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Network and Technical Barriers to E-Learning: Insights from Faculty at Khartoum University – Sudan

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Abstract
This study aimed to identify the most significant technical and technological barriers faced by faculty in distance education and to propose solutions. Thus, it sought to identify technical and technological issues affecting e-learning effectiveness and develop remedial recommendations to improve the digital learning environment in both technical and human dimensions. The descriptive survey examined KhartoumUniversity faculty views on distance-education challenges. This study also employed a comparative strategy to assess earlier studies in this field and a statistical methodology to analyze and interpret questionnaire data. An electronic survey on hardware, connection, infrastructure, and technical topics, including digital content design and virtual interaction, was created to collect field data. KhartoumUniversity's 245 faculty members received this Google Forms questionnaire about difficulties and solutions. A main hypothesis "What technical and technological obstacles prevent effective e-learning at KhartoumUniversity?" led to various sub-hypotheses. According to statistical data, faculty's biggest e-learning obstacles are inadequate physical and technological infrastructure. Missing rooms and labs with current tools had the greatest mean (2.33469) and standard deviation (0.76970). On the other hand, "lack of training programs to develop e-learning user skills" was rated lowest with 0.73031 standard deviation and 1.567347 mean. Overall, the study analyzed several technical and technological studies on distant education difficulties.

Keywords: Network Barriers, Technical Challenges, Distance Education, E-Learning, Higher Education

I. Introduction

The development and progress in the field of modern educational technology has led to the emergence of many new class innovations that have been employed for academic reasons only, especially choosing from them to raise the efficiency of the class. Among these new electronic educational innovations, this has created a numerical shift and a large number of work all the elements of electronic education and an interactive electronic educational environment, legitimate with applications that are used as simple platforms free of educational interactions by both the teacher and the learner(Osman, 2023).

Undeniably, the rapid advancements in e-learning have introduced a new paradigm for most educational institutions, and universities in particular (Gama, Chipeta, & Chawinga, 2022). These institutions now bear the responsibility of developing individuals' competencies, enhancing their effectiveness, and producing graduates who can navigate technological innovations and contribute to societal development (Saifuddinovich). Furthermore, contemporary demandssuch as the necessity for lifelong learning, flexible educational pathways, and increased connectivity and openness render e-learning an indispensable strategic choice without viable alternatives(Alenezi, Wardat, & Akour, 2023).

It is preferable to convert the educational content into a program scenario that the programmer can understand, as it should be, and the feedback patterns that work to make teaching and learning tasks successful should be determined, a plan should be developed to manage learning resources in an

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electronic educational environment, Applying appropriate evaluation activities for online education, the teacher should have the ability to organize time to present and develop the course on the network, specifying a specific number to register for the course in order to prevent overloading the course site, and all users of electronic education should be provided with sufficient resources to master learning technology before presenting the course content and following up on professional development in the fields of technology and educational networks (Alenezi et al., 2023).

There are a number of free and open software programs that are used to build lessons and programs, the most famous of which are: Moodle, Atutor, Claronline, Dokeos, Interact, these programs work to design and manage educational content for any educational material using ready-made templates that can be easily modified and installed to suit the educational content to be managed(Thomson & Cochrane, 1939).

In sixth place came the nature of the course topics, which are traditional and not compatible with modern technologies, with an average calculation of 1.84 and a standard deviation of 0.78.

The course topics must be compatible with modern technologies to benefit from these modern computer-based technologies in order to benefit from the capabilities that have made this tool compete with many other educational media and many strategies that focus on the learner's activity and positivity and on work methods within the classroom, which aim to take into account individual differences or overcome some system problems within the classroom (Aldresti, 2023).

Technical support also provides a service to restore files and data. Technical support also solves technical problems in e-learning, and then explains the causes of the problem to faculty members in order to avoid its occurrence in the future. They also solve problems related to systems and applications related to e-learning and get rid of programs that hinder the work of e-learning systems (Gama et al., 2022). In eighth place came the lack of training to develop e-learning users, with an average of 1.57 and a standard deviation of 0.73. Training opportunities and ongoing support must be provided to faculty and students to achieve the mission, vision and goals of the educational institution. This includes developing and employing online e-learning technologies and skills and training all e-learning users on them.

