



## E-LEARNING IN PAKISTAN DURING AND AFTER COVID-19

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### **Abstract**

*E-learning is called electronic learning, in which learners get education by electronic devices. This method of learning has become more popular in the COVID-19 era. However, it is essential even after COVID-19 era. This particular study aims to investigate e-learning processes during and after COVID-19, to scrutinize the influence of e-learning and analyze the challenges faced by learners. A quantitative research method is employed in this study. A close-ended questionnaire is used as a tool for collecting data. An online Google form is used to prepare a questionnaire. This form is sent to the students using the snowball technique. The sample size is 340. The participants are students of different universities and colleges in Punjab, Pakistan. A random sampling technique is used for the purpose of data collection. Data are analyzed through pie charts. The study's results present the methods and influence of E-learning along with the challenges faced by students who were getting education online.*

**Keywords:** *COVID-19, Online learning, E-learning, Post-pandemic, Challenges*

### **1. Introduction:**

E-learning is a type of learning in which knowledge is acquired and used via electronic media like the Internet; different terms used for E-learning are electronic learning, online learning, and advanced learning based on use of technology. It is also called open education and distance education. It is a new concept and a new arrangement for learning. The basic feature of this type of learning is that the Internet system is used for the presentation and communication of learning.

#### **1.1 Background of the Study:**

Rosenberg narrates that the internet system is used in E-learning to improve students' knowledge and achievements. Three criteria of E-learning are mentioned here: 1. it consists of networks. 2. Certified internet techniques work as an essential part of communication regarding E-learning. 3. Transmission for E-learning. This type of learning is highly effective and meaningful compared to traditional education. According to Tom Kelly, e-learning does not have concern with trainers who categorize training and education but it's all about information and education. Here, the learners just want to get knowledge and skills to get a good job and to answer customers' questions. E-learning is a tool through which students can study independently. However, students still face issues like unmotivated and unenthusiastic with regards to study purposes. Students have to face problems of ineffective communication with their peers (Rannastu-Avalos & Siman, 2023; Wan Hassan et al., 2020). Students have to face different issues in this type of learning just because of



their lack of knowledge about technology regarding ICT skills (Wan Hassan et al., 2020). Most students did not know about using advanced technology, and this drawback proved a significant obstacle in the pandemic era.

The Internet is a pivotal element in the e-learning system. So, the poor internet services proved to be a significant obstacle to e-learning. Limited data packages on the Internet are also a big hit for false students who are getting education via E-learning, particularly those in developing countries with low internet connectivity (Al-Balas et al., 2022; Wan Hassan et al., 2020). Higher education systems also face problems with regards to establishment and management due to users' disinterest (Almaiah et al., 2020). COVID-19 has affected every field of life, but specifically, educational institutions have to face too much as it has affected learners, teachers and academic institutions worldwide (Mailizar, Almanthari, Maulana, 2021). This pandemic brought many challenges in every field of life, whether educational or not. However, the unavoidable challenge was in education in the field as it affected not only students but also teachers and administration departments. The whole world had to face these problems. Students have faced many problems using electronic devices, the Internet, and documents in soft form, attending class on time, etc. Teachers also face issues while delivering online lectures, conducting online courses, etc. Administrative departments encountered many other obstacles in controlling and maintaining balance while making strategies. World Health Organization proclaimed COVID-19 as a pandemic on 11th March 2020 (Cucinotta & Vanelli, 2020). World Health Organization declared that coronavirus was a disease and a pandemic that had spread worldwide. There was not a single country that was free from that particular disaster.

Federal Health Ministry first time verified two cases in Pakistan regarding COVID-19 in February 2020 from two different cities; Islamabad and Karachi ( Saqlain, Munir, Ahmad, Tahir, & Kamran, 2020). Students who were living in urban areas were able to get access to the Internet. Because this country is facing problems related to poverty and so many issues like challenges to maintaining infrastructure related to the speed and quality of Internet (for the students, having rural backgrounds) (Jamil, 2020a), those students who had rural backgrounds had to face too many difficulties related to the use of technology for study purposes because they were not aware of the advancement of these technological devices. It had become a challenge for them to continue their study using unfamiliar electronic devices. One thing that was very challenging for them was internet use. The slow speed of the Internet was a big hurdle for them during online lectures. The low quality of the network was also a drawback while getting an education in the online educational plane.

Many research studies have emphasized the prestige of ICT skills in students, even at their school level and at home (Ritzhaupt et al., 2014). ICT skills are essential to get an education through electronic learning. Students must learn these skills in this era of technological advancements as different researchers have concluded that students must learn these skills from their school and home, which is the beginning of their learning. Moreover, some research studies have highlighted the importance of ICT related to the framework at academic institutions and the instructors' perceptions of ICT (Safdar et al., 2011). Researchers in the academic domain highly accept the importance of ICT skills. If instructors have limited digital literacy and low pedagogical skills, it can become a significant hurdle in the educational domain. They have also highlighted the value of ICT under the umbrella of E-Learning.

### **1.2 Statement of Problem:**

Students have to face numerous challenges while getting an education during COVID-19 era. Traditional learning was shifted into online learning, which was a challenge for students as so many students did not know the use of online platforms for educational purposes. They were not aware of the methods of online learning (or E-Learning). Students encounter too many challenges to continue their studies in adverse circumstances. However, students' satisfaction is still questioned with regards to the influence of e-learning.

### **1.3 Research Questions:**

- What are the methods of E-Learning adaptation in Pakistan during and after the COVID-19 pandemic?
- What are E-Learning's effects on learning outcomes, student engagement and accessibility?
- What are the challenges faced by the students in e-learning?

