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# Impact of COVID-19 on achieving the goal of sustainable development: E-learning and educational productivity

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## ABSTRACT

The COVID-19 pandemic has had a thought-provoking impact on the Sustainable Development Goals (SDGs) that were approved by United Nations in the year 2015. Therefore, taking this very consideration forward, this study primarily explores the impact of COVID-19, particularly on the SDG number 4, i.e., education. Due to the COVID-19 contagion, given the unusual and never been experienced circumstances, educational institutions all over the world have been forced to establish their e-learning systems practically overnight. For this purpose, we collected the relevant data from middle school students, by using a technique known as convenience sampling. Furthermore, moving on in the same context, we also developed an integrated model with five dimensions, i.e., Learner, Design, Technology, Instructor, and Environment, in order to gauge this relationship in further detail. The empirical findings of the step-wise multiple regression analysis revealed that the learners' attitude towards the computer, learners' internet self-efficacy, usefulness, instructors' response timelines, and the instructors' attitude towards e-learning, positively and significantly tend to affect the middle school student's satisfaction with online. Whereas, learners' computer anxiety, ease of use, system availability, internet availability, learning climate, and interactions negatively affects the middle school students' satisfaction. These results imply that developing countries could possibly achieve goal number 4 (Education) of the Sustainable Development Goals, by improving the learner satisfaction, and further strengthening the implementation of their E-Learning practices.

**Abbreviations:** ATC: Learner attitude towards computer; CA: Learner computer anxiety; ISE: Learner internet self-efficacy; CU: Usefulness; EU: Ease of use; SA: System availability; IA: Internet availability; RT: Instructor Response timeliness ; ATL: Instructor attitude toward e-learning; LC: Learning climate; LI: Learner interaction; ELS: E-Learner Satisfaction

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## 1. Introduction

The COVID-19 pandemic has a thought-provoking impact on the Sustainable Development Goals (SDGs) that were approved by the United Nations in 2015 (Cf, 2015). Out of these goals, the fourth goal of the SDGs has been formulated to address the global level of education, in terms of 'Quality Education'. This particular goal propagates that every learner must obtain the skills and knowledge that is required to endorse sustainable development in the world, for the betterment of the global population, the future generations, and the environment. However, the advent of COVID-19 has affected the education sector of the entire world, primarily due to the closure of educational institutions. Even a year after its spread of this infection all over the world, The COVID-19 pandemic still remains a serious challenge for the entire humanity, and unfortunately, the world is still in its firm grip. Throughout the world as we know it, every aspect of life has completely been altered with the spread of this virus. In such times, the prime aim of all the countries is to decrease the rapid spread of COVID-19 in the society (Mirza et al., 2020; Osman, 2020; Rizvi et al., 2020). Therefore, as a drastic measure to curtail mass infection, schools, colleges, universities, and other higher education institutions worldwide were closed due to the spread of the deadly COVID-19 (Murphy, 2020). As a result, policy makers adopted to the new normal as rapidly as they could, especially in the global educational sector. As of the current scenario as well, most of the educational institutions worldwide have adapted to the E-learning system, so as to continue the process of teaching and learning (Weeden & Cornwell, 2020).

E-learning is a concept of delivering knowledge or education through the internet, satellite, interactive TV, intranet, or extranet among the learners (Chen, 2011). The concept of E-learning includes applying modern technology, and the E- tools available, for an effective two-way communication, so as to impart knowledge to all the relevant stakeholders in the education sector on a global level (Thanji & Vasantha, 2016). During the COVID-19 pandemic, E-learning has been found to be a critical instrument for efficiently continuing education across all levels (Alipio, 2020; Basilaia & Kavadze, 2020; Soni, 2020). E-learning requires a significant amount of time and commitment, in order to create an environment that supports learners in both informal and formal resources (Yuan, 2021). In this regard, rawford et al. (2020) highlighted that a speedy conversion of face to face education to E-learning has given rise to several obstacles and issues during the COVID-19 pandemic across the world.

It is noteworthy that there is no doubt that it is a positive evolution of the learning process that a new medium of instruction has been actively, rather exclusively explored all around the world. However, the most pressing question in everyone's mind is whether or not E-learning proves to be the most effective and satisfactory mode of instructions for the students; especially middle school students who have a plethora of stimuli and triggers around them, given that they are stepping into young adulthood. As a result of the rapid spread of the COVID-19 pandemic, E-learning has become an integral, rather primary part of education on a global level, mainly at the graduation or post-graduation level. The concept of E-learning has been around for more than two decades, however, it has not taken precedence over physical learning as of yet. The main purpose of E-learning has been to facilitate students to

transition smoothly into the concept of distance learning, online courses, or diplomas. It can be fathomed that no one around the world would have thought that E-learning would become the primary mode of instruction from the pre-school to university level, in the short term. This leads to two main questions that are asked globally; that is to say, whether the resources for E-learning are feasible and easily obtainable, and also whether they provide academic satisfaction to the students.

Online learning has been, and continues to be a challenge for developing countries due to the lack of resources that are experienced by these countries. In this regard though, Basilaia and Kvakadze (2020) claimed that E-learning is a tool that could deliver effective outcomes in digitally advanced countries, but for the other countries, this claim cannot be made with complete conviction. This is because the students of developing countries have faced several problems when it comes to E-learning. The immediate ones of these include the lack of digital devices that are readily and adequately available at home, lack of affordable, reliable, and a fast internet connection, especially in rural and backward areas (Wains & Mahmood, 2008). Despite these barriers, after the abrupt spike in the infection rates of COVID-19 on a global level, the schools have established their e-learning system overnight, so as to continue the teaching and learning process. It has been a challenge for the teachers as well as students to adapt to this new system, as many have had to learn how to teach all over again.

Keeping these intricacies in mind, this study mainly focuses on the students of private schools, so the students' level of satisfaction can be determined. If the results come out to be favorable they would be empirically applied accordingly, in order to expand the E-learning initiatives in Pakistan. Thus, this study would primarily be focusing on the processes and application of E-learning in Pakistan's middle schools, as it happens to be a critical stage for students who are stepping into young adulthood. Multiple researches have already been carried out based on the discipline of online learning in Pakistan, but these have mostly been focused on the application of virtual learning practices on a university level. This study, therefore, will cover the gap in the existing literature, by focusing on the middle school students' level of satisfaction. Moving on in the same context, in their study (Mailizar & Fan, 2019) proposed that future research should be conducted on the students' opinions regarding online learning, in order to examine the issues faced by them. In normal circumstances, several researchers such as (Ali & Ahmad, 2011; Bukhsh, 2007; Farid et al., 2015; Yousuf, 2007) have conducted empirical studies, in order to analyze the problems and issues faced by students, specifically related to online learning, for achieving their learning goals. Therefore it is the need of the hour to explore the problems and issues related to E-learning, particularly during the COVID-19 pandemic.

