Investigating Infrastructure for Implementing E-Learning: A Case Study of Badakhshan University

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Abstract

E-learning has transformed education worldwide, providing flexibility and inclusiveness in learning, especially in developing countries like Afghanistan, and this study examined the infrastructure and readiness of Badakhshan University for implementing e-learning. The aim of this research is to identify the main infrastructure challenges and assess the organizational, technological and human capacity for implementing digital learning. Using a mixed-method approach, this research collected data by administering structured questionnaires to 114 respondents, namely students, instructors, and administrative staff, and document analysis was also used to support the findings. The findings indicate that while e-learning is highly valued among students and educators and they are ready to adopt this effective method, key barriers including insecure internet connectivity, lack of access to electronic devices, poor technical support, and low training of students and ICT staff pose a major challenge in implementing e-learning. Fortunately, despite these barriers, there is a favorable attitude towards e-learning adoption among most stakeholders, provided that programs for infrastructure development and capacity building are put in place. This research provides contextual evidence on e-learning readiness in a developing environment and provides policy-related recommendations to policymakers, university leadership, and development partners. The experience of Badakhshan University serves as a model for other similar universities in Afghanistan and beyond.

Keywords: Badakhshan University, Digital Education in Afghanistan, Educational Infrastructure, E-Learning Implementation, Technology Integration in Education

Introduction

E-learning has revolutionized education throughout the world, providing flexibility and inclusivity in learning particularly in developing nations such as Afghanistan. This research examines issues of concern that impact the adoption of e-learning at Badakhshan University, with a focus on infrastructure, various student backgrounds, and social and cultural issues.

E-learning makes use of online resources to teach in ways other than in a physical classroom, and helps to combat distance and time problems. Yet for success, robust technology infrastructure, institution backing, and acceptance by the broader society are essential. The universities in Afghanistan, such as Badakhshan University, struggle with issues such as restricted application of technology and ongoing dependence on conventional teaching.

Badakhshan University's students range in their ages, genders, and levels of education, and they both pose challenges and opportunities for the application of e-learning. Studies illustrate that individuals' perception of how easy and useful the technology is can predict the success of the application of e-learning, and they can be different in various groups of people (Gurban and Almogren, 2022: 11).

The differences in genders also render the adoption of e-learning more difficult. Despite the progress, cultural and financial issues still hinder many women from pursuing a university education (Sofizada,2022: 52).

The study utilizes qualitative and quantitative methods to examine the preparedness of Badakhshan University for e-learning. Through the analysis of infrastructure and students' diversity, the study provides useful recommendations to education leaders and policymakers to develop equitable and efficient e-learning solutions.

E-learning can greatly benefit higher education in Afghanistan, but achievement is contingent on the resolution of problems with infrastructure, students' backdrops, and cultural challenges. This study aims to inform action toward making the uptake of e-learning more sustained and inclusive in Badakhshan University and other universities.

Even as the world is witnessing increasing momentum in the digitalization of education, Afghan higher education institutions, as in the case of Badakhshan, find it challenging to establish responsive e-learning mechanisms because of infrastructural, demographic, and social-cultural challenges. Badakhshan University, having a young and diverse student base, encapsulates the national difficulty of the region in a profound deficit of reliable internet connectivity, an inadequate supply of digital equipment, low rates of learning management system (LMS) utilization, poor instructor training, and poor technical backup. In addition, the gender gap and restricted access for disabled students make these challenges even more pronounced, preventing full participation in online education.

The current infrastructure in the university is inadequate for fulfilling contemporary demands of e-learning, as reflected in low scores of systemic reliability, security, and accessibility. Even while students and teaching staff report moderate levels of receptivity to digital learning, the positive attitude is largely unused because of systemic constraints. If such constraints are not met

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by swift and concerted action, Badakhshan University's e-learning potential may continue to exist as a theoretical possibility, rather than a working reality.

Based on the analysis, the study thus answers a very important query: What are the infrastructural as well as contextual problems affecting the effective implementation of the e-learning at Badakhshan University, and how can they be resolved to facilitate accessible, sustainable, and quality digital learning?

