The Effect of Technology and Service on Learning Systems During the COVID-19 Pandemic

Arif Ullah1*, Özlem Batur Dinler2, Canan Batur Şahin3

1* Universiti Tun Hussein Onn Malaysia, Faculty of Computer Science and Information Technology, Johor, Malaysia, (ORCID: 0000-0002-7740-2206), arifullahms88@gmail.com
2 Siirt University, Faculty of Engineering, Department of Computer Engineering, Siirt, Turkey, (ORCID: 0000-0002-2955-6761), o.b.dinler@siirt.edu.tr
3 Malatya Turgut Özal University, Faculty of Engineering and Natural Sciences, Department of Computer Engineering, Malatya, Turkey, (ORCID: 0000-0002-2131-6368), canan.batur@ozal.edu.tr

(1st International Conference on Applied Engineering and Natural Sciences (ICAENS)- 1-3 November 2021)

DOI: 10.31590/ejosat.990073


Abstract

Background/Objectives: The new type of coronavirus disease first appeared in the Wuhan province of China in December 2019. The World Health Organization (WHO) declared this disease a pandemic in February 2020. This pandemic has significantly affected many areas such as education, economy, trade, business life, social life, and primarily health all over the world. In this context, the present study investigates the effect of COVID-19 on the education system. The effect of the COVID-19 pandemic on education systems across the world has caused major changes and shifted the entire curriculum to e-learning systems through online approaches. The study aimed to help universities develop an e-learning platform to facilitate the education of their students under COVID-19 conditions and assess what the role of technology and services would be in learning systems after the COVID-19 pandemic. Approaches: To this end, a review was conducted based on questionnaires from different universities in Morocco. The number of universities consulted, samples, inclusion and exclusion criteria, demographic characteristics of the studied samples, statistical analysis of the obtained results, different suggestions and implementations of learning systems were discussed. Conclusion and future research: This paper shed some light on the growth of e-learning systems during the pandemic and any disasters and provided suggestions for different academic institutions on how to deal with these challenges associated with e-learning.

Keywords: COVID-19, Technology, Learning System, Effect of COVID-19, Internet.

COVID-19 Pandemisi Sırasında Teknoloji ve Hizmetlerin Öğrenme Sistemlerine Etkisi

Öz

Arka Plan/Amaç: Yeni tip koronavirüs hastalığı ilk olarak Çin'in Wuhan eyaletinde Aralık 2019'da ortaya çıktı. Dünya Sağlık Örgütü (DSÖ), bu hastağın Şubat 2020'de bir pandemi ilan etti. Bu pandemi tüm dünyada başta sağlık olmak üzere eğitim, ekonomi, ticaret, iş hayatı, sosyal hayatı ve sağlıkla ilgili büyük değişikliklere yol açmıştır. Bu bağlama, bu çalışma COVID-19 pandemisinin eğitim sistemlerine etkisi konusundaki araştırmaların önceliğine değinilmiştir. Çalışma, öğrencilerin COVID-19 koşullarında eğitimlerini yürütmeleri için bir e-öğretim platformu geliştirme konusunda araştırmaları ve bu konuda son verileri evaluate etmiştir. Çalışma, üniversite öğrencilerinin COVID-19 koşullarında eğitim verme ve alma konularına dair araştırmaların önemini vurgulamaktadır. Yalnızca: Bu çalışma, fakat bir üniversitede değil, farklı üniversitelerin gelen anketlere dayalı olarak bir inceleme yapılmıştır. Danışlan üniversite sayısı, örneklem, inclusion and exclusion criteria, demographic characteristics of the studied samples, statistical analysis of the obtained results, different suggestions and implementations of learning systems were discussed. Conclusion and future research: This paper shed some light on the growth of e-learning systems during the pandemic and any disasters and provided suggestions for different academic institutions on how to deal with these challenges associated with e-learning.


http://dergipark.gov.tr/ejosat

* Corresponding Author: arifullahms88@gmail.com

106
1. Introduction

The COVID-19 pandemic has challenged education systems and changed the entire world from different aspects. During the COVID-19 pandemic, different countries have addressed the crisis according to their levels. However, education systems in the entire world have shifted to the e-learning mechanism after COVID-19. It was difficult to prepare these learning systems in a short time, especially for countries of the Third World due to the lack of different technologies. In the last five decades, significant growth has been observed in the field of education systems worldwide. However, the COVID-19 pandemic has tested these developments, following which all physical activities have been transformed into virtual systems. For virtualization, different technologies are needed [1]-[2]. It is possible to increase educational productivity with online learning opportunities and the usage of open educational resources and other technologies due to the acceleration of the learning rate [3]. After the emergence of COVID-19, almost 120 countries have closed schools and universities, which affected almost a billion students across the world. Afterward, universities and schools have introduced courses through online portals by adopting different technologies. One of the main advantages of e-learning systems is that postgraduate students are registered as part-time students because they also work in different fields [4]-[5].

