of online education. However, they also found that the primary challenge was related to communication between teachers and students. They also reported other challenges related to online assessment of students, use of technological tools and other technical barriers, anxiety, time management and technophobia [38].

In Bahrain, Zoom was employed for large-group resource sessions (lectures), professional skills sessions, community health activities, and laboratory sessions, including anatomy demonstrations. Big Blue Button (Moodle) was used for small-group tutorial sessions and for uploading recorded videos of educational activities, lecture notes, and for formative assessment. The ExamSoft platform was used for summative assessment, while exam integrity was monitored by using exam ID and video proctoring [29]. A toolbox was developed to provide systematic guidance on effectively planning and conducting an online OSCE (Objective Structured Clinical Examination). However, online examinations face several challenges in terms of resource intensity, academic integrity, student and teacher training, examination validity, and acceptance by regulatory institutions [39]. Tayem et al. [29] found that online education is acceptable for theoretical parts of medical curricula, but the authors emphasized the additional need for face-to-face education that includes practical and clinical sessions to develop psychomotor skills. They also indicated the need to improve the information technology infrastructure and faculty staff training.

In the United Arab Emirates, the Ministry of Education took several steps towards the implementation of online education to maintain the educational process during the pandemic after the four-week closure of all higher education institutions. They conducted professional training for teachers and administrators, coordinated with Hamdan Bin Mohammed Smart University to provide technical training to academic staff, facilitated the implementation of online education in institutions, and established advanced operation centres for following up and monitoring the educational process. They also supported students and their parents by establishing several free platforms in collaboration with private organizations and facilitating a technical helpline to resolve any technical problems, as well as through providing free mobile internet packages and high-speed satellite broadband services for families at various locations with no home internet connection. The Ministry also published a document that determines the roles and responsibilities of all stakeholders involved in online education, together with regulations and procedures for dealing with offences related to online education [40].

Online medical education can, therefore, be implemented successfully in ACATCs as there is no problem with process or with the system implemented. Moreover, ACATCs can utilize paid-for or free systems specifically designed for an institution, with scheduled conferencing, simulation tracking, and reporting systems. Teachers and students can be trained to use whiteboards, blogs and wikis. The contents of online medical education sites can be further improved through enriching educational materials, designing more-innovative lessons based on group discussion, and providing instructive medical tutorials with free access to the contents. The quality of the contents can also be improved through making contents more up-to-date and relevant to the needs of trainees in the society in which the knowledge and skills gained can be both useful and practical [25]. Several tools, such as Padlet, Socrative, DialedIn, Quizlet, and Clicker, can also be utilized to improve the interactive communication and clinical skills of newly qualified doctors [39]. However, medical institutions in ACATCs still face challenges in developing online assessment systems and improving the capabilities of educators and students. Online examinations have been generally successful in evaluating the understanding of students in ACATCs, through analytical questions rather than memorization of information. It should also be possible to design quizzes and assess students through online assessment systems with proctoring. However, the assessment of clinical competencies remains a challenge that requires innovative solutions.

Several advanced technologies, such as simulated patients, simulated operation theatres, and Mini-Clinical Evaluation Exercises (Mini-CEX), can be suggested to guide and assess clinical performance. Online assessments, open-book student assessments and online OSCEs can be considered to measure competencies [39]. In addition, developing apps such as Quizlet and Quizizz can also improve student interest and engagement [39].

Researchers have indicated that both students and teachers should be well trained for online assessment and should be informed about cheating, impersonation, and plagiarism to assure the integrity of the whole examination system, and to create an environment that fosters the readiness and capacity for learning of staff and students [39]. The process of online examinations requires further clarification and guidelines in terms of time allocation and mechanisms to improve performance. In addition, the importance of regulatory issues that improve institutional readiness and acceptance of online assessment should be emphasized to solve problems reported in standardizing the overall mechanism of online examinations [14, 39].

5 Arab Countries with Intermediate Technical Capabilities

Arab countries in this group (ACITCs) attempted to utilize national resources in order to offer online education during the COVID-19 pandemic. However, several challenges were reported by both students and educators. In Egypt, the pandemic presented an opportunity for better utilization of national Egyptian learning-resource repositories such as the Egyptian Knowledge Bank (EKB), which was established by the Egyptian government in 2016. An online library of learning resources was offered free-of-charge to all Egyptian citizens. However, the investigation undertaken in Egypt indicated that educators have limited access to formal learning-management systems. Instead, they found that social media can be effectively used to create a positive learning experience. Therefore, they successfully implemented the use of free communication software such as Zoom, Microsoft Teams, and Google Classroom, or used social media platforms such as WhatsApp, Facebook, and YouTube to preserve the educational process in exceptional and emergency situations such as the COVID-19 pandemic [30].

Several barriers, such as low internet access, lack of requisite digital equipment and accessories, high cost of efficient gadgets, and physical problems like headache and eye strain, were also reported by students in Egypt. For instance, only 27.7% of students at Tanta University preferred e-learning as a method for medical education and acquiring clinical skills due to technological and infrastructure barriers, pedagogical barriers, personal barriers, sociodemographic and financial barriers [41]. In addition, about 62.2% of students complained of physical problems like fatigue, headache and problems related to eye strain because of long-duration use of e-learning devices [41].

Mortagy and colleagues also reported other challenges, such as the limited availability of materials and technology for online courses, and limited social interaction [30]. Defects in the infrastructure due to the lack of access to stable internet connections on a wide scale, lack of hardware such as tablets and laptops for student use at home, and lack of online learning platforms, were also reported.

Arab countries in this group heavily depended on recorded lectures, poster presentations, problem-solving skills, self-learning, student presentations and online assignments [39]. However, some institutions managed to undertake some form of online assessment, such as I-Cloud form quizzes in Egypt, and online examinations, student presentations, case studies and open-book exams in Jordan [39].

While investigators reported conducting specialized workshops for teachers with well-structured training programmes in ACATCs, development of the capacity of educators to use online digital technologies has been another major challenge for educators in ACITCs. In Egypt, various strategies were developed to build the capacity of educators, such as preparing short videos on how to use software packages, developing orientation programmes on the use of IT for teachers and students, and effective use of social media for education. In addition, training about online assessment was undertaken through virtual sessions, orientation videos and written instructions [39]. Students in Egyptian medical schools reported that educators had not been fully prepared for online teaching, and that online education is not as interesting or as effective as face-to-face teaching [30]. They have suggested student-centred activities using games, quizzes, and multimedia to make classes more interactive, as well as incorporation of scenarios, interactive diagnostic reasoning software, and virtual simulation to motivate students.

Similar research, which was undertaken in Jordan, indicated that social media platforms can be a new efficient way of preserving the education process during a pandemic. However, researchers reported that internet quality and coverage were the main challenges that faced medical students since their overall satisfaction with distance learning during the COVID-19 pandemic was only 26.8%. The preferred modality of teaching was synchronous live streaming [42]. A cross-sectional study among medical students in Marrakesh found that 79% of students appreciated the use of virtual learning during the COVID-19 pandemic, and 80.2% thought that the online courses were understandable. Moreover, 41.4% preferred blended education and 68.5% of the students would recommend continuing distance learning after the pandemic [43]. Similarly, Falfoul and co-workers indicated that e-learning is well appreciated by ophthalmology residents in Tunisia as they could improve their knowledge about various ophthalmologic conditions and problem-solving skills through the Moodle online learning platform [44].

As can be seen, there is a need to provide all medical educators with comprehensive knowledge and skills about the use of online platforms and technologies. O'Doherty and his colleagues in their integrative review have indicated the need to build the capacity of educators to understand their own pedagogical role and shift to accommodate the online environment. They have indicated that cultural resistances among overworked staff have been significant barriers in preventing the engagement of students with technology-based education [2]. Lack of time, which was linked to lack of incentives, lack of technical skills, poor infrastructure, and poor communication, was also some of the barriers that prevented educators from successful engagement with online learning [2].

In summary, online education can be implemented successfully in ACATCs if educators are appropriately prepared to provide medical students with interactive methods that can improve their engagement.

6 Arab Countries with Minimal Technical Capabilities

Researchers in Arab countries with minimal technical capabilities (ACMTCs) believe that online medical education is ineffective due to the modest infrastructure, limited technical capabilities, problematical virtual-learning environment, and weak technical skills. However, online medical education in these countries can hold promise and be effective despite challenges and limited resources. Several studies have provided evidence about the effectiveness of online education and MOOCs in improving learning among refugees and in making higher education more accessible [45]. They have indicated that online education, delivered in fragile contexts, and MOOCs have emphasized the role of the learner and of enhanced learning through technology [45–49].

Iraq, Libya, Somalia, Sudan, Syria, and Yemen are facing protracted crises [39]. In a recent qualitative, exploratory, key informant-based survey including medical, dental, pharmacy and nursing faculties from the Eastern Mediterranean region, Wajid and Gedik found that Sudanese medical institutions have suffered from financial constraints, limited electricity supply, harsh weather, and unavailability of software packages, internet, and electronic devices. In Sudan and Iraq, the COVID-19 pandemic caused delays of three to four months in the completion of the academic year and the admission of new students [39]. Yemen was also unable to start online learning due to weak IT support, and both educators and students mostly learned through trial and error [39].

In Iraq, medical institutions modified their medical curricula and prioritized materials that could be taught easily online to encourage interactive discussions [39].

It is interesting to note that researchers found that most students in ACMTCs have good knowledge of information and communications technology (ICT) despite the challenges and obstacles. For instance, in Libya, a nationwide study reported that 54.1% of students thought that interactive learning could be achieved by distance learning [29]. However, only 21% agreed that clinical learning could be attained successfully by using electronic approaches [50]. In the study, 90% of medical students reported that they had good, very good, or high levels of computer and IT proficiency [50] and had access to fourth-generation internet services with an acceptable or good internet connection [50]. Researchers concluded that the findings supported the feasibility of implementing e-learning programs for medical students since 93% of the students owned a smartphone, and 75% of them had personal computers [50]. These results support the possibility of using smartphone applications to provide access to online learning and medical education lectures [50]. The findings also highlight the need to provide interactive sessions through optimized tools on smartphones, since most participants use their phones more than their computers [50]. Indeed, in the study, 66.5% of student participants thought that conflicts in Libya could pose challenges for e-learning and 78.3% thought that it would be difficult to participate in e-learning due to high financial costs, resulting from the civil war and financial crisis [50].

In other countries such as Lebanon, the COVID-19 pandemic has accelerated the transformation of medical education to online and blended learning. For instance, Mashaal and Ahmadieh stated that the Medical Faculty in the Beirut Arab University shifted to online medical education to comply with the accreditation standards. They indicated that 57% of the sessions were delivered in synchronous formats using Zoom and Microsoft Teams platforms, 11% of sessions were uploaded for later needs, and 32% were delivered in a combined approach. About 40% of students were satisfied with online learning. The majority (75%) considered it a good alternative to face-to-face theoretical sessions during the pandemic. However, 50% of students did not agree to attend practical/clinical online sessions, 42% were not satisfied with online assessment and considered it unfair, and 78% suggested the pass/fail system as a fair alternative [51]. Researchers also reported that face-to-face learning was preferred to online learning because the former saved time, participation was easier, there was better knowledge transfer, and more interactivity [51]. Similar opinions were obtained from instructors investigated in this study. They found that face-to-face teaching is superior to online teaching with respect to less wasting of time, easier attendance, better knowledge transfer, easiness of asking questions, and better feedback. They also indicated that online assessment is unfair and should be replaced by a pass/fail system [51].

In Syria, the ongoing crisis, in its 11th year, has affected the infrastructure of the country, with severe damage to education, health and business [52, 53]. People are struggling to meet most basic needs due to their economic status resulting from sanctions and the drop of more than 75% in the value of the Syrian currency [52].

Electricity generation, because of the shortage of fuel and gas, has fallen to 25% of its level prior to the crisis; a supply of electricity has become a luxury and often lasts for an hour or less during the day, with many families having no supply at all [54, 55].

The increasing number of students and decreasing number of medical staff members who stayed in the country have affected the quantity and quality of medical education, and the future of Syrian physicians has become challenging [56]. It has been suggested that online education could be a great opportunity for medical students during the dreadful war that has destroyed every aspect of life in Syria [56]. Research has highlighted the value of online education despite the challenges faced during the Syrian crisis [53, 56].

Osmosis, which is an online medical learning platform that was launched in 2012 and is based in the USA, has proved to be a great opportunity for Syrian medical students. It granted more than 3000 Syrian medical students free access to different open education resources (OERs) and allowed them to benefit from online educational platforms. Syrian medical students collaborated with Osmosis to provide translation capacities in their native language and contribute to content creation and promotion [56]. They have translated all available disease-oriented and clinical-reasoning videos on Osmosis into Arabic, and the project is still ongoing [56]. The translation of online platforms into the native language of students was found to be an important factor in attracting students from Syria [56]. Previously, linguistic and cultural barriers have been among those that negatively affect the participation rate of health professionals in online courses [57, 58]. Researchers have argued for the necessity to develop specialized courses that can meet each country's needs, in terms of providing linguistic and cultural diversity [32, 57, 58]. They have advocated for online courses to offer content in native languages to increase the diversity of students undertaking these courses. In addition, a systematic review indicated that institutes and experts in mature countries, who have developed the majority of MOOCs' contents, are focusing on the use of advanced technologies in disease prevention, diagnosis, and treatment within their health systems rather than focusing on the non-communicable and infectious diseases that are more prevalent in developing countries [57]. Researchers also found more success in attracting students from developing countries when the online platforms were translated into their native language [32].

In fact, medical curricula in Syrian faculties are delivered in Arabic [59]. Previous work has reported that using English erects barriers that limit pursuing internationally recognized standards in Syrian medical education [59]. However, there is limited research currently available about the effectiveness of online medical education in Syria.

A recent study undertaken by Kenjrawi and Dashash indicated that asynchronous electronic medical education is an effective and feasible means to introduce the concept of evidence-based medicine (EBM) to Syrian medical practitioners, improving their skills, and promoting positive attitudes to EBM [60]. A more recent study undertaken by Shamsy and Dashash [61] provided evidence about the usefulness of online medical education in improving the learning and practice of dental health professionals. Usefulness was defined as increased knowledge of health workers, improved clinical practice and implementation, as well as development of communication skills.

The overall satisfaction level with online learning was found to be high despite the challenges and barriers faced. Participants were motivated by the benefits of mastering the contents of an online course in less time compared with traditional learning. Through self-directed learning, they were able to achieve their individual goals and fulfil their requirements by using their time and all available limited resources flexibly, and by fitting online learning into their busy schedules when convenient. Participants located in rural areas outside the capital stated that online education helped them to update their knowledge and skills in their home. During the crisis, they preferred to face the internet and electricity supply difficulties associated with online education rather than the insecurity caused by transportation and petrol-supply problems associated with face-to-face education.

However, the study found that some participants felt dissatisfaction because they thought that the flexibility of online learning made them lazy, feel bored and did not encourage them to complete the course. They were accustomed to interacting with the teacher and working under stress to a fixed schedule. Factors leading to a negative perception of online courses in ACMTCs were lack of interest, unfamiliarity with the learning environment and its tools, late participation in the course, lack of confidence about completing the course and benefiting from it, anxiety about being an independent learner, and lack of interactivity of the course and engagement tools. It seems that participants, who were familiar with traditional learning rather than self-directed learning, did not like the flexibility of online learning as they could not control their educational needs and utilize their time appropriately to achieve the required outcomes; they were unable to move beyond their instructional comfort zones [62].

Another reason for not preferring online learning and its flexibility might be the presence of different learning styles of participants [63]. Four different learning styles have been defined by Kolb: the accommodative learning style, in which the learner takes pleasure in planning, doing, and gaining a new experience [64]; the assimilative learning style, in which the learner successfully creates conceptual models; the divergent learning style, in which the learner takes their emotion and thoughts into account during learning; and the convergent learning style, in which learners are more successful at problem solving [64, 65]. Moreover, these studies reported that students tend to choose lessons, courses, or educational activities that are compatible with their attitudes and learning styles in both online education and in face-to-face environments [65]. In the online environment, Gülbahar and Alper identified seven learning styles and found that participants with an independent learning style prefer to work individually through guidance, while participants with a social learning style prefer to work in a group [66]. They also stated that participants preferred seeing and hearing in audio-visual learning, doing in active learning, reading in verbal learning, overthinking in logical learning, and establishing relationships with emotions in intuitive learning [66]. This might explain why some participants recommended adding forums to online courses for interactions, while others preferred interactive videos or simulated sessions [61].

Therefore, in ACMTCs, it can be suggested that online courses should be designed with a variety of resources and tools to accommodate and engage visual, aural, verbal, physical, logical, social, and solitary learners. For instance, YouTube videos, recorded lectures, hands-on labs, transcripts, games, quizzes, activities, synchronous sessions, and discussion boards with self-reflection corners should be considered in future online courses to engage all learners with different learning styles [61].

There is also a need to modify the topics that are considered in face-to-face learning so that educators provide participants with a variety of educational contents and consider the cognitive load by including topics that meet the needs of participants. In addition, online courses could be enriched with more clinical-case scenarios, videos, and virtual training sessions through implementing artificial intelligence to stimulate real-life situations.

The lack of closed communication was also reported as a challenge that faced participants in ACMTCs [61]. To make online education more successful, participants suggested the need to improve interaction with their peers and teachers by adding online discussion sessions and boards, and to improve the engagement of participants in the learning process by combining online learning with face-to-face clinical training. It seems that interaction is crucial for appropriate learning and a successful course. Singer in his four developed strategies, which aimed at delivering successful online education, suggested to prioritize interaction, create engaging experiences, offer flexibility, and understand student behaviour [24].

Some health professionals also reported English language barriers and an inability to understand the added English references. It appears that reading English articles and references is a neglected competency that should be addressed in medical curricula in Arab countries. Therefore, future work should further consider solutions to this problem, such as translating the references and recent guidelines into Arabic.

Based on the TOE framework, several factors affecting the success of online education in ACMTCs have been observed, for instance, the lack of *institutional support* and limited direction towards tools or programs required for implementation of online learning.

The implementation of online medical education in ACMTCs should be encouraged due to limited resources, such as insufficient classrooms, lecture halls, medical educators, and a limited capacity to enrol and educate students. Moreover, online learning can bridge distances in rural areas as it can make up-to-date information more accessible and reduce the need for teaching theoretical topics in traditional classes where there are a limited number of medical teachers. In addition, online learning can also strengthen the practical training for health workers and their continuing medical education, both of which are inadequate in quantity and quality [67]. It has been suggested that theoretical and procedural training should be covered through online learning and practical skills covered through face-to-face training [67].

Taking into consideration the problems related to internet access and electricity, it can be suggested to improve website navigations to facilitate accessibility to contents. Synchronous and asynchronous sessions can be also considered for engagement.

However, there is a need to develop a plan for improving communication with participants and creating several opportunities for peer-to-peer and participant-to-teacher interactions. For instance, videoconferencing platforms and live classes can be implemented to encourage participants to ask questions. Discussion boards and virtual rooms can be created to allow participants to share reflections on their experience.

Providing participants with a certificate of completion at the end of the course is recommended, as it can be very effective in enhancing motivation, and increasing commitments. Previously, Soundariya and Deepika suggested that student engagement can be enhanced by interactive sessions, suitable choice of software and platforms, multiple-choice questions, quizzes, games, clinical scenarios, chat boxes, and breakout rooms [68]. They also stated that sharing the objective of sessions with students, incorporating visual images in presentations, and acknowledging student responses by giving a digital badge as a token of appreciation can improve engagement and commitments [68]. Recommendations that can improve understanding, inform policies for improving the quality of Arabic design and practices for online education are summarized in Table 1.

7 Conclusion

The advent of the COVID-19 pandemic has forced medical educators worldwide to adapt rapidly to the changing educational environment and to the needs of medical professionals, who have been under stress while managing the health and educational challenges of COVID-19 [69]. In Arab countries, challenges that affected the successful implementation of online learning included time constraints, poor technical skills, inadequate infrastructure, socio-economic factors, educational inequality, heavy workload, absence of institutional strategies and support, lack of clear assessment and supervision, and negative attitudes. However, the pandemic has been a great opportunity for some Arab countries to implement online medical education successfully despite these challenges. Notably, Arab countries were able to take advantages of online education and develop educational activities ranging from offline sessions and uploading electronic contents to implementation of virtual patients and online assessment. Such approaches and tools could be developed and shared to strengthen the quality, and the credibility, of online education and evaluation in Arab countries. A collaborative work that aims at providing detailed analysis about the implementation of online medical education in Arab countries is highly recommended. To bring about successful transformative and sustainable changes, Arab countries should ensure that technologies are not implemented without first understanding the socioeconomics and the political situation of a particular country, as well as supporting institutions with appropriate regulations.