### **1.4 Research Objectives:**

- To investigate the methods of E-Learning in Pakistan during COVID-19.
- To examine the influence of e-learning in academic institutions in Pakistan.
- To analyze the challenges faced by learners of E-learning.

### **1.5 Significance of the Study:**

This particular research study is expected to provide valuable insights into the implementation as well as impacts of e-learning in Pakistan during and after COVID-19 crisis. It will be beneficial to pinpoint the challenges which students face during this pandemic. Enhancing teachers' pedagogy and digital literacy skills will also prove very fruitful. It will help policymakers to develop policies based on e-learning. It will benefit the students by increasing their engagement and getting better results in teaching, based on ICT.

## **2. Literature Review:**

Pakistan is an underdeveloped country that is considered backwards compared to advanced countries. Online learning is an fruitful and effective tool in the hands of advanced countries (Basilaia & Kvavadze, 2020). So, developing countries have to face countless challenges with regards to the technological-use in online learning domain during pandemic era. Developed countries have skills in using electronic devices that's why they were not as surprised as the developing countries.

A manual method is mainly used for various purposes related to teaching or learning. This method has a firm grip even in administrative departments regarding institutional institutions (Salam, Jianqiu, Pathan, & Lei, 2017). Excessive use of manual methods surprised so many people as they were shocked when they encountered the online system in every field. The online system was complex for those who did not know the benefits of this system. Challenges that students face in Pakistan during e-learning include weak internet connection and the internet and lack of affordability for these resources due to their rural background or areas (Wains & Mahmood, 2008). Like other developing countries, Pakistan faces problems using an online education system. These problems became huge for students from impoverished and rural backgrounds. Due to the backward area, they face problems related to poor networks and expensive internet data packages. Due to this abrupt change in learning, many changes occurred in educational departments. However, their ultimate focus was on transferring their academic content from hard to soft form,



and they were not interested in teaching methods for delivering the content. The students' online learning scenario highly affected their ability to participate in learning (Zhong, 2020).

Another primary problem students face while getting an education through digital learning is the interaction between students and their teachers. They have to wait a lot for the responses of their concerned teachers through email (Zhong, 2020). Students get an easy access to their teachers to share their problems in the traditional way of learning unlike online way of learning. Because there are some obstacles in the online way of learning and these obstacles may be related to time management and teachers' responses to solve the student's problems. Students have to use different means to ask questions and get the instructors' responses. This means email, and this source is ineffective in this regard as the teachers can respond over it when they see the email. Otherwise, they remain unaware of the problems. Sometimes, they read the email when the time to submit an assignment to students is over.

On-campus learning has the benefit of sharing information in situations not available in digital learning (Britt, 2006). Information shared in on-campus learning is more effective and fruitful than information shared in online learning. However, there are many problems with this type of learning, such as ambiguity in the information provided through an online platform compared to on-campus learning.

All academic institutions were advised to close their campuses and to adopt digital and online learning modes (Ali, 2020). The COVID-19 era was a great challenge for all fields, but it became severe in educational institutions. It startled the whole world, and all educational institutions were advised to shut down their traditional teaching and learning online to save lives and continue their academic activities.

Many research studies in Pakistan related to E-learning about everyday situations, not in an adverse situation like a pandemic. According to these studies, E-learning is considered a non-essential aspect for upgrading learning and teaching methods (e.g., Ali & Ahmad, 2011; Bukhsh, 2007; Farid et al., 2015; Yousaf, 2007). E-learning is not a concept that comes before us in the pandemic era. A bulk of different research studies have been accomplished on this particular topic and notability of electronic learning is accepted before the pandemic era. According to many research studies, electronic learning is not a crucial aspect of enhancing and improving different pedagogical methods and ways of learning. However, this way of learning has higher importance in the COVID-19 era.

A study revealed various aspects of satisfaction related to collaboration and engagement between students and teachers during e-learning which were same as in conventional learning. Because the content was designed correctly and updated, the instructors were guided to improve their skills and knowledge (Ali & Ahmad, 2011). Some favorable aspects were drawn from this study related to the interaction between students and teachers. This connection must be strong for successful learning and teaching outcomes. If the content is appropriately designed for the students and a managed timetable, timetable, then it can be as satisfactory as in conventional learning. Proper guidance can enhance the ability of students and teachers to relate to the study and teaching, respectively.

Some research studies have pinpointed various challenges with regards to e-learning during pandemic era (Mailizar et al., 2020). Many problems are highlighted by the different researchers which were faced by educational institutions along with student and teachers in the era of COVID-



19. Students face problems with electronic devices and social media apps while getting an education. The teachers also faced problems due to the lack of knowledge about different applications for teaching purposes. Several educational institutions have to face many difficulties in educational administration particularly in pedagogy and learning management. A massive obstacle in the way of online learning is agrarian background of students.

Toquero (2020) narrates a dire need for educational institutions to upgrade their teaching methods and curriculum. Teaching must advance to lead a nation towards development. E-learning is an advanced way of learning. Teaching strategies must be improved by using online learning methods because it reduces the efforts used in conventional teaching methods and learning.

The COVID-19 era forced us to shut down conventional way of learning and to start up online way of learning to fill the gap due to this pandemic. As an estimate, this would be continued for 3 to 4 months to lessen the danger of the prevailing corona virus (Lauren, 2020). Corona virus was a widespread disease which compelled every field to be shut down. All institutions were bound to shift their conventional way of education to the online way of education. So, this distance learning comes under the domain of E-learning, also electronic learning.