Training can be obtained through training courses, and the possibility of securing training online, recording training courses, and ensuring that they can access all recorded training courses throughout the semester. Training opportunities must be provided for e-learning workers, such as visual production, editing, audio recording, directing video clips, and recording lectures (Eli-Chukwu et al., 2023). The educational institution also provides training for faculty members in e-learning to develop course materials to ensure that the program's courses keep pace with modern technologies in e-learning. Also, faculty members and new students in the program receive adequate training and resources on e-learning(Thomson & Cochrane, 1939)

Modern technologies are characterized by being easy to use and integrate into many traditional strategies to develop them or increase their efficiency, such as problem-solving methods and various discovery methods, which has made them characterized by many important advantages that appear as a result of actual application in the educational field (Osman, 2023). In seventh place came the difficulty of providing assistance when needed, with a mean of 1.77 and a standard deviation of 0.68. Providing assistance when needed in e-learning is considered one of the most important procedures that helps faculty members and students to know many technical and artistic things that they do not know about e-learning (Feizi & Rahmani, 2023).

In addition to helping to shape the roles and methods of teaching and learning in accordance with the advancements of modern educational thought, e-learning seeks to offer an academic environment rich in a variety of teaching resources that are tailored to the needs and abilities of the learners (Feizi & Rahmani, 2023). Although e-learning technologies have become widely used in the educational process due to their rapid development, the e-learning system is confronted with several threats and challenges(Mokhtar, Hilaluddin, & Nik Nazli, 2023). Through a case study of University of Khartoum faculty members, this study aimed to identify the technical and network threats and challenges that come with using e-learning in practice.

Research Question

1. What network and technical barriers and difficulties do faculty members face when using e-learning at the University of Khartoum?
2. What are the technical and network obstacles that hinder the effectiveness of e-learning at the University of Khartoum?

II. Literature Review

The goal of the study was to ascertain the e-learning preferences, issues, attitudes, and skills of nursingstudents during the COVID-19 pandemic.In this cross-sectional survey, 228 nursing undergraduates. Results During the COVID-19 pandemic, most nursing students at Zanjan University of Medical Sciences took online courses from the comfort of their own homes using mobile phones. Students reported that participating in e-classes on their phones presented more logistical challenges because of typing difficulties and frequent internet outages.
It was difficult for teachers to keep the classroom under control when students left the virtual online classroom on their initiative rather than remaining for the entire lesson.Despite the technological challenges, students had positive opinions about the e-learning format.

There was a correlation between the attitudes of students by gender and educational background. In light of COVID-19, this study examines the challenges e-learning faces in Nigerian higher education(Nouraey & Al-Badi, 2023). Three hundred ninety-five academics from private, state, and federal universities in Nigeria who specialise in a range of fields were given a structured questionnaire as part of the study's quantitative research methodology. The quantitative data was analysed using descriptive statistics. The data indicates that Nigerian Higher Education Institutions (HEIs) are still in the early phases of e-learning implementation. Moreover, there was no e-learning curriculum in existence before the outbreak. Additionally, both lecturers and students encountered significant difficulties when implementing e-learning because of a lack of infrastructure to support e-learning and a lack of knowledge about information and communications technology (Jafar et al., 2023).

Difficulties in implementing e-learning

This study examines e-learning in contemporary education at Afghan universities with the goals of identifying best practices, addressing issues, and analyzing trends. It uses surveys and content analysis for both quantitative and qualitative data as part of a mixed-methods approach.One hundred eighty participants were selected using a stratified random sampling technique, which guarantees representation from a variety of faculties. For increased student engagement, key findings highlight the broad use of gamification, mobile learning, multimedia content, and learning management systems.

Difficulties in implementing e-learning are highlighted by obstacles like resistance to change and content management. The implications guide strategic decision-making and actions for educators, legislators, and instructional designers. In summary, this study offers a thorough analysis of the issues and trends surrounding e-learning, providing practical advice for the continuing discussion in the field of digital education (Atashinsadaf, Ramezani-Badr, Long, Imanipour, & Amini, 2024).The purpose of this study is to look into the key obstacles and variables that affected higher education institutions' successful implementation of e-learning platforms both before and during the COVID-19 pandemic.

Difficulties in implementing e-learning

The results highlight the biggest barriers to successful online learning, showing that, according to the literature review, behavioural, organisational, and technological problems are major factors preventing e-learning initiatives in colleges and universities. This paper provides recommendations for educators, researchers, and policymakers by identifying the significant challenges encountered both prior to and during the pandemic. Additionally, it gives academics and administrators in educational settings a framework. (Hakimi, Katebzadah, & Fazil, 2024). Examining the factors influencing college students' technology use was the aim of this study.