1.1. Effect of COVID-19

The coronavirus disease 2019 (COVID-19) emerged in December 2019, causing many changes in life and society worldwide. COVID-19 was declared a global public health emergency by the World Health Organization (WHO) on January 30th, 2020, and it became a pandemic. After most of the countries were affected and the number of cases and death ratio increased, the entire world started implementing lockdowns. All activities were closed due to social distancing, and education systems were also affected, causing all universities and schools to be closed. Few months after lockdown, people became familiar with handling COVID-19 and started working from different angles and in different styles by considering different parameters. Each country started working in a different field by following the standard operating procedure (SOP), which they introduced for their people’s protection due to the COVID-19 pandemic [6]-[7]. Figure 1 presents the effect of COVID-19 worldwide.

Figure 1: Effect of Covid-19 world-wide (unicef.org)

1.2. Learning Systems After COVID-19

The domain of education is one of the best examples of changes in the world due to the COVID-19 pandemic. All activities of education systems have been transformed into e-learning systems, where all teaching activities have been transferred to online communication and learning platforms. On these platforms, both the teacher and student interact while using different applications for teaching. This is not the first example. In 2009, the traditional education system was stopped due to the H1N1 flu outbreak, which affected the education system. After the COVID-19 pandemic, the face-to-face learning system was changed to distance learning, or simply, to e-learning systems. Many governments tried to keep up with the exponential spread of COVID-19. Thus, there was very limited time for organizations to prepare for a remote teaching regime. If possible, preparations could have been completed, and Figure 2 demonstrates the applications and software used during the COVID-19 pandemic [8]-[10].

Figure 2 shows the different applications and software used by various countries for educational purposes according to their requirements during the COVID-19 pandemic. Due to COVID-19, e-learning is becoming very popular worldwide because almost all activities are performed based on technology via the internet. Online learning or e-learning is effective in developed countries, but it is not effective in most of the underdeveloping countries due to different reasons. One of the main elements of learning systems is smartphones. However, they are not effective in learning due to a significant amount of content that can be accessed using smartphones [12]-[13]. After the survey of organizational agility (Wu, 2020), it was observed that online learning systems had several issues, including content change into digital, online teaching methods and different resources used for education systems. Furthermore, the main issues of online systems are the effects and efficacy of online education and the range of learning goals guiding our educational and instructional priorities. The absence of access to quick, cheap and reliable internet connections prevents online learning, particularly for individuals living in rural areas and marginalized communities in different countries [14]. After the COVID-19 pandemic, the student’s entire education progress has changed in a different way. For example, different students need to change from schools to universities or colleges to training sections, according to their education level. This changes student’s life or encourages different roles in students. However, due to COVID-19, all these activities have been stopped, and only the online system has remained without any social progress[15]-[16].
2. Material and Method

