ICT-Based Distance Higher Education: A Necessity During the Era of COVID-19 Outbreak

Murat Tahir Çaldağ, Ebru Gökalp, and Nurcan Alkış

Abstract The COVID-19 outbreak, declared as a public health emergency of international concern in March 2020, has forced governments across the world to take action for satisfying social isolation requirements of the pandemic to decrease the spread of coronavirus. The first action higher institutions made is closing universities, suspending face-to-face classes, and switching to distance education. ICT-based distance education for higher institutions seems suitable to alleviate the COVID-19 outbreak since it does not require face-to-face communication; however, it should be planned carefully to get benefit from its advantages. One of the most challenging issues of distance higher education is choosing the appropriate technology. In this scope, this chapter aims to evaluate ICT-based distance higher education technologies, grouped under five categories: learning management systems, massive open online course platforms, platforms for video conferencing, social media platforms, and digital learning content tools. The evaluation of these technologies showed that although different platforms are used for different purposes, there is a lack of an integrated platform that supports all functionalities from a holistic perspective for improving the efficiency of distance higher education offered and supporting shifting to student-centered distance education model. To this aim, the necessities for the future are also described in this study.

Keywords Distance education · Emerging technologies · COVID-19 · Evaluation
1 Introduction

The COVID-19 outbreak, firstly reported in December 2019, in Wuhan, Hubei, China, has spread to the world in a short amount of period. It was declared as a pandemic by the World Health Organization (WHO) in March 2020. As of August 11, 2020, confirmed COVID-19 cases amount is up to 20 million as well as the global death toll is over 735,000 [1].

This kind of pandemic crisis can cause a problem of an overwhelming healthcare system if the number of cases increases sharply in a short amount of time. In order to reduce the spread rate of the coronavirus, countries have to apply some restrictions, as quarantine and lockdown, which can have a significant challenge on the education system. Since one of the crowded places, which causes spreading the virus so quickly, is the classroom. Thus, the first decision governments made after learning the first cases in their country is closing schools, suspending face-to-face classes, and switching to distance education. Students living in 186 countries have been affected by this pandemic crisis.

Distance education can be defined as “education that takes place when a teacher and student(s) are separated by physical distance, and technology is used to bridge the instructional gap” [2]. Distance education is an effective way of tackling the COVID-19 outbreak since the teachers and learners/students do not have to come together physically at the same place, they can stay at their home being isolated from other people while involving a distance education program. Although the distance education can provide reducing the spread rate of the COVID-19 and it is inevitable to use it to alleviate the COVID-19, determination of the best technology to be used in the distance education brings a challenging issue for the education providers [3].

Countries have taken different actions for their schools and education programs. Most governments temporarily closed all of their educational institutions, while some governments closed their schools locally [4]. Some countries reopened their schools; for example, the children up to 11 years old have returned their school after a break in Denmark. Although distance education may result in some problems for educating younger students, especially for children up to 11, it provides the highest degree of effectiveness in higher institutions. Thus, higher education institutions across the world have changed their school-based education programs to distance education programs for the continuation of education to meet COVID-19 social-isolation requirements. However, the sociological and technological readiness level of the universities for this urgent transition has not been evaluated.

Distance education programs totally depend on the use of technology. The utilization of emerging information and communication technologies (ICT), including different kinds of ICT applications, has the potential of providing increased efficiency and the satisfaction level of the student and teacher for distance education activities [5, 6]. As a result of the evolution of ICT, the technology used for distance education has changed a lot from radio and television to computers and
interactive applications [7]. These technological improvements positively affected the acceptance and effectiveness of distance education. However, which technology is the best for distance education is still a debate. In this scope, this study aims to analyze ICT tools and applications used for the purpose of distance education in higher institutions and identify the necessities for more effective applications for distance higher education, especially for urgent transitions from formal education to distance education. To accomplished the aim of the study, ICT based distance education literature and the tools used in distance education have been reviewed systematically and synthesized.

The remainder of this chapter has four main sections: first, the result of the literature review of related studies are given, then emerging ICT applications used for distance higher education are described, followed by findings and future directions for distance higher education; lastly, the chapter is concluded with final remarks in the conclusion section.

2 Related Studies

2.1 Distance Education

The developments and improvements in ICT have changed how educational activities are delivered. Traditional education environments have been replaced with electronic environments providing synchronous or asynchronous communication over the internet. The critical characteristic of distance education is removing the necessity of face-to-face communication [3, 8]. However, it should not be thought of as delivering teaching materials at a distance; it also requires the establishment of effective two-way communication [3].

When we look at the history of distance education, it is observed that it has started to be evolved worldwide since the 1980s [2]. Different terms have been used to describe it, such as distance learning, distance teaching, e-learning. Distance education has three generations of evolution in the literature [9]:

- **First-generation distance education**: It covers using only a single technology, which can be tv channels, radio channels, and print-based materials. The drawback of this first-generation distance education is the lack of direct communication between teachers and students.

- **Second-generation distance education**: It includes usage of multiple media applications, including broadcasting and print media. The third person guides communication between parties in a limited manner.

- **Third-generation distance education**: It includes two-way communication between teachers and students via videoconferencing technologies. Bates [10] stated that an efficient learning environment needs to provide interaction between teachers and learners, learners and learners, and learners and learning
materials. Thus, it can be asserted that the third-generation distance education can only satisfy this need. It is needed to utilize ICT tools that provide two-way communication in an effective manner.