The Main Question of this research is :

Is Badakhshan University ready in terms of infrastructure and admission requirements to implement e-learning?

And the Sub Questions are:

1. To what extent is Badakhshan University equipped with the necessary technical and infrastructural resources to implement e-learning?

2. What institutional and human capacities exist among faculty, students, and administrative staff to support the transition to e-learning?

3. What are the key barriers to effective implementation of e-learning at Badakhshan University and what strategies can be suggested to overcome them?

The Main Objective of this research is:

To evaluate the readiness of Badakhshan University for implementing e-learning by assessing its infrastructural capacity, institutional support, and socio-cultural context, and to identify key factors and strategies for effective adoption.

And the Sub-Objectives are:

1. To analyze the infrastructural challenges at Badakhshan University such as internet connectivity, availability of hardware, and technical support that impact the integration of e-learning systems.

2. To assess the institutional and human capacity among faculty, students, and administrative staff, including availability of LMS platforms and training programs, to support the transition to e-learning.

3. To examine the influence of demographic diversity (age, gender, educational background) on the acceptance and use of e-learning platforms by students and faculty.

4. To identify socio-cultural and economic barriers including gender norms, cultural perceptions, and financial limitations that affect the willingness to adopt e-learning.

5. To recommend practical strategies for improving the university’s technological infrastructure, enhancing institutional capacity, and promoting inclusive and culturally sensitive e-learning practices.

The adoption of e-learning in higher education, particularly in emerging economies like Afghanistan, has been widely researched. This review synthesizes studies on infrastructure, challenges, and opportunities, focusing on key themes: demographic considerations, success and failure factors, technological infrastructure, and gender dynamics.

Understanding student demographics is crucial for effective e-learning policies. (Shahzad et al., 2024: 1) analyzed student demographics at WO University, highlighting age distribution and faculty representation as key factors in engagement strategies. (Hakimi et al, 2024) further emphasized faculty-specific e-learning trends, underscoring the need for tailored approaches.

(Barikzai et al., 2024: 1) identified four themes in e-learning implementation: success factors, failure factors, recommendations, and future research. Key barriers include lack of ICT knowledge and access to digital tools (Oryakhail et al., 2021). Addressing these institutional and individual challenges is vital for successful e-learning adoption.

A robust digital infrastructure is essential. (Nasrat et al, 2020: 242) found financial, technical, and regulatory hurdles at Shaikh Zayed University, while (Taniwall et al, 2021: 65) noted a preference for traditional teaching over e-learning. (Hasas et al., 2024) explored IoT's potential in education but highlighted infrastructural limitations. (Saay and Norta, 2018: 55) proposed an interoperable e-learning framework to enhance institutional collaboration.

Socio-cultural barriers affect female participation in e-learning. (Sofizada, 2022: 35) found that Afghan women face access challenges due to economic and cultural constraints. (Hakimi et al, 2023: 107) noted that despite e-learning's potential, gender discrimination persists. (Shahzad et al., 2022: 2) found no gender difference in e-learning portal usage but stressed the importance of system quality and satisfaction.

Effective strategies include adopting Learning Management Systems (LMS), multimedia content, and mobile learning (Hakimi et al., 2024: 87). Teacher training is also critical (Karimi et al., 2023: 591; Quraishi et al., 2024). Future research should focus on long-term e-learning impacts and context-sensitive frameworks (Barikzai et al., 2024: 1).

E-learning in Afghanistan presents opportunities but requires addressing demographic, infrastructural, and gender-related challenges. Policymakers and educators must develop adaptive strategies to enhance digital education in emerging economies.

What makes this research unique is its focused, context-specific investigation of e-learning readiness at Badakhshan University, a geographically remote and underserved institution in Afghanistan that has been largely overlooked in existing literature. While previous studies have broadly examined e-learning in Afghan universities, they often generalize findings across diverse institutions without accounting for regional disparities in infrastructure, socio-cultural norms, and institutional capacities. This study uniquely integrates a detailed assessment of technical infrastructure, human and institutional readiness, and localized socio-cultural factors, dynamics and economic constraints within the distinct context of Badakhshan. By grounding the research in a single case study, it provides nuanced insights and actionable recommendations tailored to the university's specific needs, which can also serve as a model for similar institutions in marginalized or resource-constrained regions.