There are many problems that academic institutions have to face during the era of the pandemic about online learning. Among these problems are the impacts of electronic learning and the benefits of online learning (McPherson & Bacow, 2015). There are different positive and negative impacts of online learning. Online way of learning is extremely beneficial for developing self-study and does not have time boundaries as conventional learning. However, it made students passive as they got limited feedback. There are also many technological issues related to their usage; in some cases, there is overreliance on electronic and digital tools.

The second problem is mainly related to digital teaching, which is helpful in guiding our priorities about instruction and education (Liguori & Winkler, 2020). This abrupt change in the teaching methods raised the importance of effective pedagogical techniques while adopting a digital environment. However, there are different impacts of digital teaching that varies student to student with regards to their participation along with the results of their learning. The transformation of conventional learning to online learning is not an easy task. Many hurdles and problems are linked to it (Crawford, Butler-Henderson, Rudolph, & Glowatz, 2020). The COVID-19 era was a massive challenge for every field worldwide. All working modes were shifted to an online way of learning, but it was challenging to accept and adopt this change. Many hurdles came in the way of adopting this type of learning, including using different devices, internet access, knowledge about different applications used for this purpose, poverty, etc.

### **1. Methodology:**

A quantitative research method is employed in this research study. A close-ended questionnaire is used for the collection of data. The questionnaire was prepared using Google Forms. Questionnaire was based on five sections; first section was about participants' demographic information, and the second and third sections were based on the methods of e-learning during and after COVID-19. The fourth section was based on the effects of E-learning on learners, and the fifth described the students' challenges. Data were collected by sending online Google forms to the students. A random sampling technique was used to collect data. Various pie charts were used for purpose of analysis.

However, this study explored the methods used by students who took online classes during and after the pandemic. It also explored the effects and challenges faced by online learners.

## 2. Data Collection:

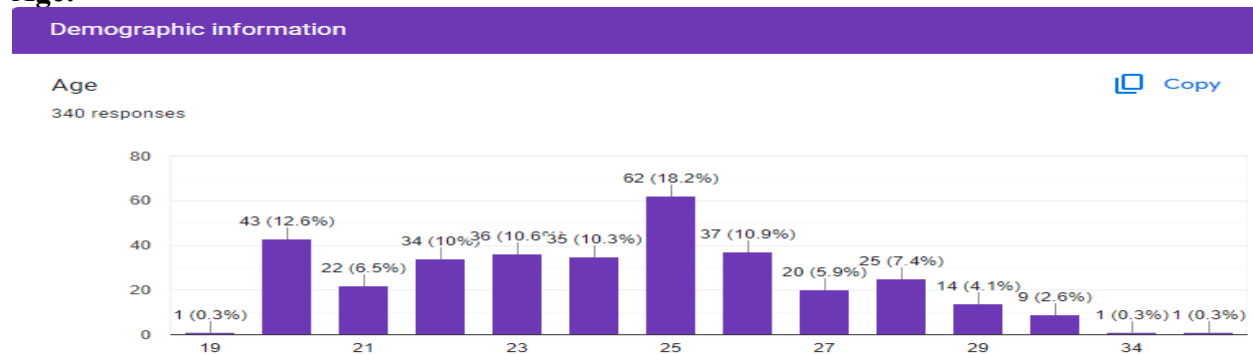
Data is collected from the students taking online classes during the pandemic era. Data is collected randomly, including students from different universities and colleges. There were a total of 340 participants. The questionnaire is used as a data collection tool. A questionnaire based on Google Forms was sent to the participants using snowball techniques. This questionnaire was prepared by focusing on the four basic keywords (methods used in): COVID-19 era, COVID-19 era, Effects, and Challenges. There were a total of five sections. The first section was based on demographic information, and the other four sections were based on the four basic keywords mentioned above. There were a total of 18 questions.

## 3. Data Analysis:

Data is analyzed in the form of pie charts. Each question is analyzed separately. Uq. A pie chart shows the percentage of responses given to all; the participants' demographic information is analyzed. There were five questions in the first section: age, gender, institution, department, and province. All questions are analyzed separately, and they are mentioned below with a graphical representation.

### Section: 1 Demographic information

#### Age:

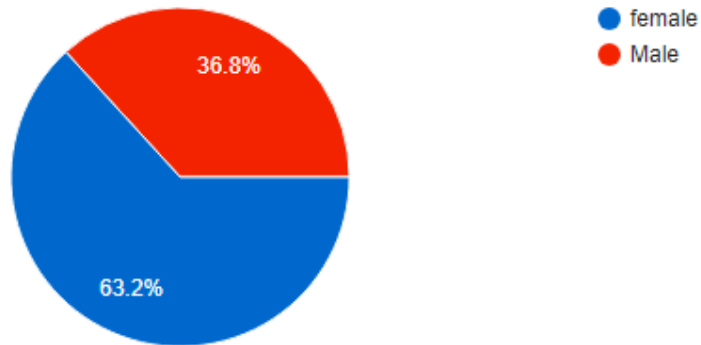


According to the above graph, the age limit of 340 participants was between 19 and 34. These students took online classes during the pandemic era.

**Gender:**

Gender

337 responses

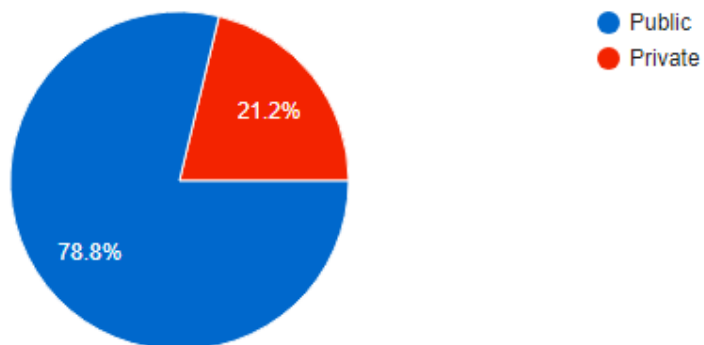


The above graph clearly shows that there were more female participants than male participants. 63.2% were female participants, and 36.8% were male participants.

