Iqra Fatima, et. al.International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 14, Issue 2, February, 2024, pp: 16-27

LITERATURE SURVEY OPEN ACCESS

Augmented Analysis of E-Learning Platforms Through Machine Learning in Diversion Of COVID-19

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ABSTRACT
The Coronavirus Disease (COVID-19) outbreak posed severe concerns to global education systems. During the coronavirus pandemic, information technology played a critical role in the deployment of distant learning by developing various learning management systems (Google Classroom, Zoom, Google Meet, Edmodo, Moodle, Microsoft Team) and other information media. As online teaching was not a common form of education in schools and universities before the pandemic, most teachers had no or limited experience with it. This study aimed to augment the analysis of different LMSs 'based on teachers' and students' perceptions of adapting to different e-learning modes. This study used a survey method by employing a structured questionnaire. 500 graduate and undergraduate students from different universities in Punjab were participants in this survey. The data was analyzed using the Python programs Pandas, Numpy suite for data collation, Matplotlib, Seaborn kit for data visualization, and Scikit learn. The findings show that the Zoom platform promotes independent learning with 95% critical thinking and 95% test accuracy.

Keywords - COVID-19, higher education, e-learning, learning management system, augmented analysis

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Date of Submission: 03-02-2024 Date of acceptance: 14-02-2024

I. INTRODUCTION

Education has performed an essential role in human civilization thus far; education is the starting point for all advancements in human existence [1]. In essence, education is a catalyst for individual and collective progress. It is an investment in the future of a society, shaping the minds and capabilities of its citizens. Without education, the full realization of a vision for an advanced, enlightened, and equitable civilization is significantly hampered. [2]. Various educational approaches continue to change in response to changing periods and patterns of human existence [3]. There has been considerable expansion in the provision of education at all levels across the world during the last 50 years [4]. The current COVID-19 pandemic has proven to be the most challenging for education systems [5].

The SARS-CoV-2 virus is the source of the coronavirus disease 2019 (COVID-19), a respiratory ailment, culminating in interstitial pneumonia and acute respiratory distress syndrome (ARDS) [6]. A clinical study of the virus demonstrated that it was spread from person to person [7]. On March 11, 2020, the World Health Organization (WHO) proclaimed the COVID-19 pandemic, when the number of confirmed cases worldwide reached five million and spread rapidly [8,9].

The COVID-19 outbreak has brought about a rapid transformation in higher education, impacting areas such as instructional delivery, technological readiness, financial sustainability, internationalization, and mental health support. Institutions continue to adapt and innovate to meet the evolving needs of students and the broader educational community [10,11]. To prevent the virus from spreading, the government has devised various strategies, including isolation, social and physical separation, and widespread societal limitations [12]. To minimize educational destruction, West Sulawesi University Minister of Education and Culture issued Circular Letter 211 / UN55 / HK / 2020 on March 27, 2020, requiring all recovery activities to be conducted from home via online learning, allowing students and professors to continue their studies [13].

The COVID-19 epidemic accelerated the adoption of video streaming, e-learning, remote working, and related technologies in a matter of days [14]. E-learning is also known as e-education, remote learning, or online learning [15]. Various studies on online learning have been conducted during the ongoing pandemic [16]. During the coronavirus

pandemic, information technology plays a critical role in the deployment of distant learning [17]. Despite the Covid-19 pandemic, information technology has rapidly developed various Learning Management systems (LMS), including e-learning: Google Classroom, Zoom, Google Meet, Edmodo, Moodle, Blackboard [18,19], WhatsApp, and other forms of information media and online networks that can link instructors and students to ensure that the educational process proceeds as intended [20,21].

Although several technologies are accessible for online education, they can occasionally cause plenty of issues [22]. Hardware and software issues [20,23], installation issues, downloading errors, LMS login problems, audio and video problems, financial issues, and concerns related to personal information protection are among the difficulties and challenges associated with modern technology [24,25]. As a result, students find online learning tedious and uninteresting [26].

With all of these limitations in mind, the current study's goal is to provide a better educational understanding of the types of technology that can best fit in when fear is a dominant figure in 'teachers' and 'students' lives. Learning management systems (LMSs) come with ambiguous user environments, hidden costs, administration manuals, bulky developers and limitations in terms of integration, interoperability, localization and bandwidth requirements [27]. Choosing the best LMS for your needs requires considerable research, a prevalent issue in web-based education [28]. This paper will present an Augmented Analysis of various LMS based on 'student's experiences through a survey during a pandemic [29].