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Research Methodology

This research adopts a mixed-methods approach to assess the readiness for e-learning at Badakhshan University. The combination of both qualitative and quantitative methods allows for a comprehensive exploration of the factors influencing e-learning adoption, including infrastructural, demographic, and socio-cultural aspects. The research methodology is designed to capture a wide range of perspectives from students, faculty, and administrative staff.

This study employs a descriptive case study design, focusing on Badakhshan University as a representative institution for exploring e-learning readiness in Afghanistan. The case study approach provides a detailed examination of the challenges and opportunities specific to the university's context and offers insights that can inform broader national and regional e-learning initiatives.

Data for this study are collected using a combination of surveys, interviews, and document analysis.

Surveys: A structured survey was distributed to students, faculty, and staff to collect quantitative data on various aspects of e-learning readiness. The survey includes closed-ended questions designed to assess infrastructural challenges (e.g., internet access, hardware availability, technical support), demographic information, and attitudes towards e-learning.

A stratified random sampling technique was used to select participants for the survey, ensuring that all relevant groups (students, instructors, and administrative staff) were adequately represented. The total sample size was 114 participants, with the following distribution:

57 students, 29 instructors (academic staff across various disciplines), 9 administrative staff (including IT support and administrative personnel) and 19 graduate.

Data analysis will follow a thematic approach for qualitative data and statistical analysis for quantitative data.

Quantitative Analysis: Survey responses will be analyzed using descriptive statistics (e.g., frequencies, percentages, means) to assess the current state of e-learning infrastructure, faculty readiness, and students' attitudes towards e-learning. Additionally, inferential statistics (e.g., chi-square tests, t-tests) will be used to identify any significant differences in responses based on demographic factors such as gender, age, and academic role.

This study follows ethical guidelines to ensure the confidentiality and privacy of participants. Informed consent will be obtained from all participants, and they will be assured that their participation is voluntary and that they can withdraw at any time without any consequences. All data will be anonymized, and results will be reported in aggregate form to prevent identification of individual respondents.

This methodology aims to provide a robust and comprehensive analysis of the readiness for e-learning at Badakhshan University, identifying key challenges and opportunities for successful implementation.

Research plays a crucial role in addressing societal challenges, fostering innovation, and shaping policy choices.

Research generates insights across disciplines that can be used to make new discoveries. Technology research (as experienced during the COVID-19 pandemic, which closed schools and universities for extended periods) has mitigated the world's most devastating threats with specific studies. In addition, research in fields such as artificial intelligence and machine learning has helped improve predictive models for educational, healthcare, environmental, and other problems.

Research fuels innovation, increases productivity, and increases competitiveness. Countries that invest in R&D, such as South Korea and Germany, experience stronger economic growth. In addition, research guides sustainable economic policies and balances development with environmental and social needs – crucial in combating climate change.

As mentioned, biological problems, disabilities, and other factors in educational and educational systems have repeatedly created obstacles and disrupted the educational system from time to time, therefore, the existence of an e-learning system is considered an urgent need for every educational institution. Therefore, this study examines the infrastructure for implementing e-learning at the University of Badakhshan to identify existing obstacles and challenges and provide reasonable solutions so that we can achieve a stable educational system and institution in all biological and environmental conditions.

Results & Finding

This section presents the findings of the survey conducted at Badakhshan University to evaluate the existing infrastructure and readiness for implementing e-learning systems.

Interpretation of Figure 1

The respondents were mostly male (94.7%) and only 5.3% were female, and this is due to the university being closed to females, so a limited number of Badakhshan University graduates participated in this study.