**Institution:**

Institution

339 responses



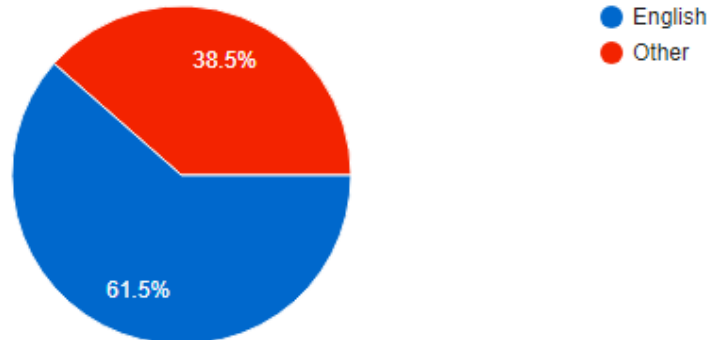
There was a higher range of participants who were studying in public institutions than those who were studying in private. The percentage is represented in the above graph.



**Department:**

Department

340 responses

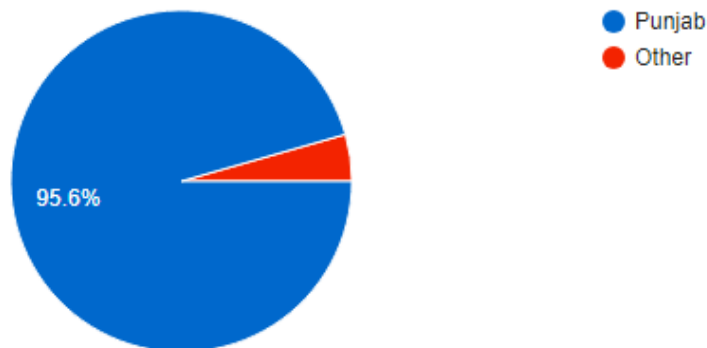


There were only two options for the participants: either their department was English or any other. So, there was a higher range of students who belonged to English than to any other department. The percentage is mentioned in the above pie chart.

**Province:**

Province

340 responses



Mostly students were belonged to province Punjab. There were very few non-local students in the universities and colleges that's why there percentage in very low. There were only 4.3% students who belonged to other province.

All demographic information is encapsulated in the table given below:

Age	Minimum 19	Maximum 34
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Gender	Female 63.2%	Male 36.8%
Institution	Public 78.8%	Private 21.2%
Department	English 61.5%	Other 38.5%
Province	Punjab 95.6%	Other 4.4%

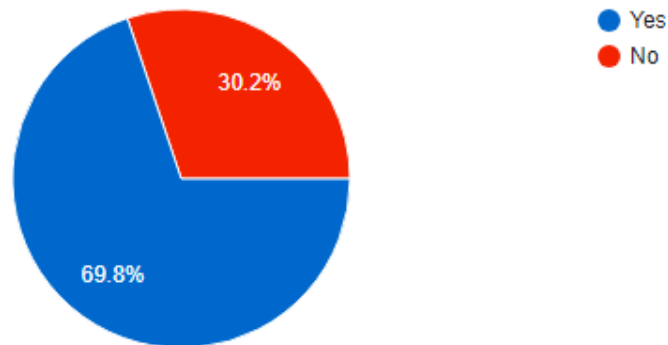
## Section: 2

The section was based on the methods used during the COVID-19 era for educational purposes. There were a total of four questions in section 2. The graphical representation is presented below:

### Question:1

Did the mobile phones highly use for online learning among all popular devices?

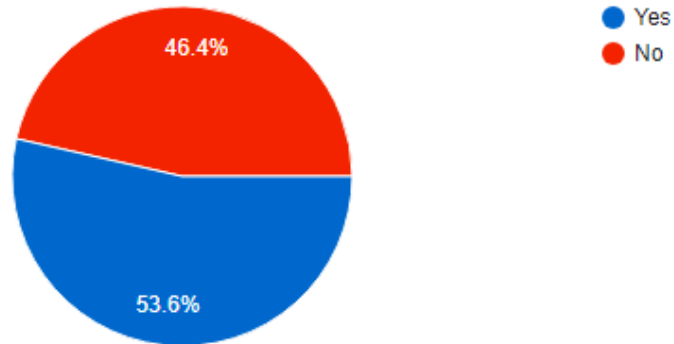
338 responses



**Question: 2**

Did Learning Management Systems utilize for education purposes?

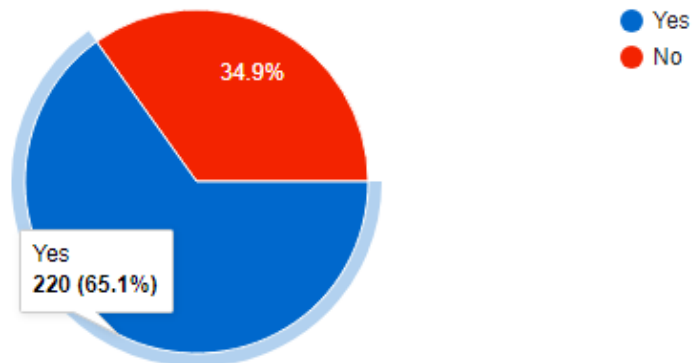
338 responses



**Question: 3**

Did the video conferencing tools use during online learning (like Zoom and Google Meet)?