This study has also incorporated the positive and negative aspects of E-learning practices, in order to evaluate its influence on the student's level of satisfaction. Most of the variables that would impact the students' e-learning were included in the study, in order to examine the association between e-learning and students' level of satisfaction. It is important to note here that establishing and running an e-learning system is the requirement of the day, but it is also crucial to note whether the learning objectives have been achieved. In case of the absence of a learning plan, where the learning

objectives are met accordingly, educationists must ask themselves about the strategies that should be adopted in order to improve e-learning. It must be noted that there is no benefit in just pursuing e-learning practices if the actual receivers, that is the students, are not satisfied with it. In order to achieve this, there are major gaps that need to be covered, so as to reach to the point where most students would feel satisfied with the learning, and immense progress would be made to fulfill the gap in terms of gaining the targeted level of education.

## 2. Literature review

After the approval of the seventeen UN-sustainable development goals in 2015, several empirical studies, for instance, (Anwar et al., 2021; Jun et al., 2021; Su et al., 2020; Su, Huang, et al., 2021; Su, Sun, et al., 2021; Umar et al., 2020, 2021) have suggested that the policies must achieve these various sustainable development goals. Some of these include clean and affordable energy (goal-7), economic growth (goal-8), sustainable cities (goal-11), climate change (goal-13), and public-private partnership (goal-17). Whereas, quality education (Goal-4) is a measure that is relatively ignored in the literature. Moreover, especially after the unexpected rapid spread of COVID-19 at the end of 2019, the educational sector has been severely and adversely affected by the sudden adoption of E-learning practices.

Although the first wave of the novel covid-19 pandemic saw the world shift to an online learning system completely, in the second wave most educational institutions resorted to a hybrid learning system. Keeping in mind that people around the world are now starting to ease into life with Covid-19 as the new normal, researchers are interested in finding out the effect of hybrid learning systems on the students' level of satisfaction. In this regard, a prior study was referred to, in order to analyze the influence of hybrid learning, which is a combination of face-to-face and e-learning systems, on students' level of satisfaction. Moreover, in a study by Adams et al. (2015), an experiment was conducted to compare the effectiveness of a hybrid versus a traditional lecture format. It was observed that apart from the format, the rest of the variables such as the instructor, the lesson content, the worksheets, and assessments were exactly the same. The results of this experiment showed that there was a significant difference between the satisfaction dynamics of the traditional and hybrid learning systems. The students of traditional learning showed better levels of performance as compared to the other group of students. In addition to this, the analysis also revealed that the students in the hybrid learning format were not quite interactive with each other and the instructors, due to the barriers that existed in the modes of communication, and relied on technology for all the learning materials. This study emphasized on the notion that e-learning can affect students' satisfaction due to a lack of face-to-face interaction with the instructors and peers. In another study, (Cole et al., 2014) revealed that the students are relatively satisfied as compared to totally online learning. The research was conducted over a time span ranging from three years, between graduate and undergraduate students. There were 541 students who attempted an online survey, while there was no significant difference in the levels, age, or gender of the participants. Results revealed that the participating student

population was relatively satisfied with these factors, including the convenience that came with e-learning. However though, these same students were less satisfied with online learning when it came to the question of the lack of interaction with their instructors as well as peers. Therefore, this study showed that overall, hybrid learning tends to have a positive impact on the level of student satisfaction.

At another instance, a report was prepared in which (Moore, 2010) argued that a superior quality of e-education could be achieved, if the five key principles were to be followed. These included the incorporation and consideration of learning effectiveness, scale, access, faculty, and student satisfaction. It is commonly believed that instructors and institutions can develop strategies, whereby they can train students on the most effective practices to make the most of their online learning experience, and an interactive pedagogy can also be resorted to, so as make the lessons interactive and effective. Another study by Lorenzo and others (2015) revealed that there are seven factors that could potentially fulfill the level of student satisfaction. Sun et al. (2008) identified the factors, after surveying a sample of 295 students. These included the course quality, course flexibility, instructor attitude, computer anxiety, and diversity of the assessment. In online learning, it was observed that the essence of these factors is gauged by the measure that if the quality of these factors is up to the standard, it will surely lead to an adequate level of student satisfaction. However, the time has now completely evolved the learning, as well as the teaching styles. It is crucial for teachers to shift learning from text based methods to more interactive, creative and strategic ways which keep the learners engaged throughout the learning process. Although modifications have been made in the previous decades, this has to become mandatory practice now, especially since the Covid-19 has made us realize that the dynamics and future of education could potentially change forever. The importance of this is highlighted a study by Gray and DiLoreto (2016). The researchers focused on four factors, so as to establish a positive relationship between E-Learning practices and the variable of student satisfaction. These factors included the 'Course Structure,' 'Student engagement,' 'Learner interaction,' and 'Instructor Presence'. The results of the study showed that the usage of effective strategies, particularly in designing these factors would significantly impact the students' e-learning capabilities, as well as their level of satisfaction.

Following the same context, studies have shown that online assessment is the major factor that discourages interest in e-learning practices, and thus, the level of satisfaction of the recipients of the course material. There are not a lot of effective strategies that can make the experience of online assessment authentic. In this regard, Barber et al. (2015) analyzed this perspective by emphasizing upon the importance of three factors, so as to improve the pedagogy for E-learning that is required to achieve students' satisfaction. These factors include online authentic assessment tasks, problem-based learning, and productive and meaningful communities. The authors argue that there is a positive relationship between these three factors. That is to say that the students should be given a certain amount of autonomy to choose the way they want to learn for an effective outcome. The said research was conducted among students by combining the three factors, so as to test the effectiveness of this new pedagogy. The results showed that students must be prepared according to the current time

period, in order to achieve the most effective and efficient level of education. It is noteworthy that student satisfaction is deemed to be directly proportional to an instructor's capability. The importance of it has been highlighted by Fletcher and Bullock (2015) as they analyzed the importance of the instructor's compatibility with the students, particularly in an online teaching environment. The research was conducted by collecting information from journal entries, e-mails, and monthly Skype calls. The authors realized the importance of an interactive relationship between the coaches and the students, and the effects this relationship has on the designed learning outcomes. This study also made them realize how important it is to develop pedagogies that are especially targeted towards online learning, so as to achieve the most effective results.