Although distance education is not suitable for all face-to-face higher education programs, for example, distance education in the field of dental will be challenging, cause of lack of practice-based learning from a distance. It has many advantages, such as reaching a vast number of students at the same time without having a constraint of class capacity [3], saving time, reducing costs, allowing students to learn anywhere at any time, providing active learner-centered learning instead of teacher-centered one [11].

Another term used with ICT-based distance education is mobile learning (m-learning). M-learning refers to use of mobile devices to access learning content. Researches showed that students are willing to use m-learning and their use is affected from different factors such as perceived ease of use, attitude, perceived behavioral control, and subjective norms [12]. Also, m-learning adoption can be affected from cultural differences [13]. M-learning can be a considered a part of distance education.

### 2.2 Studies Related to ICT-Based Distance Education

The utilization of ICT tools that support third-generation distance education brings many different concepts in higher education institutions, including e-learning, blended learning, online learning, web-based learning, and distance learning [8, 14]. While e-learning, distance learning, web-based learning, online learning, and distance education concepts sometimes are used synonymously, blended learning refers to the combination of classroom learning and e-learning [15]. Though the differences between online learning, e-learning, and distance learning are a debate, distance education is considered the overall and inclusive term used in higher education; thus, we used this term in this study.

One of the ICT-based distance education tools is the Learning Management System (LMS), which is the base of blended learning as well as e-learning. One of the widely used ICT-based LMS used is the Modular Object-Oriented Dynamic Learning Environment (Moodle) [15], while there are other LMSs, such as Blackboard [16] and various homegrown LMSs. Moodle allows educators to share documents with the students, to give assignments, to conduct exams and quizzes, to communicate with learners over chat and forum [17]. Moodle depends on Social Constructionist Pedagogy, in which students construct their own learning packages from the materials delivered to them [17, 18]. Al-Ajlan and Zedan [17] compared Moodle with different Virtual Learning Environments and identified it as the best platform in terms of functionalities, technical features, and aspects for their university. Another study conducted by Oproiu [19] concluded that the Moodle
platform could be used to support students learning and increase the quality of online courses. Flipped classrooms, a strategy of blended learning applications, combines different technologies to improve learning including LMSs, video sharing services, and MOOC [20].

There are many studies related to the evaluation of existing LMSs in the literature. They investigated LMSs based on different criteria. Stewart et al. [21] evaluated LMSs based on systems administration, cost, instructional design, and teaching & learning capabilities. Kim and Lee [22] assessed LMSs based upon instruction management, screen design, technology, interaction, and student evaluation. According to Ozkan et al. [23], it is necessary to provide quality of system, information, and service. One of the latest studies by Arh and Blažič [24], evaluation criteria of LMSs are functional environment, ease of use, course analysis, tutoring & didactics, assessment, and standards supports. Another study conducted by Arpaci [25] examined the effects of perceived usefulness, ease of use and self-efficacy factors on LMS use.

WebCT (Web Course Tools) developed in 1995 are used to deliver courses to students integrating instructional tools, including a glossary, references, quiz module, self-test, and communication tools, including a chat room, e-mail, bulletin board and calendar [26]. Studies showed that students find WebCT as useful to access lecture notes and course information [27]. The studies examining the effectiveness of course websites showed that easy to use websites having communication tools are more successful [28].

Apart from LMSs and WebCT, the ICT tools and applications used for communication in the distance higher education could be classified based on the different characteristics, as synchronous or asynchronous applications. While synchronous tools could be audio graphics, audio conferencing as in a telephone conference, broadcast radio and television, teleconferencing, computer conferencing such as chat and internet telephony [6], asynchronous media includes audio and videotapes CDs, e-mail, computer files transfers, virtual conferences, multimedia products, offline, web-based learning formats [6]. Studies in the literature related to the evaluation of these technologies by UNESCO, World Bank, and OECD [29–31] assess them based on connectivity type, interaction, main functionality, platform, conditions of use, language, target group, subject, format, costs, and offline option.

Also cloud computing services have been used in distance education. They enable students to access their learning materials from anywhere and any device. Integrating these services to educational setting may increase students academic performance and success [32] and universities could develop cloud-based application and encourage use of them [33]. On the other hand cloud computing services could be used to work on same documents in group projects by the students and for collaboration by educators [34].
3 Emerging ICT Applications Used for Distance Education

The utilization of emerging technologies, like data analytics, cloud computing, everything as a service (XaaS), in the field of distance higher education can provide many innovative solutions, such as the development of a more useful learning environment which enables monitoring the learning process [6], as well as collecting and analyzing feedback from learners to improve the provide education service in a more effective manner.

We categorized Emerging ICT applications used in distance higher education into five groups, as LMSs, Massive Open Online Course (MOOC) Platforms, live-video conferencing platforms, social media platforms, and digital learning content tools, as illustrated in Fig. 1. In the scope of this study, we aim to evaluate these technologies to understand the existing situation and define future directions for ICT-based distance higher education.

![Fig. 1 Emerging ICT applications used in distance education](image-url)
3.1 Learning Management Systems

LMSs are used to deliver educational course materials, like lecture notes, exams, announcements in a web-based environment. According to Croitoru and Dinu [35], the features and capabilities of LMSs used in higher education are communication, productivity, student involvement, administration, course delivery, curriculum design, hardware/software, and pricing/licensing.