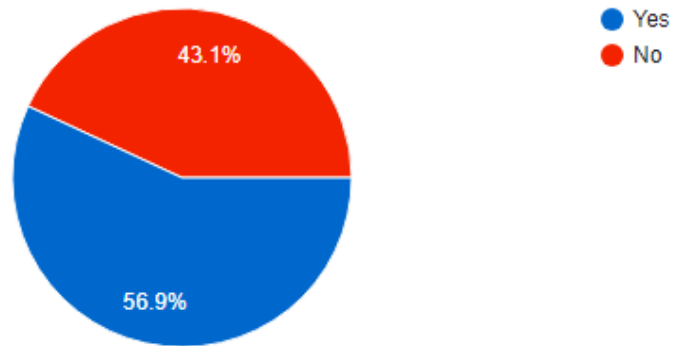
338 responses



**Question: 4**

Did the online quizzes and assessments conduct during COVID-19 era?

339 responses



**Description:**

The second section was based on the methods used in the COVID-19 era.

Mobile Phones are highly used in this era. These methods were asked from the students in the questionnaire who were taking online classes in the pandemic era.

Learning Management Systems are also used in the pandemic era. This system is related to assessments and, documentation, etc.

Zoom and Google Meet were used in this era.

Online quizzes and assessments are used in this era according to the percentage of responses. So, the majority of the students respond positively to all these methods asked by the researcher.

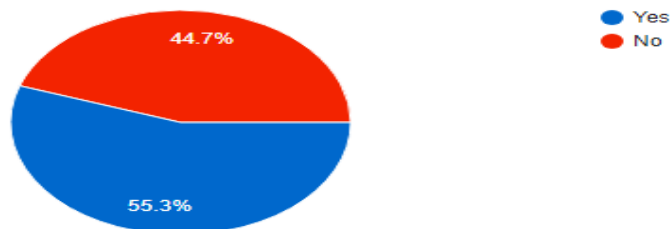
**Section: 3**

There were a total of four questions in section 3. The graphical representation is presented below:

**Question:1**

Do you agree with this statement that "Students became familiar with different search engines after passing through the pandemic era"?

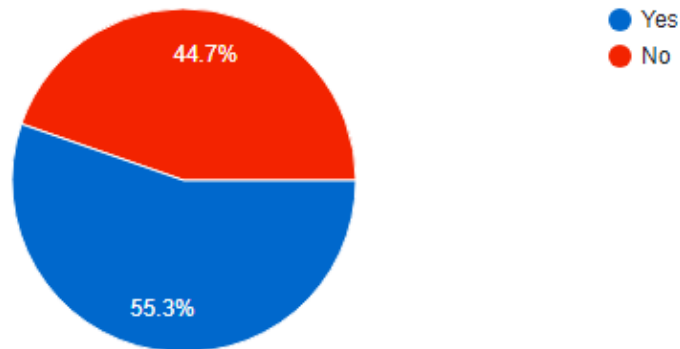
340 responses



**Question:2**

Do you think Artificial Intelligence (AI) have become as powered learning tools in the post pandemic era?

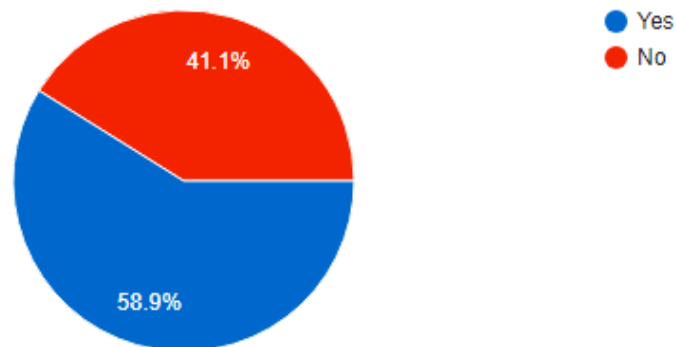
338 responses



**Question:3**

Do you accept this that " Blended learning has become primary teaching method in post pandemic era'?

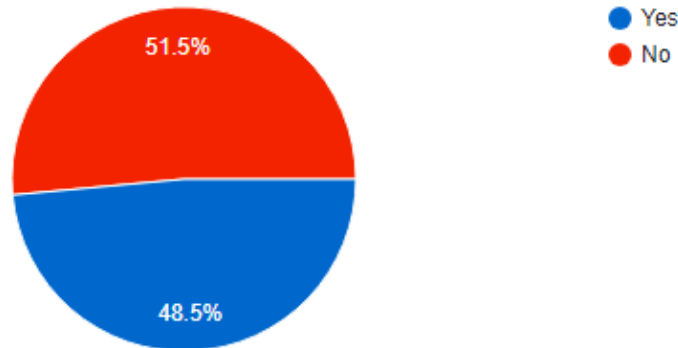
338 responses



**Question:4**

Do you agree that " online learning leads to online earning in post pandemic era?

340 responses



**Description:**

The third section was based on the methods used after the COVID-19 era. Students learned about different search engines in E-learning methods in the later pandemic era. Students are getting awareness about the use of AI in the later-corona virus era. Blended learning has become a teaching method in the after the pandemic era that most of the students accept. People mostly learned about the importance of online earning in the era of COVID-19. They are earning even in the post-pandemic era, and students accept this reality; 48.5 students responded positively to it.

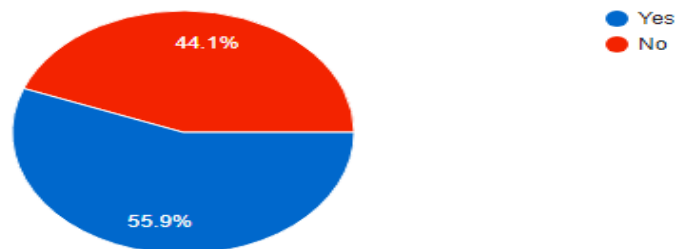
**Section: 4**

There were a total of five questions in section 4. The graphical representation is presented below:

**Question: 1**

Are the students satisfied from E-learning (online learning)?