At another instance, a study conducted on high school students by Baig (2011) was based on the differences between face-to-face and online learning. The results revealed that the findings were, in fact, in favor of online learning. He also observed that the students showed better outcomes when using the mode of online learning. He further argued that the students in such a situation, tend to have better opportunities to access and share the course content. He felt that the students would be out of the box, gaining access to different material and online tools for learning, in the comfort of their own time and space. This study showed a progressive association between student satisfaction and e-learning. As online learning is based on information communication and technology, the quality of the ICT directly impacts it as well. In a study by Supriadi and Sa'ud (2017), the authors analyzed that the application of ICT tends to provide an edge in the learning environment. For the most effective and satisfactory results, it is the institutions that require proper and adequate infrastructure, human resources, leaders, and organizational commitment. The author also highlighted the importance of ICT applications for the most effective online learning experience. Other than that, the research also implemented the analytical-descriptive method through a qualitative approach, by gathering information through interviews, observations, and analysis. Three distinct factors, namely of education, research, and community service, were deemed to be crucial in empirically applying the ICT setup. The improved and effective setup is believed to provide an opportunity for quality-based learning to students, eventually leading to student satisfaction.

Moving on, using the data from Indonesia, in their study, Agung et al. (2020) highlighted the role of Indonesia's Ministry of Education and Culture during the pandemic, by shifting the mode of learning from traditional to online. The study analyzed students' insight into online learning, and a survey was conducted based on their perceptions in terms of their role in e-learning in various aspects. These aspects included deciding factors such as punctuality, and the submission of assignments, etc. The results demonstrated that the lack of internet availability and teaching media were the two key issues that were experienced in e-learning. Moreover, Agung et al. (2020) also revealed that the obstacles faced when pursuing e-learning tend to take a toll on the students' perception of the learning system. At another instance, Dong et al. (2020) also highlighted the parents' beliefs and attitudes towards their children's online learning. In this regard, a survey was conducted in a sample of 3275 Chinese parents regarding online learning during COVID-19. Results showed that

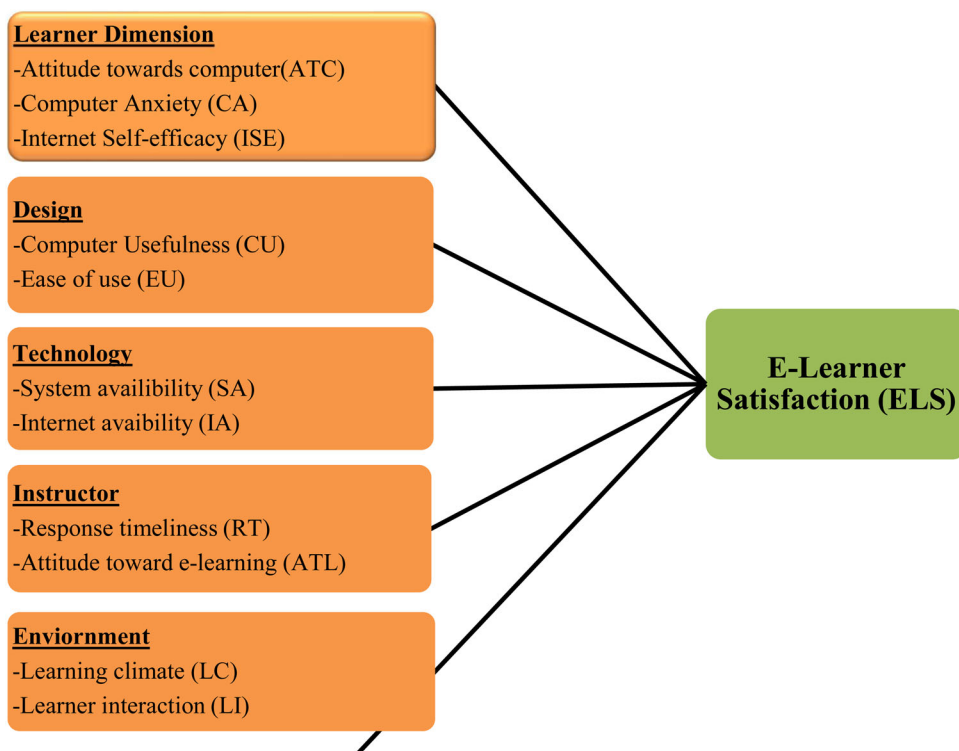
approximately 92% of students' participated in online learning, but around 85% of the students did not spend full time on it. The majority of the parents were dissatisfied with the concept of e-learning, primarily due to shortcomings of online learning, lack of children's ability to regulate the procedure (especially in the case of young learners), and the lack of parents' ability to learn the system quickly enough, in order to guide their children. The study further highlighted the parent's additional stress related to the pandemic, thus affecting their life. The findings of the study suggested that there must be an improvement in the policies, as well as the teachers' training, as the Chinese parents were not ready to embrace this new wave of learning as the new normal.

We can fathom that the student's level of satisfaction is critically based on the learning evaluation, assessments, and accountability. In this regard, Huber and Helm (2020) held a survey in the beginning phase of the global lockdown, in order to assess the factors that came into play during the pandemic. The purpose of the study was to evaluate the current ongoing procedure of learning, perhaps for further improvement. This survey was initially conducted in Germany, Austria, and Switzerland but later extended to other countries as well. It was mainly based on the quality of design and information, psychological and environmental factors that came into play when assessing students' performances. The results showed that the students could adapt to the system, but their lack of motivation was a key factor in the low performance. The ratio of these students was about one-third, who were able to manage their time and also remain active in their online classes. In contrast, the ratio of the less active students was higher. The study concluded that although the teachers were able to perform efficiently, more relevant policies and training courses will be required to effectively stimulate the students' interest in online learning. Furthermore, other studies, such as those of Gillett-Swan (2017) and Agarwal and Dewan (2020) showed similar results for college and university students as well. These also suggested that further improvements are, and will be required in policymaking and designing e-learning initiatives, so as to achieve the valuable outcome.