2.1. Current Technologies And Services Used in Learning Systems

Information and communication technologies (ICTs) have quickly become one of the main supports of today’s society. Nowadays, a lot of countries regard understanding the said technologies and becoming proficient in their major concepts and skills as an indispensable part of basic education, along with writing, reading, and arithmetic. Thus, education informatization has become a new paradigm of online education, called smart e-learning, that allows for inserting the theory of modern education based on educational data and uses supporting technologies to make better use of intelligent e-learning services [17]-[18]. In this sense, we can speak of two different axes of data-based services, among which online learning is a three-level architecture: the first level is data, the second is supporting technology, and the third level is service. Under the traditional category of data, it is possible to divide educational data into three groups: unstructured data, semi-structured educational data, and structured educational data. The main supporting technologies cover digital tools and products that can be used in education and online teaching. They include typical services, e-learner profiles, generation and navigation of learning paths, and a knowledge graph construction process. In intelligent e-learning, the descriptive analysis makes it possible to target, describe, summarize, and analyze the data historically and educationally and perform typical tasks allowing including the profile of the e-learner and the KG construction. The diagnostic analysis consists of identifying the trends’ causes and the learning results of e-learners. As long as the analysis continues, it allows monitoring the e-learner status, resource usage, action, and decision autonomously or semi-autonomously [19]-[20]. The COVID-19 pandemic has affected countless areas of human activity, including education systems, on a large scale worldwide. According to the data of (UNESCO 2020), more than 1500,000,000 university students, who cannot attend their universities, have been affected. Due to the effect of COVID-19, the education system was shut down. However, after becoming familiar with this problem, UNESCO has recommended equipping educational institutions with online learning tools [21]-[22]. We live in the age of information technologies, which play a vital role in different fields, and education is one of them. The shift from the classical design of teaching and training, which is approaching in a hidden way, represents a source of both difficulties and opportunities for higher education institutions. Thus, some of the issues in the future education system after the COVID-19 pandemic are discussed in this paper, and results are collected from a questionnaire-based study.

2.1.1. Problem Statement

This study was designed to critically examine the effect of technology and service on learning systems during the COVID-19 pandemic. The present research investigated its positive and negative impacts on the education system and checked different issues. After COVID-19, technology was included in the education system, and it is required to investigate which section needs improvement and more specific modification with regard to technology and services.

2.1.2. Objectives of the Study

- To find positive impacts of technology on the education system during the COVID-19 pandemic.
- To find negative impacts of technology and service on the education system during the COVID-19 pandemic.
- To provide recommendations for improvement of technology and service after the COVID-19 pandemic.

2.1.3. Hypothesis

The study is based on the following hypothesis, and Figure 3 presents the theoretical framework of the paper.

Figure 3: Theoretical Framework.
2.2. Simulation Environment

Structural equation modeling (SEM) is used to conduct multivariate analysis. SEM is a statistical modeling instrument which can solve casual and complex covariance relationships among different variables. It basically represents a set of multivariate techniques, including measurement and structural equation simultaneously [27]-[28]. PLS, LISREL, EQS, and AMOS represent the most common SEM techniques. EQS, LISREL, and AMOS are covariance-based methods, whereas PLS is a component-based technique [29]. SEM is used for covariance in the analysis techniques rather than correlation in other tools such as regression analysis in SPSS, yielding better results compared to correlation [30]-[31]. SEM was used in this study because it evaluates the theoretical proposition, showing the correlation between constructs and the credibility of the theoretical model [32]-[33]. Furthermore, the main advantage of using SEM is the increased application of SEM in performance-related studies [34]-[35]. The mentioned advantages include its ability to conduct multifaceted and multiple regression analysis as a whole simultaneously, its use for the generation of results. Moreover, the PLS algorithm and bootstrapping technique are used for the measurement of data as well as the structure of the model [36]-[37].

3. Results and Discussion

Finally, the results of the paper demonstrate that students are satisfied with the learning system during the COVID-19 pandemic in different universities in Morocco with positive images and few negative images. The above-mentioned findings are important for universities when they start the e-learning of students due to the impact of COVID-19, which causes a paradigm shift in the education sector, especially in universities. In the course of the paradigm shift and the adoption of online learning, universities should concentrate on ICT together with reliability, tangibility, assurance, and responsiveness. Furthermore, when universities start the e-learning of students, they will make use of different services in positive and negative aspects. Thus, through a paradigm shift, universities are able to maintain their operations via online learning as a result of applying the elements mentioned above under the COVID-19 conditions. Table 1 shows the results of the collection after simulation, while Figure 4 demonstrates the simulation process.