LMS used in higher education can be categorized by considering their purpose, applicability to open source, proprietary, and offering cloud-based solutions [36]. Open-source LMSs provide users to use, change, create and distribute them free of charge. The critical feature of open-source LMSs is the public free license, which offers users to customize their LMS based on their needs and goals [36]. Proprietary LMSs are the platforms that are licensed to their developers or owners on usage and distribution. These systems are required to be installed on the servers and computers of the higher education institution [36]. On the contrary, cloud-based LMSs do not require installation and infrastructure necessities; cloud-based LMSs offer flexibility and a more feasible financial solution by offering it as a service accessible over the internet [36, 37].

Existing LMSs used extensively in higher education can be identified as Moodle, Sakai, ATutor, Google Classroom, Blackboard, D2L Brightspace, and Docebo [38, 39] are evaluated in Table 1. The most widely used LMS is Moodle, created by the developer Martin Dougiamas in 1999 and released in 2001 as an open-source platform for educators and learners [40, 41]. Implementation of this open-source software in a web-based platform and customizing it based on the necessities of the higher institution offers interaction between teachers and students on creating dynamic courses accessible from any time and place [41]. Another LMS used in higher education is Sakai, developed in 2004 as open-source software to support education with a flexible online-based platform [42]. The LMS focusing on the accessibility of people having disabilities is ATutor, which was created in 2002 as an open-source software [43]. Blackboard, founded by Matthew Pittinsky and Michael Chasen in 1997 as a web-based proprietary LMS, aims to offer educators to share their course-related materials with students through the web [34, 35]. Eventually, it evolved to a greater scale, which offers services from K-12 to higher education and beyond [44, 46]. Desire2Learn, founded by John Baker in 1999, offers services to healthcare, government, corporate, and education sectors [47]. D2L Brightspace provides online collaboration tools for educators and students. Docebo is a cloud-based LMS with artificial intelligence integration with suggestions and improvements for the users [48]. Google Classroom is a cloud-based platform providing free to use service for educators and students for offering communication with collaborative tools [49].

All of the LMSs offer similar features on synchronous & asynchronous communication, customization options, video conference integrations, mobile learning support, and basic user and content tracking tools. The primary difference between
open source and proprietary LMSs is the higher institutions’ choice of use. Moodle, Sakai, and ATutor systems offer freemium options with a public license that promotes the systems for a more comprehensive and varied user base. Google Classroom offers a different approach as a free to use without a public license. Although there is not any dedicated technical support, the information and problems that are encountered on these systems are answered on community forums or web pages. Blackboard Learn, D2L Brightspace and Docebo offers only premium options with no general use public licenses and dedicated technical support for their customers. Although these systems offer a solution for distance education, the more integration options and detailed user analytics tracking can help educators and students for an improved learning environment.

### 3.2 Massive Open Online Course Platforms

Massive online open courses (MOOCs) are online courses aimed at providing open, interactive, collaborative learning for massive participation via the web [50–52]. MOOC provide students access to numerous resources at anywhere and anytime [53]. Since innovative solutions providing more accessibility and flexibility can be obtained with MOOC platforms, they have a disruptive effect on the traditional teaching and learning methods. The popular MOOC platforms generally have been spinoffs or a joint effort with universities having an excellent reputation across the world. To illustrate, One of the well-known MOOC platforms of Edx has a joint effort with universities of Harvard and MIT; other examples are Coursera and Udacity, which are collaborated with Stanford University.

There are several challenges for administrating MOOCs, such as accreditation, monetization, recognition, quality, and evaluation mechanisms [54]. Although MOOCs offer a variety of learning subjects, it faces accreditation problems which have a consequence of the lack of evaluation of courses and materials. The most popular MOOCs used for higher education, as Coursera, EdX, Udacity, Canvas Network, OpenLearning, FutureLearn, LinkedinLearning, are evaluated in Table 2.

As seen in the table, MOOC having the highest number of participants is Coursera comparing to others. MOOC platforms differentiate on business models rather than the features they provide. Although the primary goal of MOOCs was to offer open access and scalable education for masses when they were firstly launched [55], nowadays, many MOOC providers execute the strategy of offering courses for people who have a premium subscription. While Coursera, EdX, Udacity, and FeatureLearn have hybrid business models with free of charge and paid courses, OpenLearn and LinkedinLearn implement the premium business model with free trial versions. Only Canvas Network offers free access to courses.
### Table 1  The evaluation of LMSs used in distance higher education

| Business model          | Moodle | Sakai | ATutor | Google Classroom | Blackboard Learn | D2L Brightspace | Docebo |
|-------------------------|--------|-------|--------|------------------|------------------|-----------------|--------|
|                         | Freemium | Freemium | Freemium | Free              | Premium          | Premium         | Premium         |
| Open source             | Y      | Y     | Y      | N                | N                | N               | N                |
| License                 | GPL    | ECL   | GPL    | N/A              | N/A              | N/A             | GPL              |
| Video conference integration | Y     | Y     | Y      | Y                | Y                | Y               | Y                |
| Countries               | 234    | 20    | N/A    | N/A              | 50+              | N/A             | 10+              |
| Language                | 139    | 20    | 20+    | N/A              | 20+              | 10+             | 30+              |
| User tracking analytics | Y      | Y     | Y      | Y                | Y                | Y               | Y                |
| Asynchronous communication | Y      | Y     | Y      | Y                | Y                | Y               | Y                |
| Synchronous communication | Y      | Y     | Y      | Y                | Y                | Y               | Y                |
| Customization option    | Y      | Y     | Y      | Y                | Y                | Y               | Y                |
| Mobile learning support | Y      | Y     | Y      | Y                | Y                | Y               | Y                |
| Dedicated technical support | N      | N     | N      | N                | Y                | Y               | Y                |