In some studies, the positive effects of online learning have also been highlighted. The novel COVID-19 has revolutionized the education sector, and this can potentially lead to positive outcomes as well. In this regard, Gupta (2018) argued regarding the geographical importance of e-learning, and how it can benefit students worldwide in order to access learning. Similarly, Bakia et al. (2012) also emphasized that online education paves the way for affordable education to those individuals and communities who are not in the position to afford the costs of education. Other than that, Conrad (2002) also highlighted the popularity of online learning in the education sector. At another instance, a study by Tsai (2016) communicates the importance of student engagement in learning by way of effective strategies, as it is crucial to engage the student in the learning process in order to achieve positive outcomes.

It is noteworthy that the results of all the above studies are inconclusive and mixed, as a few studies show the negative impacts of e-learning, while some studies show the positive impacts of the e-learning systems. Therefore, during the Covid-19 pandemic period, it is necessary to investigate the impact of e-learning on the education sector, and suggest suitable policy implications for achieving goal number 4, i.e., 'Quality Education', of the sustainable development goals of the United Nations.





**Figure 1.** Theoretical framework of the model.  
Source: Author Estimation.

### 3. Methodology

#### 3.1. Theoretical framework

At the beginning of March 2020, educational institutions switched to online learning in a span of a few days, due to the novel Covid-19 pandemic. This was done without any proper planning and training for the teachers and students. Although modern technologies have made an attempt to replace traditional classroom systems gradually, and have had a substantial impact on the graduate and post-graduate students learning avenues and capabilities (Azhari & Ming, 2015; Shirky, 2008), this sudden shift from classroom teaching to an online mode, particularly for middle-school students has been nothing short of challenging. The main objective of the present study was to study the impact of the influencing factors on middle school E-learner satisfaction. The theoretical framework of this study is based on the studies of Sun et al. (2008) and Lee et al. (2020). Moreover, the learners' dimension has been measured by Gattiker and Hlavka (1992), while the learners' attitude towards computer learning, and the learners' computer anxiety has been gauged by Barbeite and Weiss (2004). Moreover, the learners' internet self-efficacy has been analysed by Joo et al. (2000). For the present study, the e-learning's (Arbaugh, 2000) design dimension has been analysed, primarily by using its usefulness and ease. In this regard, the technological dimension that has been taken into consideration contains a total of 8 items. These include the system availability that has been adapted from Amoroso and Cheney

(1991), and internet availability that has been adapted by Sun et al. (2008), with a further 4 items that are contained in each of these dimensions. as for the instructors' dimension, instructor response timeliness (Thurmond et al., 2002), and instructor attitude toward e-learning (Webster & Hackley, 1997) were taken as valid measured. Then, the environmental dimension was divided into two factors; learning climate by Thurmond et al. (2002), and learner interaction by Arbaugh (2000). Also, in order to measure the dependent variable that is the e-learner satisfaction, the scale suggested by Arbaugh (2000) has been referred to. Thus, the theoretical model for the paper is as follows (Figure 1):

The study has the following hypotheses:

1. Learner attitude towards the usage of computers positively affects E-learner satisfaction
2. Learner computer anxiety positively affects ELS
3. Learner internet self-efficacy positively affects ELS
4. Usefulness positively affects ELS
5. Ease of use positively affects ELS
6. System availability positively affects ELS
7. Internet availability positively affects ELS
8. Instructor Response timeliness positively affects ELS
9. Instructor attitude towards e-learning positively affects ELS
10. Learning climate positively affects ELS
11. Learner interaction positively affects ELS

### **3.2. Sample and data collection**

This study was conducted, based on the private middle school students who were pursuing e-learning programs. The teachers took live sessions through different platforms, and the assignments were posted and evaluated on the platform. The analysis part has been looked into in terms of individual basis, and the respondents were grade 6–8 students of the school. Moreover, the data was collected through convenience sampling, by conducting personal visits, and via an online questionnaire survey from the students who were using E-learning for educational continuity during the COVID-19 pandemic. Also, the survey form was shared via the Google classroom service, students' e-mail IDs, and WhatsApp groups, so as to approach most of them to fill in the online questionnaire. Out of 385 responses from the middle school students, 350 responses were collected with complete information, with a response rate of 90.99 percent. The data was collected over a time span from May 2020 to December 2020.

## **4. Results**

This section represents the empirical findings of the study.

**Table 1.** Demographics of the study.

|   |  | Frequency        | Percent |       |
|---|--|------------------|---------|-------|
| Gender  | Male                                   | 164              | 46.85   |       |
|   | Female                                 | 186              | 53.14   |       |
| Age   | 7–10                                   | 115              | 32.85   |       |
|   | 11–13                                  | 200              | 57.14   |       |
|   | 14–17                                  | 35               | 10      |       |
|   | Grade                                  |                  |         |       |
| Grade   | Grade 6                                | 86               | 24.57   |       |
|   | Grade 7                                | 106              | 30.28   |       |
|   | Grade 8                                | 158              | 45.14   |       |
| Siblings  | None                                   | 4                | 1.14    |       |
|   | 1                                      | 94               | 26.86   |       |
|   | 2                                      | 178              | 50.86   |       |
|   | 3                                      | 74               | 21.14   |       |
|   | 4 and above                            | 19               | 5.43    |       |
| Father's education  | Elementary graduate                    | 36               | 10.28   |       |
|   | High School graduate                   | 70               | 20.00   |       |
|   | College graduate                       | 127              | 36.29   |       |
|   | Vocational/Diploma                     | 46               | 13.14   |       |
|   | Master's/Doctorate degree              | 71               | 20.39   |       |
|   | Did not attend school                  | 0                | 0       |       |
| Mother's education  | Elementary graduate                    | 55               | 15.71   |       |
|   | High School graduate                   | 85               | 24.39   |       |
|   | College graduate                       | 137              | 39.14   |       |
|   | Vocational/Diploma                     | 21               | 6.00    |       |
|   | Master's/Doctorate degree              | 52               | 14.86   |       |
| Did not attend school   | 0                                      | 0                |         |       |
|   | Devices available at home for internet | desktop computer | 89      | 25.43 |
|   |  | laptop           | 155     | 44.28 |
|   |  | smartphone       | 55      | 15.71 |
| tablet  |  | 51               | 14.57   |       |
| Household members providing instructional support for e-learning                              | Parents/ guardians                     | 10               | 2.86    |       |
|   | Elder Siblings                         | 6                | 1.71    |       |
|   | Grand parents                          | 11               | 3.14    |       |
|   | Able to do independently               | 323              | 92.28   |       |
| Special education needs (i.e., physical, mental, developmental disability, medical condition) | Yes                                    | 9                | 2.57    |       |

Source: Author Estimation.