- The eruption of the COVID-19 pandemic prompted a swift and substantial shift in education, leading to the widespread adoption of e-learning platforms as a means of diverting the impact of the virus on the educational landscape.
- An augmented analysis was undertaken to evaluate the effectiveness and contribution of various e-learning platforms in mitigating the disruptions caused by the pandemic, with a focus on platforms such as Google Classroom, Zoom, Google Meet, Edmodo, Microsoft Team, and Moodle.
- The study aimed to provide a comprehensive understanding of how these platforms facilitated continuity in education by offering remote learning solutions, enabling students and educators to adapt to the new normal.
- Among the platforms assessed, Zoom emerged as a standout contributor, offering a versatile and interactive virtual space that closely simulated the traditional classroom setting, thereby enhancing the overall e-learning experience.

There are five sections in the remainder of the paper. Part II includes the literature about our investigation. Section III elaborated on the methodology work. Section IV describes the experimental setup and results of the research. Section V highlights the discussion of limitations and future work. Finally, section VI provides a conclusion of the study.

II. LITERATURE WORK

At the beginning of 2021, WHO declared the new infection pandemic, SARS-CoV2, a worldwide major public health issue [6]. Controlling infections and physical removal are essential to prevent further virus spread and control the pandemic [30]. Compulsory physical separation has been adopted in many countries, including Pakistan, resulting in national schools and universities [10,31]. Under this policy, higher educational institutions must make suitable and timely modifications so that their education continues and academic progress continues. The activities for education and learning have immediately been changed to complete e-learning [32].

Several studies have been conducted to determine the value and effectiveness of e-learning implementation [29,33]. It is promoted as a teaching method by numerous universities worldwide that is widely appreciated by students. Generally accepted for several reasons, a few of which specifically relate to students, like ease of use, flexibility also better environmental control. Nevertheless, there are several limitations to learning, despite its many advantages, such as social isolation, lack of interaction between student teachers, connectivity issues, etc. [29,34].

In the COVID-19 pandemic, online education has become the prime source of education. With this growing popularity, students have become a top priority for education in the application of online learning. Conventional learning methods are no longer enough to meet the needs of the learning process [35].

A survey was conducted by [36], with 136 student questionnaires collected from institutions in Indonesia and Malaysia. When dealing with the present pandemic coronavirus, students are aware of e-learning as a distant learning system. 51% agree on e-learning preparation, 38% declare e-learning planning neutral, and 68% declare e-learning implementation neutral. A student assessment and a positive view of e-learning are important factors in the success of e-learning.

Learners who possess a fixed perspective find it challenging to adapt to new situations, whereas

pupils who possess a growth mindset adjust quickly. For online learning, there isn't a single paradigm that works for everyone. There are several subjects to select from, each with its prerequisites. Different online learning methods are required for different disciplines and age groups [37]. Interactivity, flexibility, self-pacing, and potential are all advantages of online learning. It also enables physically challenged learners to acquire in a virtual environment while restricting their movement [38]. [39] stated that the factors that influenced student perceptions of learning were discovered to be certainty of design, interaction with instructors, and active discussion. This study's emphasis on collaborative learning could necessarily be applied to other types of remote learning. However, learning management systems have functions that could be used to support remote learning and comprehensive student understanding.

Some authors discussed that When a student's preferred method of learning differed from the method used in the learning management system, his or her performance suffered. As a result, LMS research can be distinguished by a wide variety of situations on a wide range of outcome variables using a diverse range of explanatory models [40]. It is challenging and inconceivable to draw broad conclusions after this study. When researchers try to understand the impact of learning context, LMS use, and learning outcomes, the issue appears to be highly noticeable.

Researchers investigated the impact of the COVID-19 pandemic on online education. They emailed 1,289 COM students and staff members a survey between March and April 2020 [40]. During the COVID-19 pandemic, barriers to online medical education included communication, student evaluation, technological tool use, online experience, pandemic-related worry or stress, time management, and technophobia.