This chapter has been a snapshot that covers only the available published research in the region and has not discussed online medical education in all Arab countries. Further research is still needed to explore the effectiveness of online learning in

Table 1 Recommendations for improving the quality of Arabic online medical education

Recommendations	ACATCs	ACITCs	ACMTCs
Contents	Improve Arabic contents Modify contents to align with online teaching methods	Improve readiness of educators to accept online learning and reduce or revise contents to align with online teaching methods Improve skills to design images and animations that increase student engagement Improve acceptance of online assessment methods through training of staff and students	Improve Arabic and English contents Modify traditional curricula and prioritize materials to decrease load Consider learning style and comfort zone
Process	Decrease workload on faculty to be able to contribute to online sessions Integrate clinical simulations and advanced technologies for improving clinical skills Introduce virtual technologies Improve readiness for online assessment through digital technologies, regulations, training, improve validity, and reliability	Apply online/offline sessions Improve institutional capacities, IT technical support, establish IT department	Apply MOOCs that are relevant to society Apply offline/flexible sessions Consider easy navigation with no third-party software
System	Utilize national platform to improve engagement and online assessment Improve IT technical support Customize software to institutional needs	Utilize national platform Customize free software to improve readiness of staff and satisfaction Improve student engagement through discussion, surveys, forums	Consider free platform

various institutions in Arab countries, taking into consideration the technological, financial, and institutional barriers and enablers.

Acknowledging the fact that this would be far from complete during the current circumstances, several approaches could be implemented that would improve the quality of future online courses in Arab countries. For example, online education oriented towards common health problems is still limited in Arab countries despite its continuous improvement and distribution. There is also room for improvement on the side of instructional design, Arabic contents, developing more quality learning materials and movement beyond comfort zones, as well as a need to develop robust capacity-building and professional development programmes for both teachers and students to train them on the effective use of online educational technologies.

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Transnational Education and E-Learning

Adi I. Arida

Abstract As a result of the COVID-19 pandemic, higher education institutions in the Arab world are facing new and unprecedented trends, which are rapidly changing the global higher education landscape. While transnational education (TNE) is becoming increasingly popular as a provision of internationally recognized education, the temporary shift from traditional, face-to-face teaching, and learning to distance education was a challenge for all to provide an experience similar to that to which the student was previously accustomed (traditional face-to-face mode of delivery).

In the transnational education programs, the emergency replacement of traditional classrooms with virtual ones has also raised significant challenges in terms of student equity and pedagogy. However, given the current transient crisis in higher education, the TNE program could be the cornerstone of rebuilding the international education system.

This chapter will discuss the challenges facing TNE programs and discuss future opportunities and impacts in teaching and learning and student support through the emergence of the e-learning and distance-education landscape.

Keywords Transnational education · Higher education institutions · COVID-19 pandemic · Transient crisis · Face-to-face learning · Distance education · Hybrid learning

1 Introduction

The COVID-19 pandemic has changed and shaken many sections and sectors, causing unpreceded disruption to numerous systems worldwide; educational sectors were not an exception. Countries around the world had to close their various academic institutions and implement social distancing to prevent any further spread of COVID-19. To keep moving forward with education during the pandemic, the mode of delivery

A. I. Arida (✉)
Institute of Applied Technology, Fatima College of Health Sciences, Abu Dhabi, United Arab Emirates
e-mail: adiarida@gmail.com

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changed from conventional face-to-face learning to online remote teaching. Governments around the world are now recognizing the importance of remote online teaching [1]. During the recent COVID-19 pandemic, transformation of conventional learning to online-based teaching and learning was a necessity. As a result, COVID-19 proved that you could learn at any time, from anywhere, and that by using advanced technology universities can develop different learning approaches to continue education in all situations. Teaching and learning approaches are continually changing and advancing, and online education is accepted nowadays by the institutions [2, 3]. A common perception is still that the quality of online education is not equal to face-to-face classroom-based education.

Around 1.6 billion learners across the globe were affected during the COVID-19 pandemic, in more than 190 countries where educational institutions were closed. This number represents almost 90% of the world student population [4]. In addition to that, there was a decline in the number of international learners in all countries studied. According to the Institute of International Education (IIE) in the USA, there was 43% decrease in new international-student enrollment in the Fall of 2020 [5].

Transnational education (TNE) is education delivered in a country other than the country in which the awarding institution is based, i.e., students based in country Y studying for a degree from a university in country Z. Moreover, TNE, which is a new emerging area with a growing number of both providers and learners, is spreading across the globe to deliver different higher education programs.

During COVID-19, especially in countries that were disrupted at the beginning of the pandemic and had to close their institutions, almost all TNE programs were also canceled. Therefore, due to restrictions in travel, the various pedagogic approaches used in TNE were transformed to remote or online education (teaching and learning). Most TNE providers were forced to adapt swiftly to the new reality, and this has raised significant issues in the virtualization of both pedagogy and equity.

Blended learning (a combination of traditional and online education) and/or online education are now an integral part of learning and education across the world due to the experience of higher educational institutions during the prolonged period of the COVID-19 pandemic. Many universities and colleges have been adopting and implementing these approaches.

The general perception of the quality of blended or online education has started to change and the pandemic has influenced institutions to invest in these newer systems of education [6]. Moreover, blended/online education has proved that it is useful and valid for many learners, and it is starting a new era in the revolution of online education.

There is currently a transformation in education systems, and despite facing various challenges, TNE programs are still a cornerstone in the revamp of international education post-COVID-19. Here, the pros and cons of the different models of TNE program are discussed as well as the various challenges that were faced by the TNE programs during the pandemic. Furthermore, the opportunities that were created due to replacement of face-to-face classrooms by remote teaching and learning are documented. The various experiences by different authors on how this restructuring in the educational system affected their TNE students' experience and challenges in remote learning/education, and how they coped with COVID-19, will be shared. Future visions of, and barriers to, transnational higher education will be also reviewed.

2 Methodological Perspective and Approach

Reviews of the scholarly literature on TNE and online/e-learning with emphasis on COVID-19 will be presented. Discussions will be structured around the different experiences, perspectives, and objectives of TNE's stakeholders who took on and faced challenges during the pandemic. A systematic approach was used to identify peer-reviewed journals up until 2021. Less than 20 articles were published before the pandemic and were simply reviewed as an introduction to TNE while the remaining journals/articles focused on the opportunities and challenges around good practices by stakeholders, as well as on learning online and TNE.

Google Scholar and Web of Science were used in the review, and "e-learning," "COVID-19 pandemic," and "TNE/transnational education" were searched for in peer-reviewed journal articles up to 2021, using the keywords "blended learning," and "online education." Any non-peer-reviewed journal was excluded from this review. Guidelines and reports by higher education and governments of top TNE hosts and foreign countries were used.

Online education and e-learning were used in the inclusion criteria that are related to cross-border higher education. Blended learning is the umbrella term for a range of learning approaches to capture a variety of blends, and ranges from traditional face-to-face to technology-assisted instructions.

Three categories of blended learning are available in terms of: (1) a course that is designed from scratch (high-impact blends); (2) a course in which existing activities have been replaced (medium-impact blends); and (3) a course in which activities have been added to an existing course (low-impact blends) [7]. The inclusion criterion for selecting papers was TNE courses during the COVID-19 pandemic. Accordingly, less than 60 articles were used for the systematic review, and several good practices of TNE are highlighted up to the year 2021.

3 Overview of Transnational Education

The export of education has grown substantially over the last two decades. This has been achieved through developing sophisticated and successful approaches to the provision of higher education internationally to many students who are located outside the countries of the higher education institutions (HEIs) that are awarding the degree. These approaches can consist of an array of collaborative arrangements with degree-awarding institutions from major education-exporting countries [8]. Traditionally, those students would have traveled to foreign countries to study for an international qualification but are now pursuing foreign degrees in their home or neighboring countries at local institutions. This form of award-bearing educational provisioning by an HEI in one country to students based in another country is termed transnational education (TNE) or sometimes cross-border education. The range and number of TNE activities, such as remote campuses and joint degree programs, continue to grow rapidly to address international customer demand, especially in higher education [8].

4 Transnational Education

The UNESCO/Council of Europe Code of Good Practice in the Provision of Transnational Education defines TNE as, "to study programs or educational services in which the learners are located in a country different from the one where the awarding institution is based" [9], i.e., students based in country *A* studying for a degree from a university in country *B*. In TNE, learners do not cross the borders or move to the other country where the degree-awarding is; instead, the academic program moves to the learners in their home countries [10]. Included in TNE programs are the host country's domestic students taking TNE programs, expatriate students living in the host country, and the international students traveling to the TNE host country [10].

A general definition of TNE would be all types of higher education program in which learners based in country *A* study for a degree from a university in country *B*. The country in which the awarding institution is located is called the foreign or sending TNE country; the country where TNE learners take the TNE program to achieve a foreign degree is called the receiving or host TNE country; and the institutions in the host country are called host institutions. Joint degrees or partnerships with overseas host institutions are the official ways to deliver such an education through online courses with qualifications or branch campuses.

In recent years, many countries have been involved in TNE, and there has been unprecedented growth in Western universities delivering education throughout the Middle East, Asia, and Africa [11–13]. The UK, Australia, Germany, France, and USA are the leaders in providing TNE programs [14]. On the other hand, Malaysia, Singapore, China, Qatar, and UAE are the leading host countries for TNE programs [14, 15].

The undergraduate level dominates most TNE programs, especially for mathematics, technology, engineering, computing, and medical science. Post-graduate TNE programs are also becoming popular [16].

5 Benefits and Downsides of TNE

Transnational Education (TNE) consists of three stakeholders: governments, partner institutions, and students (foreign and host) [17]. An appropriate setting is needed for a TNE program for the three stakeholders. Having a degree from the USA, Australia, and UK sounds like an exciting experience and enriching. On the other hand, these countries are expensive and not all students can afford the courses. Therefore, having a degree from these countries while studying from the home country through TNE will be much less costly. Learners can be exposed to pedagogies from these expensive countries, with their international standards and quality, without having to bear the high costs of fees, accommodation, and travel overseas [18]. Learners will be exposed to a high quality of teaching/learning and be taught using new innovative practices along with state-of-the-art technologies. Student assessments, discussions, projects, and participation will be judged differently and that will add to their soft skills such as teamwork and communication [19, 20].

Being exposed to a new country, culture, new attitudes of people and daily routine is a challenge [21]. In some cases, depression may happen due to culture shock, especially for students who are exposed to completely new cultures. Although there are many ways and available guidelines to avoid cultural shocks, students opting for TNE often face fewer cultural shocks than those going overseas and are, therefore, more capable of concentrating on their studies [21–23]. Both home and foreign institutions can benefit from TNE programs and can easily gain revenues with little effort. On the other hand, Wilkins and Juusola [13] found that host-country governments soon realized that TNE is a contributor to increased capacity in higher education, which could lead to the creation of an Education Hub by contributing to knowledge innovation and by satisfying the needs of skilled labor.

In the United Arab Emirates (UAE), as an example, almost 90% of its population consists of expatriates who cannot enroll in public universities where education is free. Accordingly, the government has allowed universities from India, USA, UK, and Australia to operate in the UAE, keeping in mind that the host (UAE) government's support is essential for the continuation of TNE activities [24].

Underestimation of the start-up costs of TNE partnerships for the foreign institutions, and failure to foresee the difficulties of operating, resulted in a limited number of failed and/or non-profitable programs, which were mainly due to the overestimation of student enrollments and revenue streams [13, 17]. It was realized that the modest financial returns from TNE could never replace those from exported education [24]. However, many degree-awarding TNE institutions are now moving into larger, new, purpose-built International Branch Campuses (IBCs). This approach is used to enhance the individual institution's prestige, educational quality, and legitimacy in order to increase financial revenues for the institution, which is important for its sustainability and future expansion, and to help build its global brand. Knight [10] and Wilkins [17] saw that TNE engagement is a way to enhance knowledge capacity, cultural understanding, and research in an institution.

Although TNE programs are now a popular way of achieving degrees, they are criticized in relation to student experience and satisfaction; nevertheless, TNE is expected to provide programs identical to those of the degree-awarding institutions [25]. One of the major concerns among students is that their TNE program is not delivered by the core instructors/faculty of the awarding institutions and that, therefore, the quality of that TNE program may not be equivalent to the one in the real campus of the foreign (awarding) university [26]. An example of this was the canceling by the Ministry of Education in China of the licenses of many UK HEIs and the calling off of many partnerships that were under development [24].

A TNE tutor survey [25] supported the need to contextualize the taught curriculum to the national culture as not all the content was transnationally transportable. Another concern was misalignment between the home offering country and the branch campus with respect to the quality and diversity of the student body, copying forms of cultural colonization, missing data to drive the decision-making, policies, and organizational culture, and adaption to the current/new localized context [27].

6 Common Forms of TNE

Under the definition of TNE, academic institutions are working together to jointly teach or solely provide TNE to teach learners without them needing to travel abroad. A wide variety of forms or modes and activities can be used with TNE programs, from remote campuses to joint degree programs with other higher education institutions and sharing best practices.

Two major categories of TNE are available [10]: (1) Foreign education institutions will have a local host "collaborative partner" to deliver the academic programs, and this is called collaborative TNE provision; and (2) no institutions from the host country are involved in the process of the design or delivery of the academic program. This is called a stand-alone TNE provision (independent).

In transnational education, there is a wide variety of concepts and modes of operation under these two categories. These include distance learning, online learning, dual and joint degree programs, and fly-in faculties for short courses. Based on the previously mentioned survey, the followings are the forms of TNE that have been globally adopted (see Table 1).

Co-founded or Joint Institutions: This relatively new form of TNE is an interesting alternative to the IBC model co-founded by multiple universities from different countries [10].

Joint, Dual, or Multiple Degrees: This is the popular mode of TNE offering one and/or dual and/or multiple qualifications. In the joint degree program, an academic degree/qualification is offered with the insignias of both sending and host HEIs on the certificate. In a double-degree case, two separate certificates (qualifications) are provided individually for each HEI. Multiple degree qualifications (at least 3) follow the same procedure.

Table 1 Different categories and types of transnational education (TNE)

Categories of TNE/types	Collaborative TNE provision	Independent TNE provision
Co-Founded/Joint Institutions These may also be independent with multiple institutions from foreign countries	Yes	No
Joint/Dual/Multiple Degree	Yes	No
Distance/Online Delivery	No	Yes
Twinning and Articulation	Yes	No
International Branch Campus (IBC)	No	Yes
Course-to-Course Credit Transfer	Yes	No
International Franchising and Degree Validation	No	Yes
Progression Agreement/Sequential Degrees	Yes	No

Distance Delivery/Online Delivery: Distance education is also a form of TNE; the local host (country) support is provided to distance-education students [10]. Those programs can be delivered through various technologies, whether computers or satellites, or through any other technological means across the countries.

Twinning and Articulation: This is a recognition by academic institution *A* of a study at institution *B* in another country as a partial credit toward a program at institution *A*. In this approach, students will experience life in the campus of the foreign institution by physically attending at the foreign awarding-university campus for a specific time period, according to TNE arrangements and agreements. This specific period is divided between partner institutions, and the study in the host country could be either an optional part of the program or a compulsory period of study [16]. As an example, a learner who has registered with an overseas partner can be assigned to a UK-validated program if the learner has achieved a particular level of contact (face-to-face or virtual) while not on campus or performance in their studies with the overseas institution (partner) [16].

International Branch Campus (IBC): In flying-faculty models and IBCs (TNE engagement models as well), the campuses are set up by a foreign HEI in another country to offer its education to local students in that country. The foreign (awarding) academic institution is partially responsible for the quality assurance of the branch campus and overall strategy [13]. The branch campus will have the basic infrastructure, such as open-access computer laboratories, dining facilities, and library, where learners at the branch campus can have a similar experience to those in the home campus [13]. Branch campuses may be either temporary or fixed, in other words similar to international franchises, and the franchisee will be the campus of the franchiser. Malaysia, UAE, Singapore, Qatar, and China are the main transnational higher education hubs hosting most of the IBCs [17].

Currently, the rate of establishment of IBCs has slowed down due to the difficulty of maintaining student recruitment targets, which has led to financial loss. However, in Indonesia, Mexico and Morocco, and other countries, operational IBCs are still being opened [29].

International Franchising and Degree Validation Agreement: This is recognized as a contractual arrangement/agreement between institutions from different countries, based on a mutual recognition/license between the institutions. In this approach, the franchiser (the institution) in a foreign country allows the franchisee (an institution) in the host country to offer the foreign institution's programs to learners in the local institution. In this model, the home university has the authority to conduct all the different assessments, and to set and mark assessments and examinations. However, problems often arise with franchising, which is a financially inexpensive way of penetrating a new market, if the joint-venture partner and the home institution/university, which is usually a private for-profit institution, have opposing and different objectives (e.g., profit maximizing versus academic quality) [28]. In franchising concepts, new private independent universities in a host country are developing programs that primarily offer franchised academic programs from different foreign providers and individually franchised programs [12].

The validation model (initiated by UK universities) is a variation of franchising in that the curriculum for a degree is taught in the home university while being designed by the awarding institution in the foreign country. The awarding institution tests the quality of the degree and recognizes the degree as well; in this case, validation is considered to be a variation of franchising, where the curriculum is developed by the foreign intuition through an institutional accreditation process that is viewed to be equivalent to that of the home academic institution in order to allow the partner to validate the offering university's degree(s).

7 Delivery Modes for Teaching and Learning Materials

Delivery of teaching and learning (T&L) material(s) can vary for the same TNE at different academic institutions. A blend of face-to-face and online delivery of T&L materials is one approach, and others consist of wholly face-to-face delivery or online delivery, or a combination of both in different ratios [16]. Some joint degree programs offer face-to-face delivery of the materials and here faculties from both host and foreign institutions are directly involved in the delivery of the material. Some foreign institutions recruit their faculty in the host country only during the whole semester/term, or recruit what is called a "flying faculty" at the foreign institution and send it to the host country only for material delivery. The delivery of T&L materials can be via a "block" teaching style, where material is provided in an intensive block, 1 week in some cases, where learning is compressed. This is done usually with learners studying only one course at a time. Other modes can be spread over the whole conventional term to deliver a full-time course.

8 Key Elements in Developing a TNE

An evolution in the development of different and new forms of TNE programs has happened lately. Hence, TNE is expanding and growing and has become widely accepted as a popular way of acquiring international educational certificates and awards. Many new elements have been added while developing TNE's processes, for example, new regulations, new modes of delivery, new partnerships, and new actors [10]. The previously discussed TNE modes have been developed based on defining and agreeing upon, mode of delivery, curriculum development, faculty arrangement, accreditation, and the type of qualification TNE learners get. Knight [10] has discussed these in detail.

9 Growth of TNE Around the World

The UK offers a world-class education with a global reputation and a strong presence in world markets, in which the UK is the second largest provider of international education with a 10% share. British education expertise is exported abroad, and the quality of British education products and services is well regarded in world markets. The British Educational Suppliers Association (BESA) identifies China as one such market which is worth $500 billion, with $677 million spent on EdTech each year. The UK is a dominant player in the provision of various different TNE programs around the globe, and Malaysia, for example, relies on TNE to meet the high demand that local Malaysian public universities cannot adequately meet [15]. The main reason for relying on UK universities is the global acceptability of British education and its quality; it has been found that there is a competitive employability advantage for those graduating from these UK universities and that, at the same time, they have an international outlook. A TNE from a UK university provides a qualification, skills, and valuable cultural capital in knowledge and dispositions. Also, a UK TNE program is marketed as cost-effective for learners who are looking for a UK education and its associated benefits and cannot afford to study overseas [15]. A UK TNE program is usually offered in a similar way to those offered at the foreign (main) academic institution in the UK in terms of qualification awarded, academic standards, and course content.

In 2019–2020, 453,390 students were studying through UK TNE programs (or 449,690 excluding Oxford Brookes). The total number of reported UK TNE students decreased by 213,425 students (~32%) compared with 2018–2019, largely due to changes in reporting by one provider. Oxford Brookes University accounted for over one-third of all TNE students. In 2019–2020 Oxford Brookes changed their reporting practices [30].

Australia maintains a good reputation as an exporter of education and many of its providers do operate overseas, offering high-quality higher education through various TNE agreements/arrangements. Singapore, China, and Malaysia are the three major markets for the Australian Universities followed by Sri Lanka, Vietnam, and India, and they comprise the largest number of enrolled students who were studying in 2018 [11]. In China, the number of Australian–Chinese TNE programs at the undergraduate level has increased to 150 since the first programs were approved in 1994. Australia has become the third-largest country, behind the UK and the USA, as a TNE partner [11]. All Australian TNE programs are managed by individual providers with specific TNE partnerships and approaches, and their delivery models are in constant development and evolution. International branch campuses are the preferred TNE models for Australian providers as they provide greater control over quality and standards, but at the cost of larger investment and risk to sustainability. Hence, at least six Australian International Branch Campuses in different places have now closed in China.