*Y* yes, *N* no, *N/A* not applicable

*GPL* general public license, *ECL* educational community license
3.3 Platforms for Video Conferencing

Videoconferencing in the context of higher education is defined as synchronous video and audio communication between participants, including educators and students in different geographical places [56, 57]. Because of the COVID-19 pandemic, there has been an emerging shift in digital communication for higher education. Even though videoconferencing technology dates back to 1964, current tools and platforms have not been analyzed in the literature [57]. In our study, we included popular video conference platforms enabling tools, like screen sharing and whiteboard options for higher education. These platforms are Zoom, Google Meets, Microsoft Teams, and Skype.

The COVID-19 outbreak has a massive effect on the usage of Zoom. The peak usage from December 2019 to July 2020 has increased from 10 to 300 million. It offers some limited functionalities for free of up to 100 participants, with a 40 min time limit. The premium option providing unlimited videoconference duration with more features is available for paid subscriptions.

As shown in Table 3, business models of the videoconference platforms have an impact on the capabilities they offered. The full functionality of the tools is locked behind a paywall. The premium options of Zoom, Google Meet, Microsoft Teams, and Skype have almost the same features, except for the lack of whiteboard option in Google Meet. Zoom has the best free to use features to other platforms with limitations on time and participants. Although Microsoft Teams offers no time limit and 250 max participants, the absence of a recording option is a critical factor. From the aspect of the required bandwidth for live video communication, Zoom and Microsoft Teams have the lowest requirements. All free-to-use videoconference tools do not have an analytics tracking option, which is needed for a more efficient evaluation of distance learning.

| Business model | Coursera | EdX | Udacity | Canvas network | Open learning | Future learn | LinkedIn learning |
|----------------|----------|-----|---------|----------------|---------------|--------------|-----------------|
| Global rank*   | 358      | 1.897 | 5.668 | 37.183 | 36.047 | 4.903 | N/A |
| Total visits (M)* | 70.13 | 21.85 | 6.47 | 1.13 | 1.25 | 7.8 | N/A |
| Avg. time on platform (min)* | 15 | 8 | 17 | 17 | 20 | 6 | N/A |
| User tracking analytics | Y | Y | Y | Y | Y | Y | Y |
| Mobile compatibility | Y | Y | Y | Y | Y | Y | Y |
| Total No. of learners (mil) | 66 | 24 | 11.5 | – | 2.17 | 10 | 17 |

*July 2020 www.similarweb.com Desktop and Mobile Web Statistics

Table 2 The evaluation of MOOCs used in distance higher education
**Table 3** The evaluation of MOOCs used in distance higher education

|                      | Zoom               | Google Meet        | Microsoft Teams   | Skype               |
|----------------------|--------------------|--------------------|-------------------|---------------------|
|                      | Zoom-Free          | Zoom-Premium       | Teams-Free        | Teams-Premium       | Freemium           |
| **Business Model**   | Free               | Premium            | Free              | Premium             | Freemium           |
| **Max no of participants** | 100               | 500                | 100–250           | 250                 | 25                 |
| **Time limit**       | 40 min.            | None               | None              | None                | None               |
| **Document sharing** | Y                  | Y                  | Y                 | Y                   | Y                  |
| **Whiteboard**       | Y                  | Y                  | N                 | Y                   | Y                  |
| **Share screen**     | Y                  | Y                  | Y                 | Y                   | Y                  |
| **Record option**    | Y                  | Y                  | Y                 | N                   | Y                  |
| **Analytics tracking** | N                  | Y                  | Y                 | N                   | Y                  |
| **Mobile compatibility** | Y                  | Y                  | Y                 | Y                   | Y                  |
| **Bandwidth requirements** | 1.2/1.2           | 1.2/1.2            | 3.2/2.6           | 1.2/1.2             | 1.5/1.5            |

*720p quality video (upload/download) Mbps*
3.4 Social Media Platforms

The usage of social networking platforms, including Facebook, Twitter, YouTube, and blogs, can be used for communication and sharing course materials in the distance higher education [58]. These tools are suitable for improving the capabilities of knowledge sharing and interactivity, since social networking platforms support interaction among learners, especially in different geographical areas [59]. Streaming media platforms offers flexibility, high student engagement, equity of access, the ability for tracking, cost efficiency, and creation of communities [60]. The steep learning curve, low attendance, and communication infrastructure are limitations of these platforms for distance higher education [60]. In this study, we evaluated the most widely used and free of charge social media streaming platforms as Youtube Live, Instagram, Facebook Live, Linkedin Live, as given in Table 4.

All social media platforms for streaming in higher education provide detailed analytics tracking and free to use options. That creates an opportunity for detailed evaluation and improvement of the education offered. The best streaming social media platform is Youtube, with its higher time limit, resolution, and frame per second. Although other platforms have the necessary specifications for streaming lessons, it is absolute that Youtube offers the highest quality among all social media platforms.