The study population consisted of 1,875 surveys from Romanian university students taking online courses during the COVID-19 pandemic. The results demonstrate that external factors do not affect perceived usefulness. Students, therefore, think that perceived ease of use has no bearing on their intention to use new technology. The results linked academic achievement to Romanian students' use of e-learning during the pandemic and their enjoyment of it. Additionally, the results demonstrate that external factors do not affect perceived utility. Because of this, students think that perceived ease of use has no bearing on their intention to use new technology(Aldresti, 2023).

This study intends to provide a review of the literature on the difficulties encountered in establishing and offering e-learning at Indonesian universities from a variety of angles. The literature on the challenges of e-learning in Indonesia was found and examined using the literature review approach. The conclusion drawn from this analysis of the literature is that there are a number of difficulties arising from the perspectives of the teacher, the student, the educational aspect, and the technology aspect. Four factors that have hampered the adoption of e-learning in Indonesian higher education have been identified. An attempt to investigate and identify successful e-learning deployment strategies at Indonesian universities may involve analyzing the difficulties encountered during the process (Fülöp, Breaz, Topor, Ionescu, & Dragolea, 2023).

This study aims to identify the main challenges that higher-education students encounter with e-learning, considering their residences across Peninsular Malaysia. It also examines these students' readiness to engage in e-learning. To accomplish these objectives, a cross-sectional survey design was used. The sample comprised 761 students from public (95.3%) and private (4.7%) institutions located in Peninsular Malaysia. The survey was administered online. Findings indicate that six distinct student groups in Peninsular Malaysia face a range of difficulties when participating in e-learning.

Additionally, the results show that students are less likely to stick with e-learning programs if they encounter more difficulties. The study's findings are essential for tackling e-learning's problems, which will assist stakeholders in addressing and enhancing students' skills (Abdelfattah, Al Alawi, Dahleez, & El Saleh, 2023).Examining the problems and challenges that teachers and students faced when utilising e-learning was the aim of this study. A systematic review was used to collect research data on e-learning. Based on the results of the systematic review, a conceptual framework was created and separated into two primary categories: e-learning difficulties and challenges.

III. Materials and Methods

Research Design

The descriptive survey research design was applied in this study to find and study technical and network barriers to e-learning success at the University of Khartoum. The design was adopted due to the fact that it permits the collection of quantitative data from a large population to describe the conditions, opinions, and problems present. The plan also allowed comparison with findings from previous studies, justifying the outcomes to be reliant on both regional and global contexts. Statistical analysis was used to draw conclusions on the data collected, ensuring that the outcomes were reliable as well as reflective of the experiences of the faculty.

Population and Sampling

The population of interest were all the faculty members in the University of Khartoum engaged in offering courses through e-learning platforms. From this population, random sampling technique was applied to ensure that the sample is representative and there is no selection bias. Among 245 faculty members who responded, all 38 colleges within the university were accounted for. The sample size was determined using Thomson & Cochrane's (1939) formula for descriptive study sample size and has used 0.5 as proportion for maximum variability with a standard significance level. Demographically, the sample comprised 37.55% male and 62.45% female professors with mixed literary (60.82%) and scientific (39.18%) specializations, and varied ranks of academics from professors to teaching assistants.
The sample size was determined according to the law of sample size determination in descriptive studies (Thomson & Cochrane, 1939), the following law:

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$$N = \frac{\left(Z2\frac{\alpha}{2}\,P(1-P)\right)}{D2}$$

P: proportion of employees (good)
P = 50% = 0.5
1-p = 50% =0.5
$(Z\alpha\ )$
$/2$ critical value (It is found in the normal distribution table)
α=significance level (Significance level)

In this study, we designed a comprehensive questionnaire in collaboration with e-learning experts to ensure the questions were inclusive and relevant. We measured the reliability of the questionnaire statistically using Cronbach's alpha. The steps for selecting the random sample were thoroughly documented to ensure representativeness. Special attention was given to handling incomplete responses and missing data to maintain analysis quality. Additionally, a pilot test was conducted before full deployment, which helped improve question phrasing and participant understanding. Finally, we strictly adhered to preserving participant privacy and ensuring their consent and satisfaction throughout the research process. These procedures contributed to collecting accurate and reliable data that reflect the real technical and educational challenges at the university.