10 Issues with TNE Partnerships: Quality Assurance and Regulatory

The term TNE implies the crossing of legislative, linguistic, cultural, national, and international borders. The main targets for TNE partnerships are the rapidly growing economies in Asia and the Middle East, where the legislative, linguistic, and cultural environments are different from those of the exporting academic institutions [28]. Therefore, harmonizing and adopting/adapting to these different systems, which have different references and stakeholders, are not an easy process as there is no specific TNE benchmarking or any general framework that could align the differing educational values and structures of TNE qualifications and TNE institutions. To make any necessary alignments, these different agreements/partnerships must comply with the legal and legislative requirements of the host and foreign countries by showing international best practice.

In an Australian publication by the Melbourne Centre for the Study of Higher Education, [11] Croucher et al. stated that providers are most concerned about the sovereign issues, navigation of which can be quite complex, and how they can deal with governments and the rules in different countries. Therefore, it would seem that, as far as the practice and regulatory aspects of a TNE policy are concerned, many host countries are imposing new restrictions. Croucher et al. [11] also found that excellent national universities may find difficulties in expanding their programs outside their countries while, at the same time, some fraudulent and non-recognized institutions, known as “degree mills,” can operate in a different national context.

11 The COVID-19 Pandemic and TNE

By 2020, the effects of COVID-19 had become worldwide, causing a significant impact in most economic sectors, especially the educational sector where profound changes had to be made to its systems in general.

Social distancing was one of the measures taken to prevent the spread of the COVID-19 virus. This measure was taken after the declaration of COVID-19 as a pandemic by the Director-General of the World Health Organization (WHO) on January 30, 2020 [31]. Social distancing was implemented by most governments around the world as a pandemic precautionary measure. This measure caused unprecedented health and socio-economic crises that will mark our lives for some time and impacted the entire education sector around the world [3]. At all levels of education, universities, colleges, and schools were closed by the respective local governments. The first country to stop face-to-face education at that time was China, and the government asked educational institutes to continue all forms of education online. For the first time, this led the world to start a digital pedagogical revolution. Locked-down cities and strict travel restrictions were imposed worldwide, and this had a significant impact on education. To enable education to continue, therefore, most countries switched from conventional traditional classes to remote online formats. Likewise, TNE programs transformed their traditional learning and teaching activities into remote online education [32]. Technology adoption in teaching and learning, and pedagogic transformation were involved in this rapid restructuring of education delivery [33–35].

The pandemic also disrupted international-student mobility, although the nature of TNE means that its systems are not vulnerable to travel restrictions. Therefore, TNE was in a better position to accommodate the changes by adjusting some of its various parameters for the post-pandemic world.

The merits of TNE became apparent during the pandemic when many students who originally planned to travel abroad for a foreign degree decided to study from their home country. This still does not prevent criticism of the quality of TNE regardless of the delivery modes and partnership models. This is because governments were forced to impose travel restrictions as they were worried about the well-being and health of students in foreign countries; moreover, families also faced financial challenges during the pandemic and were worried about allowing their children to travel abroad to high-cost countries [36]. During COVID-19, TNE was the alternative option for learners who were seeking a foreign degree at an affordable cost. It is worth noting here that the alumni statistics of TNE graduates indicate that many employers viewed the TNE experiences in a positive way, and this resulted in the TNE partnerships route becoming more popular and attractive as means to achieve a foreign degree [37].

In China, because of the fast spread of the virus in 2020, it was realized that a plan-B option for TNE programs was required to accommodate the educational process, and most instructors started to prepare seriously for online teaching and learning [38]. Eventually, all universities transferred their onsite teaching to online [39]. Other TNE host countries, such as Vietnam, Malaysia, Singapore, Thailand, Korea, the Middle East, also adopted the same concept as the virus spread. Foreign institutions had to implement extra measures in terms of curriculum and changing the weight of examinations and coursework, switching (or removing) in-laboratory assessments/activities to computer-based assessments/activities, rearranging course delivery to be, for example, blended-based (hybrid) to accommodate the time difference between different countries, and so on. This has presented a dilemma for HEIs!

12 Transnational Education and Online Learning (E-Learning)

The pandemic tested the preparedness of HEIs for the continuation of essential teaching activities, such as sharing lectures in real-time, delivering courses, and running video-based tutorials [40]. The closure of academic institutions and the imposed travel restrictions caused multiple TNE problems, such as interruptions to student engagement and learning, difficulties in carrying out internal evaluation and review or continuous assessment, and difficulties in maintaining the academic calendar, recruitment of teaching staff, and admission processes. The easiest way to maintain the educational activities, at that time, was to switch to an online format through online education or remote online teaching and learning.

Online education has been established for some time now, and it is no longer an "off-the-shelf" product for many academic institutions since it has evolved beyond just the provision of infrastructure and the digitalization of activities and material. In order to prevent any risk of diminishing the quality of education or the student learning experience, online education requires a substantial number of resources and careful planning, which means a high workload for instructors [41].

In a traditional classroom, the personal interaction between the instructor and the student is irreplaceable and an invaluable component of learning and teaching; however, the expansion and adoption of online education are increasing, and replacing parts of the regular lectures is generally accepted by instructors. At the same time, when it comes to the value of online education, there is a change in perception by the various key stakeholders, including students, families, higher education providers, academics, and regulators [41].

Currently, remote online learning and teaching is being recognized and adopted by many countries, even though some of those countries' institutions have not yet formally recognized online education [42]. The pandemic proved that both foreign and host countries noted the efficacy and acceptability of online learning and teaching and, therefore, permitted flexibility in terms of conducting assessments, course content and delivery, and engaging learners. The pandemic encouraged evolving institutions to invest in online learning although the pandemic was itself a hazard to humanity.

13 The Implications of Educational Quality and Rapid Changes

During the pandemic, students, awarding bodies, and providers were needed to adopt forms of delivery different from the original traditional delivery models which involved the students having to physically attend a class. Any revisions to the mode of delivery were influenced by the location of the students. A certain amount of in-campus delivery could still continue in some countries. This has resulted in hybrid/ blended teaching in which an in-campus activity is combined with synchronous or self-paced study of the material, and staff are in contact through various digital means. Flying faculties moved to online teaching rather than face-to-face delivery due to national and international travel restrictions. Local instructor support in a branch campus, or TNE-partner staff, was in some cases able to continue, depending on local government requirements and the level of restrictions.

Green et al. [42] stated, and strongly recommended, that any retrospective change in a delivery mode that had to happen on the spot should be approved by regulatory bodies, both statutory and professional, through annual activity agreements, operational delivery plans, and so on. They also noted that, when changes were made, all professional services should be involved in the decision-making process. This emphasis was based on the need to ensure continued access to learning resources (IT and library) as well [42, 43].

14 Suggestions for Instructors Using the E-Learning (Remote Online Learning) Mode of Delivery

During the pandemic, the fast transition from conventional learning to e-learning happened with minimal guidance or support. Consequently, not everyone had a smooth transition during this change, since the forms of learning and teaching interactions changed, while the pedagogy, content, and assessments remained the same. Instructors and learners found new ways to interact and connect through technological means. This has allowed the delivery mode to change and has redefined the teaching and learning process. Incorporating the necessary techniques and tools with proper planning of pedagogy, content, and assessment was very crucial for communication between the tutor(s) and the student in order to provide the best teaching/ learning experience to all stakeholders.

In the context of TNE, several good practices have been identified for e-learning/ online learning and teaching based on different experiences and experiments:

Speaking: If anyone uses a microphone during a lecture, it is always good to speak louder and keep the microphone far from your mouth. This way the microphone will not amplify the sound of the instructors' breathing, thus giving the instructor more confidence.

Managing the technology used by an instructor: Here the instructor is encouraged to use multiple monitors and to turn off the laptop's notifications. As e-learning/online learning involves the use of several technologies, it is advisable for the instructor to start their session early in order that he/she has time to check audio/video connections to avoid unexpected issues.

Holding the learners' attention: To achieve the necessary learning outcomes during a lecture, instructors need to hold the learners' attention which is greatly affected and influenced by students' tendencies to communicate and interact with each other [44]. If an unfamiliar terminology is used, learners will be demotivated in any live synchronous session, or in a lecture; therefore, if an instructor is to use any unfamiliar terminology, it is always advisable for the lecturer to describe complex terminologies with simplified examples. It is recommended that suitable font sizes are used so that each student in the classroom can read any slides.

Asynchronous (self-paced) versus synchronous teaching and learning: Try to provide lectures before a scheduled class and make a short video(s) relating to the lecture slides available to students asynchronously. A synchronous live session can start after that and the instructor should not repeat what is on the lecture slides but rather should add and complement the uploaded slides by explaining them in more detail, with illustrative examples, and by providing tasks for the learners to engage with. Question and answer (Q&A) formats, with short answers, should always be encouraged among students to increase their participation and involvement in the course. In a discussion forum, questions from students could be posted anonymously to themselves on the platform used to avoid any embarrassment if the question is sensitive or inconvenient. In live synchronous sessions, offering practical tasks for students to undertake will encourage the engagement of a greater number of different students in the class.

The use of applications that monitor student engagement during a live synchronous session will help keep track of participation especially if the class size/capacity is large.

Asynchronous interactions in teaching and learning: Supporting and measuring learners' engagement in the class is the main concern in an asynchronous (self-paced) class. The design of the material, including its various activities, is a major factor in the engagement and interaction of different students, without undermining the role of the instructor. The instructor's visibility and engagement are crucial in increasing students' engagement in an asynchronous session. One of the most important activities here will be the discussion forums, which will enable all stakeholders (instructor and students) to participate in exchanging ideas in the session, to discuss, share information, and give feedback. They can all collaborate in an asynchronous session with the following added benefits:

1. Learners who feel less able or too shy to participate in face-to-face discussions may feel more confident in contributing.
2. Learners can have time to consider the topic and reflect before they respond.
3. Learners can receive and give peer feedback on their ideas and/or work.
4. Learner collaboration can lead to meaningful and constructive ideas.

5. Forums can be customized so that they are either open to all students or the students are divided into groups.

Feedback from students in real-time will increase students' collaboration and engagement. There are many tools that allow the instructors to facilitate and encourage interaction with and among students. Mentimeter, for example, is an online interactive platform used to get real-time feedback and input from students, enabling instructors to read the classroom anonymously.

The followings are some examples of how to improve students' engagement through best practices:

- At the start of a class, the instructor should spend some time with students to identify their questions about the material.
- With the help of interactive technologies, the instructor should make time for general discussions of a particular question(s).
- Use interactive technologies (e.g., Mentimeter) and polls, for example, to sense learners' reactions, comprehension, and experience of the material. The instructor must try to "read the room."
- Use platforms like Zoom, MS Teams, etc. to create small groups through breakout rooms to start peer discussions for student collaboration.

Online quizzes: These engage learners and offer them a chance to assess their progress; quizzes also help lecturers to review the students' comprehension. When using quizzes as informative assessments, the quiz should be programmed in such a way that students automatically receive the answers and the reasons they were incorrect if they get a question wrong. Quizzes can be an efficient tool to review students' learning outcome(s) at the end of a topic. This self-assessment allows students the opportunity to practice this method, which is especially helpful if students are facing future formative/summative assessments that use quizzes to measure and assess their learning.

15 The Role of Higher Education Institutions

The COVID-19 pandemic caused ongoing stress and disruption to all our lifestyles, and higher education institutions (HEIs) have been trying to ensure that the crisis will not disadvantage learners' achievements and academic progression. During the pandemic, HEIs had to take strict precautions to keep all students safe and had to transform face-to-face learning into online mode for the continuation of learning. This required the adoption of new technologies, learning methods, and teaching. In this regard, institutions had to change many of their policies and procedures, and some changes resulted in unexpected outcomes, such as sudden shutdowns of computer servers due to the large number of end-users (students) [45]. Moreover, not all platforms had features like breakout rooms for small group discussions. Most of the HEIs had to change their assessment techniques and procedures by adopting alternative assessment methods. These alternative assessments varied: extended-period online exams in which students submit their answers within the allocated time frame, answering a paper as usual within the normal exam time, online proctored exams, and take-home exams. Higher education institutes had, in advance, multiple alternative plans for unexpected issues, and were able to keep students updated about those plans, including proper instructions on these alternative plans.

16 The Role of Regulatory Bodies

Regulation of TNE and its quality assurance are important elements for foreign and host academic institutions to ensure that TNE programs are of an acceptable standard. Host countries have regulatory bodies and procedures for assuring TNE's quality [13].

The Malaysian Qualification Framework (MQF) is implemented by the Malaysian Qualification Agency (MQA) as a basis for quality assurance of higher education in Malaysia as a host country. The Quality Assurance Agency for Higher Education (QAA), which is an independent evaluator/accessor, monitors the quality of UK TNE [46]. In the UK, the QAA has been conducting in-country (home) audits of UK TNE operations across a range of countries (host countries); moreover, many countries are helping their universities to expand their own TNE activities and have also started monitoring those TNE activities to improve their higher education reputation [28]. This rigorous internal quality assurance accounts for the success of the export of UK higher education, which is dependent on visible and explicit confirmation of external quality evaluation and careful regulation. The method of quality evaluation and enhancement of UK TNE is now commissioned by GuildHE and Universities UK (UUK), and this has demonstrated the ongoing commitment of higher education authorities in the UK to deliver high-quality TNE experiences [46].

17 Opportunities and Challenges to TNE

The dramatic digital revolution that was seen in the education sector due to the COVID-19 pandemic resulted in universities adding innovative approaches and changes of mode to their courses. Higher education providers, students, regulators, and families faced many challenges, and the rapid change in the delivery mode was one of the great challenges in TNE programs as it relied completely on adjusting existing technologies [47], which is a challenging task for instructors and learners.

18 Technological Challenges and Adjustment

There has been significant advancement of educational tools and platforms, and these are available to be adopted. Microsoft Teams and Zoom provide cloud-based teleconferencing with video platforms. Blackboard Collaborate is another example of a cloud-based platform. This advancement does not eliminate challenges for TNE instructors and students who must engage with remote online education from home via these different available platforms and educational tools [43, 48] because a high-speed line might not available or there might be an interrupted internet connection. The previous two reasons are common problems for any remote online education and will result in concerns for provision of the educational process. Many students in TNE programs have limited access to a high-speed internet connection [32]; therefore, their learning experience will not be equal to that of others with such a connection.

19 Learners' Support and Students' Differing Expectations

Students enrolled in TNE are accustomed to a certain mode of teaching delivery but, due to the pandemic, their learning process has been disturbed by the significant changes that were made during the complete shift to online education [49]. To avoid this disruption, academic institutions had to frequently communicate with students to keep them updated on these changes. At the same time, these institutions had to offer support and guidance to students on any newly added techniques, platforms, and technologies in their current educational journey to ensure that the learning outcomes of the TNE were achieved, and that the students' different expectations were met. Engaging learners in communication with the academic institution was extremely important to ensure that all stakeholders were aligned and familiar with the changes needed to deliver the procedures and techniques used in the educational process.

20 Different Time Zones and Well-Being

Students had to go back home during the pandemic, due to the closure of their academic institutions in the best interest of the students' mental and physical health and well-being. This resulted in students attending their online programs in different time zones, which was a challenge prior to transforming traditional in-class learning into remote online learning, as it was not possible to deliver learning activities in a synchronous mode (instructor and students are online at the same time) [35]. This challenge was met by blending in-person delivery with a remote online format, an approach that included a mix of both synchronous and asynchronous modes of delivery [50].

21 Inequality in Learning

Di Pietro et al. [51] tried to identify the factors causing learning gaps. They found that learning loss was huge during the COVID-19 pandemic, which led to educational inequality [52, 53]. However, the closure of universities and the pandemic did not affect students equally; TNE students had limited access to technical equipment during remote online education, a limitation that also extended to facilities like an ambient personal environment (quiet place) and a suitable broadband internet service.

This forced switch to online education was a challenge to learning and equality. Not all students were equally prepared, or able, to make this move to online education with the necessary equipment such as a stable broadband internet connection and a personal computer or device. This created a divide between those who could not meet the basic needs of the contemporary pattern and those who could. These inequalities were based on the technology skills of the individual and the ability to afford the relevant technologies (economy) [40]. Therefore, a personalized and customized blended learning system will be the ideal solution in the post-pandemic era.

22 Addendum (if Required) to TNE Partnership Agreements

There are legally bindings terms for TNE delivery modes; these had to be changed when TNE programs were adapted to an alternative delivery model during the pandemic to allow the educational process to continue. Green et al. [42] advised all TNE partners to review the terms of any operational agreement and the overarching legal agreement, which articulates the responsibilities and roles between partners. They advised partners to check if those formal agreements would allow any changes to the delivery mode, and to introduce addendums (if any) to the agreements in line with their usual approval processes for permitting the necessary changes caused by adhering to any emergency regulations (COVID-19 pandemic). It must be noted here that any emergency regulations would have to be short-term and adapted to be consistent with their existing operating agreements, and that this may require substantial adjustments.

23 Impacts on Staff and Student Well-Being

Burns et al. [54] emphasized that, in a competitive environment, the increased pressure to perform well academically contributes to the sub-optimal well-being of students and is not sustainable. A dramatic shift in the learning environment would be a major contributor to poor well-being for learners who must contend with the new conditions resulting from the pandemic. Zhai and Du [55] mentioned that a reduced capacity to cope was associated with the technological shift and the lack of physical contact with academic staff, putting learners under increased pressure to meet deadlines without access to the support that they normally experienced during their studies.

Jackson emphasized that priority should be given to improving online learning [56] since that will have an impact on students' future well-being, motivation, and engagement. He also mentioned that the approach taken by universities to manage interactions and online learning had increased students' anxiety and harmed their well-being; this is in addition to the detrimental consequences of students being at home and anxious [56].

24 Opportunities

The pandemic has tested the capability of current education systems around the world and has challenged all stakeholders. By forcing new modes of delivery, the pandemic showed stakeholders the effectiveness of technology-assisted learning and the value of online education. The pandemic brought resilience and confidence to the educational system, which gained the capacity to deal with any future emergencies. The hybrid, or blended, mode of delivery is now seriously considered as the viable model for the future in education. Learners now need to be prepared for an environment where knowledge is not a fixed set of ideas; this is needed for students all around the world.

25 Future of Transnational Education and Higher Education in the World

One of the United Nations' (UN) 17 Sustainable Development Goals (SDGs) is education, and the sustainable development of TNE is an important aim for SDG 4 to pursue (to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all).

Before the COVID-19 pandemic, face-to-face education had always been the norm for university programs, and online learning was considered as an optional extra. Many universities are now reconsidering their use of technologies to offer a hybrid/blended approach to learning. Nowadays, education is not limited to how or where you learn, but rather the important matter is that the student continues to learn. Therefore, universities are making use of technologies and developing their hybrid/ blended learning approaches.

It will take some time to feel the impact of the pandemic on international enrollments in academic institutions in traditional world destinations. Times Higher Education conducted an audience poll during one of their sessions and found that the pandemic has led to a 25% drop in the number of conventional international-student enrollments (i.e., reduced student mobility) in the UK, while their TNE programs were receiving student applications in overwhelming numbers. Universities around the world now need to consider their role as global social enterprises more holistically with their key responsibility to address sustainability and employability challenges [41].

26 Conclusion

During efforts to prevent the spread of the COVID-19 pandemic, the global education system has been transformed, with online education and transnational education as the primary means of instruction regardless of the challenges faced, the most important of which are unreliable broadband internet services preventing synchronous connections between staff and students, and the lack of digital devices for some students.

The future impact and online learning reliability are still under debate by employers. Hence, stakeholders from all parties must collaborate to develop an inclusive and accessible learning environment, and educational resources to maintain the sustainability, inclusiveness, and accessibility of education, and its sociality.