3.5 Digital Learning Content Tools

The task of creating digital content for educators used to deliver courses in the traditional teaching environment can be challenging [61]. In order to compensate for the lack of visual and physical connection, different variety of instructional materials can be used in distance education [62]. There are various digital learning

Table 4 The evaluation of social media platforms used in distance higher education

|                      | Youtube | Instagram | Facebook Live | LinkedIn Live |
|----------------------|---------|-----------|---------------|---------------|
| Business model       | Free    | Free      | Free          | Free          |
| Live stream          | Y       | Y         | Y             | Y             |
| Time limit (h)       | 12      | 1         | 4             | 4             |
| Resolution           | 4 K UHD | 1080p     | 720p          | 1080p         |
| Detailed analytics tracking | Y     | Y         | Y             | Y             |
| Platform             | All platforms | All platforms | Smartphones and tablets | All platforms |
| Frame per second     | 60      | 30        | 30            | 30            |
content tools for educators and learners for the purpose of content creation as Piktochart, Squigl, Nearpod, Edpuzzle, Buncee, Mindmup, and Trello [31]. **Piktochart** is a collaborative design platform that offers students and educators to easily create and design visually appealing presentations, infographics, and reports [63]. Another tool used for digital content creation is **Squigl** offering speech and text transformation to animated videos with artificial intelligence [64]. While **Nearpod** is a content creation platform that aims to help educators to create interactive lessons by adding interactive elements, links, and video integrations to existing lesson materials, and it also provides tracking with synchronous features [65]. **Edpuzzle** is a video lesson creation tool with student tracking systems [66]. Another tool, **Buncee** is a creation and presentation tool on visualizing designs [67]. There are also some interactive tools for creating mindmaps online, as **Mindmup**, which offers a design tool for creating mind maps with cloud storage options for improved accessibility [68]. The final tool, **Trello** provides a visual collaboration, organization, and planning tool used for lessons as well as faculty collaborations [69].

As shown in Table 5, all of digital learning content tools offer similar capabilities for the aspect of collaboration, technical support, and mobile compatibility. Some of them, as MindMup, Buncee, Edpuzzle, Trello, Nearpod, offer freemium business models for achieving broader accessibility. They also provide integration with LMSs or other software to increase collaboration and sharing. One of the most critical challenges on distance learning content tools is the limited features on free of charge option. Another challenge can be defined as the storage size.

## 4 Findings and Future Directions for Distance Higher Education

As a result of analyzing existing ICT tools used in distance higher education, it was observed that although there are different tools used for different purposes, as managing course materials, synchronous videoconferences, asynchronous course delivery for massive people and digital content creation. There is not any integrated platform offering functionalities from a holistic perspective for improving the efficiency of distance higher education offered and supporting shifting from instructor-centered education to student-centered distance education model. In order to satisfy this gap, the necessities for the future are described in this section. We classified these necessities into five main phases of distance higher education; as design and development, administration, delivery, assessment of learning experience, and evaluation of distance education courses.
| Business model              | MindMup | Buncee | Edpuzzle | Trello | Nearpod | Squigl | Piktochart |
|----------------------------|---------|--------|----------|--------|---------|--------|------------|
| Freemium                   | Freemium| Freemium| Freemium| Freemium| Freemium| Freemium| Freemium   |
| Storage                    | 100 KB–100 MB | N/A    | 20 videos+ | N/A    | 1–5 GB  | 10–50 GB | 1 GB       |
| Integration with LMS and other software | Y       | Y      | Y        | Y      | Y       | N      | N          |
| Collaboration Tools        | Y       | Y      | Y        | Y      | Y       | Y      | Y          |
| Mobile compatibility       | Y       | Y      | Y        | Y      | Y       | Y      | Y          |
| Technical support          | Y       | Y      | Y        | Y      | Y       | Y      | Y          |
4.1 Design and Development of Distance Education Courses

One of the most critical keys for offering successful distance higher education is designing and developing course materials before the course begins. As a result of the unexpected COVID-19 pandemic crisis, which forced higher education providers to shift to emergency remote delivery of courses they give, the course materials they had to use were designed for face-to-face education and not appropriate for distance education. That caused challenges for learners and resulted in inefficient course delivery. In order to prevent this problem, the course materials, such as lecture notes, homework, projects, exams for the course should be prepared for distance education. The distance education provider needs to be creative and innovative in the design and structure of the course. A critical issue that should be taken into consideration while designing a distance education course is planning activities encouraging interaction among learners as well as learners and the instructor. Adaptation of successful interactive learning experiences working in the traditional class environment into the distance learning environment could be an approach. Another approach, the visualization of concepts and ideas in lecture notes, could have a significant impact on the efficiency of learning and teaching for the lecture delivered online. Improving visualization of ideas and concepts as a result of the utilization of emergent ICT tools is needed for the future to improve the effectiveness of distance higher education.