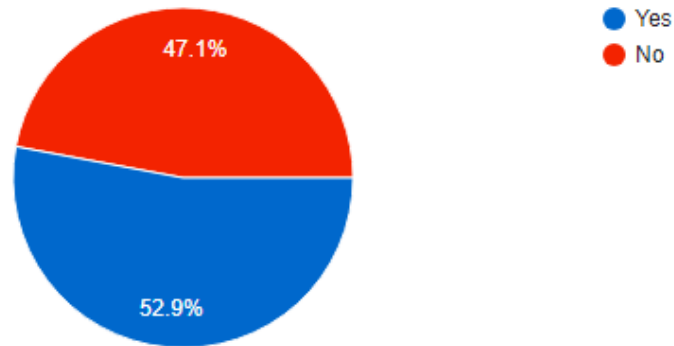
340 responses



**Question: 2**

Is the online learning work as tool to improve students' ability with regards to learning skills?

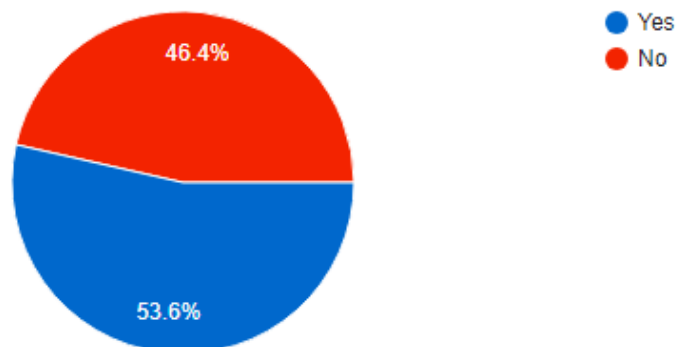
340 responses



**Question: 3**

Do the online classes equally informative as compare to active learning in campus?

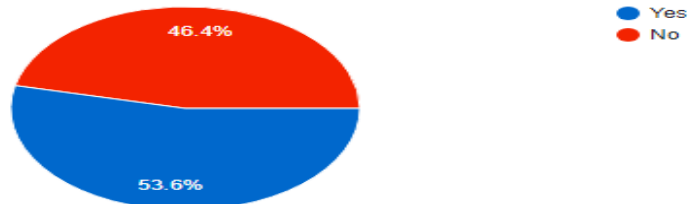
338 responses



**Question: 4**

Has E-learning reduced costs for institutions?

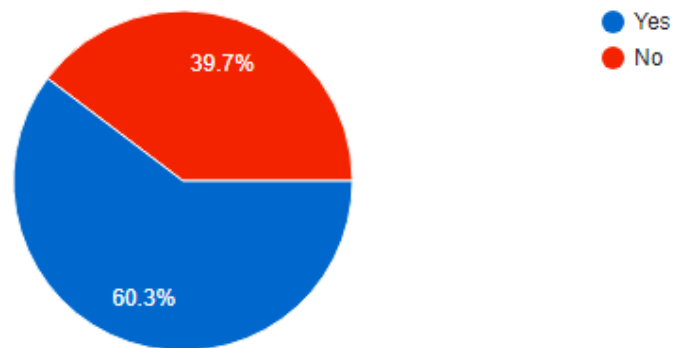
332 responses



**Question: 5**

Has E-learning increased the accessibility for remote students?

340 responses



**Description:**

The fourth section is based on E-learning's effects on online learners. These effects can be positive or negative. Some effects are mentioned in the questionnaire, and the students' responses are presented in percentage form through a pie chart.

According to the responses, more than 50% of students are satisfied from e-learning method.

E-learning effects positively as it enhance the learning skills of students.

Online classes are as informative as on-campus classes, and they are accepted by more than 50% of students who take online classes.

Students have accepted this because, due to online classes, the cost of getting an education has been reduced. They are free from hostel dues, van rent, pocket money given by their parents, note printing, etc.

Students from remote areas have to suffer a lot with regards to travel, accommodation, ethnicity problems, societal issues, etc. However, they feel relaxed and easily get access due to online learning, which is why most students respond positively to this statement.

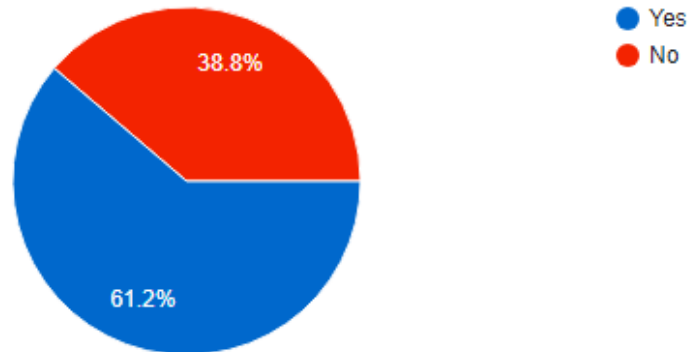
**Section: 5**

There were a total of five questions in section 4. The graphical representation is presented below:

**Question: 1**

Do you think that time management is a big challenge for online learners?