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Cognitive Presence as a Catalyst for Creating a Community of Inquiry in Online Learning: Insights from a Lebanese Higher Education Context

Ghania Zgheib, Sara Salloum, and Mathilde Azar

Abstract An important feature of quality online learning is establishing and promoting an inquiry-based approach to teaching and learning that contributes to enhanced online learning experiences. The Communities of Inquiry (COI) framework dubs high student inquiry in online learning as Cognitive Presence (CP), which centers teaching and learning around students' collaborative exploration of concepts. The purpose of this chapter is to present findings from a study that examined methods and strategies used in online teaching during and after the pandemic, and to explore faculty and students' perceptions regarding this mode of learning. More particularly, the study explored the extent to which CP was manifested in the online learning experience. The study was guided by the COI framework as a theoretical framework and Cultural-Historical Activity Theory (CHAT) as research framework to analyze facilitators of, and barriers to, realizing high levels of CP in online learning. Faculty interviews ($N = 8$), observations of recorded synchronous sessions (a total of 10), and student surveys ($N = 114$) were used to gather data. Findings from this study revealed that the sudden shift to online teaching and the absence of formal professional development resulted in an authoritarian/transmissive teaching approach and low student engagement, hence, limited CP. Nevertheless, some students found this approach helpful as they were used to traditional teaching approaches. Faculty engaged in self-directed professional learning, an approach that could be further leveraged in both traditional and online courses.

G. Zgheib (✉)
Department of Education, University of Balamand, Koura, Lebanon
e-mail: guenia.zgheib@balamand.edu.lb

S. Salloum
Department of Teacher Education, Ohio University, Athens, OH, USA
e-mail: salloum@ohio.edu

M. Azar
Department of Nursing Program, University of Balamand, Koura, Lebanon
e-mail: mathilde.azar@balamand.edu.lb

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1 Introduction

Remote online teaching and learning has gained traction during the COVID-19 pandemic due to the need for social distancing. This has resulted in a significant shift toward online and virtual classrooms, as well as an increase in the use of educational technology and online resources. With the prospect of online and hybrid learning becoming the new normal, attention to providing quality online teaching and learning has become essential, as poor online learning design may lead to misperceptions about this modality, when in truth educational institutions should be taking advantage of the affordances and the possibilities of online learning. An important feature of quality online learning is establishing and promoting an inquiry-based instructional approach since such approach contributes to enhanced online learning [1]. Within an inquiry-based approach, learners co-construct meaning and knowledge through sustained and productive explorations and communication around phenomena or problems. In essence, they partake in an '*inquiry community*,' thus realizing higher levels of learning and thinking [2]. Accordingly, the Community of Inquiry (COI) framework was developed to emphasize the importance of creating collaborative communities of inquiry in the planning and design of online learning environments [1]. The COI framework advocates promoting three types of 'presences' in online and blended learning environments: cognitive, social, and teaching. Cognitive presence (CP), particularly, "goes to the heart of the community of inquiry" [3] and is defined as the extent to which learners engage in constructing meaning through sustained and active inquiry during their online learning [3]. High levels of CP in online and blended learning environments open spaces for critical discourse, reflection, and the development of higher levels of thinking and reasoning [4].

Given the scarcity of research on online learning in the Arab world, and the need to develop pedagogically grounded online courses, the purpose of the current study is to examine methods and strategies used in online teaching during and after the pandemic and to explore faculty and students' perceptions regarding this mode of learning; particularly, we explored the extent to which CP was manifested in the online learning experience. The theoretical framework of this study is the COI framework, and hence, the research questions are as follows:

1. What aspects of CP are evident in an emergency remote-learning situation?
   (a) What types and characteristics of learning and knowledge are manifested in online activities and interactions?
   (b) How and what aspects of student inquiry are promoted in learning activities, technologies, and interactions?

2. What are students' perceptions of the levels of CP demonstrated in online courses/ teaching and their related factors?
3. What are instructors' perceptions of the teaching strategies in online courses/ teaching?

Focusing on CP in this study was purposeful and springs from our commitment as educators toward promoting active and more student-centered approaches in higher education in all modalities, in-person, hybrid, and purely online, particularly considering that this is an area of growth for higher education institutions across Lebanon and the Arab world.

2 Literature Review

A preliminary scrutiny of the state of Lebanese online teaching and learning shows that online learning had been an underexplored area in practice and in research until all educational institutions were forced to shift to online teaching due to COVID-19 [5]. In Lebanon, some higher education institutions had been experimenting informally with online learning pre-pandemic, yet post-pandemic some institutions have developed fully online certificates or online programs that are accredited internationally. In Lebanon, there are no guidelines and policies that govern online programs despite a draft law that was proposed in May 2016 allowing a maximum of 60% of a course to be delivered online but has not yet taken effect [6].

The shift to online learning has provided first-hand online teaching and learning experience to both faculty and students. It has contributed to the development of digital literacy and autonomous learning of students [7]. In a survey conducted to investigate students' readiness to learn online in a private higher education institution in Lebanon, the results revealed that higher education students in Lebanon possess the necessary technology skills, have access to technology, have the communication and social interactions needed in online environments, and have the self-regulated skills to learn in online environments, yet they were not willing to spend 4–6 h of online learning per week [8]. This study contradicted findings by other studies [9] that revealed that adoption of e-learning is immature among Lebanese students as a result of the traditional pedagogies used in instruction and because of technology issues.

The pandemic put institutions to the test and, more specifically, faculty who had to develop technology skills and online pedagogies in a very short time. Previous research has shown that faculty have yet to exploit the affordances of technologies and need support to implement technology in their teaching [10]. In addition to faculty skills, Lebanon faces infrastructure challenges related to internet speed, electricity, and access to personal devices that facilitate the online learning process [5]. Those challenges had always been the barriers to online learning adoption in Lebanon [11].

In light of the above-mentioned complex Lebanese context and to better understand sociocultural *and* locally based facilitators and barriers to realizing CP in online learning in higher education, we utilized Cultural-Historical Activity Theory (CHAT) as an analytic framework. This framework posits that understanding an activity, such as online teaching and learning, requires studying the broader social, cultural, and historical context in which the activity is situated [12]. Indeed, CHAT is being increasingly recognized as a transformative framework for analyzing needs and outcomes, and the potential of such needs as drivers of change [13–15]. In the following sections, both COI and CHAT are explained and elaborated.

2.1 Community of Inquiry Framework

The COI framework is a constructivist approach which postulates that effective online learning entails the development of a community that supports meaningful inquiry and deep learning [1, 16]. An educational community of inquiry is defined as "a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding" [17]. The concept is grounded in John Dewey's (1938) view of practical inquiry which takes into consideration the role of *community* in individual development [18]. This sense of community is further emphasized in online learning environments where there is a need to foster cognitive and emotional connections in physically separated learners. The COI framework emphasizes high levels of student engagement and collective meaning-making and knowledge construction within online learning experiences. It helps create a collaborative environment that entails open and purposeful communication through the development of three essential and interdependent elements: social, cognitive, and teaching presence [1] (Fig. 1). All three presences should be considered in a balanced manner to get an effective and higher-order online learning experience.

Teaching presence (TP) is defined as "the design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worth-while learning outcomes" [19]. The teachers' role is very essential in establishing teaching presence through facilitation of discourse, agreement, and disagreement; encouraging, acknowledging students' responses, prompting, engaging students in discussions, and assessing learners' needs [20]. Teaching presence also involves establishing curriculum content, timelines, managing the online learning process and the learning activities, and providing direction to the learning experience [21]. Hence, the structure and leadership of online courses are central to establishing TP.

"Social presence (SP) is the element that explains the ability of people to present themselves as 'real people' through a communication medium. Most studies on SP focus on how students present themselves and/or are perceived as 'real' people online" [22]. Therefore, SP refers to the affective and social dimensions of belonging to an environment [19] and is established when the individuals identify as part of a community where they can establish purposeful communication and can reflect their own personal characteristics [23]. There are three categories of SP indicator [3],

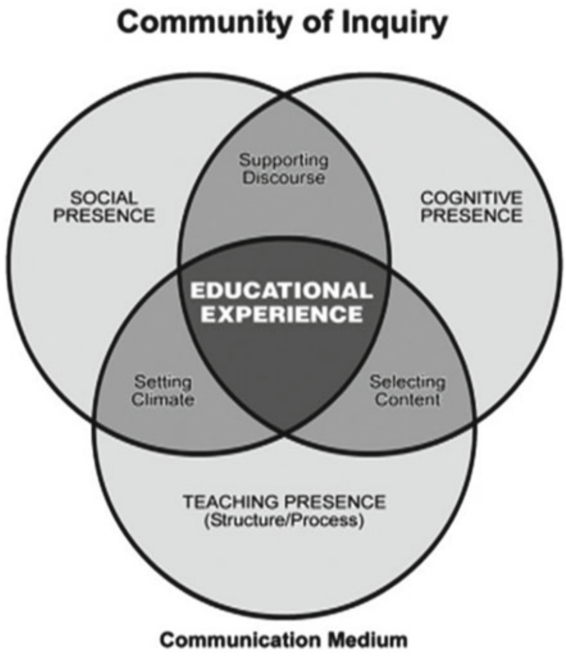

Fig. 1 Community of inquiry framework [3]

namely: (1) emotional (affective) expression, where learners share personal expressions and values; (2) open communication, where learners develop aspects of mutual awareness and recognition; and (3) group cohesion, where learners build and sustain a sense of group commitment. Studies show that SP is an essential first step in a successful online learning experience as it's related to student satisfaction [16, 24, 25] and it influences CP [26]. Unlike face-to-face learning, online learning is isolated and may result experiences of anxiety and stress [18].

2.2 Cognitive Presence

Although both SP and TP are very important, in this study we focus on CP, because it is quintessential for realizing a community of inquiry as it involves tasking learners with collectively exploring a problem, issue, or phenomenon. It is defined by the Practical Inquiry model that identifies four phases in the inquiry process: triggering events, exploration, integration, and resolution [21]. Triggering events occur when a problem occurs requiring further inquiry. This stage is "inductive" and "evocative" [3]. The second phase, exploration, requires reflection and critical thinking as it engages the learner in exchanging information and discussing divergences [3]. As a result of exploration, in the third phase, integration, students connect ideas from different sources creating solutions to the initial problem [3, 27]. The fourth phase, resolution, is attained when the learners apply the new knowledge to solve the problem and assess the solution. Cognitive presence is achieved when all four phases progress and complete each other.

Through iteration between discourse and reflection, learners construct meaning and develop understandings. Indeed, technology in itself, and many online platforms and tools, can highly support inquiry-based learning due to its interactive and up-to-date features, and it can serve as an inquiry partner for instructors by helping them elicit their students' diverse ideas about topics and keep track of progressions in students' ideas [28]. A recent study [2] explored students' CP in relation to their participation in Massive Open Online Courses (MOOCs). The study revealed that the triggering phase of CP does not have a strong impact on how well students learn in the inquiry process. The study [2] found that learning is mostly correlated with the phases of exploration, integration, and resolution of CP as they engage the learner in information processing further than the triggering stage. Consequently, the study [2] suggested that integration had a more positive impact on learning when compared with exploration and resolution since it engages learners in more complex cognitive processing to build up resolutions.

Research suggests that CP in online learning environments can be enhanced through various instructional strategies such as collaborative activities, reflection, and the use of real-world scenarios [1]. The use of collaborative activities, such as group discussions and peer evaluations, leads to an increase in CP among online learners [1]. Additionally, the incorporation of real-world scenarios and problem-based learning activities also contributes to an increase in CP [29, 30]. Video plays a key role in adding authenticity to online learning and increasing CP [24]. Reflection has also been found to be a crucial component in enhancing CP in online learning. Structuring online discussions appropriately contributes to learners' reflective process which is enhanced by the four processes of CP. More particularly, the resolution phase should include a reflective element [31].

Learning activities and teaching strategies that foster CP in online courses mainly focus on open-ended discussion questions that promote divergent thinking and multiple perspectives, peer review of discussions, group discussions and brainstorming, providing multiple representations of content and a variety of activities, journaling and blogging, writing position papers, engaging in service learning and fieldwork, developing rubrics for discussions and course activities, involving students with videos, case studies, labs, stories, and simulation, and providing frequent opportunities for testing [18].

2.3 CHAT

Understanding complex learning situations, particularly when introducing novel tools, requires theoretical lenses that acknowledge the material-discursive and temporal aspects of learning in addition to the sociopolitical and cultural dimensions of educational settings [14, 32]. One such theoretical paradigm is Cultural-Historical

Activity Theory (CHAT). Rooted in Vygotsky's sociocultural perspective, CHAT emphasizes the inseparability of the individual from society, thus conceptualizing individuals and their environment as a holistic unit of analysis. More specifically, CHAT posits that the socially organized *activity* surrounding the individual is the major unit of analysis [33]. An activity comprises a combination of collective actions toward a purpose or an *object*: it is object-oriented, collective, and culturally mediated [34]. Engeström [35] developed the construct of an 'activity system' to characterize collaborative and purposeful human practices within their broad historical sociocultural context and identified a number of elements within an activity system (Fig. 2): (a) the *object* is the purpose or problem space targeted by the activity and this *object* is transformed into *outcomes*; (b) the *subject* is the individual or a group (collective activity) who directs the activity toward the perceived *object*; (c) *instruments* or *mediating artifacts* are cultural mediating tools utilized by or are available to the *subject* and *community* to target the *object,* such tools can be physical and symbolic (e.g., language), external and internal tools (e.g., information and communications technology [ICT] tools), and can either enable or constrain the activity; (d) the *community* represents individuals who share the same *object* (albeit with possibly different interpretations) and so distinguish themselves from other communities; (e) *rules* are the explicit and implicit norms, regulations, and conventions that regulate and control actions and interactions within the activity, and finally (f) *division of labor* refers to division of tasks *and* power among members of the community within the activity.

Online learning teaching and learning can be considered as an activity system. Its *object* would encompass certain types of learning, the coverage of predetermined material, and/or the development of desired competencies. The instructor as the *subject* attempts to realize the *object*, utilizing mediating tools seen as appropriate, available, and effective. Indeed, this activity is collective (as compared to individual) within the broad historical–cultural–social context of the educational organization/institution and so would inherently entail 'multi-voicedness,' where

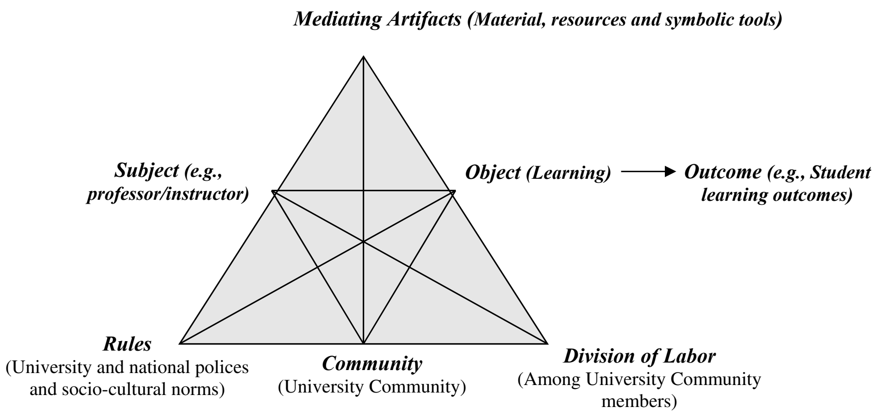

Fig. 2 The classroom as an activity system

different members of the community are bound to harbor multiple interests, traditions, and points of view. As such, the system itself carries "multiple layers and strands of history engraved in its artefacts, rules and conventions" [36]. In view of 'multi-voicedness' and the *ambiguous interpretive* nature of *objects,* the activity elements are in a constant dynamic relationship and, more often than not, give rise to dialectical contradictions among them [36]. In fact, contradictions, usually manifested as tensions, conflicts, and dilemmas, are a key principle of CHAT, as they can become motivators for change and translate into "innovative attempts to change the activity" through expansive learning [36]. *Expansive learning* or a qualitative transformation of the activity system starts from a contradiction between the elements of an activity system and the *subject's* and/or *community's* attempt at resolving it. Change may start at the individual level through the processes of internalization–externalization experienced by the *subject* and may lead either to adherence of the *subject* or to transformation of knowledge acquired by society if the contradiction is not sustainable [33]. Expansive learning is successful when the system develops a new expanded and "more complex *object* and concept for their *activity*" [34]. Moreover, expansive learning as a materially and socially mediated process would involve the development and appropriation of new *instruments, rules,* and/or *division of labor*.

As a transformative framework, CHAT, with its principle of contradictions as a driving force for change and expansive learning across the whole system, is frequently suggested to be a useful guide for *research in educational technology* and a lens to understand organizational use of ICT tools and human–computer interactions [37–39]. For example, CHAT is suggested to provide insights into transformation and restructuring of teaching practices [38], as a way to illuminate implicit and at times invisible and naturalized processes and interactions [40], and to explore and compare larger system issues and the influence of contextual factors on educators' utilization of new educational tools. Particularly, CHAT helps us better understand the contradictions that contribute to adherence and ones that facilitate transformation and expansive learning of the individual and system [41]. In this chapter, we use CHAT as an analytic framework to better understand and address barriers to enhancing CP in online learning as a desired *object* in the Lebanese higher education context.

3 Methodology

We adopted a mixed-methods and multiple-case-study approach to enrich our findings with insights from both qualitative and quantitative data collection methods, insights that we hope will generate workable and informative action [42]. Our case studies were *instrumental* and focused on exploring and characterizing the opportunities and challenges that emerge when transitioning courses into online formats in a higher education setting, and particularly the influence of these on CP.

3.1 Context and Sampling

This study is part of larger study on transition to online learning in a private higher education institution in Lebanon. The university studied is a non-profit and independent institution of higher education founded in 1988. It has a yearly approximate enrollment of 5500 students and has 12 faculties. The university follows a credit system, and its language of instruction is English (except for certain Arabic language and studies, history, cultural studies, and theology courses). The university is also one of the top-ranking universities in Lebanon.

Prior to COVID-19, the university did not have wide experience in online learning except for two faculty-specific initiatives. The Institute of Theology offers an online program to students living abroad. Also, the Department of Education had experimented with hybrid courses. In general, the faculty at this higher education institution had no prior training to adopt online teaching, but had some workshops guided by the IT department and the Department of Education to integrate technology into their teaching. The university has always used Moodle as the main learning management system. At the onset of the pandemic and the transition to online learning, the institution purchased a video-conferencing system license, Webex, and all faculty received training to shift to remote teaching. The IT department also developed an online proctoring system for midterm and final exams.

Data were collected between Spring 2020 and Spring 2022 from a purposeful sample of eight courses with the following sampling criteria: courses were chosen from different faculties and departments to include courses from science, engineering, health sciences, and psychology from the social sciences. The other criterion was that the courses had at least 15 students. Table 1 outlines the courses and the number of students.

3.2 Data Sources

As per an instrumental case-study approach, data were collected through multiple sources.

3.2.1 Quantitative Data

Our quantitative data consisted of the COI student survey adopted from Kovanović et al. (2018; [43]). The five-point Likert-scale COI instrument, originally developed by Arbaugh [23], measures students' perceptions of cognitive, social, and teaching presence in online courses (see Appendix A). The COI student survey has been widely used to assess online courses, across different disciplines and with large samples [43–46]. The instrument's Cronbach's alpha reliability was found to be 0.84 (0.94 for teaching presence, 0.91 for social presence, and 0.95 for cognitive presence)

Table 1 Courses selected for this study and number of students

Subject	Area	Number of students
Psychology	Social Sciences	33
Physics	STEM with high mathematical content	68
Nursing	STEM with more disciplinary content	31
Mechanical Engineering	STEM with high mathematical content	39
Computer Science	STEM with high mathematical content	17
Biology	STEM with more disciplinary content	20
Health Sciences	STEM with high mathematical content	16

across four higher education institutions [23]. The English-version instrument was piloted with students who were not included in the study for comprehensibility and language clarity.

The total instrument is composed of 34 items; however, for this study, we only focused on the CP section of the survey, which includes 12 items covering the following sub-scales with three items under each: triggering event, exploration, integration, and resolution. In total, 114 students completed the survey (around 50% response rate). Prior to data collection, all eligible students were informed about the aim of the study and about the questionnaire that requires approximately 7–10 min to complete.

3.2.2 Qualitative Data

Qualitative data were collected through online classroom observations of recorded Webex sessions and instructor interviews. Qualitative data provided thick data and deepened our understanding of participants' perceptions, their subjective experiences, and classroom practices, thus supporting data triangulation for enhanced rigor. Course instructors were interviewed at the end of the semester about their perceptions of the online teaching and learning experiences in general, and the quality of the educational experience, particularly in terms of students' learning, engagement, and communications. Instructors also discussed their online teaching practices. Interviews lasted around 50–90 min and were transcribed verbatim for close analysis.

Course observation data consisted of two randomly chosen recordings of synchronous instruction from the first five courses listed in Table 1. The course observation checklist was adopted from the same survey instrument [42] and modified to fit the purpose of the observations (Appendix B). Course observation data allowed us to observe online teaching in action or instructors' teaching practices.