The uptake of e-learning technologies was impacted by several factors during the COVID-19 epidemic, as noted by the authors who examined the main challenges. Aspects of culture, self-efficacy, technology, trust factors and e-learning system quality are the essential elements that influence the respondents' use of e-learning systems, as well as universities, should consider them in plans based on the findings. Furthermore, the data indicated that employing an e-learning system has three key challenges: (1) technical difficulties with the system, (2) change management concerns, and (3) financial support issues [41].

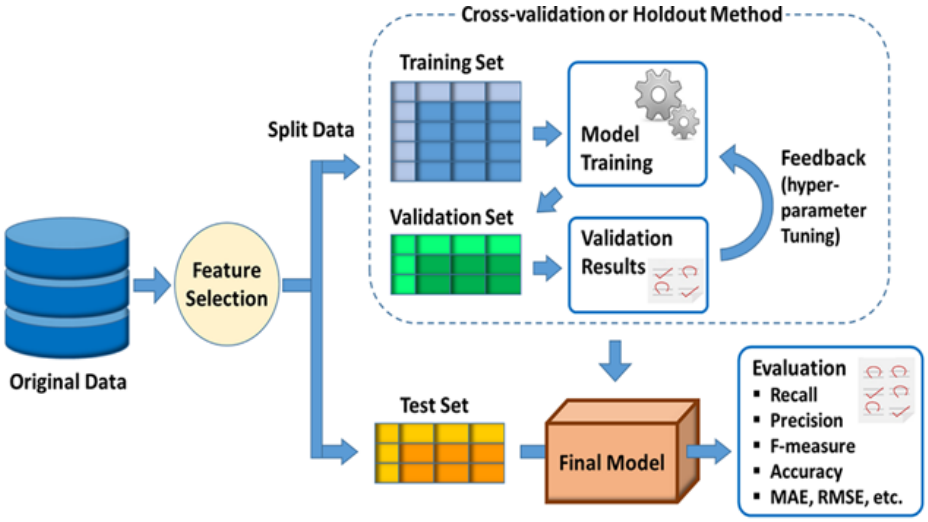
III. MATERIAL AND METHODS

In this section, workflow and the methodology procedure followed for the development of the customized data source, data processing, cleaning and transformation are discussed in Figure 1.

3.1. DATA SOURCE

This is a survey-based study of 500 (171 male and 329 female) Undergraduate, master, Postgraduate, and PhD students studying in various universities in Punjab, Pakistan. Participants' ages ranged from 16 to 32. Following are the frequencies chart for participants' age, gender and academic level.

Figure 1. Methodology illustrating the suggested Model's Workflow.



3.2. Data Processing

Cleaning variables and data instances, as well as transforming the dataset to a CSV file, are all part of dataset pre-processing. Comma-separated values (CSV) is an acronym for "comma-separated values." It is a plain text file format in which data is stored on a single sheet rather than in rows and columns of a file. A CSV file is a plain text file that can be opened in several different programs, including Notepad and other tools that work with plain text. Commas are used to separate data in a CSV file, as the name implies. It is a way for applications to exchange structured information among programs that cannot easily communicate to each other directly such as the contents of a spreadsheet.

There were five sections to the questionnaire. The first component gathered data on the 'respondent's bio-data information. In the second portion, they were asked about their learning needs and attitudes toward using LMS in their institutions. The third section required respondents to choose their institution's current LMS type and share their personal learning preferences based on LMS experiences. The fourth portion investigated the factors influencing LMS usage and how they are preferred. The learner's opinions and attitudes regarding LMS were elicited in the fifth segment.

This questionnaire has four types of questions: 5-point Likert scales, multiple-choice, closed and open types. Likert scales are coded from 0 to 4, with 0 being for neutral, 1 being for strongly disagree, 2 being for disagree, 3 being for agree and 4 being for strongly agree. Closed-type (Yes and No) questions are coded 0–1, with 1 indicating "Yes" and 0 indicating "No".

3.3. Data Collection and Procedure

The most common data collection method is a questionnaire survey. Within three weeks, 500 questionnaires were completed, and the data was saved in an Excel file and transferred to a desktop computer for processing. The response rate was high, and the participants completed all survey sections. When this data is gathered, Pakistan has implemented a remote learning policy, mandating all respondents to be students with prior distance learning experience.