Data Collection Method

Data was collected through a structured electronic questionnaire, which was developed in collaboration with e-learning experts. The instrument was developed to meet a wide range of network and technical problems, including infrastructure, availability of hardware and software, technical support, development of digital content, and training for the users. To ensure validity, the initial questionnaire was reviewed by a panel of experts, including e-learning department managers from different colleges. Pilot testing was employed to rectify the questions for clarity and use.

It was made available over the internet using Google Forms, allowing for easy reach and ease of access. It was particularly well-suited to the study population, considering that it was compatible with the computer-based nature of the topic in question. Incomplete responses and missing information were provided for in a way that would not invalidate analysis.

Data Analysis

Data gathered were analyzed using Statistical Package for the Social Sciences (SPSS). Means, standard deviations, and frequency distributions were calculated for ranking and interpreting the severity of each identified problem. The questionnaire employed a three-point Likert scale (agree, sometimes, disagree) to measure the perception of the faculty, in which numerical values were assigned for statistical analysis. Instrument reliability was tested using Cronbach's alpha, with an assessment of internal consistency. The most significant limitation was to determine the top scoring bar to make recommendations as a priority. For example, "lack of equipped classrooms and laboratories" ranked first, while "lack of training programs for e-learning users" ranked last. This facilitated recommending change to the key issues easily.

Ethical Considerations

Ethical standards were followed during the research process. Participants were informed of the purpose of the research and of their right to withdraw at any moment without penalty. Informed consent was obtained electronically before participation. Confidentiality of information was strictly kept; personally identifiable information was not gathered or provided. Responses were securely retained, and outcomes were published in aggregate form so that individuals could not be identified. Secondly, the research also followed principles of beneficence by ensuring that the findings would help enhance conditions of e-learning at the institution. The application of an online questionnaire minimized any possible harm to participants and valued their convenience and time.

IV. Results

Results of data analysis of the study of technical and artistic challenges of e-learning. Case study of a professor at KhartoumUniversity. Distribution of the study sample according to job grade: Table (1) shows that 60% of the study sample are assistant professors, with a number of 148 assistant professors, while the other 40% of the study sample varies from associate professor, professor, lecturer, and teaching assistant.

Table 1: Distribution of the study sample according to job grade

Job Title	Number	Percentage %
Professor	13	13
Associate Professor	39	39
Assistant Professor	148	148
Lecturer	35	35
Teaching Assistant	10	10
Total 245	245	245

Table 2: Distribution of the study sample according to gender:

Gender	Number	Percentage %
Male	92	62.45%
Female	153	37.55%
Total	245	100%

It is clear from Table 3 that 55% of the faculty members (study sample) have literary specializations, while 45% have scientific specializations, according to the study sample.

Table 3: specializations

Specialization	Number	Percentage %
Literary Specialization	149	60.82%
Scientific Specialization	96	39.18%
Total	245	100%

Section Two: It deals with an analysis of the technical and artistic challenges and consists of 8 paragraphs. Study analysis of technical and artistic challenges of e-learning:

According to the analysis of the questionnaire, the technical and artistic challenges of e-learning were represented from the point of view of faculty members at Khartoum University, as shown in the following table:

Table 4: Learning from the perspective of faculty members

Challenge	N	Minimum	Maximum	Mean	Std. Deviation
Lack of training to develop e-learning users	245	1.00	3.00	1.57	0.73
Lack of laboratories for e-learning processes in the college	245	1.00	3.00	2.31	0.77
Lack of halls and laboratories equipped with the necessary modern tools and devices	245	1.00	3.00	2.33	0.77
Difficulty in getting help when needed	245	1.00	3.00	1.77	0.68
The high cost of developing good software for e-learning style	245	1.00	2.00	2.12	0.75
The nature of the course topics is traditional and not compatible with modern technologies.	245	1.00	3.00	1.84	0.78
Difficulty in implementing curricula as electronic software	245	1.00	4.00	2.00	0.72
Lack of availability of specialized technicians to solve technical problems related to e-learning	245	1.00	2.00	2.09	0.76

Paragraph No. (3), which concerns the lack of halls and laboratories equipped with the necessary modern tools and devices, ranked first with the highest mean score of 2.33 and a standard deviation of 0.77. There are some elements in the internal environment of classrooms that affect the quality of the educational process and the academic performance of students.(Karjo & Andreani, 2023).