4.2 Administration of Distance Education Courses

Delivering course materials from a single channel and administrating this channel is another critical issue for distance education. The requirements of the platform offering distance education can be defined as accessibility from anywhere anytime, reliability, usability, interoperability with other tools, reusability, manageability, capabilities of mixing media and methods, supporting personalized education by considering individual differences, supporting learners’ control and involvement, creating group collaboration. While an existing ICT tool, Moodle provides administrating course materials in an effective manner by offering functionalities of content delivery, announcement, e-mail, grade books, forums, chat rooms, exams, and assignment, it does not have features as synchronous videoconferencing, video analytics, prompt messaging via a mobile device, and personalized education. Also, Current Intellectual Property policies and copyright laws should be adapted to overcome problems related to the complexity of protecting ownership rights for the future.
4.3 Delivery of Distance Education Courses

Frequency and quality of interaction have the highest impact on the success of distance higher education. Interaction between the instructor and students, so critical for the distant learner, can be classified as synchronous and asynchronous interaction. While synchronous interaction covers live-stream videoconferencing, online discussion in chat rooms, making the quiz while videoconferencing, asynchronous interaction covers quizzes, exams, homework, projects, lecture notes, posts on forums. During the delivery of distance education courses, communication, and collaboration among students, achieving an active learning experience rather than the passive one, obtaining prompt feedback are vital issues for efficient distance education. Although synchronous interactions are desirable, they could present problems when ensuring equal access for all learners. Time zones differences or overlapping some other responsibilities (e.g., work, other classes, etc.) may pose complications. The most appropriate alternative should be determined for the course while designing it. The ICT tool should satisfy both synchronous and asynchronous video conferencing options with no privacy concern and low bandwidth necessity.

4.4 Assessment of Learning Experience

The process design of the assessment of learning experience is also a vital issue for the successful distance higher education. Alternative instruments for assessing learning experience in an objective manner can be defined as quizzes, exams, assignments, projects, and take-homes. The most appropriate instrument(s) should be selected based on the performance objectives of the course. For example, for a course given through a MOOC platform with asynchronous videos, the assessment instruments could be objective testing or peer-reviewed comments. The selected assessment instrument should satisfy the requirements of transparency, validity, reliability, fairness, and clarity of expectations. The selected assessment instrument should support practicing newly acquired skills, result in suggestive feedback, and provide motivation to succeed for learners.

4.5 Evaluation of Distance Education Courses

We predict that the term of data-driven distance higher education will be used frequently in the future. The utilization of an emergent technology of data analytics [70–72] provides us to measure, collect, analyze, and report data about the progress of the learner as well as the effectiveness and efficiency of the course materials. Tracking learning experience as a result of the utilization of data analytics and
visualization of the progress of the learner is a necessity to improve the effectiveness of distance education. Data-based evaluation of the effectiveness of the course materials provides to identify what works and what needs to be improved in the next revised version. Evaluation of courses should be used for continuous improvement.

5 Discussion

This chapter identified the necessities for the direction of future distance education for better implementations. First of all, the findings and the literature showed that distance education courses should be designed and developed before course delivery. COVID-19 outbreak forced rapid transition from formal education to distance education and caused ineffective courses, since courses designed for formal education have been delivered in an improper way, online. Second, the administration of online courses over a single platform is critical issue for distance education. For example, one of widely used LMS Moodle is effective in course delivery including content sharing, announcements, grade book, e-mail tool, forums, chat rooms, quiz module and assignment module, it does not have features like synchronous video-conferencing, video analytics, prompt messaging via a mobile device, and personalized education. Third, the interaction between students and educators, students and students are important for an effective distance education. The distance education technology used should support both synchronous and asynchronous interaction between the participants for an active learning experience, which is required for better learning experience. Fourthly, an important part of distance education is assessment of students’ learning activities. Appropriate assessment tools should be selected according to course objectives. Lastly, the evaluation of distance education via data analytics technology will be used for improvement of distance education by measuring, collecting and analyzing data of learner and course materials in the future. As a conclusion a single integrated system serving all needs of distance education is needed for better implementations in the future.

6 Conclusion

COVID-19 outbreak forced many higher education institutions to shift to emergent distance delivery of courses with no face-to-face interactions. The fast switch from formal education to distance education has many challenges, including choosing the most appropriate technology. While it is questioned which technology is best for distance education, with the improvement in ICTs, there are many tools directly or indirectly serving distance education for different purposes like sharing course materials and synchronous video conferencing. These tools categorized under five
groups as Learning Management Systems, Massive Open Online Course Platforms, Platforms for Video Conferencing, Social Media Platforms, and Digital Learning Content Tools are evaluated in this chapter. As a result of the evaluation, it is observed that there is a lack of an integrated platform offering functionalities from a holistic perspective for improving the efficiency of distance higher education. In order to satisfy this gap, necessities for the future are defined to improve the effectiveness and user satisfaction of distance higher education in this chapter.

The COVID-19 outbreak forced rapid transition from formal education to distance education and caused ineffective courses since courses designed for formal education have to be delivered in distance education environments. The aim of this study is to prevent problems as delivering ineffective courses and support to take advantage of distance higher education, as saving time, reducing costs, allowing students to learn anywhere at any time, and providing active learner-centered learning.

Contributions of this study are to analyze the current situation by evaluating existing ICT tools used for the higher distance education, and to identify necessities for the future to be able to provide more effective distance education. Educators and higher institutions can benefit from this study for selecting the best technology they need, and ICT providers can also use the findings of this study while developing ICT applications for the higher distance education.