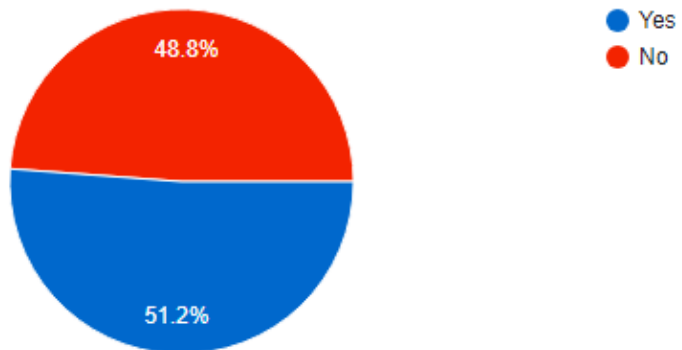
338 responses



**Question: 2**

Is the poor internet connection huge obstacle in accessing online courses?

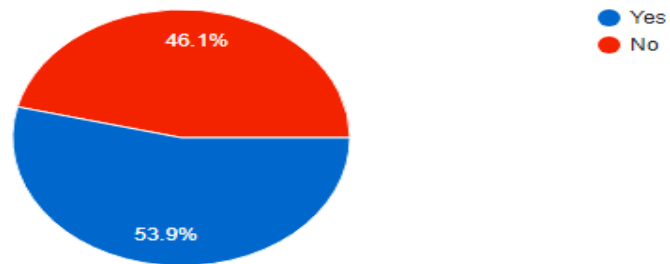
338 responses



**Question: 3**

Do you agree that online courses are having lack of clarity and organization?

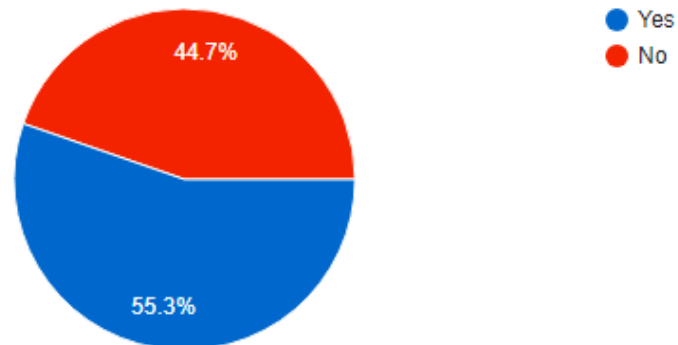
336 responses



**Question: 4**

Do the teachers follow the given time table to conduct online class?

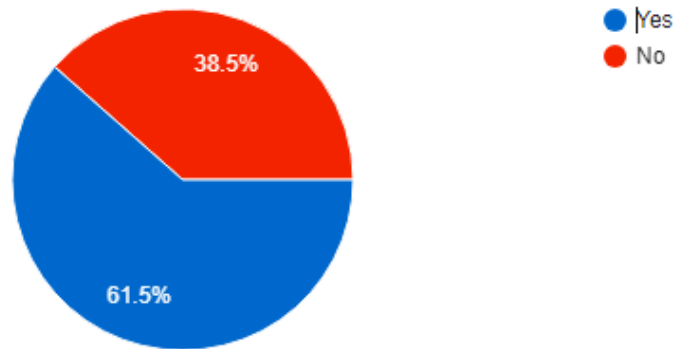
340 responses



**Question: 5**

is the interaction between teachers and students a serious problem related to E-learning?

335 responses



**Description:**

Fifth section is based on the challenges which are faced by the students during pandemic era. Responses of students give an idea about the types of challenges face by them.

It is accepted that time management and poor internet connection were big challenges faced by online learners because the majority of the students responded positively to this question.

Most students respond positively to their teachers' responsibility to take classes according to the timetable. Although the timetable can vary, the participants of this study accepted their teachers' punctual behavior.

The given content was ambiguous and not easy to understand compared to the content of the on-campus classes.

The student and teacher's interaction was also a considerable challenge. Their interaction was poor, and it was not easy to get responses from teachers on time.

All the responses of the participants are encapsulated in one table given below:

This table presents questionnaire's structure which is exactly relevant to research questions of this particular research study.

Research questions of this particular study are based on the four basic keywords, and the questionnaire for data collection is based on the four basic sections, ignoring the demographic information section.

All questions are written in the tables, along with the participants' responses based on the percentage. This makes it easier to understand the responses to the questions.

Section:2 E-learning Methods during COVID-19	Yes	No
Did the mobile phones highly use for online learning among all popular devices?	69.8%	30.2%



Did Learning Management Systems utilize for education purposes?	53.6%	46.4%
Did the Video conferencing tools use during online learning (like Zoom and Google Meet)?	65.1%	34.9%
Did the online Quizzes and assessments conduct during COVID-19?	56.9%	34.1%
<b>Section:3 Post COVID-19 E-learning Methods</b>		
Do you agree with this statement that “Students became familiar with different search engines after passing through the pandemic era”?	55.3%	44.7%
Do you think Artificial intelligence have become powered learning tools in post pandemic era?	55.3%	44.7%
Do you accept this that “Blended learning has become primary teaching method in post pandemic era?”	58.9%	41.1%
Do you agree that “online learning leads to online earning in post pandemic era”?	48.5%	51.5%
<b>Section:4 Effects of E-learning</b>		
Are the students satisfied from E-learning (online learning)?	55.9%	44.1%
Is the online learning work as tool to improve students’ ability with regards to learning skills?	52.9%	47.1%
Do the online classes equally informative as compare to active learning in campus?	53.6%	46.4%
Has E-learning reduced the costs for institutions?	53.6%	46.4%
Has E-learning increased the accessibility for remote students?	63.3%	39.7%
<b>Section:5 Challenges</b>		
Do you think that time management is a big challenge for online learners?	61.2%	38.8%
Is the poor internet connection huge obstacle in accessing online courses?	51.2%	48.8%
Do you agree that online courses are having lack of clarity and organization?	53.9%	46.1%
Do the teachers follow the given time table to conduct online class?	55.3%	44.7%
Is the interaction between teachers and students a serious problem related to E-learning?	61.5%	38.5%

### 1. Conclusion:

It is brought to an ended that different methods of E-learning were utilized during COVID-19, such as Learning Management systems, online quizzes, and assessments. Some applications, like Google Meet and Zoom, were used to continue online classes (learning). These applications were mainly used on mobiles rather than laptops, tablets, etc. Moreover, the use of AI and different



search engines became frequent after pandemic era. Online learning during COVID-19 gave birth to 'Blending learning'.