### Table 1. Data Process.

<table>
<thead>
<tr>
<th>HH1</th>
<th>HH2</th>
<th>HH3</th>
<th>HH4</th>
<th>HH5</th>
<th>HH6</th>
<th>HH7</th>
<th>HH8</th>
<th>HH9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.533</td>
<td>0.614</td>
<td>0.432</td>
<td>0.899</td>
<td>0.56</td>
<td>0.584</td>
<td>0.571</td>
<td>0.511</td>
<td>0.545</td>
</tr>
<tr>
<td>0.595</td>
<td>0.433</td>
<td>0.618</td>
<td>0.525</td>
<td>0.392</td>
<td>0.552</td>
<td>0.471</td>
<td>0.38</td>
<td>0.854</td>
</tr>
<tr>
<td>0.589</td>
<td>0.415</td>
<td>0.654</td>
<td>0.543</td>
<td>0.497</td>
<td>0.626</td>
<td>0.335</td>
<td>0.553</td>
<td>0.235</td>
</tr>
<tr>
<td>0.258</td>
<td>0.163</td>
<td>0.296</td>
<td>0.237</td>
<td>0.389</td>
<td>0.397</td>
<td>0.101</td>
<td>0.438</td>
<td>0.191</td>
</tr>
</tbody>
</table>
| 0.617 | 0.42 | 0.866 | 0.644 | 0.47 | 0.489 | 0.426 | 0.615 | 0.723 | 0.152 | 0.757 | 0.539 | 0.756 | 0.641 | 0.878 | 0.68 | 0.34 | 0.884 | 0.511 | 0.327

---

- **H1.** E-information quality has a caring connotation with students’ e-learning.
- **H2.** Students’ e-learning arbitrates the relationship between e-service qualities.
- **H3.** Students’ satisfaction arbitrates the relationship between students’ e-learning and university image.
- **H4.** The relationship between e-learning and the cost of different devices is mediated by students’ satisfaction.
- **H5.** Students’ satisfaction with the cost of technology and its future implications.

2.1.4. Data Collection

The target population of the current paper consisted of students selected from different public and private universities in Morocco according to their ranking in QS World Ranking 2020. Online questionnaires were employed for data collection from the universities using online education systems continuously under the current COVID-19 conditions. Data collection was performed using an online questionnaire with the help of the Google platform. Three hundred questionnaire responses in total were obtained, and the number of responses that could be used for data analysis was 300.

2.1.5. Questionnaire and Methods

The questionnaire consists of 30 items on the basis of the research of [23]-[24]. The main categories used are technology and communication, consisting of 10 items. The quality of e-learning service consists of four dimensions, which were adopted by [25], and the effect of device and connection consists of 3 dimensions adopted by [26].
The construct validity is checked by conducting a parallel analysis and is a powerful technique; it measures the components of the factor to be retained after performing the factor analysis. The current study confirmed that students were satisfied with the vital components of online education in an emergency, such as the COVID-19 pandemic. The three main elements of the system are technology, services and devices, and their quality. These studies have a positive aspect in improving education systems during this pandemic and some negative aspects about the service quality and cost.

The present research suggested that the e-learning of students was one of the essential components of providing online education in an alternative condition, such as the COVID-19 pandemic. Nevertheless, the e-learning of students includes three main elements: e-service, quality, and e-information quality. The findings of the research emphasized that technology and service played an affirmative role in improving the e-learning of students. The development of students’ e-learning is possible with better technology and service. Previous research also supports the mentioned findings. In accordance with [38], technology and service play a primary role in promoting students’ e-learning. Moreover, further research confirms a significant positive impact of technology and service on the e-learning of students [39]-[40]. Additionally, the study findings also confirmed that the quality of e-service contributed positively to promoting the e-learning of students. Thus, the quality of e-service quality represents the central component of the paradigm shift. Higher e-service and resource quality can assist with the paradigm shift in universities. A higher quality of e-service may encourage students to learn using an online system. In line with the present research, [41] argued that the quality of e-service had a direct effect on the faithfulness of e-learning students. In consistency with this research, different previous studies also emphasized that the quality of e-service and resources positively affected the e-learning of students [42]. Moreover, the current research demonstrated that the quality of e-service should have perceptibility, dependability, receptiveness, and declaration for the purpose of encouraging the e-learning of students. Furthermore, it is necessary to ensure a higher quality of e-information with the aim of providing a better student e-learning system. E-learning quality is dynamic for the purpose of developing a students’ e-learning system and motivating students to benefit from the online learning facility. Prior studies in the literature are also parallel with the present research and provide pieces of evidence indicating that the quality of e-information has a positive effect on improving students’ e-learning. Previous research has examined a significant positive impact of e-information on the learning of students [43]. In parallel with this research, different previous studies also emphasized that the quality of e-service positively affected a students’ e-learning system. Moreover, the present research confirmed that e-service quality should possess reliability, tangibility, assurance, and responsiveness for the purpose of promoting the e-learning of students. In addition, it is necessary to ensure a higher quality of e-information with the aim of providing a better student e-learning system. The third section discusses the cost and connection procedures students are uncomfortable with. The fifth section discusses the real time section and privacy and service section (SS), which are the main issues that need to be solved in the future. The last section states that more studies are needed on the same platform (AVA) for sharing different contents with different students. The survey indicated positive results or images during the COVID-19 pandemic. However, few main suggestions were made. For example, an improvement is needed after the COVID-19 pandemic, when different organizations design different platforms for learning systems. Figures 5 and 6 show the impact of COVID-19 on the education system.
3.1. Future Trends in Learning Systems