3.4. Data Analysis

The 3.8 version of Python was used, along with packages stated below; To find out "students' perceptions/feedback about e-learning platforms during the COVID-19 pan-demic," the Scikit-learn kit, Matplotlib, the Seaborn package, and Pandas were used in the data analysis process.

3.5. System Requirements

Requirements of the research project included;

- Install any Python version above 3.8.
- Install pip for Python.
- Install Jupiter notebook.

IV. RESULTS

This study's implementations utilized Python within Jupyter Notebook. The dataset was accessed via a CSV file. The chapter includes discussions on model training, test accuracy, and various evaluation measures. The results were displayed through components like the confusion matrix, model training

and test accuracy, as well as the classification report. To enhance visualization, a bar graph for each query was generated using Matplotlib and Seaborn.

4.1. DATA COLLECTION AND PROCEDURE

Data can be loaded in different forms into Python, such as CSV, TSV, and Excel. For each kind of data, different packages and libraries are available for data reading and pre-processing in Python. Because our dataset is in CSV format, 'that's why read it with the Read CSV operator as discussed in Table 1.

Table 1. Frequency and Percentage of Students who are using E-Learning Platform.

Respond	Frequency	Percentages
Master	84	16.834%
PGD	151	30.261%
UGD	261	52.305%
PhD	3	0.601%
Total	499	100%

4.2. DATA FILTRATION

In exploratory data analysis (EDA), the most relevant features were identified, and columns with less impact on the data analysis, model training section, and prediction result were eliminated. Python Pandas, an open-source data analysis and manipulation package is used to create a correlation heatmap.

4.3. DATA EVALUATION

The research findings were examined with the Python "scipy" and "sklearn" toolkits, as well as several other Python packages including "pandas," "numpy," and "seaborn."

Table 2. Frequency and Percentage of Students who are using E-Learning Platform.

Response	Frequency	Percentages
Neutral	97	19.439%
Agree	336	67.335%
Disagree	10	2.004%
Strongly Disagree	4	0.802%
Strongly Agree	52	10.421%
Total	499	100%

The analysed data has been visualized with the help of a Bar chart and a Pi chart data explained in Figure 2.

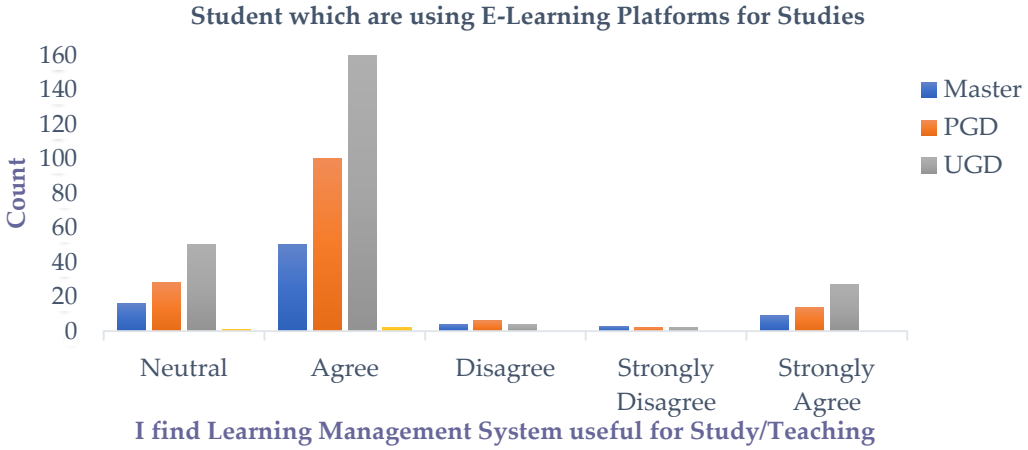


Figure 2. Frequency and Percentage of students using LMS w.r.t. Academic-Level.

Figure 2, illustrates the ratio of undergraduates, postgraduates, masters, and PhD students using the eLearning platform for studies during the COVID-19 pandemic frequency and percentage discussed in Table 2.