3.3 Data Analysis

Students' responses to the questionnaire were converted into a numerical score for each student participant. Means and standard deviations of the 12 items of the COI instrument under CP were calculated and analyzed. Means and standard deviations of the 12 items of the CP were calculated. The quantitative data were analyzed descriptively and inferentially.

Interview and class observation data were analyzed qualitatively through thematic analysis [47, 48]. Thematic analysis was utilized to identify, analyze, organize, describe, and report themes around our qualitative data. The six phases of thematic analysis include:

Phase 1. Familiarization with data
Phase 2. Generating codes
Phase 3. Searching for themes
Phase 4. Reviewing themes
Phase 5. Defining and naming themes
Phase 6. Producing the report

As a hybrid approach that combines inductive and deductive reasoning, thematic analysis of qualitative data enables rigorous and methodical analysis while adhering to high-level trustworthiness criteria [48]. As investigators, we conducted among ourselves a form of inter-rater reliability or investigator triangulation of the interview and observation. We first analyzed together at least two interview transcripts to generate codes around general attitudes and perceptions of online teaching and learning, its advantages and disadvantages, and its rewards and challenges. We also discerned how they describe their pedagogy and pedagogical practices and activities, the quality of communications between them and their students, and their professional learning with the online format.

Online session recordings were analyzed both deductively and inductively. The online sessions were analyzed based on the frequency of the CP aspect that was observed in the recordings. Emergent themes were also used for practices or critical incidents not captured by the checklist, for example dimensions of knowledge targeted and any evidence of student-led inquiry. The collective and dialectic analysis of transcripts allowed the investigators to solidify understanding of the codes used and for extraction, review, and naming of themes. Triangulation of different data sources and negative-case analysis were conducted to enhance credibility of our study. We hoped that the heterogeneity of the sample and providing detailed verbatim demonstrative responses would provide in-depth and rich data for enhanced rigor.

A final level of analysis was constructing an activity system representation of the online teaching and learning activity as a schematic and structural model that describes and organizes a series of practices [36]. To illuminate series of practices and perspectives, data from the qualitative and quantitative analyses and the discerned themes informed the activity systems' various elements: *instruments*, *object*, *rules*, *community*, *division of labor*, and *outcome* (Fig. 1). Patterns in online teaching and practices and kinds of learning sought were discerned from observation data and informed mostly *instruments* and *object*. Interview data and student-filled survey informed *instruments*, *object*, *rules*, *community*, and *division of labor*. Once the activity systems were constructed, a final step involved identifying areas of contradiction and congruence in each context. Contradictions were identified when participants expressed challenges and difficulties toward reaching what they saw as *object.* Contradictions were also discerned when participants expressed contrasting views with others in the *community* (e.g., students, other instructors, administrators). The co-authors engaged in a dialectic and iterative process to construct the activity system and identify contradictions: we discussed, arranged, and re-arranged results from different data analyses into the different elements of a classroom's activity system and what constitutes contradictions.

4 Findings

4.1 Analysis of Survey Findings

Table 2 presents the sociodemographic characteristics of the participants. Of the 114 students who completed the questionnaire, 55 (48.2%) were males and 59 (51.8%) were females. Most of the participants fall under the age category 18–21 years (85.1%) and most of the students were at the senior level of study (36.8%) specializing specifically in biology (29.8%) followed by mechanical engineering (21.1%) and nursing (19.3%).

The internal consistency of the COI CP was found to be excellent with a value of 0.958. Descriptive statistics showed that the mean of the COI CP was 3.61 in a five-point Likert-scale (Table 3). The highest mean for CP was observed at the "Integration" stage where learning activities helped students integrate the course concepts. Students rated indicators of "Triggering events," "Exploration," and "Resolution" lower with mean scores of 3.56, 3.57, and 3.59, respectively.

Table 2 Sociodemographic characteristics of students

		Frequency (%)
Gender	Female	59 (51.8%)
	Male	55 (48.2%)
Age categories	[18–21 years]	97 (85.1%)
	[22–30 years]	15 (13.2%)
	[31–40 years]	2 (1.8%)
Academic status	Sophomore	33 (28.9%)
	Junior	37 (32.5%)
	Senior	42 (36.8%)
	Graduate	2 (1.8%)
Major	Mechanical Engineering	24 (21.1%)
	Chemical Engineering	9 (7.9%)
	Nursing	22 (19.3%)
	Biology	34 (29.8%)
	Medical lab	17 (14.9%)
	Physical Education	3 (2.6%)
	Tourism and Hotel Management	1 (0.9%)
	Public Health	2 (1.8%)
	Computer Engineering	1 (1.8%)

4.2 *Analysis of Interview Findings*

In this section, we present themes condensed from the interviews with the six instructors (Table 4); these themes are explained below and supported with data in the form of verbatim responses. Across the interviews, instructor's general attitudes and perceptions around online teaching varied across time (e.g., during the COVID-19 lockdown and the year after), and they saw both advantages and disadvantages; notwithstanding, they all agreed that the experience became better with time and more exposure to the format. Promoting safety-distancing and uninterrupted teaching were the major advantages identified. Interestingly, session recordings were regarded as both an advantage and disadvantage as shown in the excerpts below:

> Advantages: *"In [in-person] class there is no recording the session, then who attended benefits and the one who didn't he missed out." [STEM instructor].*
>
> Disadvantage: *"…students are not disciplined, and because there is the recordings. Using the electricity cut as a reason for us to record. We are recording the session, then the student will not attend the lecture and the student will go and listen to the recording later and this is a drawback for the online" "And this is a big, big, problem that I have. They do not attend.*

Table 3 Mean scores of cognitive presence as identified by students

Cognitive presence	**3.61**
Triggering event	3.56
23. Problems posed increased my interest in course issues	3.61
24. Course activities piqued my curiosity	3.47
25. I felt motivated to explore content-related questions	3.61
Exploration	**3.57**
26. I utilized a variety of information sources to explore problems posed in this course	3.65
27. Brainstorming and finding relevant information helped me resolve content-related questions	3.66
28. Online discussions were valuable in helping me appreciate different perspectives	3.41
Integration	**3.71**
29. Combining new information helped me answer questions raised in course activities	3.72
30. Learning activities helped me construct explanations/solutions	3.75
31. Reflection on course content and discussions helped me understand fundamental concepts in this class	3.67
Resolution	**3.59**
32. I can describe ways to test and apply the knowledge created in this course	3.64
33. I have developed solutions to course problems that can be applied in practice	3.55
34. I can apply the knowledge created in this course to my work or other non-class-related activities	3.58

Most of the students do not attend, um, few attend, and this is um, I think this is a problem because you need to, to, uh, ask a question, to interact with the lecturer in order really to understand the lecture, not only listen to the recording" [STEM instructor].

Even as instructors saw session recordings as providing extra support and access to students, some saw that students may become too reliant on them and hence attend less sessions, particularly students who are not 'disciplined' or 'serious.' It is worth mentioning here, that online attendance cannot be enforced in the Lebanese context due to the frequent electricity outages exacerbated by Lebanon's declining political and economic situation. A major disadvantage identified by the instructors was the limited interactions and responses from students in the online format as opposed to the in-person format:

"The difficulty was being interactive with the students and engaging with them, that was the main challenge. Umm, the material is the same, the idea is the same, um (small pause), how I'm explaining the examples and the way I'm going to deliver them, it had to change for them to be engaged" [Social science instructor].

In terms of pedagogical approach, a highly instructor-centered approach emerged as a preferred pedagogy. For example, in the STEM courses with high mathematical content and mathematical problems, instructors utilized guided practice, where they showed and modeled to students applications of concepts and how to solve exercises

Table 4 Themes generated from faculty interviews

General Perceptions	
General attitudes and perceptions on online teaching and learning and its advantages and disadvantages	• Not a preferred format for several instructors, especially highly mathematical courses • Requires more effort from instructors, but gets better with experience • Engagement and participation are connected to students' responsibility, seriousness, and discipline
Themes connected to cognitive presence	
Instructors' general teaching/pedagogy	• Mostly highly instructor-centered approaches • Authoritarian/interactive through mostly convergent questions – Modeling mathematical procedures – Presenting information • Occasional student-centered strategies in social sciences
Online teaching approach and practices	• Guided practice in courses that entail solving exercises (e.g., physics and statistics) • Showing online videos for content-heavy material (e.g., life science) to avoid monotony • Asking students to explain slides prepared by instructor • Case-study group analysis in the social science course
Self-directed learning and institutional support	• Instructors themselves researched and 'discovered' online tools to use in online sessions, e.g., MathType and breakout rooms • Institution was present for technical difficulties and creating recordings, but not for online teaching approaches and strategies

using whiteboards and annotation tools or other technological tools (e.g., annotating PPT or PDFs, MathType). A STEM (mathematical) instructor explained to us how he displayed an algorithmic problem on the shared screen, asked his students for solutions, and annotated as they shared; afterward, he shared the correct answer that he had prepared beforehand and explained the solution. Another STEM (mathematical) instructor expressed:

> *"I use them, annotation, I draw and there is the PowerPoint as another file different than the presentation, I draw on it, meaning, I draw on it, imagine me sketching on the board, I do it the same, but in front of them step by step…the students are loving this thing … The idea is that with the tools in my hand, I feel satisfied that I am transmitting all the ideas" [STEM instructor].*

As for the content-heavy STEM course, the instructor expressed the importance of having lectures 'live' and 'interactive,' for students to memorize the target information:

"So, they don't attend the lecture and my lecture, my lecture usually online, even in live, it's interactive, so I ask questions, I like the student to answer. So, they will remember and memorize the lecture before studying themselves" [STEM instructor].

All STEM instructors emphasized the importance of *presenting* and *showing* the material, for example through PowerPoint presentations and YouTube videos. During these pedagogical practices, they asked questions, albeit with mostly limited responses from students in the online format as compared to the in-person format as mentioned above. Their questions aimed to: (a) check for understanding, (b) correct misconceptions, and (c) help students memorize information.

The instructors expressed working hard at providing students with the teaching and learning experiences akin to the ones experienced in-person teaching. To do so, several of the instructors mentioned that they themselves researched online tools. For example, one of the STEM instructors mentioned discovering MathType that can be used to show students how equations are manipulated and derived, whereas the social science instructor 'discovered' breakout rooms herself in the platform used. As for teaching in ways that engage students more, two of the STEM instructors mentioned that they attempted to make the session more interactive by incorporating real-life examples and applications that demonstrate the concepts at hand—please see excerpt below from the social science instructor, where she explains what she says to her nursing students:

"…how they're going to apply these definitions that they learned into the case study this is what's interesting, this is what's important to me and it's interesting for them also because for them, now, it's like 'Ohhh, now I understand why I'm learning this it's meaningful not just like just giving them information, no I'm going to use them'. So, it's also going to give them motivation" [Social science instructor].

As for involving students in ways other than in presenting material or guided practice, two of the instructors mentioned the two strategies they used in in-person teaching and how they tried to bring these into the online format. In the content-heavy STEM class, the instructor usually asks students to read and explain her slides. However, she said that she found this challenging in online format because she and students cannot see each other like they can in the physical classroom.

"I ask them questions and mostly I don't read the slide myself. I let the students read then I ask the other student the questions. I asked them to explain…" [STEM instructor].

In the social science course, the instructor asks her students to discuss in small groups in break-out rooms before the whole-class discussion.

"You know, like I discovered it by myself, for me it was amazing. Now I can have the students in groups, we can work in a different way" [Social science instructor].

The above example is the closest to students collectively co-constructing knowledge, even as they do not approach constructing meaning through sustained and active inquiry during online learning experiences. As such, a strong CP as defined by Western scholars was not very evident in our data, particularly as it related to students conducting sustained inquiries into the target material.

4.3 Analysis of Observations

In total, 10 Webex-recorded sessions from the various courses in Table 1 were analyzed based on the checklist (Table 5). The analysis was based on the frequency of the COI elements in addition to notes that were recorded in the form of narrative (not included in Table 5).

Table 5 suggests that elements of CP and its process were barely evident except for the following two indicators: "Course problems trigger solutions that can be applied in real life" and "Learning activities are authentic and can be applied in the workplace." The online learning experience did not engage learners in any form of sustained inquiry. The first step in the process of inquiry is triggering events, and this was visible only in 2/10 sessions when the instructor used case studies in the nursing courses to pique the students' curiosity.

Table 5 Average of mean ratings of cognitive presence indicators per student perception

	N	**VR**	**R**	**O**	**F**
Items	**1**	**2**	**3**	**4**	**5**
Cognitive Presence (Inquiry)					
Triggering event					
18. The instructor poses problems that increase the students' interest in course issues. (Inquiry)	1	6	3		
19. The instructor uses course activities that pique the students' curiosity. (Inquiry)	3	2	3	2	
Exploration					
20. The instructor incites the students to utilize a variety of information sources to explore problems posed in this course		10			
21. The instructor pushes the students to do a brainstorming exercise and find relevant information that helps them resolve content-related questions and understand their different perspectives		10			
Integration					
22. The learning activities encourage students to combine new information to answer questions	3	5	2		
23. Learning activities helped students construct explanations/ solutions	2	4	1	3	
24. Learning activities involve students in reflections on course content	1	5	1	3	
Resolution					
25. Course problems trigger solutions that can be applied in real life	3			7	
26. Learning activities are authentic and can be applied in the workplace	3			7	

N: Never; VR: Very Rarely; R: Rarely; O: Often; F: Frequently

The exploration phase was very rarely observed in the Webex sessions; there was no evidence of students' engagement with the content, brainstorming, and searching for information to help them resolve content-related questions and understanding of different perspectives. All observed sessions were instructor-centered and direct instruction was the main methodology used. The instructors used different resources, such as images, video, textbooks, and case studies, yet course interactions were mainly instrcutor-led.

As for the third phase that involves integration of new knowledge, there were few instances when this was observed. In 3/10 sessions, learning activities helped students construct explanations/solutions and involved students in reflections on course content.

This was evident in nursing and health-sciences courses that provided examples and case studies for students to discuss and reflect on.

The final step in the inquiry process is resolution. This was evident in the observations despite the absence of the other steps. In 7/10 observed sessions, course problems triggered solutions that could be applied in real life, and the learning activities were authentic and could be applied in the workplace. For instance, in the programming (computer science) course, the instructor introduced students to real examples. Similarly, the physics course presented exercises that could be applied in real life. Despite the instructor-centered approach used, the instructor of both physics and programming courses modeled and scaffolded the solutions of exercises to students. In the nursing course, videos of real-life cases were shown to students followed by discussions and resolutions. Overall, most of the courses used real-life examples and problems in the absence of a sustained inquiry process.

5 Discussion

5.1 *Prevalent Instructor-Centered Approach*

The interview data and the observations revealed that the teaching approach that was mainly adopted in online courses was instructor-centered, which influenced the ways that CP materialized in online teaching. Observations of online sessions showed mostly modeling, explaining, and scaffolding of learning that is guided by the instructor [49] with limited student interaction and absence of triggering events, exploration, and integration, which are key elements in the inquiry process [2]. This may be attributed to several factors such as the availability of session recordings post-class which encouraged students to be passive in the synchronous sessions or skip class sessions and watch the recordings later. Another factor is instructors' limited readiness to adopt an online pedagogy, and instead, transfer the transmissive teaching approach that they were used to prior to COVID-19.

The study showed that the traditional transmissive teaching that was already prevalent in face-to-face teaching [50] shifted to the remote classrooms using the technology affordances provided by the Webex platform. Inquiry-based strategies that include pair work, group work, and problem-solving had already been barely used in Lebanese higher education prior to COVID-19 [50]. Readiness to adopt online teaching methodology is associated with the instructors' skills, habits, and methods in the face-to-face classroom [51]. Online learning calls for an array of methodologies that engage the learners in problem-based learning, inquiry-based learning, scenario-based learning, etc. [52]. Consequently, in online learning, the instrcutors' role has to shift from lecturer to facilitator, putting the learner at the center of the learning process, and this requires the development of a set of online teaching and instructional design skills [52, 53]. In this study, instructors attempted to create an interactive environment, albeit in an authoritative way, using an Initiation–Response–Follow up or feedback (IRF) mode of communication in the online settings. Hence, the findings of this study revealed methods that had already been part of the traditional instructor-centered teaching.

While all the elements of CP complete each other and are interrelated [19], the element of resolution was evident in this study based on observations and faculty description of their teaching strategies. Mainly, resolution was depicted in case studies that were discussed with students and in modeling the solutions of physics and computing problems during the synchronous sessions. Despite the problem–solution aspect in those learning activities, they were mainly instructor-led. The students were not given room to collectively explore the problems and integrate new knowledge to propose solutions. On the other hand, students rated integration higher than other dimensions with the following criteria being rated as the highest "*Learning activities helped me construct explanations/solutions*." According to Liu et al. (2022; [2]), integration has a more positive impact on learning when compared with exploration and resolution since it engages learners in more complex cognitive processing to build up resolutions. The students in this study are used to the instructor-centered approach which explains why they found the types of learning activity offered to them, such as modeling and explaining, helpful. Other studies have pointed out to the fact that students prefer the didactic mode over other student-centered approaches [53]. Hence, the rating of this criterion does not necessarily reflect the true nature of integration in CP, but may speak to the instructors' delignet efforts at modeling and scaffolding complex concepts and learning material.

Research shows that instructors' pedagogical and content knowledge impacts their use of learning technologies [52, 53]. This study indicated that science disciplines provided real-life examples and case studies as part of the teaching process. In courses that require solving exercises such as in physics and computing, the instructors modeled solutions of exercises to students, which students found helpful.

5.2 Instructors' Self-Directed Professional Learning

The instructors responded to the emergency online learning situation, and later to it as an institutional format, through self-directed learning, where many actively researched on their own and 'discovered' new tools to enhance their online teaching. Such self-directed learning is significant and can be leveraged for further professional devolvement. As importantly, faculty's self-directed learning needs to be supported by their institution, where the institution and its values and attitudes toward online learning influence the faculty's motivation and professional development [54–56], particularly toward more interactive teaching with more student-led explorations and hence stronger CP. Yet, transition to online teaching during the pandemic occurred unexpectedly, which translated into limited technical and pedagogical support for faculty, and little attention to best practices to online course design and implementation in higher education.

5.3 CHAT Analysis

The findings and the emergent themes outlined above helped inform the different elements of online teaching as an activity system and illuminate contradictions among them in relation to CP, as an *aspired-to-object* in Lebanese online and blended higher education. Setting the instructors as the *subject* and CP as an *object* helps us, as researchers, identify challenges and obstacles to CP as an outcome, and ways to support instructors to realize it in online and hybrid formats. Figure 3 illustrates graphically the activity system analysis of this study's data and findings and shows the situational factors that guided our interpretations of the contradictions facing CP as an *aspired-to-object* (Table 6). Four major contradiction areas appear to be facing enactment of CP or establishing online learning as a space for collective exploration and authentic problem-solving: these contradiction areas are outlined in Table 6, along with how instructors actively tried to tackle them.

To begin with, the *rules* that lead to online teaching and learning came about as a response to the emergency online learning situation and later as an 'imposed' format in light of the country's, and the institution's, mounting sociopolitical and socioeconomic crises [57]. These situational realities stand in contradiction to a well-planned transformation in instructional approaches and formats that combine top-down institutional initiatives with faculties' bottom-up, self-directed, and motivated professional development for designing online learning experiences. Within this contradiction, CHAT illuminates sociocultural implications and the influence of the historical, social, and organizational contexts on transitioning to online teaching and learning and the way technological *instruments* are used. Studying the changes in institutional cultures needs to consider the economy and history of the complex global social arenas that underly them [58]. The pandemic put all institutions and faculties to the test, compelling them to develop technology skills and online pedagogies within a limited time frame and with limited infrastructures in place [8]. Our

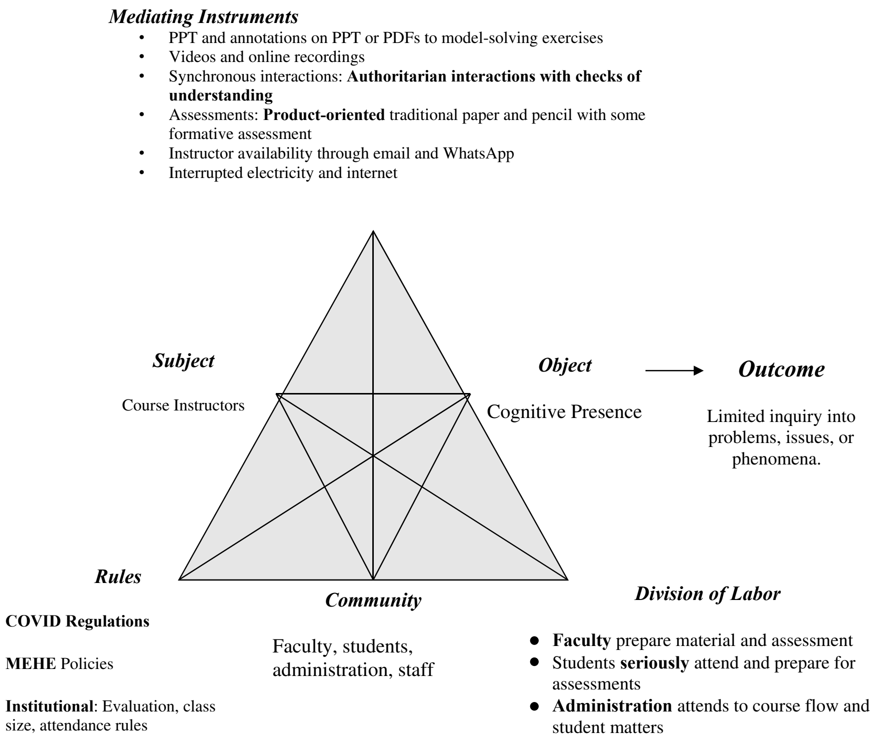

Fig. 3 Activity system analysis of the online learning experience at the institution

CHAT analysis shows that institutional rules were indeed influenced by the pandemic and the economic crisis jointly, whereby rules around students' attendance or using their cameras could not be implemented, and hence participation was further limited.