There is an urgent need to create a ubiquitous learning environment by incorporating hybrid human intelligence into the loop to create safe, intelligent, and engaging online learning environments to promote performance and experience with learning services personalized as well as a huge online learning service, especially when they first appeared in the world. Some infectious diseases like COVID-19 emerge. Therefore, future work will be as follows. The intelligent knowledge service and online learning, undoubtedly, enable e-learners to learn and acquire knowledge [44]-[45]. At the same time, there are numerous scattered and chaotic online educational resources, causing low resource usage and learning efficiency. Hence, there is an urgent need to transfer numbers of educational resources into a cohesive knowledge system and service. Finally, the systematization of knowledge on the basis of the KG service leads to an orderly, thematic, and visual organization, management, and service of knowledge teaching. AR/VR services improve with the developing VR/AR technology, services with enhanced VR/AR online educational resources, including virtual physical resources and chemical experiments, and virtual design/green combustion engineering training will become popular, in particular with human-type personalized teaching assistants or intelligent agents with the integration of services such as Q/A and effective interaction. Intelligent EQA systems, methods, and services still do not have scientific EQA since they have become a limitation to improving the e-learning quality [46]-[47]. Developing technology will be essential for the evaluation of production. Various types of assessment work together for the purpose of capturing and analyzing the abilities of online learners and online learning environments, taking into account full reliability, validity, fairness, and confidentiality, in establishing a mechanism for feedback and communication between learners and teachers, and then performing a thorough and scientific evaluation. Digital property protection or privacy services remain an important issue in online services. There is no exception for e-learning and its services. Certain tasks need to be performed for the prevention of
3.2. Limitations and Future Directions

Although the present research has contributed to the literature significantly, there are several limitations in the current study, which can represent directions for future research. Firstly, the findings of the current research are primarily valid for developing countries where the development of e-learning systems is in the early phase. Nevertheless, e-learning systems have a good organization in the majority of the developed countries. It is necessary to conduct future studies in developed countries as a result of extending the framework of current studies. Secondly, the present research just provided the framework for e-learning systems. Nevertheless, universities are experiencing various difficulties in implementing e-learning systems. Thus, future research must address the challenges experienced by universities concerning the e-learning system and provide a potential solution. Thirdly, a questionnaire survey constitutes the basis of the current paper. However, future research should also involve interviews with higher authorities in universities to acquire precise information about online learning.

4. Conclusions and Recommendations

This paper presents the impact of the COVID-19 pandemic on the education system and mentions the affected geographical region and the faculty studied (age group/university and stream, duration of study). The COVID-19 pandemic has changed the entire world structure due to social distancing and also the education system. Therefore, it is necessary to apply digitalization to the education system critically. Furthermore, there is a need for a broader societal dialogue about the goals of education and about the society kind we want to develop in under the COVCIID-19 conditions. Despite the fact that the current study has made a considerable contribution to the literature and practice, it also has some limitations, which can be directions for future research.

Firstly, the findings of this paper can primarily be applied to developing countries where the development of the online education system is in the beginning phase. Nevertheless, the majority of the developed countries have well-established online learning systems. It is necessary to conduct future studies in developed countries on the main issues of the cost of devices and network availability. Thirdly, a questionnaire survey constitutes the basis of the current paper. However, future research should also involve interviews with higher authorities in universities to acquire precise information about online learning.

Acknowledgements

The authors would like to express their gratitude to the...


[28] LOWRY, P. B., & GASKIN, J. (2014), Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it. IEEE transactions on professional communication,57(2), 123-146. https://doi.org/10.1109/TPC.2014.2312452.