References

1. WHO: WHO coronavirus disease (COVID-19) dashboard (2020)
2. Willis, B.: Distance education: a practical guide. Educational Technology Publications, Englewood Cliffs, New Jersey (1993)
3. Perry, W., Rumble, G.: A short guide to distance education. International Extension College, Cambridge (1987)
4. Education: from disruption to recovery. Available at https://en.unesco.org/covid19/educationresponse
5. Agrawal, A.K., Mittal, G.K.: The role of ICT in higher education for the 21st century: ICT as a change agent for education. In: Multidisciplinary higher education, research, dynamics & concepts: opportunities & challenges for sustainable development, pp. 76–83 (2018)
6. Oyovwe-Tinuoye, G., Adogbeji, B.O.: Information communication technologies (ICT) as an enhancing tool in quality education for transformation of individual and the nation. Int. J. Acad. Res. Bus. Soc. Sci. 3, 21–32 (2013)
7. Casey, D.M.: A journey to legitimacy: the historical development of distance education through technology. TechTrends 52, 45–51 (2008)
8. Moore, J.L., Dickson-Deane, C., Galyen, K.: e-Learning, online learning, and distance learning environments: are they the same? Internet High. Educ. 14, 129–135 (2011)
9. (Tony) Bates, A.W.: Technology, e-Learning and distance education, 2nd edn. EdiRoutledge, New York (2005)
10. (Tony) Bates, A.W.: Technology, open learning and distance education. Routledge, New York, NY (1995)
11. Cowan, J.: The advantages and disadvantages of distance education. In: Howard, R., McGrath, I. (eds.) Distance education for language teachers: a UK perspective, pp. 14–20. Multilingual Matters, Clevedon (1995)
12. Al-Emran, M., Arpaci, I., Salloum, S.A.: An empirical examination of continuous intention to use m-learning: an integrated model. Educ. Inf. Technol. 2899–2918 (2020)
13. Arpaci, I.: A comparative study of the effects of cultural differences on the adoption of mobile learning. Br. J. Educ. Technol. 46, 699–712 (2015)
14. Kumar, R.: Convergence of ICT and education. World Acad. Sci. Eng. Technol. 40, 556–559 (2009)
15. Patel, D., Patel, H.I.: Blended learning in higher education using MOODLE open source learning management tool. Int. J. Adv. Res. Comput. Sci. 8, 439–442 (2017)
16. Andrews, T., Tyman, B.: Distance learners: connected, mobile and resourceful individuals, Australas. J. Educ. Technol. 28 (2012)
17. Al-Ajlan, A., Zedan, H.: Why moodle. In: Proceedings of the IEEE computer society workshop on future trends of distributed computing systems, pp. 58–64 (2008)
18. Aranda, A.D.: Moodle for distance education. Distance Learn. 8, 25–28 (2011)
19. Oproiu, G.C.: A Study about using e-learning platform (Moodle) in University teaching process. In: Proc. Soc. Behav. Sci. 426–432 (2015)
20. Arpaci, I., Basol, G.: The impact of preservice teachers’ cognitive and technological perceptions on their continuous intention to use flipped classroom. Educ. Inf. Technol. 25, 3503–3514 (2020)
21. Stewart, B., Briton, D., Gismondi, M., Heller, B., Kennepehl, D., McGreal, R., et al.: Choosing moodle: an evaluation of learning management systems at Athabasca, in methods and applications for advancing distance education technologies: international issues and solutions, pp. 167–173. IGI Global (2009)
22. Kim, S.W., Lee, M.G.: Validation of an evaluation model for learning management systems: original article. J. Comput. Assist. Learn. 24, 284–294 (2008)
23. Ozkan, S., Koseler, R., Baykal, N.: Evaluating learning management systems: hexagonal e-learning assessment model (HELAM). Proc. Eur. Mediterr. Conf. Inf. Syst. EMCSIS 2008 (3), 111–130 (2008)
24. Arh, T., Blažič, B.J.: Application of multi-attribute decision making approach to learning management systems evaluation. J. Comput. 2, 28–37 (2007)
25. Arpaci, I.: The role of self-efficacy in predicting use of distance education tools and learning management systems. Turkish Online J. Distance Educ. 18, 52–62 (2017)
26. Burgess, L.A.: WebCT as an e-learning tool: a study of technology students’ perceptions. J. Technol. Educ. 15 (2003)
27. Devi, P.: An ICT-based distance education model an evaluation of ICT-based modes at the university of the South Pacific. Victoria University of Wellington (2006)
28. Elicker, J.D., O’malley, A.L., Williams, C.M.: Does an interactive WebCT site help students learn? Teach. Psychol. 35, 126–131 (2008)
29. Reimers, F., Schleicher, A., Saavedra, J., Tuominen, S.: Supporting the continuation of teaching and learning during the COVID-19 Pandemic, pp. 1–38 (2020)
30. World Bank: Remote learning, distance education and online learning during the COVID19 pandemic, remote learning, distance education and online learning during the COVID19 pandemic (2020)
31. Distance Learning Solutions. Available at https://en.unesco.org/covid19/educationresponse/solutions
32. Arpaci, I.: Antecedents and consequences of cloud computing adoption in education to achieve knowledge management. Comput. Hum. Behav. 70, 382–390 (2017)
33. Arpaci, I.: A hybrid modeling approach for predicting the educational use of mobile cloud computing services in higher education. Comput. Hum. Behav. 90, 181–187 (2019)