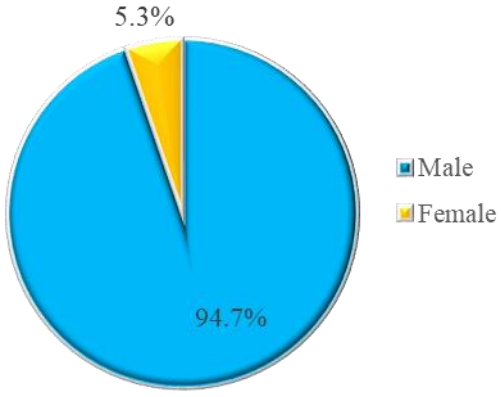

Figure 1: Respondents by gender

Interpretation of Figure 2

Most participants (64.9%) were under 25 years old, followed by 28.1% aged between 25 and 35. Only 7% were aged 36–45, and no respondents were over 45. This reflects a youthful academic environment, potentially more adaptable to technology.

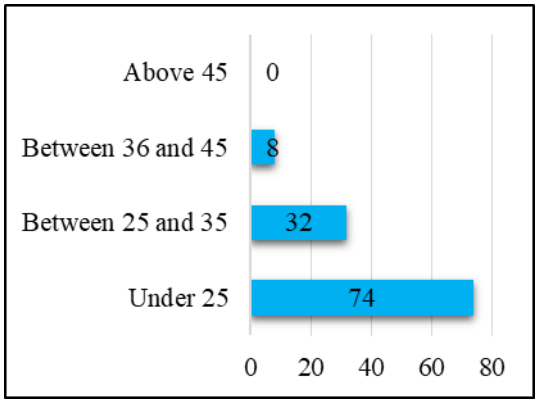

Figure 2: A diverse range of ages among participants

Interpretation of Figure 3

A large proportion of respondents held bachelor's degrees (86.8%), with 11.4% having master's and only 1.8% holding PhDs.

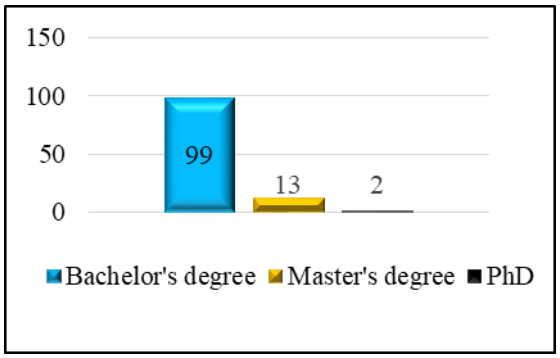

Figure 3: Participants according to academic degree

Interpretation of Figure 4

Half of the respondents were students (50%), 25.4% were instructors, 16.7% were graduates, and 7.9% were employees. This mix provides diverse perspectives across academic roles.

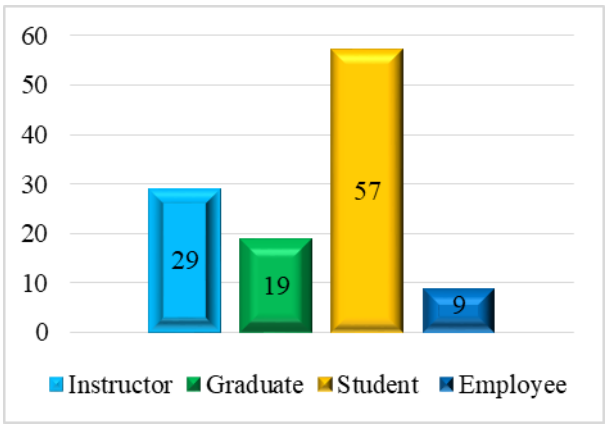

Figure 4: Participants according to educational level

Interpretation of Figure 5

Only 5.3% reported having access to high-speed, stable internet. The majority (54.4%) reported no access, and 40.4% claimed relative access. Limited internet access is a major barrier to e-learning implementation.

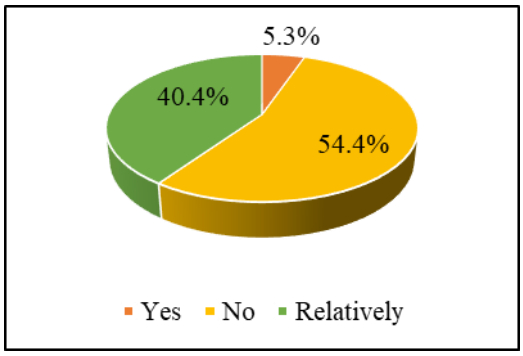

Figure 5: Internet status

Interpretation of Figure 6

48.2% rated the quality of online education as weak and 21.9% as very weak. Only 2.6% rated it as very good, and 27.2% as good. These ratings suggest dissatisfaction with current online learning experiences.