#### 4.1. Demographic analysis

The results of the demographic analysis have been discussed in [Table 1](#).

[Table 1](#) presents the demographics of the respondents. From a total of 350 respondents, 164 were male, and 168 were females. The respondents were the students of grade 6, grade 7, and grade 8, constituting to 24.57%, 30.28%, and 45.14% of the total sample population, respectively. 4 of the students had no siblings, while 94 of them had one sibling. Also, 178 respondents had two siblings, while 74 of them had three siblings, and finally, 19 children had four and more number of siblings. Most of the students' fathers were college graduates. While all the mothers of the students were also adequately educated. For their online learning classes, 155(44.28%) students were using the laptop, 55(15.71%) smartphones, and 51(14.57%) tablets. Moreover, these students were also able to work independently, with little or no assistance from their guardians or parents. That is to say that, 10(2.86%) of these students were taking their parents' help, 6(1.71%) were taking help from their elder

**Table 2.** Results of descriptive statistics.

| Variables                             | Mean  | S.D  | Skewness | Kurtosis |
|---------------------------------------|-------|------|----------|----------|
| Learner attitude towards computer     | 2.538 | .766 | −.881    | .513     |
| Learner computer anxiety              | 3.036 | .615 | .053     | −.001    |
| Learner internet self-efficacy        | 3.431 | .354 | .685     | 1.351    |
| Usefulness                            | 3.673 | .786 | −.911    | 1.147    |
| Ease of use                           | 2.246 | .325 | .441     | −.401    |
| System availability                   | 1.809 | .898 | −.798    | .392     |
| Internet availability                 | 2.967 | .442 | .342     | .855     |
| Instructor Response timeliness        | 2.678 | .944 | −.731    | 1.180    |
| Instructor attitude toward e-learning | 2.941 | .597 | .051     | −.366    |
| Learning climate                      | 3.087 | .644 | .053     | −.408    |
| Learner interaction                   | 3.456 | .679 | −.841    | .290     |
| E-Lerner Satisfaction                 | 3.744 | .835 | −.814    | .291     |

Source: Author Estimation.

brothers, and 11(3.14%) were being guided by their grandparents for online learning. Students who had access to broadband internet were 159(45.43%) in number, those who were using their own mobile data were 91(26%) in number, those who had borrowed connections (neighbor, relatives) were 61(17.43%) in number, and those who went to other places outside their homes to gain access to the internet were 39(4.14%) in number. In addition to this, 183(52.29%) students preferred face-to-face learning, 120(34.29%) preferred hybrid, and 47(13.43%) of them were happy with online learning. Only 9(2.57%) students had special education needs. the descriptive statistics of the variables have been presented in below [Table 2](#).

#### 4.2. Descriptive statistics

[Table 2](#) presents the means and the standard deviations of the variables in order to measure the correlation between the variables that have been taken into consideration. The results showed that all the variables were significant in nature. Moreover, the learner computer anxiety, learner internet self-efficacy, usefulness, learning climate, learner iteration and e-learning satisfaction tended to have a greater impact, since their means were relatively greater (i.e., 3.0369, 3.43, 3.6734, 3.0872, 3.4566, 3.7441 respectively) and standard deviations (.615, .354, .786, .644, .679, .835 respectively).

In addition to this, the data normality was also checked for the skewness and kurtosis, before the step-wise multiple regression analysis, in order to fulfill the basic assumption of the analysis. All values of the skewness and kurtosis were found to be between the normal ranges, indicating the normal distribution of the data. The study also applied the correlation test, as presented in [Table 3](#), in order to assess the problem of multi-collinearity.

#### 4.3. Correlation matrix

The Pearson correlation (two-tailed) measure was referred to, in order measure the correlation between the two variables. Typically, the correlation method is used to measure how much a change in one variable causes a change in another variable. The value of the correlation between any two variables (different) must ideally be less than 0.9, which otherwise specifies a strong correlation, due to which multi-

**Table 3.** Results of correlation.

|     | ATC    | CA      | ISE     | CU      | EU      | SA      | IA      | RT     | ATL    | LC      | LI     | ELS |
|-----|--------|---------|---------|---------|---------|---------|---------|--------|--------|---------|--------|-----|
| ATC | 1      |         |         |         |         |         |         |        |        |         |        |     |
| CA  | .571** | 1       |         |         |         |         |         |        |        |         |        |     |
| ISE | .664** | .561**  | 1       |         |         |         |         |        |        |         |        |     |
| CU  | .693** | .468**  | .687**  | 1       |         |         |         |        |        |         |        |     |
| EU  | .780** | .583**  | .722**  | .671**  | 1       |         |         |        |        |         |        |     |
| SA  | .503** | .479**  | .544**  | .689    | -.54**  | 1       |         |        |        |         |        |     |
| IA  | .719** | .643**  | -.736** | .631**  | .599**  | -.638** | 1       |        |        |         |        |     |
| RT  | .561** | .780**  | .583**  | -.722** | -.619** | -.768** | .563**  | 1      |        |         |        |     |
| ATL | .583** | .663**  | .521**  | -.638** | .713**  | .719**  | -.611** | .651** | 1      |         |        |     |
| LC  | .479** | .7541** | -.679   | .768**  | .588**  | -.791** | .745**  | .791** | .638** | 1       |        |     |
| LI  | .664** | .561**  | .634    | .719**  | .610**  | .647**  | .769**  | .601** | .768** | -.669** | 1      |     |
| ELS | .780** | .583**  | .722**  | .503**  | .579**  | -.544** | .543**  | .743** | .719** | -.612** | .746** | 1   |

Valid N (listwise).

\*\*Correlation is significant at the 0.01 level (2-tailed).

Source: Author Estimation.