Other contradiction areas that emerged were internal, concerning the deployment of *instruments*, interactions among *subjects* and the *community* (especially students), and *division of labor*. As shown in Fig. 3, teaching approaches and interactions in online sessions were traditional with authoritarian classroom interactions: use of *instruments* (such as YouTube or PPT) was to 'transmit' content, and questioning mostly followed a closed IRF mode with predetermined responses to questions [41], with **limited** participation and opportunities for building on ideas. As such, although faculty and students had access to several technological tools, instructors' pedagogical orientations were pivotal in determining how they and their students used these tools and leveraged their affordances [10, 54]. Even previously used, more student-centered practices that could have supported a higher CP (e.g., asking students to explain information on slides prepared by the instructor) became more challenging online, with only '*serious*' students attending and participating (*subject–community* contradiction). This *subject–community* contradiction shows that the community (instructors, students, and even leadership) did not value the activity in the same

Table 6 Emergent contradiction areas among activity system elements

Contradiction areas	Attempts at resolutions by *subjects*
Subject—Rules • Online teaching and learning emerged first by necessity (COVID-19) and later top-down due to sociopolitical and socioeconomic factors and hardships	
Instruments—Object • Highly **authoritarian classroom interactions:** mostly closed-ended IRF • Highly **authoritarian** use of *instruments* (e.g., PPT and YouTube videos) • **Static tools** limited '*showing*' student how to solve	**Content-based:** Asynchronous student-centered discussions **Mathematics-based:** Annotation and derivation tools to model thinking and processes Recording practical procedures (e.g., lab) or posting videos the show them
Subject—Community • Poor attendance • **Students** rely on recording and do not attend	Relaxed attendance rules
Subject—Division of Labor • Faculty need more time to prepare courses and have less time for research • Limited institutional IT and instructional design support (e.g., PD) • Students **seriously** attend and prepare for assessments	Instructors researched themselves online learning tools

way or share a 'vision' of the teaching and learning online activity [58], leading to instructor frustration. Indeed, this gave rise to challenges and contradictions around *division of labor*, since routine teaching, like modeling or guided practice in solving exercises became more time- and effort-consuming in the online format. In fact, with limited planned and careful professional development, faculty had to research and 'discover' tools themselves.

To sum up, our CHAT analysis toward realizing CP as a desired *object* indicates a dire need to not only involve faculty in systemic and sustained professional development [13, 15] but also the need for institutions with all their community to engage collectively in identifying and negotiating joint *objects* and acknowledging that all community members are participating in a joint activity [32]. Through serious efforts toward developing shared understandings of CP as an *object*, productive and thoughtful *division of labor*, and engaged capacity-building activities, the university community as whole can move forward with actionable knowledge toward high-quality online/hybrid teaching and learning: that is, teaching and learning modes with a strong CP (and other presences) that promote cognitive and affective levels of participation among students and their instructors and the higher education institution as whole [58].

6 Conclusion

In this study, we attempted to explore, conceptually and empirically, contradictions that can either initiate or hinder expansive learning across the institution and the development of *novel mediating tools and technologies* in the Lebanese context. The study showed that adopting inquiry-based approaches in higher education, particularly in STEM majors, is no easy feat, and needs to be partaken through self-directed and collective faculty learning *along with* serious institutional ideological, pedagogical, and technological support. The data gathered revealed that the online courses lacked proper instructional design, resulting in a transition of the traditional/authoritarian teaching approaches to the online environment. While students appreciated the transmissive modeling/explaining approach used by instructors, this led to reduced student engagement.

With changing times and diverse students' needs, it is imperative that, as with learners, faculty and instructors engage in an '*inquiry community*' as a professional development model for continually growing as pedagogues, who strive toward best practices in teaching in general, and online teaching and learning in particular. Some faculty members researched tools to enhance students' roles and somewhat advance inquiry into their online teaching, thus enhancing aspects of CP in their courses: they attempted to use activities such as collaborative activities and group discussions in breakout rooms and to incorporate real-world scenarios [3]. This self-directed learning by faculty, witnessed in this study, can further be harnessed and leveraged through creating faculty learning communities (FLCs), whereby faculty receive ongoing support from each other as they explore, challenge, and reflect on their ideologies and practices [59]. The CHAT analysis and contradictions can be used while participating in FLCs both as a way to highlight felt and pressing needs and for discussion and dialogues on how to address them [60].

Indeed, participation in FLCs has been suggested as a bottom-up professional development model that facilitates and supports adoption of active pedagogies such inquiry-based approaches [61, 62]. The FLCs created by faculty and instructors promote a democratic learning community that strives to address student, institutional, and societal needs [63]; as such, faculty are positioned as collaborative change agents who support each other and assume transformed action [61, 62]. Particularly when targeted toward specific pedagogical goals, e.g., promoting CP as an *object* and the deployment of active technological tools, FLCs have been found to be an effective model of faculty learning [61, 64].

The potential of FLCs notwithstanding, meaningful capacity-building through FLCs also requires institutional top-down transformation on the part of the higher education institutions for systemic and sustainable change. The institution provided, to a certain extent, IT support for faculty through professional development sessions to use the video-conferencing tool and the online proctoring system, but course/instructional design support was provided minimally. A lower quality of online courses may undermine the educational benefits of online learning [65]. The presence of instructional design support with the help of instructional designers who guide faculty in the design and delivery of online courses is key in producing quality online courses and shifting teaching to a more student-centered approach resulting in enhanced student learning outcomes [66].

Since all higher education institutions experimented with online education for around 18 months, we see a potential for the growth of online learning as a pedagogical approach in the Lebanese context. Quality assurance guidelines particular for the Lebanese context, given the infrastructure problems, should be put in place, proper instructional design should be provided to instructors, and both bottom-up and top-down approaches to faculty learning should be encouraged.

APPENDIX A

Student Survey

Items	SD	D	N	A	SA
	1	2	3	4	5
I. Teaching Presence					
Design and Organization					
1. The instructor clearly communicated important course topics					
2. The instructor clearly communicated important course goals					
3. The instructor provided clear instructions on how to participate in course learning activities					
4. The instructor clearly communicated important due dates/time frames for learning activities					
Facilitation					
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn					
6. The instructor was helpful in guiding the class toward understanding course topics in a way that helped me clarify my thinking					
7. The instructor helped to keep course participants engaged and participating in productive dialogue					
8. The instructor helped keep the course participants on task in a way that helped me to learn					
9. The instructor encouraged course participants to explore new concepts in this course					
10. Instructor's actions reinforced the development of a sense of community among course participants					
Direct Instruction					

(continued)

(continued)

Items	SD 1	D 2	N 3	A 4	SA 5
11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn					
12. The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives					
13. The instructor provided feedback in a timely fashion					
II. Social Presence					
Affective expression					
14. Getting to know other course participants gave me a sense of belonging in the course					
15. I was able to form distinct impressions of some course participants					
16. Online or web-based communication is an excellent medium for social interaction					
Open communication					
17. I felt comfortable conversing through the online medium					
18. I felt comfortable participating in the course discussions					
19. I felt comfortable interacting with other course participants					
Group cohesion					
20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust					
21. I felt that my point of view was acknowledged by other course participants					
22. Online discussions help me to develop a sense of collaboration					
III. Cognitive Presence					
Triggering event					
23. Problems posed increased my interest in course issues					
24. Course activities piqued my curiosity					
25. I felt motivated to explore content-related questions					
Exploration					
26. I utilized a variety of information sources to explore problems posed in this course					
27. Brainstorming and finding relevant information helped me resolve content-related questions					
28. Online discussions were valuable in helping me appreciate different perspectives					
Integration					
29. Combining new information helped me answer questions raised in course activities					
30. Learning activities helped me construct explanations/solutions					

(continued)

(continued)

Items	SD	D	N	A	SA
	1	2	3	4	5
31. Reflection on course content and discussions helped me understand fundamental concepts in this class					
Resolution					
32. I can describe ways to test and apply the knowledge created in this course					
33. I have developed solutions to course problems that can be applied in practice					
34. I can apply the knowledge created in this course to my work or other non-class-related activities					

SD: Strongly disagree; D: Disagree; N: Neutral: A: Agree; SA: Strongly Agree

Appendix B

Observation Checklist

Items	N	VR	R	O	F	Notes/indicators and evidence or counter-evidence
	1	2	3	4	5	
Faculty/Teaching Presence						
Design and Organization						
1. The instructor clearly communicated important course**/ session** topics to the students						
2. The instructor clearly communicated important **course/session** goals						
3. The instructor provided clear instructions on how to participate in course learning activities						
4. The instructor clearly communicated important due dates/time frames for learning activities						
Facilitation						

(continued)

(continued)

Items	N 1	VR 2	R 3	O 4	F 5	Notes/indicators and evidence or counter-evidence
5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped the students to learn The instructor identified areas of confusion or misconception and used this knowledge to enhance student learning The instructor allowed room for student views and built on them						
6. The instructor was helpful in <u>guiding</u> the class toward understanding course topics in a way that helped the students clarify their thinking The instructor used open- and closed-ended questions purposefully to clarify students' thinking						
7. The instructor helped to keep the students engaged and participating in productive dialogue. What forms of dialogue?						
8. The instructor helped keep the students on-task in a way that helped them to learn. Time on task and focus						
9. The instructor encouraged the students to explore new concepts in this course						
10. Instructor actions reinforced the development of a <u>sense of community</u> among the students (can be deduced from more-concrete items, such as group work, student discussion in breakout, acknowledging students' concerns and comfort)						**Indicators**
Direct Instruction						
11. The instructor helped to focus discussion on relevant issues in a way that helped the students to learn						

(continued)

(continued)

Items	N	VR	R	O	F	Notes/indicators and evidence or counter-evidence
	1	2	3	4	5	
12. The instructor provided feedback that helped the students understand their strengths and weaknesses relative to the course's goals and objectives. What kind of feedback? Based on data						
Social Presence						
Affective expression						
13. Students are given an opportunity to self-express in the course						
14. The instructor shows interest in the students' concerns, comfort, and belonging in the course						
Open communication						
15. The instructor encourages discussions with the students						
16. The instructor encourages the students to interact with one another, share their ideas, and discuss and argue about them comfortably						
Group cohesion						
17. The instructor encourages students' teamwork and collaboration, e.g., breakout rooms and group projects						
Cognitive Presence (Inquiry)						
Triggering event						
18. The instructor poses problems that increase the students' interest in course issues. (Inquiry)						
19. The instructor uses course activities that pique the students' curiosity. (Inquiry)						
Exploration						

(continued)

(continued)

Items	N	VR	R	O	F	Notes/indicators and evidence or counter-evidence
	1	2	3	4	5	
20. The instructor incites the students to utilize a variety of information sources to explore problems posed in this course						
21. The instructor pushes the students to do a brainstorming exercise and find relevant information that helps them resolve content-related questions and understand their different perspectives						
Integration						
22. The learning activities encourage students to combine new information to answer questions						
23. Learning activities help students construct explanations/solutions						
24. Learning activities involve students in reflections on course content						
25. Course problems trigger solutions that can be applied in real life						
26. Learning activities are authentic and can be applied in the workplace						

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Beyond Digital Learning Modalities and Tools: Centering Learners' Socioemotional Wellbeing in the Context of E-Learning in the Arab Region

Maha Al-Freih and Maha Bali

Abstract The higher education sector in the Arab region is undergoing significant transformation, especially in the area of online and digital learning. The COVID-19 pandemic served as a wake-up call to higher education institutions, pushing leaders and decision-makers to build on the momentum gained and reposition digital learning as central to their strategic plans and future success. However, while Arab countries succeeded in ensuring continuity of education using distance and online technologies and platforms, these initial solutions were mainly devised to overcome the physical separation imposed due to public health concerns, with less attention being paid to the social and emotional ramifications of this shift on learners and instructors alike in the midst of an anxiety-inducing time of uncertainty due to the pandemic itself. This chapter is our contribution to enriching the current discourse surrounding digital learning in the Arab world and reflects on recent developments in research and practice surrounding adult learners' social, emotional, and psychological wellbeing as we attempt to answer the following questions: What might centering learners' emotional and social wellbeing look like within the context of distance and e-learning in the Arab region? How did educators develop the skills and literacies needed to create human-centered learning experiences? And finally, what are the challenges facing university educators as they attempt to apply these practices, particularly in Arab universities? To answer these questions, we interviewed seven university educators from Egypt and Saudi Arabia about their experiences of teaching online during the pandemic. We make connections between relevant notions, theories, and practices emerging from Arab cultures and educators as well as Western and non-Western approaches, and their application in the Arab context, such as humanizing online

M. Al-Freih (✉)
College of Education, Department of Educational Technology, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia
e-mail: mmalforaih@pnu.edu.sa

M. Bali
American University in Cairo, New Cairo, Egypt
e-mail: bali@aucegypt.edu

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learning, ethics, and pedagogies of care, Intentionally Equitable Hospitality, equity/care matrix, trauma-informed pedagogy, Universal Design for Learning, engaged pedagogy, and critical digital pedagogy.

Keywords Pedagogy of care · Critical digital pedagogy · Humanizing online learning · Socioemotional wellbeing · E-learning · Distance education · Higher education · Arab universities

1 Introduction

The higher education sector in the Arab region is undergoing significant transformations, especially in the area of online and e-learning. Until recently, online and distance learning as a formal learning/teaching modality did not garner much attention and was considered subpar to traditional face-to-face courses and programs. However, the forced shift to distance and online learning in response to the COVID-19 pandemic served as a wake-up call to higher education institutions globally, pushing leaders and decision-makers to reevaluate e-learning as an embedded and permanent part of their learning ecosystem and to build on the momentum gained during the pandemic by repositioning e-learning as central to their strategic plans and future success. That said, this abrupt and sudden shift to online and distance learning during the pandemic, which happened almost overnight, was not ideal [1, 2]. The goal was to ensure continuity of education, and most of the effort at the time was focused mainly on ensuring technology availability, functioning infrastructure, providing technical workshops to instructors, and supporting them as they moved their face-to-face courses online, with less attention being paid to the pedagogical implications and socioemotional ramifications of this shift on learners and instructors alike.

This abrupt and sudden move to remote and online teaching during the pandemic presented substantial challenges to educators who were expected to continue their teaching remotely, in many cases overnight, with little to no time to seek other options or thoughtfully rethink their course design. Students also struggled. The isolation and anxieties caused by the pandemic resulted in a decline in student health and wellbeing, an added challenge educators had to deal with as they shifted their teaching online. As a result, there has been an increased interest in more humanized, compassionate, and equity-oriented approaches to online teaching and learning and growing calls for the need to understand the implications of technology on the mental health and socioemotional wellbeing of students.

As we move away from emergency online teaching driven by uncertainties and pressure toward more proactive, high quality, and intentional online learning design and learning, we must reflect on all the challenges, gains, and lessons learned. It is during these times of significant change where we need to reflect on our priorities and purpose, and bring to the forefront the voices, needs, and the lived experiences of those our higher education institutions and systems exist to serve: the learners. This simple exercise has significant implications for the progress of digital learning in the

Arab world, as it provides the space for our human values, such as care, social justice, compassion, equity, community, and empathy to shape our conceptualization and expectations of digital learning, creating a humane experience served by technology, rather than being guided by it.

2 Positionality

The authors of this article are two educators, one in Saudi Arabia and one in Egypt.

I, Maha Al-Freih, am an Assistant Professor of Instructional Design & Technology at the College of Education at Princess Nourah bint Abdulrahman University (PNU). Prior to the pandemic, my main focus was on research and teaching—both at the graduate and undergraduate levels. Coincidentally, the research project I was involved in at the time, in collaboration with my colleagues from the United States, Heather Robinson and Whitney Kilgore, was centered around the theory and practice of care ethics in online learning and design. While my research and teaching philosophy and practice has always focused on the human element in online learning, my involvement in this research specifically became critical as I was approached by my college to serve on an emergency committee tasked with supporting educators at my college as they moved their teaching online. In this role, as we discussed support structures and technology-based pedagogical solutions, my main objective was centering our support around the values of care, empathy, and compassion—for both students and educators.

I, Maha Bali, am a Professor of Practice at the Center for Learning and Teaching at the American University in Cairo, where I am an educational/faculty developer. During the pandemic, my department supported the entire university to move online, and I was one of the main people offering workshops to educators and written guidelines to help them teach online. I was also teaching an undergraduate course. In both of my roles, putting care at the center of how we dealt with the pivot to online learning was essential care for both the students and their professors. All of the educators from my institution who were interviewed for this research are people I worked with, and this is how I know they also focused on care while teaching remotely/online. In parallel, I was collaborating online with people from all over the globe on how we can take pedagogy of care further during the pandemic and focus on equity with care. Prior to the pandemic, my work had already centered on issues of social justice and care in digital and non-digital contexts, but this focus became more important during the pandemic where more people became aware of the importance of this.

3 Why Investigate This Topic? Why now?

While the topic of mental health in education and especially in online learning had not been heavily discussed prior to the COVID-19 pandemic in 2020, it is important when discussing it in this context not to assume a correlation between mental health challenges and online learning without accounting for the effect of the pandemic itself [3].

According to Imad [4], the pandemic triggered three categories of trauma stressors: uncertainty, isolation, and loss of meaning. The uncertainty was widespread, whether due to uncertainty about health, finances, or educational situation; the isolation relates mainly to the social/physical distancing mandates around the globe; and the loss of meaning came from the inability to plan ahead for our priorities in life, which for educators and students in higher education was the educational process itself [4]. In a study spanning 31 countries, Bozkurt et al. [1] found that one of the common themes that surfaced across countries and education sectors during the pandemic was the "trauma, psychological pressure, and anxiety" (p. 3), whether due to health-related challenges, or economic or social impacts of the pandemic, and this impacted learners as well as educators and parents. At the same time, learners and teachers were forced to develop new digital skills and literacies that were unfamiliar to them and to use media they were not used to using, not only for learning purposes but also for psychological support. This, coupled with the loss of social support caused by physical distancing measures, meant that learners and educators alike had to discover new ways of finding social support. Another common theme across countries was the widening "digital divide" (p. 5), intensifying inequality in access to education between those who have access to high-speed internet and devices and those who don't.

We (Maha and Maha), as educators with many years of experience in teaching and learning online, and ways of humanizing it and doing it with care, knew that online learning *could* be used in ways that offered care for learners and supported their socioemotional wellbeing. However, we recognize that most other educators around us did not have this experience before 2020. What motivated us to conduct this study was to showcase how, during the pandemic, people who were not previously experienced in online teaching managed to find ways to show care for students and promote their socioemotional wellbeing. As online and blended learning approaches take a more prominent place in our educational systems, it is critical that we now reflect and document the practices and innovations that emerged during that period, as well as what hurdles persist, so that the lessons learned, and progress made are not lost. Our hope is that this study will offer ideas and approaches for other educators to use when they teach (online, hybrid, and offline), and that we can influence administrators and policymakers to modify the systems and cultures that pose barriers to centering pedagogies of care in higher education in the Arab region beyond the pandemic.

4 Relevant Theories, Models, and Frameworks

In this section, we briefly review several human-centered theories, models, and pedagogies, and those focusing on care and socioemotional wellbeing. While many of these theories and practices overlap and intersect, they each provide a unique focal point or perspective on issues of care, empathy, equity, social justice, and student wellbeing and how that may look like in the process of online teaching and learning.