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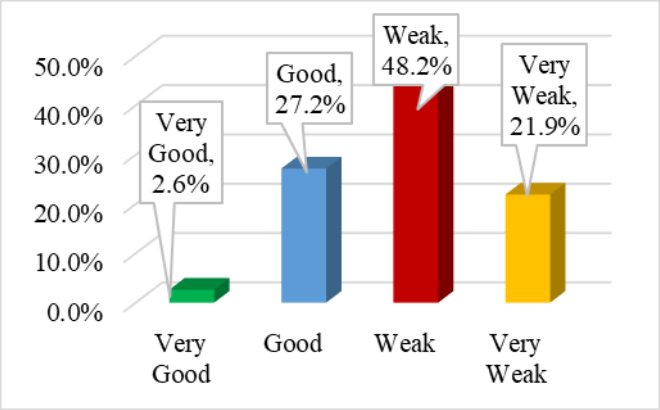

Figure 6:Quality of Education in Online Systems

Interpretation of Figure 7

Only 5.3% believe the university has sufficient hardware. Most (68.4%) indicated a lack of equipment like computers, servers, and routers, while 26.3% noted relative availability.

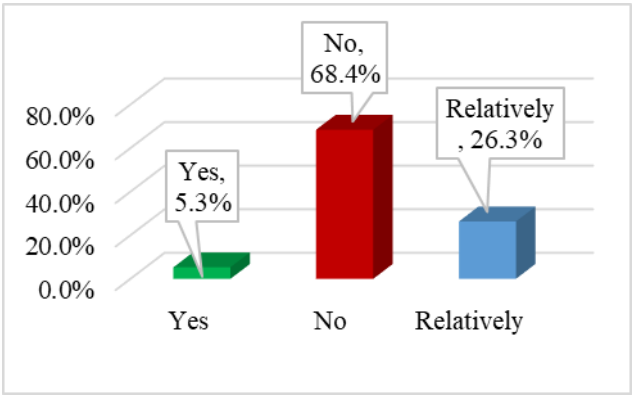

Figure 7: sufficient hardware equipment

Interpretation of Figure 8

Only 0.9% rated equipment quality as "Very good". Most rated it "Weak" (41.2%) or "Moderate" (29.8%), indicating suboptimal infrastructure.

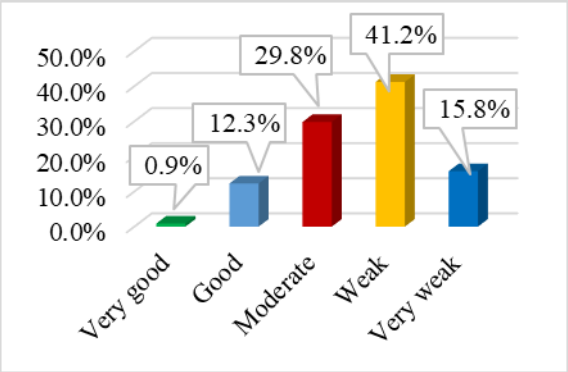

Figure 8: quality of the network and server equipment

Interpretation of Figure 9

LMS adoption is low, with only 4.4% affirming its use. 55.3% reported LMS is not used, and 40.4% said it's used relatively.

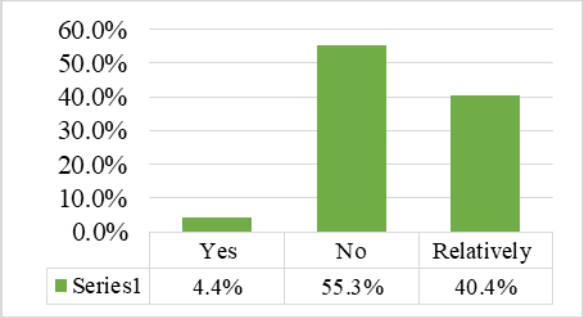

Figure 9: learning management systems (LMS) for e-learning

Interpretation of Figure 10

Only 29.8% of students have access to personal devices. 52.6% said "Relatively", while 17.5% lack access entirely highlighting another e-learning challenge.