**Table 4.** Results of step-wise multiple regression analysis (n = 350).

| Variables                             | Unstandardized coefficients |            |        |      |
|---------------------------------------|-----------------------------|------------|--------|------|
|                                       | B                           | Std. Error | t      | Sig. |
| Learner attitude towards computer     | 0.740                       | .201       | 3.667  | .001 |
| Learner computer anxiety              | -.270                       | .069       | -3.911 | .001 |
| Learner internet self-efficacy        | .310                        | .137       | 2.251  | .001 |
| Usefulness                            | .160                        | .065       | 2.451  | .000 |
| Ease of use                           | -.590                       | .231       | -2.558 | .001 |
| System availability                   | -.134                       | .021       | -6.387 | .000 |
| Internet availability                 | -.111                       | .035       | -3.117 | .000 |
| Instructor Response timeliness        | .264                        | .134       | 1.960  | .001 |
| Instructor attitude toward e-learning | .647                        | .247       | 2.619  | .001 |
| Learning climate                      | -.647                       | .184       | -3.512 | .001 |
| Learner interaction                   | -.354                       | .132       | -2.670 | .000 |

R<sup>2</sup> = 79.85.Adjusted R<sup>2</sup> = 74.9.

F statistics = 89.651.

Source: Author Estimation.

collinearity occurs in the results. In this regard, Table 3 showed that all the values were within the standard range ( $p < 0.01$ ), and there was no delinquency when it came to the multi-collinearity. The results of step-wise multiple regression have thus been presented in Table 4.

#### 4.4. Step-wise multiple regression

Table 4 presents the results of the step-wise multiple regression analysis, in order to test the eleven hypotheses that have been developed for the purpose of this study. Out of these, hypothesis 1–3 were related to the learner dimension. The results revealed that the learner attitudes towards the usage of computers ( $\beta = 0.74$ ,  $t = 3.667$ ) and the learners' internet self-efficacy ( $\beta = 0.31$ ,  $t = 2.251$ ) were positively and significantly related to the E-learner satisfaction. However, the learners' computer anxiety ( $\beta = -0.27$ ,  $t = -3.911$ ) was inversely related to the middle school students' level of satisfaction. In the design dimension, two hypotheses were tested. The first hypothesis that was regarding the usefulness of e-learning ( $\beta = 0.16$ ,  $t = 2.451$ ) was

accepted, whereas, the ease of use ( $\beta = -0.59$ ,  $t = -2.558$ ) was rejected. In the technology dimension, the two hypotheses system availability ( $\beta = -0.134$ ,  $t = -6.387$ ) and internet availability ( $\beta = -0.111$ ,  $t = -3.117$ ) were tested, and both the hypotheses were rejected. Moreover, in the instructor dimension, two hypotheses were tested. Both these hypotheses, that is the instructor response timelines ( $\beta = 0.264$ ,  $t = 1.96$ ) and the instructor's attitude towards e-learning ( $\beta = 0.647$ ,  $t = 2.619$ ), were accepted. In addition to this, the environment dimension was tested with two further hypotheses, and both these hypotheses were rejected, as the learning climate ( $\beta = -0.647$ ,  $t = -3.512$ ) and the learner interaction ( $\beta = -0.354$ ,  $t = -2.67$ ) were inversely affecting the middle school students' level of satisfaction.

## 5. Conclusion and policy implications

### 5.1. Conclusion and discussion

Despite the barriers and challenges, our findings show that there are positive as well as negative aspects of e-learning, especially during these times of uncertainty when the COVID-19 pandemic is at its peak. This teaching mode provides students an additional choice of learning style, as compared to the traditional learning style (Hollenbeck et al., 2005). Many families have taken up e-learning as a positive opportunity, by going back to their hometowns or cities, while the learning is continuous. It is not something that is limited by time and space, and can be accessed easily anywhere via computers or mobile devices as well (Kilburn et al., 2014). However on the flipside of the coin, it negatively affects e-learner satisfaction in the present study, primarily due to the lack of gadgets and internet service quality. It has been observed that the main barrier to e-learning is the lack of gadgets. For instance, if three siblings are supposed to take online classes, mostly at the same time, then it would be difficult to provide gadgets such as exclusive PCs, laptops, tablets, and smartphones to all of them. Then, another main barrier was observed to be the availability or quality of the internet service. According to Gouëdard (2021), the Covid-19 infection on a global level, has caused internet access and the advent of adequate technology to struggle, as there exists gap across countries and between different income groups of a country as well. His study also revealed that 95% of the students of developed countries have a computer to use for their schoolwork, whereas this percentage is substantially low in underdeveloped countries, and even within different income groups of a country. In the same regard, Pham et al. (2019) argued that it is important to have an in-depth study of the e-learning service quality attributes, so as to discover the most important attributes to achieve the desired outcomes from e-learning. A lack of dedication when it comes to e-learning has also been observed, especially in the case of middle school students. The primary reason for this is that they often get distracted in other activities, and find various excuses to avoid attending the online classes.

It was also crucial to study the role of teachers in the e-learning scenario, their adaptation of the system, and their interaction with their students. It can be observed that the instructor dimension is positively and significantly related to e-learner satisfaction. In this dimension, the lack of interaction with the instructors is also among one of the major concerns of ELS. Moreover, concerns regarding any online course

content are usually discussed with the relevant course instructor via e-mail, which requires a response lag time as well (Zhong, 2020).

## 5.2. Policy implications

The eleven critical factors that have been highlighted cannot be ignored when implementing sustainable development goals regarding e-learning education in schools. Based on the empirical findings, this study suggests that institutions must offer different computer training programs for middle school students, in order to address the students' computer anxiety and self-efficacy issues. An unsatisfied student is generally believed to be demotivated, and can discontinue his studies altogether as well. Schools need to strengthen their e-learning implementation efforts by motivating teachers and monitoring instructor response timeliness, in order to increase the satisfaction among middle school students. Moreover, institutions should also encourage students for online reviews, and should take their feedback, so as to take care of the students' psychological well-being as well. This study has important implications for practitioners, policymakers, and the government. The government should introduce cheap internet packages and laptop schemes for school students, in order for them to survive an efficient education system during the Covid-19 pandemic.