4.1 Humanizing Online Learning

Humanizing learning, whether online or face-to-face, calls for and supports the integration of affective and non-cognitive components of learning. To humanize online learning is to recognize that students are not merely names on a screen, rather it acknowledges the diversity students bring to the classroom and pushes us to respond to it by removing cognitive and non-cognitive barriers to student engagement that may prevent some students from reaching their full potential. According to Pacansky-Brock, Smedshammer, and Vincent-Layton [5] "*'Humanizing' is a pedagogical strategy that seeks to improve equity gaps by acknowledging the fact that learning environments are not neutral; rather, they often operate to reinforce a worldview that minoritizes some students*". Humanizing prioritizes a concern for each student as a whole person and is rich in meaningful human connections. The aim is to create a caring, inclusive, and equitable learning space where student diversity, perspectives, and experiences become a source of empowerment, learning, and growth.

Humanizing online learning serves as a pedagogical lens or an approach to online teaching and learning that integrates elements of various human-centered theories and notions such as trauma-informed pedagogy, culturally responsive teaching, social presence, validation theory, and Universal Design for Learning built on the principles of trust, presence, empathy, community, and awareness [6, 7]. It requires an intentional and critical approach to online course design and implementation where digital tools promote, rather than hinder, personal, and deep connections with instructors and other students [8].

Humanizing online learning is becoming even more critical as online learning expands the reach of higher education to include a more diverse set of learners who might have been previously left out due to social, economic, or geographical barriers. Humanizing online learning as an approach to online teaching and learning does not provide a predetermined set of rules or procedures to be followed by instructors as this notion goes against the basic premise of what humanizing learning is about. In a humanized learning environment, teaching and learning is an emergent practice and highly contextual [7, 9, 10].

4.2 Critical Digital Pedagogy

"Critical Digital Pedagogy must also be a method of **resistance** and **humanization**" [11] (emphasis added).

One of the starting points for a critical digital pedagogy is the insistence that "pedagogy is not ideologically neutral" [11], in the same manner that Freire [12] has written. This recognition that pedagogy isn't neutral is important in education as a whole, but even more important to emphasize when technology becomes involved in education, to counter some of the hyperbolic narratives that treat educational technology interventions as magic-bullet solutions.

If we define pedagogy as "a critical thinking exercise directed at learning and teaching" [13], and recognize that digital pedagogy must entail making decisions about context and learning environments as well as educational content [13], then a critical digital pedagogue is someone who questions the tools used in digital education: "It is, in fact, part of our **care** for those tools and students who use them that demands we approach educational technology critically" [14].

Critical digital pedagogy can be understood as "an approach to teaching and learning predicated on fostering agency and empowering learners (implicitly and explicitly critiquing oppressive power structures)", one that eschews a content focus in education and instead centers learning around dialogue among learners [11]. Among its practices are emphasizing community and collaboration, done by including the voices of diverse participants across boundaries, and its relevance beyond the walls of an educational institution [11]. It is learner-centered and fosters students' agency to control their learning, teaches them how to choose the most appropriate tools that will promote their learning, and empowers them to use the web in ways that teachers may or may not have designed for or anticipated [13].

4.3 Ethics and Pedagogies of Care

One of the most influential figures in shaping our understanding about the ethics of care in general and its implications for the field of education specifically is Nell Noddings [15, 16]. Pedagogies of care prioritize meaningful instructor–student relationships built on trust and emphasize mutual respect, cooperation, receptive listening, and ongoing dialogue. Central to Noddings' philosophy is the relational nature of care. She argues that relations are basic to our experiences as humans, and it is through these deep human bonds between the carer (instructor) and the cared-for (student) that one can be receptive to the expressed needs of the cared-for and respond in an appropriate manner that maintains the relationship. The cyclical nature of care is also central to her philosophy, and, as such, the caring encounter is only complete when the cared-for has acknowledged that the care has been received [16].

As educators, we are naturally driven by our care toward our students. We all—as educators—want what is best for them and their future. However, ethics of care or relational caring is not bound by what we as educators, schools, or educational systems believe is best for them, it is about building a climate of trust and respect that empowers learners to express themselves freely and openly and, in the process, provide educators with a window into the actual needs of students so they can respond in a manner that builds students up personally, academically, and morally. In this sense, the act of caring is action-oriented and requires a certain level of competency. It informs the practice of teaching rather than controlling the process of learning. It becomes the basis of all pedagogical choices and the foundation upon which we build learning experiences [15, 17].

> Virtue carers may or may not be constrained by the expressed needs or wants of the cared-for. Relational carers must take these needs and wants into account as they decide what to do. [15]

Recent research has highlighted certain instructor behaviors and course design considerations that contribute to a climate of care in an online learning environment [18–20]. Instructor presence, responsiveness, flexibility, personalized and dialogic feedback, opportunities for synchronous interactions, and promoting a sense of community and connectedness through well-designed group activities and dialogue in an online learning space can all enhance and support a sense of care and being cared-when learning online.

4.4 Equity/Care Matrix

The *equity/care matrix* [21] suggests that we cannot discuss care in any context without also addressing equity issues around care. Without integrating equity into our models of care, we cannot guarantee that care recipients are receiving the care that they would choose for themselves. Noddings [16] suggests that we "Do unto others as *they* would have done unto *them*" (emphasis added), rather than as *we* would prefer done to *ourselves*. Moreover, we cannot address injustice without care, since "justice needs care because justice requires the empathy of care in order to generate its principles" ([22], citing Okin 1990).

The matrix builds on what we know about the multi-dimensionality of social (in)justice [23] and the multitude of existing oppressions and their intersectionalities (Collins 2002, as cited in [24]), and how they are affected by context. It also recognizes that care takes many forms, all of which are influenced by power dynamics, and some of which may be harmful, paternalistic, or disingenuous.

The equity/care matrix (see Fig. 1) describes four quadrants as follows [21]:

1. No equity and no care are *systemic injustice*.
2. Equity without care is *contractual equity*. It means policies can be written to ensure equity, but if the people enacting those policies do not care, the outcomes will not be equitable or caring. It is a performative situation, a kind of diversity theater. Noddings' notion of "virtuous care" may fall under this quadrant, as people act out of duty and not genuine care.

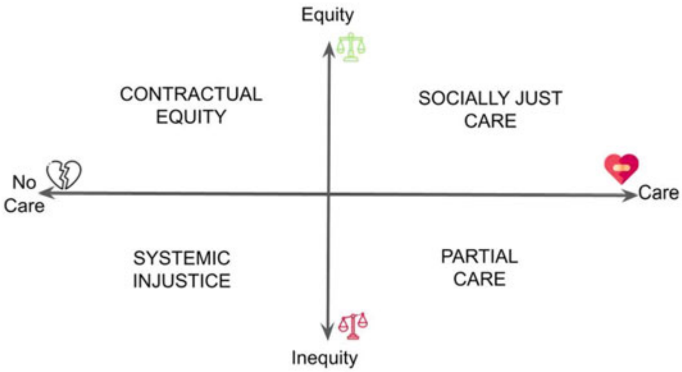

Fig. 1 Equity/care matrix

3. Care without equity is *partial care*. Partial here is in three ways: it is partial in that the burden of affective labor falls on a few while others do not care; it is partial in that only part of the population receives care, so it is selective care; and it is partial as in biased, because certain groups will be cared for, but not others. When care is distributed inequitably, both caregivers and care receivers can be harmed. As Noddings [16] suggests, caregivers "need the support of a caring community to sustain them".
4. Equity with care is what Bali and Zamora [21] call *socially just care*. It is a situation where everyone has responsibility for care and everyone is cared for (like Tronto's notion of *democratic care* [22]), and everyone has a say in how they want to be cared for (similar to Noddings [16], and Fraser's [23] notion of parity of participation), and also recognizes that caregivers in contexts that are not always reciprocal with their care recipients (like teachers, nurses, parents) need communities to care for them as well. It also builds on *intentionally equitable hospitality* [25, 26] which recognizes the power of the teacher/facilitator of a space as "host" in ensuring the needs of those furthest from justice are prioritized and offered with genuine care, similar to Noddings' notion of "relational care".

4.5 Trauma-Informed Pedagogy

Trauma has been defined in many ways; one understanding of it is as follows:

> Individual trauma results from an event, series of events, or set of circumstances that is experienced by an individual as physically or emotionally harmful or life threatening and that has lasting adverse effects on the individual's functioning and mental, physical, social, emotional, or spiritual wellbeing [27].

As previously mentioned, the pandemic triggered several trauma stressors for educators and learners alike, because of the uncertainty, physical and social isolation, and the loss of meaning it created. When individuals suffer from trauma, it can affect their ability to cope with everyday living, manage cognitive processes that impact learning such as memory and attention, reduce their capacity to regulate their behavior and manage their time, and affect their overall physical, mental, and emotional wellbeing [27].

An approach to trauma-sensitive education recognizes the importance of empowering the persons experiencing trauma and offering them choices at times where other choices have been taken from them, encouraging opportunities for collaboration, and creation of safe spaces where trust can be built [4, 27].

4.6 Universal Design for Learning

Universal Design for Learning (UDL) is an approach to designing learning experiences that "reduce barriers and maximize learning opportunities for all learners" in order to "meet the needs of all learners" [28]. As such, the guidelines offer choices to learners along three dimensions: "multiple means of engagement" addressing the "why" of learner motivation; "multiple means of representation", in the "what" educators show to learners; and "multiple means of action and expression", in "how" learners show their learning to their teachers [29]. One can see immediately how this inclusive approach to designing learning experiences would support a trauma-informed approach to education by offering learners choices along these three dimensions, and how it addresses the equity/care matrix by emphasizing the care for diverse learners and learner's abilities and interests. A UDL approach can also be expanded to become culturally relevant and antiracist, by recognizing power dynamics, challenging and redressing them [30]. Fitzgerald's [30] approach to UDL addresses learner differences even in stress levels and suggests that where trauma is probable, it is important to build learning environments that promote trust. This resonates with what trauma-informed pedagogy recommends. Recognizing that learners are different in terms of abilities and experiencing trauma may also lead educators to recognize that "the notion that one model of care will work for everyone is absurd…humans vary in their abilities to give and receive care" [22].

4.7 Engaged Pedagogy

The notion of "engaged pedagogy" was put forth by bell hooks [31, 32], who suggested that "teachers who care, who serve their students, are usually at odds with the environments wherein we teach" [32]. Such a "radical pedagogy" approach focuses on including the voices of every student in influencing and participating in decisions related to the classroom environment [31], because "caring educators" commit to a purpose of education that is "to create the conditions for freedom" [32].

"Engaged pedagogy" [31] is similar to "holistic education" (Thich Nhat Hanh, cited in [31]) and is one that integrates wellbeing into critical pedagogy, where teachers "must be actively committed to a process of self-actualization that promotes their own wellbeing if they are to teach in a manner that empowers students" ([31], Kindle location 286). It is an educator's belief that "our work is not merely to share information but to share in the intellectual and spiritual growth of our students. To teach in a manner that respects and cares for the souls of our students is essential if we are to provide the necessary conditions where learning can most deeply and intimately begin" [31].

Returning to the notion that such caring, engaged, radical pedagogy is often at odds with institutional structures, hooks [32] suggests that this philosophy and praxis are "a form of political resistance" as it "eschews the notion of reward. The satisfaction is in the act of giving itself, of creating the context where students can learn freely" [32].

5 Centering Learners' Socioemotional Wellbeing in the Context of E-Learning in the Arab Region: The Study

Our objective for this qualitative inquiry was to explore Arab educators' perspectives, experiences, and challenges as they attempt to humanize online learning and design, and to describe the perspectives and practices emerging from Arab cultures in light of the Western and non-Western approaches, notions, and theories discussed in the previous section such as ethics and pedagogies of care, UDL, equity/care matrix, engaged pedagogy, and critical digital pedagogy. The topics of inquiry that guided our interviews and analysis were:

- Q1: What might centering learners' emotional and social wellbeing look like within the context of distance and e-learning in the Arab region?
- Q2: How did educators develop the skills and literacies needed to enable them to create human-centered learning experiences?
- Q3: What are the challenges facing instructors as they attempt to apply these practices, particularly in Arab universities? And what can be done to alleviate these challenges?

The educators we interviewed for this inquiry were purposefully selected. We sought to find information-rich cases by interviewing Arab educators who have demonstrated interest in students' social and emotional wellbeing and who have taught undergraduate level courses online. We recruited educators we personally knew via sending emails and asked for network referrals of other suitable participants. A total of twelve educators with different academic backgrounds from Egypt and Saudi Arabia were invited to participate. In the end, seven participants, five from Egypt and two from Saudi Arabia, were interviewed (see Table 1 for a demographic breakdown of the participants interviewed).

Table 1 Study participants

Pseudonyms	Country	Gender	Discipline	Highest level of education	# of online courses taught[a]
Kamal	Egypt	Male	Mechanical engineering	PhD	4
May	Saudi Arabia	Female	Orthodontics	PhD	1–5
Zaina	Egypt	Female	Education	PhD	3
Dalia	Egypt	Female	Economics	PhD	5–10
Hoda	Egypt	Female	Psychology	PhD	5–10
Shamel	Egypt	Male	Computer science and engineering	PhD	11 or more
Sara	Saudi Arabia	Female	Information Systems	PhD	1–5

[a]Courses were taught at undergraduate level, except in the case of Zaina who taught two of the three courses at postgraduate level (in this study, focus was on the undergraduate course)

It is important to note that the context of the American University in Cairo is not representative of all universities in Egypt: it is a private, American liberal arts-style university, where students learn in English in small-sized classes (15–35 students). However, this context aligns with other private and American-style universities in Egypt and the region. The participants interviewed from Saudi Arabia were from two large public universities in Riyadh.

These semi-structured interviews were conducted online via Zoom or email. For those who chose to be interviewed via email, follow-up questions were sent to them to ask for clarifications or elaborations on their responses if needed.

We used thematic analysis to analyze interview data. Thematic analysis is a flexible approach to qualitative research that seeks to identify and analyze patterns or themes within data and is a useful method of analysis for understanding experiences, behaviors, and thoughts across a data set [33]. In our analysis, we followed the analytical process suggested by Braun and Clarke [33], which can be summarized in the following steps:

- Familiarizing ourselves with the data: this began by transcribing and anonymizing all Zoom interviews prior to analysis. This was followed by reading and rereading through the Zoom and email transcripts, note taking, reflections, and annotation.
- Generating initial codes: this, in our case, was performed manually by identifying interesting and relevant extracts of the data and assigning initial codes. The process was guided by our research questions.
- Searching for themes: in this step, we began grouping codes according to conceptual similarities and collating corresponding data extracts under potential themes. Identification of themes was based on its relevance and whether it captures something important in relation to our overall research questions.

- Reviewing themes: in this step, we reviewed all coded extracts to confirm whether they were representative of the themes or whether the themes needed to be reworked by breaking them down into separate themes or combining separate ones.
- Defining themes: this step consisted of describing the essence of each theme in relation to our research questions with sufficient detail to distinguish them from each other.

This process was not linear, we moved back and forth between these steps as needed. We met online regularly to discuss our individual understanding and interpretation of the data and engaged in member checking to review codes/themes and/or resolve any disagreements.

6 Findings

The findings from our qualitative inquiry are presented next and are organized around each of our main research questions.

6.1 Q1: Practices for Centering Learners' Emotional and Social Wellbeing in the Arab Region

We interviewed Arab educators to better understand their views on students' social and emotional wellbeing, and how their views and perspectives are reflected in their course design and pedagogical practices when teaching online. The interviews highlighted a wide range of perspectives, practices, and strategies centering around four main themes: (1) The Whole Person, (2) Student-Centered Practices, (3) Learning Communities, and finally, (4) Assessment Practices.

6.1.1 The Whole Person

May began her interview by saying,

> For me my priority in all honesty was the wellbeing of everyone. I care so much about emotions, the wellbeing, because I feel sometimes we drift from seeing our students as humans to seeing them as candidates who are going to graduate.

This statement encapsulates the essence of an important theme emerging from our analysis: *The Whole Person.* Several of our participants described their concern for students as a whole and shared with us some of the strategies and practices they have implemented to support their students, beyond their academic achievement and progress, that take into consideration students as human beings with unique personal experiences, aspirations, social and personal commitments, and challenges. Educators showed empathy toward students' declined mental state, brought on by the anxieties and uncertainties of the pandemic, being more attentive during online sessions and incorporating different strategies and tools during online classes to "*boost their morale*" and "*lift everyone's spirit up*".

A number of our participants expressed interest in students beyond their academic success, showing concern for students as a whole by encouraging them to find their voice and explore their potential. Take Kamal, for instance, "*Beyond helping mental wellbeing, reasons to find a purpose for the courses I teach, whichever way they take it in their life. [I was] less focused on their achievements in terms of depth and a bit more in terms of skill and ability to map to their lives*".

For some of the educators we interviewed, supporting students' mental health and social wellbeing as part of the curriculum was challenging. May reflected on this and shared her concerns regarding the limitations of the college curriculum and how it overlooks some very important life skills that students need to lead a happy and healthy life beyond their academic success and future careers, "*I mean we learn how to do CPR and all these things, but nobody taught us as adults or taught these [students] who are being prepared for life and work how to deal with their emotions, how to utilize it in efficient ways to make us more balanced individuals*". She goes on to explain,

> I am interested in the topic of emotional intelligence, and I believe our curriculum needs to include such issues. I mean everyone is talking about soft skills, for ages! But what are we actually doing to teach students soft skills? How are we evaluating and making students feel the importance of soft skills? Nothing! I took a certificate in emotional intelligence and how to be an assessor so I can understand the topic in more detail, but this was on an individual basis. After I completed the certificate, I felt how it improved my life. I felt that this message shouldn't stop at me, I started thinking how this can help students. So I tried to incorporate these topics in my classes.

Kamal also talked about how he modified his approach to teaching and how that ended up reducing stress for students and himself. He pointed out that he learned that prioritizing their wellbeing and reducing stress did not at all reduce the academic rigor or achievement. From his comment on this, it appears like he felt compelled to justify that caring for a student as a whole person does not reflect poorly on academic performance or course rigor.

6.1.2 Student-Centered Practices

The sudden and forced shift to remote teaching presented many challenges to educators, but this disruption was also an opportunity for reflection and actionable change that places student learning and wellbeing at the center. Kamal recalls, "*we were already talking about improving teaching coz of VR stuff. Forced me to take action now, all part of a bigger revision. Beginning to comprehend the meaning of student-centered education*". Several of our participants expressed their concerns regarding some of the practices that occurred during the emergency shift to remote teaching, arguing that online teaching and learning is much more than simply providing students with access to course materials and resources. May says,

> We had to be creative about finding methods to engage the [students] and establishing the relationship. Some of my colleagues chose to record their lectures but for me I did not agree with that style because moving to online isn't just about taking what you do in class and moving it online. For me I wasn't convinced.

Educators we interviewed were critical about how they incorporated technology into this new learning environment, reflecting on the pedagogical implications of technology integration and taking advantage of the affordances of these tools to support student learning and active engagement. Shamel highlighted this point, "*The priority has always been for the educational process, irrespective of the technology used. It opened our eyes to the true benefit of using digital tools for the educational process*". Educators became more intentional about the time they spend in class with their students. Dalia explained that the availability of course content and resources online freed them up to engage with students in different ways during online sessions, pushing them away from lecturing, or "*one-to-many approach*", to a "*many-to-many approach*". Kamal also discussed this point,

> Sounds like compromising content. Is it really? The way I am explaining in class vs assigning to them to self-study, they can do a lot on their own, more than we had given them credit for before… [it became important to] be judicious with 45 mins or 1 hour I have—not just lecturing, make sure they are getting feedback. Socratic method, see how they think, work their way through it. Focus on what really has to be explained in class… have them solve problems and [see] if they need support.

Zaina, Sara, May, Shamel, and Hoda described different strategies and tools they used during online sessions to support learning and promote engagement such as polls, games (e.g., crossword puzzles and role play), breakout rooms, online debates, allowing multiple modalities for participation, and in-class research and presentations. However, student learning and engagement was not their only concern. They also shared some ways in which they used technology to support student wellbeing. May would, "*Put something on the screen to talk about, something different from the class subject we are talking about. Just to have this little breaker, a breather, to grab their attention*". She goes on to say,

> But of course I don't have the tools so I search online a lot about what tools to use, games, and I liked to focus those games on something related to enhance the students or encourage them to think about how to enhance their wellbeing, to have a look at life in general, to show them that our thinking shouldn't be limited to grades, to give them a different perspective about their life.

6.1.3 Learning Communities

Establishing a sense of community and belonging seemed to be a common goal for all educators who were interviewed. The physical distance and isolation imposed by the pandemic drove educators to experiment with digital tools and find new ways for them and their students to connect and build relationships. As Kamal put it, "*You think one or two fixes will do it but priority now is shifting from the idea that I am doing something FOR them to doing things TOGETHER*".