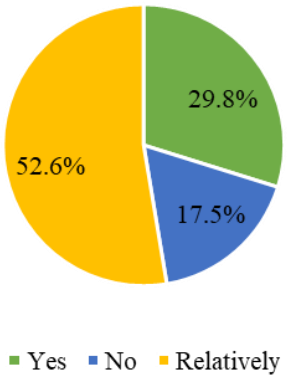

Figure 10: Level of access to electronic devices

Interpretation of Figure 11

Just 0.9% said the university provides suitable facilities and software. 46.5% said no, and 52.6% said relatively.

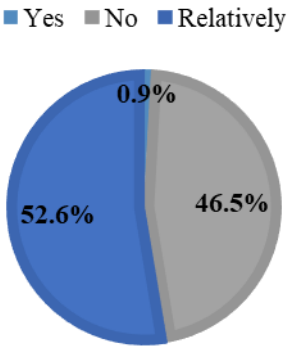

Figure 11: Providing facilities and software for students

Interpretation of Figure 12

Only 12.3% of instructors have completed training related to e-learning systems. A significant number (57.9%) said training was only partially completed, and 29.8% said no training at all.

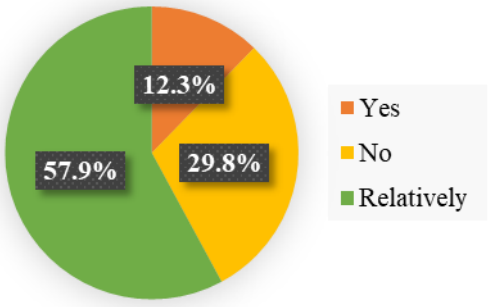

Figure 12: Holding e-learning workshops for teachers

Interpretation of Figure 13

Only 14.0% confirmed access to digital tools like e-books and specialized software. The rest reported either partial (44.7%) or no access (41.2%).

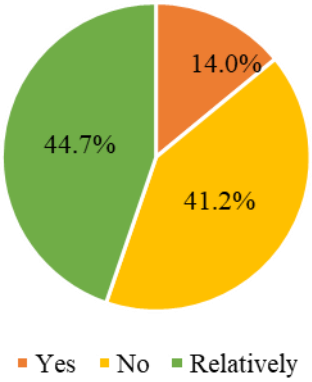

Figure 13: Access to digital educational tools for students and instructors

Interpretation of Figure 14

Welcoming of e-learning is moderate: 35.1% "Moderate", 22.8% "Much", and 19.3% "Very much". However, 22.8% expressed low enthusiasm.

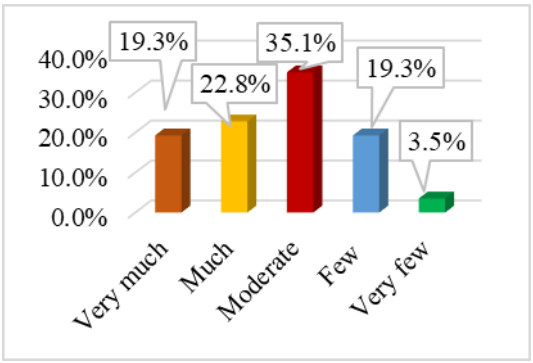

Figure 14: Level of readiness of students and professors for adapting e-learning

Interpretation of Figure 15

Security remains a concern only 9.6% said security systems are in place, while 50.9% believed they are only partially implemented.