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## References

- Adams, A. E., Randall, S., & Traustadóttir, T. (2015). A tale of two sections: An experiment to compare the effectiveness of a hybrid versus a traditional lecture format in introductory microbiology. *CBE—Life Sciences Education*, 14(1), ar6.
- Agarwal, M. S., & Dewan, D. J. (2020). An analysis of the effectiveness of online learning in colleges of Uttar Pradesh during the COVID 19 lockdown. *Journal of Xi'an University of Architecture & Technology*, 12(5), 2957–2963.
- Agung, A. S. N., Surtikanti, M. W., Quinones, C. A., & English Language Education Study Program, STKIP Pamane Talino. (2020). Students' perception of online learning during COVID-19 pandemic: A case study on the English students of STKIP Pamane Talino. *SOSHUM: Jurnal Sosial Dan Humaniora*, 10(2), 225–235. <https://doi.org/10.31940/soshum.v10i2.1316>
- Ali, A., & Ahmad, I. (2011). Key factors for determining student satisfaction in distance learning courses: A study of Allama Iqbal Open University. *Contemporary Educational Technology*, 2(2), 118–134. <https://doi.org/10.30935/cedtech/6047>
- Alipio, M. (2020). Education during COVID-19 era: Are learners in a less-economically developed country ready for e-learning? Available at SSRN 3586311.
- Amoroso, D. L., & Cheney, P. H. (1991). Testing a causal model of end-user application effectiveness. *Journal of Management Information Systems*, 8(1), 63–89.

- Anwar, A., Siddique, M., Dogan, E., & Sharif, A. (2021). The moderating role of renewable and non-renewable energy in environment-income nexus for ASEAN countries: Evidence from method of moments quantile regression. *Renewable Energy*, 164, 956–967.
- Arbaugh, J. B. (2000). Virtual classroom characteristics and student satisfaction with internet-based MBA courses. *Journal of Management Education*, 24(1), 32–54. <https://doi.org/10.1177/105256290002400104>
- Azhari, F. A., & Ming, L. C. (2015). Review of e-learning practice at the tertiary education level in Malaysia. *Indian Journal of Pharmaceutical Education and Research*, 49(4), 248–257. <https://doi.org/10.5530/ijper.49.4.2>
- Baig, M. A. (2011). A critical study of effectiveness of online learning on students' achievement. *Journal of Educational Technology*, 7(4), 28–34.
- Bakia, M., Shear, L., Toyama, Y., & Lassetter, A. (2012). *Understanding the implications of online learning for educational productivity*. Office of Educational Technology, US Department of Education.
- Barbeite, F. G., & Weiss, E. M. (2004). Computer self-efficacy and anxiety scales for an Internet sample: Testing measurement equivalence of existing measures and development of new scales. *Computers in Human Behavior*, 20(1), 1–15. [https://doi.org/10.1016/S0747-5632\(03\)00049-9](https://doi.org/10.1016/S0747-5632(03)00049-9)
- Barber, W., King, S., & Buchanan, S. (2015). Problem based learning and authentic assessment in digital pedagogy: Embracing the role of collaborative communities. *Electronic Journal of E-Learning*, 13(2), 59–67.
- Basilaia, G., & Kvavadze, D. (2020). Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. *Pedagogical Research*, 5(4). <https://doi.org/10.29333/pr/7937>
- Bukhsh, Q. (2007). Empowerment of women through distance education in Pakistan. *Turkish Online Journal of Distance Education*, 8(4), 135–151.
- Cf, O. (2015). *Transforming our world: The 2030 agenda for sustainable development*.
- Chen, J.-L. (2011). The effects of education compatibility and technological expectancy on e-learning acceptance. *Computers & Education*, 57(2), 1501–1511. <https://doi.org/10.1016/j.compedu.2011.02.009>
- Cole, M. T., Shelley, D. J., & Swartz, L. B. (2014). Online instruction, e-learning, and student satisfaction: A three year study. *The International Review of Research in Open and Distributed Learning*, 15(6), 111–131. <https://doi.org/10.19173/irrodl.v15i6.1748>
- Conrad, D. L. (2002). *Community social presence and engagement in online learning*. Department of Educational Policy Studies.
- Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 3(1), 1–20.
- Dong, C., Cao, S., & Li, H. (2020). Young children's online learning during COVID-19 pandemic: Chinese parents' beliefs and attitudes. *Children and Youth Services Review*, 118, 105440. <https://doi.org/10.1016/j.childyouth.2020.105440>
- Farid, S., Ahmad, R., Niaz, I. A., Arif, M., Shamshirband, S., & Khattak, M. D. (2015). Identification and prioritization of critical issues for the promotion of e-learning in Pakistan. *Computers in Human Behavior*, 51, 161–171. <https://doi.org/10.1016/j.chb.2015.04.037>
- Fletcher, T., & Bullock, S. M. (2015). Reframing pedagogy while teaching about teaching online: A collaborative self-study. *Professional Development in Education*, 41(4), 690–706. <https://doi.org/10.1080/19415257.2014.938357>
- Gattiker, U. E., & Hlavka, A. (1992). Computer attitudes and learning performance: Issues for management education and training. *Journal of Organizational Behavior*, 13(1), 89–101. <https://doi.org/10.1002/job.4030130109>
- Gillett-Swan, J. (2017). The challenges of online learning: Supporting and engaging the isolated learner. *Journal of Learning Design*, 10(1), 20–30. <https://doi.org/10.5204/jld.v9i3.293>
- Gouëdard, P. (2021). *Can a growth mindset help disadvantaged students close the gap?*