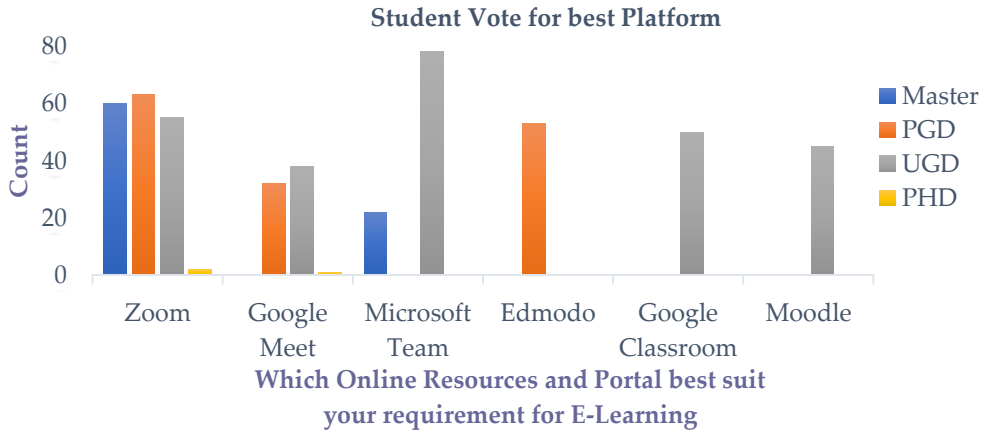


Figure 3. Online Portal that Suits Best 'Student's Requirement for E-learning.

Figure 3 represents the ratio of student votes for Zoom, Microsoft Team, Google Classroom, Google Meet, Moodle, and Edmodo as the best learning management systems.
Figure 4 elaborates on the ratio of 'student's vote for online resources and portals that best suit 'requirements for e-learning in terms of comfort level while using LMS (Zoom, Microsoft Team, Google Classroom, Google Meet, Moodle and Edmodo).

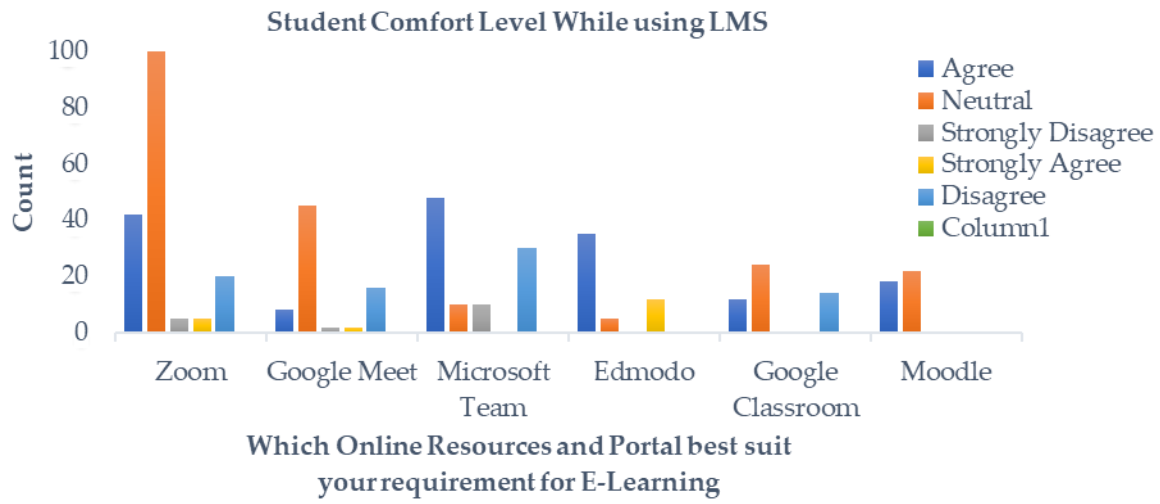


Figure 4. Students Comfort Level while using LMS.

4.4. Splitting Label and Features

In the dataset, we have the last column as the label column, which tells us the choice of the platform by students, and other columns as features discussed in Figure 5. For training the model, first, we need to convert "String" Into "Numerical" values. For Creating Training and Testing Split, 10% was taken for testing and 90% for training the model. Initializing the model and the Score function provided us with the accuracy of the Training Set as shown in Figure 5.