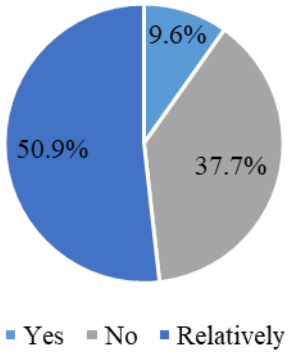

Figure 15: Security level to protect student and instructor information

Interpretation of Figure 16

Half of respondents (50.0%) identified lack of digital equipment as the biggest challenge, followed by lack of high-speed internet (36.0%) and insufficient instructor training (12.3%).

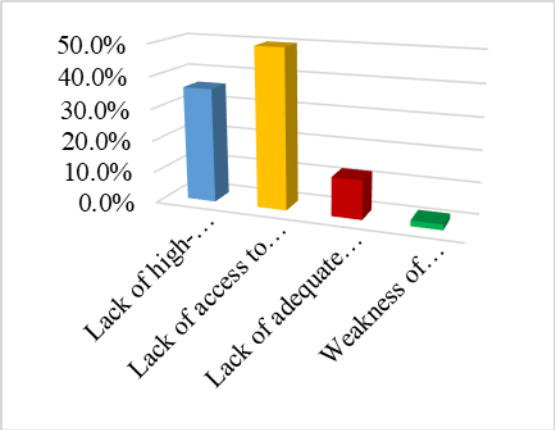

Figure 16: The university's challenge in implementation

Interpretation of Figure 17

Only 10.5% believe the network can handle many users. Nearly half (49.1%) say it's relatively able, and 40.4% say it is not.

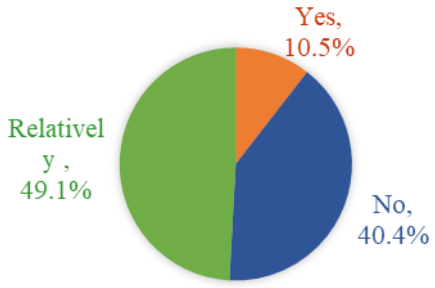

Figure 17: Simultaneous university network infrastructure support level

Interpretation of Figure 18

No respondent reported being very satisfied. Most were moderately satisfied (42.1%), while 35.1% were dissatisfied, and 12.3% were very dissatisfied.

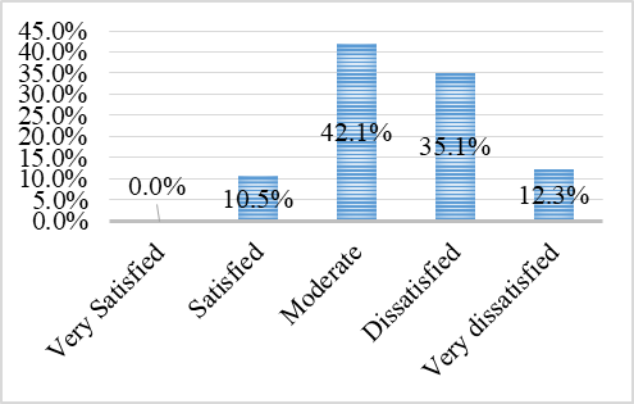

Figure 18: Level of satisfaction with university electronic services and infrastructure

Interpretation of Figure 19

Only 1.8% believe online education equals in-person quality. 62.3% disagreed, while 36.0% noted partial parity.

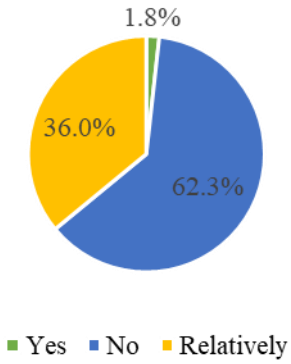

Figure 19: Quality of education in online systems

Discussion

The findings in this report present a clear view of Badakhshan University's infrastructure and readiness to put e-learning in place, but also show significant challenges and obstacles. e-learning and e-learning opportunities have emerged globally, and it is unfortunate that Badakhshan University is faced with significant barriers in doing so. For example, 94.7% of the respondents reported that internet service is unsatisfactory and the connectivity on the campus is varied. A lack of hardware, with some basic digital supplies, was noted by 68.4% of respondents and half of the respondents do not have access to personal digital devices thus impacting the support required to provide .