34. Arpaci, I.: Understanding and predicting students’ intention to use mobile cloud storage services. Comput. Hum. Behav. 58, 150–157 (2016)
35. Croitoru, M., Dinu, C.-N.: A critical analysis of learning management systems in higher education. Econ. Inf. 16, 5–18 (2016)
36. Dobre, I.: Learning management systems for higher education—an overview of available options for higher education organizations. Proc. Soc. Behav. Sci. 180, 313–320 (2015)
37. Faisal, H., Ubaidullah, M., Alammari, A.: Overview of cloud-based learning management system. Int. J. Comput. Appl. 162, 41–46 (2017)
38. Keles, M.K., Özel, S.A.: A review of distance learning and learning management systems. In: Virtual learn (2016)
39. Kaya, M.: Distance education systems used in universities of Turkey and Northern Cyprus. Proc. Soc. Behav. Sci. 31, 676–680 (2012)
40. Moodle History: Available at https://docs.moodle.org/37/en/History
41. Moodle LMS: Open source online learning|moodle. Available at https://moodle.com/lms/
42. Sakai. Available at https://www.sakailms.org/feature-details
43. ATutor: Learning management system. Available at https://atutor.github.io/atutor/index.html
44. Falvo, D.A., Johnson, B.F.: The use of learning management systems in the United States. TechTrends 51, 40–45 (2007)
45. Bradford, P., Porciello, M., Balkon, N., Backus, D.: The blackboard learning system: the Be All and End All in educational instruction? J. Educ. Technol. Syst. 35, 301–314 (2007)
46. Blackboard learning management system. Available at https://www.blackboard.com/
47. Desire2Learn. Available at https://www.d2l.com/en-mea/about/
48. Docebo Learn. Available at https://www.docebo.com/learning-management-system-lms/
49. Classroom Help. Available at https://support.google.com/edu/classroom
50. Li, Y.: MOOCs in higher education: opportunities and challenges. In: 2019 5th international conference on humanities and social science research (ICHSSR 2019) (2019)
51. Status report on the adoption of MOOCs in higher education in Latin America and Europe. Ecuador (2016)
52. De Freitas, S.I., Morgan, J., Gibson, D.: Will MOOCs transform learning and teaching in higher education? Engagement and course retention in online learning provision. Br. J. Educ. Technol. 46, 455–471 (2015)
53. Arpaci, I., Al-Emran, M., Al-Sharaﬁ, M.A.: The impact of knowledge management practices on the acceptance of Massive Open Online Courses (MOOCs) by engineering students: a cross-cultural comparison. Telemat. Informatics in press (2020)
54. Zheng, Q., Chen, L., Burgos, D.: The international comparison and trend analysis of the development of MOOCs in higher education. In: Lecture notes in educational technology, pp. 1–9. Springer (2018)
55. Yuan, L., Powell, S.: MOOCs and disruptive innovation: Implications for higher education. eLearning Pap, pp. 1–8 (2013)
56. Krutka, D.G., Carano, K.T.: Videoconferencing for global citizenship education: wise practices for social studies educators. J. Soc. Stud. Educ. Res. 7, 109–136 (2016)
57. Al-Samarraie, H.: A scoping review of videoconferencing systems in higher education: Learning paradigms, opportunities, and challenges. Int. Rev. Res. Open Distance Learn. 20, 121–140 (2019)
58. Griffith, S., Liyanage, L.: An introduction to the potential of social networking sites in education. Sites J. 20th Century Contemp. French Stud. (2008)
59. Hung, H.T., Yuen, S.C.Y.: Educational use of social networking technology in higher education. Teach. High. Educ. 15, 703–714 (2010)
60. Osteen, B., Basu, A., Allan, M.: In the current or swimming upstream? Instructors’ perceptions of teaching with streaming media in higher education. In: Streaming media delivery in higher education: methods and outcomes, pp. 136–157. IGI Global (2011)
61. Kebritchi, M., Lipschuetz, A., Santiago, L.: Issues and challenges for teaching successful online courses in higher education. J. Educ. Technol. Syst. 46, 4–29 (2017)
62. Davis, N.L., Gough, M., Taylor, L.L.: Online teaching: advantages, obstacles and tools for getting it right. J. Teach. Travel Tour. 19, 256–263 (2019)
63. Piktochart. Available at https://piktochart.com/
64. Squigl. Available at https://squigl.com/
65. Nearpod. Available at https://nearpod.com/
66. Edpuzzle. Available at https://edpuzzle.com/
67. Buncee. Available at https://app.edu.buncee.com/home
68. MindMup. Available at https://www.mindmup.com/
69. Trello. Available at https://trello.com/
70. Gokalp, M.O., Kayabay, K., Akyol, M.A., Eren, P.E., Koçyiğit, A.: Big data for industry 4.0: A conceptual framework. In 2016 International Conference on Computational Science and Computational Intelligence (CSCI) Dec 15 (pp. 431-434). IEEE (2016)
71. Çoban, S., Gökalp, M.O., Gökalp, E., Eren, P.E., Koçyiğit, A.: [WiP] Predictive maintenance in healthcare services with big data technologies. In 2018 IEEE 11th Conference on Service-Oriented Computing and Applications (SOCA) Nov 20 (pp. 93-98). IEEE (2018)
72. Gökalp, M.O., Kayabay, K., Gökalp, E., Koçyiğit, A., Eren, P.E.: Towards a model based process assessment for data analytics: An exploratory case study. In European Conference on Software Process Improvement Sep 9 (pp. 617-628). Springer, Cham (2020)