	Gender	Academic_level	Does your facilitate offline access to your lectures/documents	Does your LMS allow recording of lectures?	According to security\npoint of view which\none is more secure?	I find learning management system useful for study/ teaching	The entire content and course structure can be stored and backup in the software	Low internet Bandwidth	Support for the Tools using in the content creation such as (Dreamweaver, Flash, Word, PowerPoint)	Software Facilities with integrated Plagiarism detection option
0	1	1	0	1	0	0	2	0	0	0
1	1	1	0	0	0	0	3	0	4	0
2	1	1	0	1	0	0	1	1	3	3
3	1	1	0	1	0	0	2	0	3	2
4	1	1	0	1	0	3	2	0	3	0
…	…	…	…	…	…	…	…	…	…	…
494	0	0	1	1	5	0	3	4	3	4
495	0	0	1	1	5	0	0	4	0	3
496	1	0	1	1	5	3	3	3	3	3
497	0	0	1	0	5	0	1	0	0	4
498	0	0	1	1	5	3	0	3	2	3

499 rows * 10 columns

Figure 5. Splitting labels and features.

4.5. Model Training

In this section, we trained the Decision Tree model on the dataset, after training, the model we calculated the F-Score of the model and plotted the confusion matrix by using below mentioned mathematical equations one, two, three, and four as shared the results in Table 3.

$$Accuracy = \frac{T_P + T_N}{T_P + T_N + F_P + F_N} \quad (1)$$

$$Precision = \frac{T_P}{T_P + F_P} \quad (2)$$

$$Recall = \frac{T_P}{T_P + F_N} \quad (3)$$

$$F1 - Score = 2 * \frac{Percision * Recall}{Percision * Recall} \quad (4)$$

Table 3. The percentage for Training, Accuracy, Precision, Recall, and F-score**.**

Training Test %	Accuracy	Precision	Recall	F-score
95.49%	95.0%	95.0%	95.0%	95.0%

Participants' responses were analyzed using Python with the help of the packages below Matplotlib, the Seaborn kit for data visualization, Pandas, the Numpy suite for data collation, and Scikit-learn. The positive response rate for Zoom, Edmodo, Microsoft Team, Google Meet, Google Classroom, and Moodle were 36.4%, 10.6%, 20%, 14.8%, 10%, and 8.2%, respectively as shown in confusion metrics in Figure 6.

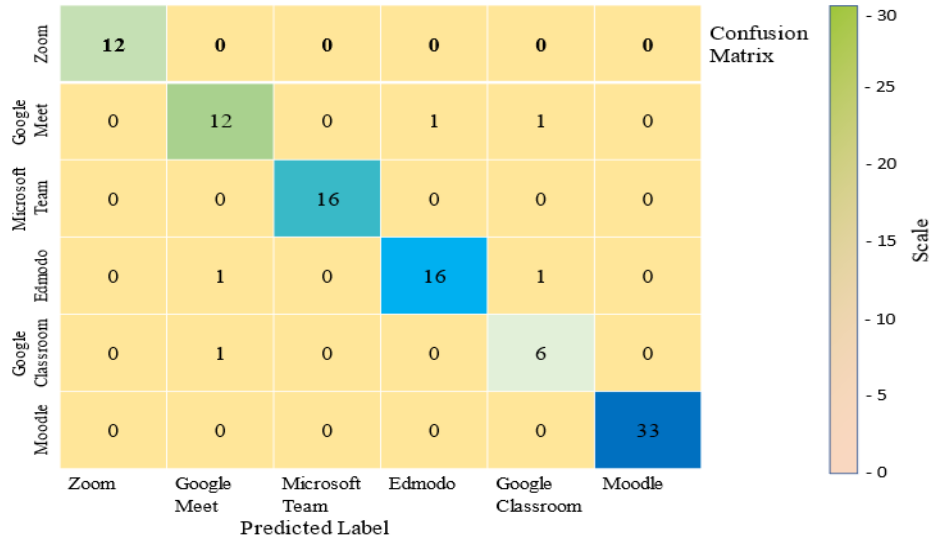


Figure 6. Confusion Matrix of predicted labels.

A 95.0% accuracy, 95.0% F1-score, 95.0% precision, 95.0% recall and 95.49% training test may significantly increase classification performance.

4.6. AUGMENTED ANALYSIS

The term "augmented analytics" is based on the term "analytics," which refers to the most efficient and beneficial automation. Natural language processing and conversational analytics will accelerate analytics and business intelligence usage by 2021 [34]. During the COVID-19 pandemic, and due to social distancing policies, video calling apps have become widely used for education, business, and social contacts.