Some of our participants found it tricky to build relationships with students online and had to find creative ways to create a sense of community and connectedness, especially at the start of the course. However, not only did participants find a number of ways in which to enhance teacher–student and student–student relationships online, but some found this to be easier in an online setting, "*In fact, sometimes it takes less time to familiarize yourself with people online than it does face-to-face, particularly with names, and you know, responses,* etc.*, some of the prompts online help you with that*" as Zaina shared. Group work and discussions, course introductions and icebreakers, hosting experts, using social media tools, allowing multiple modalities for student participation (e.g., chat, video, raising hands) were some of the strategies our participants discussed in their efforts to build connections in their course and support the development of a learning community.

Group work and discussions in particular were two of the main pedagogical approaches that educators implemented in their online teaching to support relationship building and a sense of community among their students. Educators found it easier to support student learning as they interacted within their virtual groups, Zaina explained, "*I did use group work, again this allowed me to travel and be part of small group discussions which you do a lot more eas[il]y online than you do physically… Easier to get closer to students as they were working*". Educators found group discussions and work effective in building a community of learners, allowing students to support and learn with and from each other. Sara said, "*Breakout rooms where students work in groups to solve exercises. It is the most effective method I have used. As students learn from each other, their critical thinking, problem-solving, and teamwork skills develop*".

6.1.4 Assessment Practices

During the interviews, almost all participants described some changes they made to their assessment practices. A common change in their assessment practices when teaching online was in their marked shift from traditional in-person exams that measured basic memorization and regurgitation of content to more applied types of assessment that emphasized understanding and comprehension of course content and material.

The physical distance imposed by the pandemic meant that traditional sit-in exams were not feasible, leading to some concerns about student academic integrity. According to Hoda, "*The assessment methods had to be creative and unconventional because [a] culture of "cheating" prevailed when using the old assessment methods*" referring to class exams that use multiple-choice questions (MCQs) and straightforward essay questions to measure student learning. For Hoda, using open-book exams was one strategy she used to address this concern as it emphasized "*understanding* *of the material*" and required students to "*come up with examples themselves and combine different concepts to demonstrate understanding*".

Another common theme was instructors changing perception about student assessment and its purpose. For some of our participants, the online context was challenging in gauging student understanding, pushing them to consider other types of assessment that are more extended, such as project-based assessment activities, that allow them to follow up on student progress and provide feedback on a regular basis. Kamal awarded grades for participation in assessment activities without focusing on "*correctness of answers*". Kamal provided problems for students to solve, allowing students an opportunity to "*sketch*" what the solution looks like in their head and encouraging them to comment on each other's proposed solutions. Kamal focused on the importance of giving students' ownership over their learning:

> Recently, [I started to] give them some room to negotiate breakdown of grades. If someone knows they have some sort of issue—certain percentage of quizzes, mid-terms, assignments. Spread things out so they don't stress about one thing. Always something going on, every week, stake smaller of each thing, and negotiate what stakes should be if they have, for example, athletic or co-curricular events (individual on request and come with a plan, and retrospectively). Also, wellbeing type of support. I give them up to 8% that they can shift, not much but gives a sense of ownership.

6.2 Q2: How Educators Developed These Skills and Literacies

Educators we interviewed discussed three main ways in which they developed their knowledge about human-centered teaching practices and how to implement them in their online classes. These were mainly: ***self-initiated***, ***institutionally supported***, and ***socially driven***. ***Self-initiated*** learning refers to the learning strategies and actions that instructors took on personally to develop their online teaching skills in ways that support their students' socioemotional wellbeing and was the main learning approach mentioned by all of our participants. All our participants referred to online searches and resources as a way to learn about new assessment practices and how to utilize online technologies, such as breakout rooms and polls, to engage students in online courses, including online tutorials, courses, and webinars from the Goethe Institute and UNESCO, for example. However, finding or having access to this information was only part of a larger process, and being able to implement these new ideas and practices "*required a lot more reflection, thinking and preparation than normal teaching*", as Zaina mentioned. Kamal discussed how it was important to make these changes in stages in a way that supported both the instructor as well as students, "*didn't have to do it all at once—piecemeal—whenever comfortable trying, I tried, but not [to] bite more than I can chew. Start with 2 or 3 of 10... if it works well, try more*". Our participants also mentioned their social circle and community (both online and offline) as one of the ways in which they learned about new practices and strategies they could use to enhance their online teaching and support their students, whether it was from colleagues from within the same institution, from other institutions, social networking sites, or friends. These ***socially driven*** strategies included joining online teaching communities and webinars where educators were discussing how they shifted their teaching to the pandemic or discussions with other colleagues.

Institutionally supported professional development was also an important source of learning about new practices, pedagogies, and tools; however, there was a notable difference between the experience of our participants from Egypt compared to those from Saudi Arabia. While our participants from Egypt expressed their satisfaction with the type of pedagogical support and training provided by their institutions, our educators from Saudi Arabia did not share this sentiment and mentioned that institutionally provided professional development in alignment with their needs and day-to-day experiences was more of a challenge than an opportunity for professional growth. Sara said, "*The university provides several workshops and training courses on a regular timing. However, the quality was not good and most of the training program for basic information* ". May described how she tried to support her colleagues, *"I would even loan my colleagues my username and password and even install the software for them but of course this is not practical, I just did this with people close to me"* (an example of care without equity, "selective" care, according to Bali and Zamora [20]) and went on to explain that this approach was not practical and more support should be provided at the institutional level in order for these practices to spread at scale and make an impact. May intuitively stepped up to support others with care, when the institution was not doing what was needed.

6.3 Q3: Challenges to Applying Care Practices

The interviews highlighted the many challenges educators face as they try to humanize online learning and brought to the forefront the variety of issues educators must contend with and consider as they move their teaching online whether it be at the institutional, technical, student, or personal level.

Institutional resistance was mentioned as one of the challenges facing educators. The misalignment between institutional vision, priorities, and expectations and that of educators meant they could not find the institutional support needed to create the learning experiences they envisioned for their students or have access to resources and tools that can support a learning experience that is sensitive to students' social and emotional needs and wellbeing. May said, "*This is one of the challenges I faced, the university philosophy. They want things [which] can be check marked, we did this and we did that, but when it comes to daily life, there is no attention given to these day-to-day issues*". For her, a ***top-down*** approach was crucial in encouraging and supporting instructors' adoption of caring and human-centered pedagogies when teaching online, "*…change has to come from the leader's vision. Maybe we can make a difference in our own students on an individual basis, but for scalable change whether in relation to soft skills or virtual learning, it needs a vision and push from the top*". Interestingly, not all participants shared this view as some believed that a

bottom-up approach is what would make an impact on student learning and experience, "*I believe we should as educators (don't think policymakers) communicate messages of support to whoever is in classrooms… less of a know-it-all—reach out to students, families, to alleviate pressure on performance and more emphasis on growth—a win for everyone*". Kamal commented. Kamal, who is an engineering professor, pointed out the ***social pressure*** generated outside the classroom that some students face and impacts their learning and wellbeing. For instance, he discussed some of the pressure families put on students to pursue certain degrees rather than encouraging them to choose disciplines that are more aligned with their passions and talent,

> Especially I am thinking you know in Egypt we have culture of "summit disciplines" comp sci, engineering, medicine—if my child was born Mozart I would still encourage them to study those—raw talent in my classroom I see who didn't really consent informedly to become an engineer. Lots of social pressure.

For him, addressing the students' ***external*** social environment, outside of the institution, is imperative in supporting learners' socioemotional wellbeing and development, the "*best way is to start with families, de-emphasize grades, performance, and more emphasize the actual knowledge experience, gonna be a huge change in culture—needs to be adopted*".

The ***academic culture*** that dominates higher education in the Arab region is another major obstacle facing educators who try to approach online course design and delivery in a more caring and human-centered way. Higher education institutions, with their emphasis on grades, standardization, and quality indicators that are measurable and quantifiable, make it challenging for educators to tailor their courses in a way that supports the whole student and takes into account their individual needs and goals or even relate to students on a deeper human level. Zaina noted, "*I think #1 make sure they impose or impress on faculty that they are human beings before being a position*" and goes on to say that educators in higher education institutions find it difficult to be themselves and "*feel threatened being who they are and relating as humans and makes a hell of a difference to students to understand they are dealing with a human being and not a function, as it were. It's a whole culture, [that] does not allow you to*".

Emphasis on grades and the "grades culture" resurfaced again under this theme. May shared her thoughts on this issue,

> I am not with the grades culture, where everything is about exams, grades, I am not with this culture and the whole world is shifting from that. Now people talk about assessment for learning, but we are still behind, very behind…I know that there are people like me but they are not a lot to lead to real change and we are struggling…So when you have people want to make change, and they are not asking for anything, they just want change for the sake of improvement, there is not support for this. No financial or moral support even.

Zaina described how corporate style management and administration of higher education institutions can have an impact on educators' pedagogical choices in the classroom, "*If we start emulating the private sector and corporate world—no more* *educators are going to humanize*". They explain, "*Because measured against standards and specific behaviors and outcomes and results that will not allow them to invest the time and emotions needed for a good pedagogical relationship with students*".

Changing one's own practice and beliefs can be an emotional and difficult process, and this theme emerged in our research. ***Self-resistance*** in this context refers to the internal conflict an educator goes through as they question their own assumptions and beliefs about teaching and learning and the changes they need to make to their own practices as a result. A number of participants noted that the pivot to online learning pushed them to reflect more deeply about their purpose and to think critically about their pedagogical approach. Kamal noted, "*Make sure my emotions and cognition [are] aligned. Big challenge. Problem mostly me. Resistance they [students] gave me [was] incomparable, minimal. Very receptive/open. Once they know you're trying your best, they don't have unreasonable expectations. Doing together. Exploring together. Trickiest part [is] changing myself*".

Both ***educators and students struggled*** during the sudden pivot to online teaching and learning. Instructors were challenged as they tried to adjust learning activities and course material to fit the new modality and enhance student engagement and active learning. Hoda found it difficult to engage students actively because, "*some students viewed online learning as a way to slack off, or not to be involved*" while Shamel found it difficult to, "*keep track of so many students at the same time*". Another major challenge for educators was developing ***alternative assessment methods*** that ensure academic integrity in an online context without compromising their relationship with students. Take Dalia, for instance,

> The main challenges as explained earlier were assessments and ensuring academic integrity. Whether we like it or not some students tend to stretch their limits with academic integrity, the challenge was imposing academic integrity without giving the feeling to the students that you cannot trust them.

Students also found it difficult to adjust to the new requirements of learning online. Sara described how the use of multiple online platforms and tools was overwhelming for students and had to adjust course design accordingly. Another challenge for students was using their cameras during live sessions and online presentations. However, this was not only due to personal preference, a number of participants reported ***technical difficulties*** with connectivity as a major hurdle during that time, Zaina explains, "*The only thing that was sometimes a problem could do nothing about—online sometimes they would appear without the video—I tried hard to break that but it mostly didn't work because their connections were weak*".

6.4 Student Reactions

We asked our participants about students' response to the changes they made to their approach to teaching. Not surprisingly, all of our participants found students to be very responsive and appreciative of these changes. May recalled,

> I remember after one session, after the session and it was one of those dry theoretical sessions and I was giving them those breaks, one student sent me and told me "Dr. I felt this is the first time I felt that someone is talking to us as humans" and this is a fourth-year student, so she has been at our college of 5 years. So I felt my message was reaching.

Our participants highlighted the many ways the changes they made to their course designs and teaching approach had a positive impact whether it's in terms of student learning, whole-class climate, or instructor–student relations. Hoda noted, "*Students were very engaged and in some cases I felt more confident of them achieving the learning outcomes*". Kamal said,

> Healthier for everyone and reflects a lot better in nature of the entire environment, ambiance of class so much more relaxed. Also looking at myself when explaining something my anticipation of what should be done, less rigid, let me understand these people and do best we can together.

Another positive impact this experience had was improved instructor–student relationships. Students who perceived their instructors to be more caring and attentive to their needs were more willing to try harder and be more understanding toward their instructor as well, "*Be more responsive to their needs they are more willing to make extra effort…You accommodate them they'll try to accommodate you. They're mature enough already. Treat them they like they are mature, they respond in the same manner*" Kamal noticed. With that said, Kamal explained that not all students were receptive or welcoming of this change in the beginning. He described how his new approach was a little confusing to older students who are used to or expected a certain type of learning experience, "*Younger most flexible no objection. Accept this is the way it is. A bit shocking for older. Halfway through semester get into it and appreciate it. Realize it during but it takes a while because not usual*".

7 Discussion

Human relationships and consideration for learners' social and emotional wellbeing are critical in any course, be it in-person, blended, or fully online. However, the physical distance and lack of face-to-face interactions when teaching online require intentional design and practice. Many of the examples we shared in this chapter are based on the experiences of educators who have purposefully adjusted their courses and teaching practices to take advantage of the availability of technology in support of student social and emotional wellbeing.

A well-rounded education is one that provides students with the necessary skills to succeed in their chosen careers while supporting their moral and personal development. For Noddings [16], educating the whole person is about finding the balance between what all students need or should know while providing a space for students to explore their interests and find relevance in what is being taught. A number of our participants shared this view and expressed their interest in student development beyond their academic success. Educating the whole person means that our purpose as educators is not about pushing students to achieve a standardized set of learning outcomes, we—or educational systems—set for them, it is about designing learning experiences that acknowledge and recognize that each student is differently positioned in terms of needs, cultural background, and aspirations without compromising their chances for success [34]. We can see from the interviews that the educators we interviewed focused on responding to the student as a whole person, on student-centered practices, and building community, in ways that are "shaped to the needs of individual recipients of care and individual providers, shaped to the ongoing relationships among them" [22].

Nurturing students' agency and ownership over their own learning is a key element of both critical (digital and non-digital) pedagogy, as well as an approach encouraged by trauma-informed pedagogy. Looking at the pandemic period as a time full of uncertainty, loss of meaning, and loss of a sense of control over their lives, creating spaces where learners could make their own decisions and choices could truly have an impact. Universal Design for Learning offers one framework by which to give students choices in their learning process. The one participant who emphasized nurturing student ownership was Kamal, and his experience of this and its impact on students resonated with us.

The changes our participants made to their assessment practices and the challenges they faced were prominent in our interviews. It appears that the sudden pivot to online learning during the pandemic exposed many of the issues associated with traditional forms of assessment and was an opportunity for educators to reevaluate its purpose and how they design it. Assessment, when designed with care, can be not only a powerful source of learning, but also an opportunity for personal growth and development. We tend to design assessment methods with the objective of ranking and judging students' abilities and knowledge (the "what" of learning), but what if we approached assessment as an opportunity to support student learning and well-being (the "how" and "why" of learning)? What would that look like in practice? Designing alternative assessment methods (when possible), incorporating extended and soft deadlines for submissions, engaging students in peer-assessment activities, and providing students with ongoing and personalized feedback are some of the principles and strategies that underpin our assessment practices to support deeper learning and enhance students' mental health and wellbeing. These practices prioritize student learning over grading and encourage students to learn from their mistakes rather than penalize them for it. In addition, providing opportunities for revisions and resubmissions reduces the anxiety and stress students normally associate with traditional forms of assessment and empowers them to seek help and ask questions from instructors and peers, reducing the possibility for cheating or seeking answers in ways that do not add value to student learning and development.

With respect to our second research question, on how these educators developed their literacies and skills to prepare them to cultivate socioemotional wellbeing in their classes, we saw that some learned on their own, some learned with social support, and some received institutional support. We noted that the participants from Egypt mentioned the value of pedagogical (and not just technical) institutional support whereas the participants in Saudi said there was insufficient institutional support. There may be a possible bias here in the Egyptian institution, which is that the person interviewing and selecting the participants (Maha Bali) worked in the department offering the institutional support and was herself leading most of the workshops and professional development—so this may have consciously or unconsciously biased the participants to remember and possibly express appreciation for those efforts. An important lesson to take forward here, though, is that educators who are attuned to their learners' needs and self-motivated to address learners' socioemotional needs to enhance learning and success will likely find ways to learn how to do so, whether or not institutional support is offered; however, given the prevalence of the need for pedagogical and socioemotional support, institutions should play a bigger role in supporting all educators with this dimension, rather than rely on their own affective labor in managing their own learning and supporting one another in their own time. Particularly in the pandemic situation where students were struggling so much, they would have struggled to reciprocate their teachers' care, and so, "*when… the cared-for is unable to respond in a way that completes the relation, the work of the carer becomes more and more difficult". "Carers in this position need the support of a caring community to sustain them*" [16]. Institutions should both provide the professional development needed, and additionally create spaces wherein such supportive communities can flourish. It is also important for the care to be provided equitably, by the institution, because otherwise, we end up with a "partial care" situation where some people carry the affective labor of care, and some groups receive it while others do not [21].

Unfortunately, as we saw in the challenges faced, institutional cultures and policies themselves pose obstacles to the practice of centering students' socioemotional wellbeing in university. As bell hooks states, "*Teachers who care, who serve their students, are usually at odds with the environments wherein we teach*" [32], and our results show how cultures that focus on grades and rigor can contribute to this, as well as the neoliberal trend in education focused on measurement and visible outcomes. It also seems that, other than the technical struggles both teachers and students faced, there is also some element of students themselves having internalized the way things have been historically/traditionally done in education, causing them to resist changes to those approaches when first faced with them. Even the educators we interviewed themselves sometimes cited their own internal resistance, from having seen academia focus on cognitive elements to the exclusion of socioemotional wellbeing.

In order to promote a culture of wellbeing in higher education, our participants had divergent recommendations, some of which focused on starting with the educators themselves and going bottom-up, while others focused on institutional policies, going top-down, and still others with addressing the culture in the wider society, and parents who themselves may be highly influenced by the degree/grade focus we have traditionally been exposed to. Perhaps we need to work at all of these levels simultaneously, and form allyships on one level to spread awareness on the importance of promoting socioemotional wellbeing in education, and on another level attempt to influence policy and practice more broadly. Strangely and paradoxically, there are notions of care that address a neoliberal agenda [35], a recognition that caring might produce the measurable results we seek even without genuine care for students. Institutional demands and requirements that focus on measurable outcomes and standardization in the name of "quality education" can be a source of tension for individual educators, limiting their pedagogical choices and hindering the formation of caring and genuine relationships with students [16]. We need to ensure that it does not remain the "care without equity" [21] situation, wherein a small number of educators such as those we have interviewed carry the burden of affective labor, while others continue with the status quo. We need to advocate for a movement toward a more "socially just care" [21] where all individuals within higher education have a role in an ecosystem that promotes a culture of caring for students' socioemotional wellbeing.

8 Limitations and Further Research

One of the limitations of this research is that we are only exploring a small number of contexts: all the instructors interviewed were from two Saudi universities and one Egyptian university. They provide some richness of context within these particular institutions (such as the kinds of professional development support provided) but are not necessarily representative of other institutions within the same countries. With that said, future research could expand on the findings here and explore the perspectives of educators from other institutions in Saudi Arabia, Egypt, and other Arab countries. Another important perspective to consider in relation to the topic of student socioemotional wellbeing is the student experience and how certain strategies and design elements influence their sense of wellbeing and being cared-for when learning online.

Additionally, we had offered participants the choice to be interviewed synchronously via Zoom or in writing. Those who chose to conduct Zoom interviews tended to speak more openly and deeply, and their interviews provided more detailed and rich content than those who responded in writing. Our initial written questions were meant to not be "leading", and therefore, some of the initial responses were vague and required follow-up questions. In the end, this resulted in much richer data coming from only four of the interviews that were conducted live, with much less detail to draw upon from the interviews conducted in writing.

9 Conclusion

Despite the challenges and struggles faced by instructors and students during the shift to online and distance teaching during the pandemic, evidence shows that this experience was powerful, prompting teaching faculty to reevaluate their approach to teaching and learning, reflect on their priorities and practices as educators, and reexamine the role of students in the learning process. It is clear from our results that there was a need for focusing on socioemotional wellbeing for university learners in the Arab world during the pandemic, and that there were pockets of educators who recognized this need and tried to offer this in their online classes. These educators we spoke to, none of whom were experts in online learning or socioemotional learning, sought to enhance their capacities to do so in response to needs they saw in their students, despite resistance from their institutional cultures, and even their countries' cultures that emphasize grades and performance. However, the educators in this study exhibited genuine care, "relational care" [15, 16] in their practices. In being a minority of educators doing these practices within their institutions, they risk carrying a heavier burden of affective labor, which also results in lack of equitable distribution of care toward learners—a disparity institutions have a responsibility to address in order for all learners to flourish [21].

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