- Gray, J. A., & DiLoreto, M. (2016). The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation*, 11(1), n1.
- Gupta, D. R. (2018). *A comparative study of online and face to face education for learners and teachers in management*.
- Hollenbeck, C. R., Zinkhan, G. M., & French, W. (2005). Distance learning trends and benchmarks: Lessons from an online MBA program. *Marketing Education Review*, 15(2), 39–52. <https://doi.org/10.1080/10528008.2005.11488904>
- Huber, S. G., & Helm, C. (2020). COVID-19 and schooling: Evaluation, assessment and accountability in times of crises—Reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educational Assessment, Evaluation and Accountability*, 32(2), 237–270. <https://doi.org/10.1007/s11092-020-09322-y>
- Joo, Y.-J., Bong, M., & Choi, H.-J. (2000). Self-efficacy for self-regulated learning, academic self-efficacy, and Internet self-efficacy in Web-based instruction. *Educational Technology Research and Development*, 48(2), 5–17. <https://doi.org/10.1007/BF02313398>
- Jun, W., Mughal, N., Zhao, J., Shabbir, M. S., Niedbala, G., Jain, V., & Anwar, A. (2021). Does globalization matter for environmental degradation? Nexus among energy consumption, economic growth, and carbon dioxide emission. *Energy Policy*, 153, 112230. <https://doi.org/10.1016/j.enpol.2021.112230>
- Kilburn, A., Kilburn, B., & Cates, T. (2014). Drivers of student retention: System availability, privacy, value and loyalty in online higher education. *Academy of Educational Leadership Journal*, 18(4), 1.
- Lee, D., Ng, P. M., & Bogomolova, S. (2020). The impact of university brand identification and eWOM behaviour on students' psychological well-being: A multi-group analysis among active and passive social media users. *Journal of Marketing Management*, 36(3-4), 384–403. <https://doi.org/10.1080/0267257X.2019.1702082>
- Lorenzo, G. (2015). A research review about online learning: Are students satisfied? Why do some succeed and others fail? What contributes to higher retention rates and positive learning outcomes. *Internet Learning*, 1(1), 5.
- Mailizar, M., & Fan, L. (2019). Indonesian teachers' knowledge of ICT and the use of ICT in secondary mathematics teaching. *EURASIA Journal of Mathematics, Science and Technology Education*, 16(1). <https://doi.org/10.29333/ejmste/110352>
- Mirza, N., Naqvi, B., Rahat, B., & Rizvi, S. K. A. (2020). Price reaction, volatility timing and funds' performance during Covid-19. *Finance Research Letters*, 36, 101657. <https://doi.org/10.1016/j.frl.2020.101657>
- Moore, J. C. (2010). A synthesis of Sloan-C effective practices. *Journal of Asynchronous Learning Networks*, 14(3), 24–45.
- Murphy, M. P. (2020). COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy*, 41(3), 492–505. <https://doi.org/10.1080/13523260.2020.1761749>
- Osman, M. E. (2020). Global impact of COVID-19 on education systems: The emergency remote teaching at Sultan Qaboos University. *Journal of Education for Teaching*, 46(4), 463–471. <https://doi.org/10.1080/02607476.2020.1802583>
- Pham, L., Limbu, Y. B., Bui, T. K., Nguyen, H. T., & Pham, H. T. (2019). Does e-learning service quality influence e-learning student satisfaction and loyalty? Evidence from Vietnam. *International Journal of Educational Technology in Higher Education*, 16(1), 1–26. <https://doi.org/10.1186/s41239-019-0136-3>
- Rizvi, S. K. A., Mirza, N., Naqvi, B., & Rahat, B. (2020). Covid-19 and asset management in EU: A preliminary assessment of performance and investment styles. *Journal of Asset Management*, 21(4), 281–291. <https://doi.org/10.1057/s41260-020-00172-3>
- Shirky, C. (2008). *Here comes everybody: The power of organizing without organizations*. Penguin.
- Soni, V. D. (2020). Global impact of E-learning during COVID 19. Available at SSRN 3630073.

- Su, C.-W., Huang, S.-W., Qin, M., & Umar, M. (2021). Does crude oil price stimulate economic policy uncertainty in BRICS? *Pacific-Basin Finance Journal*, 66, 101519. <https://doi.org/10.1016/j.pacfin.2021.101519>
- Su, C.-W., Qin, M., Tao, R., & Umar, M. (2020). Financial implications of fourth industrial revolution: Can bitcoin improve prospects of energy investment? *Technological Forecasting and Social Change*, 158, 120178. <https://doi.org/10.1016/j.techfore.2020.120178>
- Su, C.-W., Sun, T., Ahmad, S., & Mirza, N. (2021). Does institutional quality and remittances inflow crowd-in private investment to avoid Dutch disease? A case for emerging seven (E7) economies. *Resources Policy*, 72, 102111. <https://doi.org/10.1016/j.resourpol.2021.102111>
- Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. (2008). What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education*, 50(4), 1183–1202. <https://doi.org/10.1016/j.compedu.2006.11.007>
- Supriadi, D., & Sa'ud, U. (2017). The effectiveness of implementing information and communication technology on student academic services (A case study in Bandung Institute of Technology for the 2015-2016 period). *International Journal of Education*, 9(2), 139–148. <https://doi.org/10.17509/ije.v9i2.5478>
- Thanji, M., & Vasantha, S. (2016). ICT factors influencing consumer adoption of ecommerce offerings for education. *Indian Journal of Science and Technology*, 9(32), 1–6. <https://doi.org/10.17485/ijst/2016/v9i32/98650>
- Thurmond, V. A., Wambach, K., Connors, H. R., & Frey, B. B. (2002). Evaluation of student satisfaction: Determining the impact of a web-based environment by controlling for student characteristics. *American Journal of Distance Education*, 16(3), 169–190. [https://doi.org/10.1207/S15389286AJDE1603\\_4](https://doi.org/10.1207/S15389286AJDE1603_4)
- Tsai, C.-W. (2016). Research papers in online learning performance and behaviour. *The International Review of Research in Open and Distributed Learning*, 17(1). <https://doi.org/10.19173/irrodl.v17i1.2441>
- Umar, M., Ji, X., Kirikkaleli, D., & Xu, Q. (2020). COP21 roadmap: Do innovation, financial development, and transportation infrastructure matter for environmental sustainability in China? *Journal of Environmental Management*, 271, 111026. <https://doi.org/10.1016/j.jenvman.2020.111026>
- Umar, M., Ji, X., Mirza, N., & Rahat, B. (2021). The impact of resource curse on banking efficiency: Evidence from twelve oil producing countries. *Resources Policy*, 72, 102080. <https://doi.org/10.1016/j.resourpol.2021.102080>
- Wains, S. I., Mahmood, W. (2008). *Integrating m-learning with e-learning*. Proceedings of the 9th ACM SIGITE Conference on Information Technology Education, 31–38.
- Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology-mediated distance learning. *Academy of Management Journal*, 40(6), 1282–1309.
- Weeden, K. A., & Cornwell, B. (2020). The small-world network of college classes: Implications for epidemic spread on a university campus. *Sociological Science*, 7, 222–241. <https://doi.org/10.15195/v7.a9>
- Yousuf, M. I. (2007). Effectiveness of mobile learning in distance education. *Turkish Online Journal of Distance Education*, 8(4), 114–124.
- Yuan, L. M. (2021). Student's attitude and satisfaction towards transformative learning: A research study on emergency remote learning in tertiary education. *Creative Education*, 12(03), 494–528. <https://doi.org/10.4236/ce.2021.123035>
- Zhong, R. (2020). The coronavirus exposes education's digital divide. *The New York Times*, 18.