In the early days of stay-at-home orders in the US, Zoom, a video conferencing platform, added more than 100 million users a month. For online business lunches, lectures, social gatherings, and religious services, zoom users made the switch. Video calling technology has also been utilized by healthcare professionals to conduct telehealth visits, link family members with hospitalized loved ones, and provide training instruction. Zoom is an online learning platform that includes capabilities like screen-sharing, audio and video, lecture recording, and more. As seen in Figure 7, Zoom includes a virtual whiteboard with annotation capabilities for themes, breakout spaces for student participation, polls for student input, and chat to encourage class conversations. Zoom announced a 78% rise in earnings, with users clocking 2 billion minutes a day in virtual meetings.

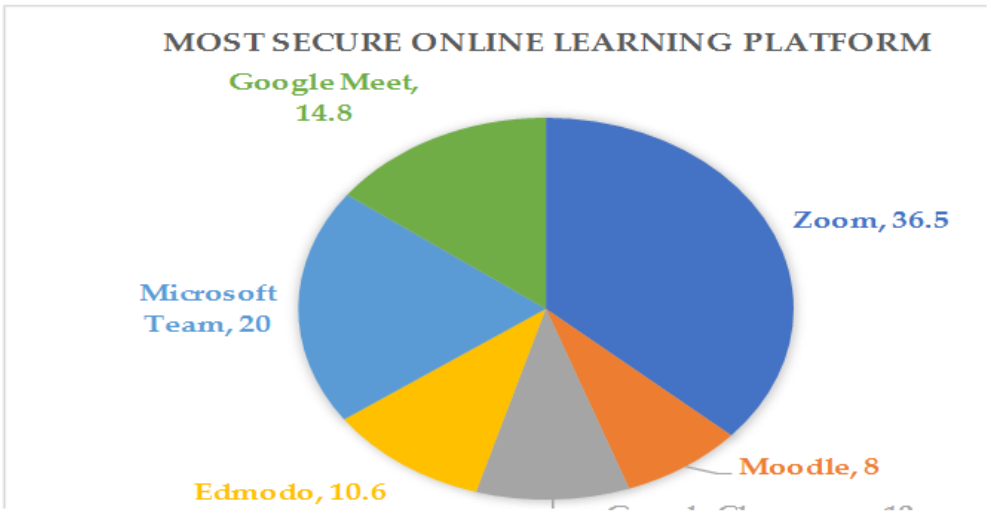


Figure 7. Most Secure Online Learning Platform.

By mid-year, Zoom had exceeded $663 million in revenue, with a $186 million net profit a significant rise from $5.5 million in the previous year and its stock price had already multiplied seven times [9].

According to study findings, Zoom Cloud Meeting is one of the most extensively used learning mediums since it enables learning activities or discussions similar to face-to-face learning and fulfils communication needs with many people anywhere and at any time without physically meeting. If Zoom has been enhanced with features like automated attendance, progress tracking, offline access to lectures, a chat box, uploading and downloading facilities, and content storage, it would provide a more comprehensive platform as shown in Figure 8.

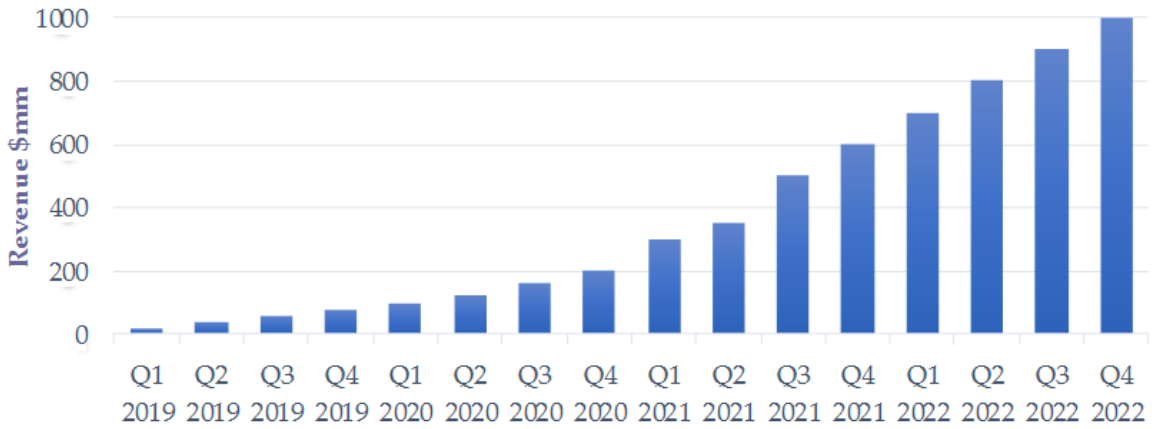


Figure 8. Zoom's Revenue Chart.