The e-Learning Officer must also ensure that all educational technology resources used to support e-learning are appropriate and reviewed periodically to ensure that the needs of the e-learning program continue to be met. The e-Learning Officer ensures that optimal technical support is available and provided to support the needs of students, faculty, trainers, and administrators in e-learning (Nouraey & Al-Badi, 2023).

Table 5. Demographic Characteristics of the Sample

Variable	Category	Count	Percentage (%)
Gender	Male	92	37.55
	Female	153	62.45
Job Title	Professor	13	5.3
	Associate Professor	39	15.9
	Assistant Professor	148	60.4
	Lecturer	35	14.3
	Teaching Assistant	10	4.1
Specialization	Literary	149	60.82
	Scientific	96	39.18

This table shows the demographic distribution of the study participants by gender, job title, and specialization.

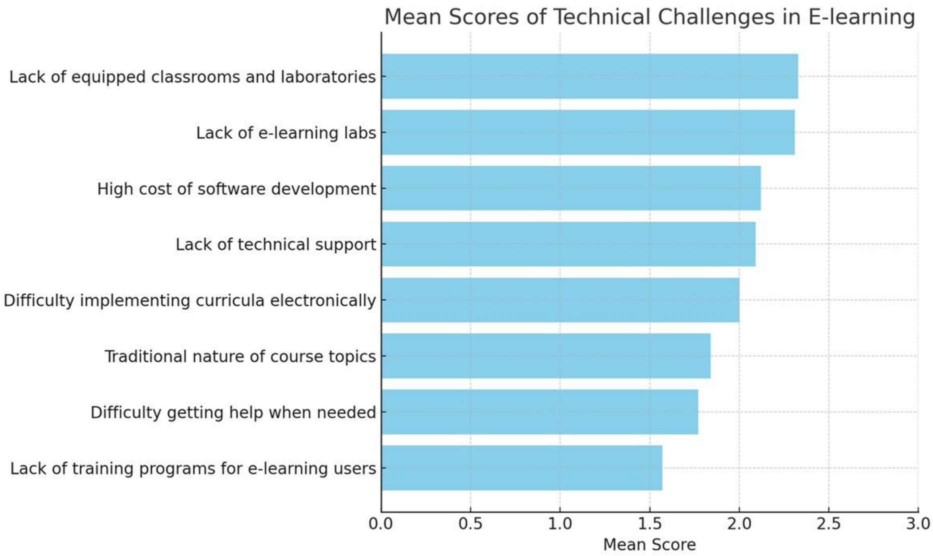
Table 6. Technical Challenges Ratings

Challenge	Mean	Standard Deviation	Rank
Lack of equipped classrooms and laboratories	2.33	0.77	1
Lack of e-learning labs	2.31	0.77	2
High cost of software development	2.12	0.75	3
Lack of technical support	2.09	0.76	4
Difficulty implementing curricula electronically	2.00	0.72	5
The traditional nature of course topics	1.84	0.78	6

Difficulty getting help when needed	1.77	0.68	7
Lack of training programs for e-learning users	1.57	0.73	8

The table above summarizes the ranking and mean scores of challenges.

Figure 1: Mean Score of technical challengers in e-learning



V. Discussion

A suitable internal environment for halls and laboratories may positively affect teachers' teaching performance and students' ability to learn, which increases the likelihood of better academic achievement.There are a number of information systems used in education, including digital interactive whiteboards, (UHDTV) ultra-high-definition television, smart boards, digital projector, and tablets (Saifuddinovich). In second place came the paragraph on the small number of laboratories for e-learning processes in the college, with an arithmetic mean of 2.31 and a standard deviation of 0.77.

Some educational institutions have resorted to the e-learning system completely, such as open universities and colleges that teach remotely. Also, some universities have designed a system that combines virtual classes with distance learning on some days and in-person classrooms on other days. In-person universities are also moving to suspend studies due to climate conditions and weather fluctuations on some days and switching to teaching on these days to distance learning via virtual classes (Aldresti, 2023).The small number of laboratories for e-learning processes is one of the problems facing faculty members. The appropriate number of laboratories for e-learning processes helps achieve the best possible quality during the educational process (Nouraey & Al-Badi, 2023).