Online learning is satisfactory for most students as it reduces the difficulties students face, such as hesitation in front of teachers and perplexed when giving presentations in front of the whole class physically. It decreases the cost of institutions related to travel, accommodations, printing notes, etc. It is also beneficial to increase the accessibility of students from remote areas. Students learned about the use of different electronic devices and getting education through electronic learning. So, e-learning has positive effects on online learners.

Some problems, difficulties, and obstacles related to E-learning are poor internet connection, time management, ambiguity, lack of organized content, and inadequate interaction between teachers and students. The students face all these.

#### 4. References:

- Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Education and information technologies*.
- Ali, I. (2020). The covid-19 pandemic: Making sense of rumor and fear: Op-ed. *Medical anthropology*.
- Ahmad, A. J., & Ingle, S. (2011). Relationships matter: case study of a university campus incubator. *International Journal of Entrepreneurial Behavior & Research*.
- Balas, V. E., Kumar, R., & Srivastava, R. (Eds.). (2020). *Recent trends and advances in artificial intelligence and internet of things*. Cham: Springer International Publishing.
- Basilaia, G., & Kvavadze, D. (2020). Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. *Pedagogical Research*.
- Britt, T. W., & Garrity, M. J. (2006). Attributions and personality as predictors of the road rage response. *British Journal of Social Psychology*.
- Bukhsh, Q. (2007). Empowerment of women through distance education in Pakistan. *Turkish Online Journal of Distance Education*.
- Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. *Acta bio medica: Atenei parmensis*.
- Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., ... & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses
- 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*.
- Hassan, W. N. F. W., Ismail, M. A., Lee, H. S., Meddah, M. S., Singh, J. K., Hussin, M. W., & Ismail, M. (2020). Mixture optimization of high-strength blended concrete using central composite design. *Construction and Building Materials*.
- Hung, M., Lauren, E., Hon, E. S., Birmingham, W. C., Xu, J., Su, S., ... & Lipsky, M. S. (2020). Social network analysis of COVID-19 sentiments: Application of artificial intelligence. *Journal of medical Internet research*.



- Jamil, S., & Appiah-Adjei, G. (2020). Battling with infodemic and disinfodemic: the quandary of journalists to report on COVID-19 pandemic in Pakistan. *Media Asia*.
- Kelly, T. M., & Bauer, D. K. (2003). Managing intellectual capital—Via e-learning—At Cisco. *Handbook on knowledge management: Knowledge directions*.
- Little, J. P., Gillen, J. B., Percival, M. E., Safdar, A., Tarnopolsky, M. A., Punthakee, Z., ... & Gibala, M. J. (2011).
- Low-volume high-intensity interval training reduces hyperglycemia and increases muscle mitochondrial capacity in patients with type 2 diabetes. *Journal of applied physiology*.
- Liguori, E., & Winkler, C. (2020). From offline to online: Challenges and opportunities for entrepreneurship education following the COVID-19 pandemic. *Entrepreneurship Education and Pedagogy*.
- Mailizar, M., & Fan, L. (2020). Indonesian Teachers' Knowledge of ICT and the Use of ICT in Secondary Mathematics Teaching. *Eurasia Journal of Mathematics, Science and Technology Education*.
- McPherson, M. S., & Bacow, L. S. (2015). Online higher education: Beyond the hype cycle. *Journal of Economic Perspectives*.
- Mailizar, M., Almanthari, A., & Maulina, S. (2021). Examining teachers' behavioral intention to use E-learning in teaching of mathematics: An extended TAM model. *Contemporary educational technology*.
- Rosenberg, M. (1965). Rosenberg self-esteem scale. *Journal of Religion and Health*.
- Rannastu-Avalos, M., Mäeots, M., & Siiman, L. A. (2023). Koostõise probleemilahendamiskuse kujundamine uurimuslikku õpet kasutades. *Estonian Journal of Education/Eesti Haridusteaduste Ajakiri*.
- Ritzhaupt, A. D., & Martin, F. (2014). Development and validation of the educational technologist multimedia competency survey. *Educational Technology Research and Development*.
- Saqlain, M., Munir, M. M., Ahmed, A., Tahir, A. H., & Kamran, S. (2020). Is Pakistan prepared to tackle the coronavirus epidemic? *Drugs & Therapy Perspectives*.
- Salam, S., Jianqiu, Z., Pathan, Z. H., & Lei, W. (2017, December). Strategic barriers in the effective integration of ICT in the public schools of Pakistan. In *Proceedings of the 2017 international conference on computer science and artificial intelligence*.
- Toquero, C. M. (2020). Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context. *Pedagogical Research*.
- Wains, S. I., & Mahmood, W. (2008, October). Integrating m-learning with e-learning. In *Proceedings of the 9th ACM SIGITE conference on Information technology education*.
- Yousuf, M. I. (2007). Effectiveness of mobile learning in distance education. Online Submission.
- Zhong, R. (2020, March 17). The coronavirus exposes education's digital divide. Retrieved from The New York Times: <https://www.nytimes.com/2020/03/17/technology/china-schools-coronavirus.html>.