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The course LMS usage is infrequently used by the respondents, only 4.4% of whom confirmed months previously a consensus confirmation for implementation/tool utilization, highlighting gaps within the institution, learning environment, and delivery systems, including a lack of training. While there are examples of some instructors integrating digital training in some form, of these, only 23.6% would be regarded as highly skilled users of digital technology, which not only limits what kind of digital content can be delivered, but negatively impacts students as well. A limited access to e-books has been reported (33%) but some access to software and virtual class sessions is also very limited - systems performance is rated poor by over 60% of the respondents. Cybersecurity and software discretion with account choices were again indicated, including unnecessary account concept, which discourages using any platform. This means there are significant systemic risks .

However, over 75% of respondents indicated they would consider adopting e-learning if there was a commitment and push towards infrastructure availability, which is significantly positive given the wide-scale issue of digital exclusion of disabled students is an issue for discussion, and the current level of satisfaction with existing systems was low satisfaction. There is potential to leverage around willingness to change, but Badakhshan University will need to make significant improvements in three areas; infrastructure, implementation of an LMS, and training to make the systems practical and useful for any e-learning development.

Conclusions

The research evaluated the infrastructure and preparedness of Badakhshan University for embracing e-learning systems. The findings identified a wide gap between the existing capabilities of the university and the demands for successful e-learning implementation.

Key challenges are a lack of access to stable, fast internet; poor-quality digital equipment; low implementation of learning management systems; and low trainer training. Most students and staff do not have regular access to individual devices and internet-based resources, whereas internal infrastructure, like an intranet and security systems, is underdeveloped. These gaps pose critical challenges for content delivery, student participation, and reliability of the systems.

In spite of such challenges, respondents have a definite, though moderate, intention of embracing e-learning, as long as necessary improvements are introduced. This reflects a positive cultural shift, as well as receptiveness, toward digital learning, which can be tapped into as a driver of change for the future.

The research highlights that e-learning, while possessing transformative power for higher education for remote places such as Badakhshan, can be successful only through strategic and holistic investment in digital infrastructure, faculty, and available policies. In the absence of closing these critical gaps, e-learning initiatives will only be underused and ineffectual.

This case study highlights the need for intervention by the leadership of the university, governments, and development organizations aimed at closing the digital gap so that quality education through new technology mediums is made accessible to all.

Recommendations

Based on the findings and analysis of the current infrastructure and readiness for e-learning at Badakhshan University, the following recommendations are proposed to foster effective and inclusive e-learning implementation:

1. **Enhance Internet Infrastructure** A stable and high-speed internet connection is foundational for any e-learning system. The university, in collaboration with government and international development partners, should invest in upgrading internet bandwidth and ensuring reliable coverage across all university areas including classrooms, dormitories, libraries, and administrative offices.
2. **Procure and Distribute Digital Equipment** To bridge the digital divide, the university should allocate budget or seek donor support to provide essential hardware such as laptops, computers, servers, routers, and projectors.
3. **Develop and Deploy an LMS Platform** Immediate steps should be taken to adopt a robust Learning Management System (LMS) such as Moodle, Google Classroom, or open-source alternatives.
4. **Strengthen Instructor Training Programs** Instructors need targeted and ongoing training in digital pedagogy, e-learning tools, and virtual classroom management.
5. **Improve Access to Educational Content and Software** The university should invest in digital libraries, e-books, and licensed educational software.
6. **Establish a Reliable Technical Support System** A dedicated IT support unit should be formed to provide timely assistance with technical issues faced by students and instructors.
7. **Ensure Cybersecurity and Data Privacy** Given the concerns about system vulnerability, the university must implement cybersecurity policies, install reliable firewalls and antivirus software, and educate users about digital safety.
8. **Support Students with Disabilities** Infrastructure and content must be adapted to support students with physical and learning disabilities.
9. **Raise Awareness and Foster Positive Attitudes** Awareness campaigns should highlight the benefits of e-learning, dispel misconceptions, and foster a culture of digital openness.

By addressing these key areas, Badakhshan University can take significant strides toward building a sustainable, inclusive, and effective e-learning ecosystem that aligns with national educational goals and global digital trends.

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