The third place was for the paragraph on the high cost of preparing good software for the e-learning style, with an average of 2.12 and a standard deviation of 0.75.Developments in hardware technology have led to the growth and development of the software industry, as the cost of hardware was very high compared to the cost of software, which was characterized by simple operations and weak capabilities (Fülöp et al., 2023).

However, the intensity of developments and competition in the hardware industry has led to a change in the situation (Atashinsadaf et al., 2024).The cost of software has become the highest and most important compared to the cost of hardware components. Especially with the emergence of e-learning software and the increasing demand for it all over the world after all educational institutions shifted to e-learning after the Corona pandemic and the increase in the cost of software, it is difficult for educational institutions to obtain this software such as Blackboard and other e-learning programs (Abdelfattah et al., 2023).

In fourth place came the lack of availability of specialized technicians to solve technical problems related to e-learning, with an average of 2.09 and a standard deviation of 0.76.

The lack of maintenance centers used to solve technical problems, especially in remote areas, and the lack of availability of people with experience and competence in the field of managing e-learning fields are considered among the most important obstacles to e-learning for all users of e-learning, including faculty members and students (Thomson & Cochrane, 1939).

Therefore, the educational institution must implement a number of measures in this aspect, such as providing training opportunities and continuous support for faculty members, including developing and employing online education techniques and skills, the possibility of obtaining online training and support related to the fair use of e-learning, the possibility of providing access to information sources and technologies necessary for the technical support staff to ensure the implementation of the necessary support needs, and providing various communication channels (website, e-mail, messages, etc.) for all users of e-learning with clear information about how to obtain technical support and various services (Eli-Chukwu et al., 2023).

In fifth place came the difficulty of applying the curricula as electronic software, with an average of 2.00 and a standard deviation of 0.72There are a number of procedures necessary to prepare the course as electronic software, including the suitability of the course for presentation over the network. Providing the material and human requirements necessary for the implementation of the project to prepare the electronic course is also considered important. Also, training the work team that will participate in this project is necessary. The specializations and tasks of each member of the work team must be determined, and the principles of learning design related to the use of technology must be applied (Jafar et al., 2023).

Assistance when needed, in the form of technical support, is a multi-tasking task. Most universities have a technical support team that provides technical support services via phone, email or websites(Hakimi et al., 2024).By providing assistance when needed, a faculty member can raise his problem through a question or inquiry and answer all questions and inquire about the problems that faculty members face when using e-learning systems and programs through the number or e-mail or ask about services related to registration or exiting the site or losing secret numbers

VI. Conclusion

The study found the most significant technical and network barriers to the performance of e-learning in the University of Khartoum. The study found that inadequate infrastructure, in terms of under-equipped rooms and limited e-learning labs, greatly hinder adoption. High software costs, insufficiency of good technical support, and hindered curricula conversion to electronic formats further limit performance. Although readiness among faculty to embrace e-learning was indicated, inadequate training and support remained universal problems. Addressing these challenges is fundamental for improving the electronic learning environment. The study forms a foundation for targeted interventions to enhance institutional readiness, technical expertise, and overall e-learning feasibility in higher education.

Limitations

Although worthwhile data is indicated through the study, several limitations must be acknowledged. The research based its findings on self-reported data from the faculty and is hence vulnerable to response bias. The study's cross-sectional design captures perceptions at a single point, and hence one cannot identify changing issues or the long-term impacts of interventions. The research also focused on a single university that could restrict generalizability to other institutions with diverse resources, cultures, or technological infrastructures. Use of an online survey, as effective as it was, may have missed individuals with very limited internet availability, and therefore potentially biased some opinions. Such limitations must be considered when analyzing the results.

VII. Recommendations

To enhance e-learning effectiveness, the university needs to invest in enhancing classrooms and laboratories with modern devices and ensuring dependable internet connectivity. The creation of inexpensive or open-source software packages can mitigate the problem of high licensing costs. University continuous professional development programs should prioritize digital pedagogy, technical assistance, and instructional design. The establishment of a technical support unit with specialized training will provide timely assistance to students and faculty. University administration should ensure proper infrastructure and capacity development funds. A culture of innovation and collaboration in e-learning will encourage faculty involvement and sustainability. Partnerships with technology providers can also allow for effective implementation and scale-up.