Furthermore, incorporating features such as evaluation test/quiz functionality as shown in Figure 8, the ability to import quizzes and lectures, improved general navigation, and a log facility for accessing previous lectures would further enhance its capabilities. Based on the features mentioned above, the Zoom platform can provide a competitive advantage that helps bring more success to businesses and gain prodigious revenue. The features which have been outlined may influence the university's decision to choose an LMS. These aspects are essential for administrators to acknowledge to choose the ideal platform for 'student's needs, teaching and learning objectives, and supporting a social learning environment

V. DISCUSSION

In this regard, the affected countries used self-distancing, and lockdown techniques, increased the number of diagnostic and counseling sites, and local big gatherings to impede the virus's spread. Similarly, students confront heightened uncertainty due to financial and health shocks (e.g., resource constraints or fears of severe illness), along with the

transition to online learning. These factors could impact academic performance, educational plans, employment decisions, trade deals, and future job prospects. COVID-19 has particularly disrupted higher education institutions.

As online teaching was not a common form of education in schools and universities before the pandemic, most teachers had no or limited experience with it. Furthermore, the e-learning system has different key challenges. When it comes to online learning, there is no such thing as a one-size-fits-all solution. The present study gives an augmented analysis of different LMS based on 'teachers' and 'students' perceptions and also reveals the effects and challenges faced by learners in adapting to different E-learning modes during a COVID-19 pandemic. This research used a survey method using a questionnaire. 500 graduate and undergraduate students from different universities in Punjab were participants in this survey. Moodle, Google Meet, Zoom, Edmodo, Google Classroom, and Microsoft Team are some potential Learning Management Systems (LMS) that can be used for teaching and learning activities at Higher Education Institutions, according to the study research. Flexibility, ease of use, accessibility, and user-friendliness are all factors considered.

The findings show that most participants indicated that Zoom as an online learning platform is relevant during a pandemic. They agreed that Zoom promotes independent learning and critical thinking. Lecturers have used Zoom functions like sharing screens to share documents for the presentation of slides, scheduling meetings, raising hands and chat functions, all of which are useful during learning. Students can use the raised hand and chat tools to share their opinions, ask questions and report any problems, such as the 'speaker's faint voice. Furthermore, all learning activities like discussions and explanations from professors can be recorded and replayed via Zoom meetings so that students can review them afterwards. It may be the best option for students with limited access to the internet.

Zoom's revenue was above $663 million with the existing features, with a net profit of $186 million from $5.5 million a year. Zoom with features like automated attendance, progress tracking, offline lectures access, chat box, uploading and downloading facility, content storage, evaluation test/quiz facility, import quizzes and lectures, general navigation and log facility to access previous lectures enhance its utility. Based on the features mentioned above, the Zoom platform can provide a competitive advantage that helps bring more success to businesses and gain prodigious revenue. The platform's benefits can be used to improve the quality of teaching at all levels of education. During the pandemic, the Zoom platform as an online learning delivery platform significantly impacted student's academic progress, attitudes, and perception.

VI. CONCLUSION

The government's decision to temporarily close educational institutions because of the COVID-19 pandemic sparked research into remote and online learning as a substitute for traditional classroom instruction. As a result, a platform for education was created that included multiple learning management systems (LMS), including Moodle, Edmodo, Zoom, Google Meet, and Microsoft Team, to maintain educational continuity while lowering health hazards. This study uses augmented analysis to evaluate the effectiveness of several LMSs while delving into the viewpoints of educators and learners on the online teaching and learning process during the pandemic. Unfortunately, the study's conclusions show that Zoom became a popular option for online education, providing a virtual setting that mimics the dynamics of a traditional classroom and is favorable to efficient instruction and communication. Nonetheless, it is stressed that having dependable and steady internet connectivity is a prerequisite for both teachers and students to successfully use the Zoom app for educational purposes, underlining the significance of this element in the larger context of remote learning.

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