Future Implications

Longitudinal study designs must be employed in the future to observe changes in e-learning obstacles over time and to determine the effectiveness of utilized solutions. Multi-university comparative studies would allow for generalizability to beyond the researched context and for the identification of context-specific challenges. Incorporation of students' as well as faculty members' viewpoints could give a holistic awareness of e-learning dynamics. Application of qualitative methods, such as interviews and focus groups, can provide information on the underlying causes. An increase in technology, such as adaptive learning systems and artificial intelligence, can also be investigated to determine potential for circumventing current limitations. In the end, ongoing research will guide evidence-based policy-making and innovative e-learning practice.

References

[1]. Abdelfattah, F., Al Alawi, A. M., Dahleez, K. A., & El Saleh, A. (2023). Reviewing the critical challenges that influence the adoption of the e-learning system in higher educational institutions in the era of the COVID-19 pandemic. *Online Information Review, 47*(7), 1225-1247.

[2]. Aldresti, F. (2023). *A Review on the Challenges of E-Learning in Higher Education in Indonesia.* Paper presented at the Fifth Sriwijaya University Learning and Education International Conference (SULE-IC 2022).

[3]. Alenezi, M., Wardat, S., & Akour, M. (2023). The need of integrating digital education in higher education: Challenges and opportunities. *Sustainability, 15*(6), 4782.

[4]. Atashinsadaf, A., Ramezani-Badr, F., Long, T., Imanipour, M., & Amini, K. (2024). Facilities, challenges, attitudes, and preferences of nursing students related to e-learning in the Covid-19 pandemic in Iranian context: a cross-sectional study. *BMC Medical Education, 24*(1), 50.

[5]. Eli-Chukwu, N. C., Igbokwe, I. C., Ifebude, B., Nmadu, D., Iguodala, W., Uma, U., . . . Akudo, F. U. (2023). Challenges confronting e-learning in higher education institutions in Nigeria amid Covid-19. *Journal of Applied Research in Higher Education, 15*(1), 238-253.

[6]. Feizi, K., & Rahmani, M. (2023). Electronic Learning in Iran Problems & Solutions â With Emphasis on Higher Educationâ. *Quarterly journal of Research and planning in Higher Education, 10*(3), 99-120.

[7]. Fülöp, M. T., Breaz, T. O., Topor, I. D., Ionescu, C. A., & Dragolea, L.-L. (2023). Challenges and perceptions of e-learning for educational sustainability in the "new normality era". *Frontiers in Psychology, 14*, 1104633.

[8]. Gama, L. C., Chipeta, G. T., & Chawinga, W. D. (2022). Electronic learning benefits and challenges in Malawi's higher education: A literature review. *Education and Information Technologies, 27*(8), 11201-11218.

[9]. Hakimi, M., Katebzadah, S., & Fazil, A. W. (2024). Comprehensive insights into e-learning in contemporary education: Analyzing trends, challenges, and best practices. *Journal of Education and Teaching Learning (JETL), 6*(1), 86-105.

[10]. Jafar, A., Dollah, R., Mittal, P., Idris, A., Kim, J. E., Abdullah, M. S., . . . Zakaria, N. S. (2023). Readiness and challenges of e-learning during the COVID-19 pandemic era: A space analysis in Peninsular Malaysia. *International Journal of Environmental Research and Public Health, 20*(2), 905.

[11]. Karjo, C. H., & Andreani, W. (2023). *E-learning Challenges for Lecturers in Indonesia Higher Education Institutions.* Paper presented at the 2023 11th International Conference on Information and Education Technology (ICIET).

[12]. Mokhtar, S., Hilaluddin, T., & Nik Nazli, N. N. N. (2023). Challenges Impacting Students' Intention to Effectively Use E-Learning Method in a Virtual Learning Environment. *International Journal of Technology in Education, 6*(2), 310-325.

[13]. Nouraey, P., & Al-Badi, A. (2023). Challenges and problems of e-learning: A conceptual framework. *Electronic Journal of e-Learning, 21*(3), 188-199.

[14]. Osman, G. (2023). Formal e-learning in Arab countries: Challenges and opportunities. *Learning, Design, and Technology: An International Compendium of Theory, Research, Practice, and Policy*, 3179-3203.

[15]. Saifuddinovich, T. A. The Role of the Fight Against Corruption in Improving Legal Culture. *JournalNX, 10*(2), 1-6.

[16]. Thomson, G. P., & Cochrane, W. (1939). Theory and practice of electron diffraction. *(No Title)*.