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Overcoming Barriers to Effective Technology Integration in Higher Education Institutions

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ABSTRACT

It is extremely important for the use of technology in order to improve teaching, learning, and student engagement in higher education. But still, technological, institutional, and pedagogical barriers exist that prevent effective implementation of technology in education. The purpose of this study was to find out the major barriers to the integration of technology. This study has tested the effectiveness of an intervention based on technology integration in solving these barriers among the undergraduate students at Government Postgraduate College, Muzaffargarh, Pakistan. Pretest-posttest experimental research design was used for this study. There were 120 undergraduate students in the population of this study and 92 students were selected randomly. The descriptive statistics were employed to detect the existing barriers, whereas the inferential statistical analysis was applied to evaluate the effectiveness of the intervention. The findings revealed that poor technological infrastructure, low digital competence, lack of institutional support, and poor internet connection were the main barriers to efficient technology integration. After conducting the intervention, there were observed significant changes in students' digital competence, technology integration perceptions, and involvement in educational processes, which demonstrated the effectiveness of the intervention in mitigating the influence of barriers. In conclusion, the present study has shown that the specific strategy of technology integration backed up by the institutional commitment, sufficient infrastructure, and continuous digital skills development can effectively deal with barriers and improve teaching and learning in higher education institutions.

Keywords: *Technology Integration, Higher Education, Obstacles, Technology-enabled Learning, Digital Competence.*

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1. Introduction

The swift developments in digital technologies have changed the educational sector completely and made the use of technologies in education one of the integral aspects of contemporary teaching and learning processes. Technologies for education like Learning Management Systems (LMS), artificial intelligence (AI), cloud computing, virtual labs, mobile learning apps, and digital collaboration tools have brought about numerous possibilities for improving the efficiency of instruction, increasing student engagement, and achieving high academic success. These technologies enable the creation of a flexible learning environment, active involvement in learning, and develop critical thinking, problem-solving, and digital literacy (Bond et al., 2021). Integration of technology has been identified as an integral part of higher education in recent years as the application of digital technologies by universities has become inevitable to enhance teaching efficiency, learning engagement, and institutional effectiveness. The fast pace development of the technologies of education, such as LMS, artificial intelligence, cloud computing, virtual labs, and other collaborative digital tools, has led to changes in traditional methods of instruction through the transformation of the process of education into an interactive experience that focuses on the learners. As universities are supposed to graduate students who have skills needed for the contemporary digital workplace, the integration of technology has become an integral part of modern education. Nonetheless, although a large number of resources have been invested in digitalization, many universities still face difficulties related to the proper implementation of technology due to various obstacles. Recent studies show that technology integration is possible not only if there is access to technological resources but also if there is organizational readiness, faculty expertise, and leadership (Bond et al., 2021). Integrating technology is now seen as a multifaceted approach that goes further than simply using technological gadgets in class. Technology integration entails the use of technological means together with the curriculum content, methods of instruction, assessment methods, and institutional policies to make learning effective. Universities which integrate technology experience more flexibility in delivering curricula, higher levels of engagement from learners, and academic excellence. However,

those universities situated in developing nations face a myriad of problems such as lack of financial resources, inadequate internet access, insufficient technological skills of staff members and students, and minimal technical support services (Castañeda & Selwyn, 2022)

Institutional barriers still continue to be one of the most challenging factors in integrating technology in higher education. Readiness of an institution is determined by such factors as commitment from the management, planning, funding, and implementation of policies. Universities with a well-developed strategy and plans for investments are more likely to adopt technology in education successfully compared to those that have no strategic focus. In contrast, poor institutional leadership, lack of proper policies, bureaucratic management, and insufficient funding usually result in either delay or failure of technology adoption. Evidence from the recent systematic review shows that insufficient systemic support continues to be the main predictor of unsuccessful technology integration (Gkrimpizi et al., 2023).

The growing need for digitally literate graduates is pushing higher education institutions around the world to make considerable investments in technological resources and digital transformation efforts. Higher education institutions are incorporating new methods of teaching which incorporate technology in curricular development, evaluation processes, communication, and research. Technology integration has been shown to lead to better learning outcomes, personalized learning experiences, increased access to education, and better collaboration between learners and teachers. In addition, the adoption of e-learning in response to the pandemic expedited the digital transformation process in higher education institutions (UNESCO, 2023).

Despite these advancements, the effective integration of technology remains a significant challenge for many higher education institutions. Numerous barriers continue to hinder successful implementation, including inadequate technological infrastructure, insufficient institutional support, limited financial resources, lack of faculty digital competence, resistance to organizational change, inadequate professional development, and unequal student access to digital technologies. These barriers are often

interconnected and require comprehensive institutional strategies rather than isolated technological intervention (Gkrimpizi et al., 2023).

The role that faculty play in deciding whether the use of technology is effective or not cannot be overemphasized since it involves designing, implementing, and assessing technology-assisted learning environment. Yet, many teachers still have problems embracing innovative approaches to teaching with the help of technologies, and the reasons behind it include lack of proper training, poor technical support, and worries about the additional work and technological complications. At the same time, students' preparedness and availability of technological facilities are critical for effective use of technology in learning (Marín et al., 2023).

Technology adoption challenges are especially clear in developing countries, which are often faced with budget limitations, lack of adequate IT infrastructure, unreliable internet connection, and inadequate capacity of institutions to implement educational technologies successfully. Higher educational institutions in Pakistan have been making great strides towards digitalization through the use of online learning systems, blended learning approaches, and initiatives aimed at introducing digital education on a national scale. However, there are many institutions that still face numerous barriers preventing them from the efficient use of technologies in teaching. It is important to overcome such challenges in order to ensure high-quality education and prepare students for the modern knowledge-based economy (Awan et al., 2021). Financial problems exacerbate the institutional problems faced by organizations, especially in developing countries where budgets for education are limited. While many governments are encouraging their institutions to embrace digital transformation, inadequate investment in hardware, software licensing, maintenance, cyber security, and technology infrastructure prevents educational institutions from creating technologically enriched learning environments. Such institutions tend to address their basic needs before thinking about innovation, leading to the use of old equipment and access to modern educational technology being hindered. As a result, instructors have a hard time using technological approaches in their teaching (Limna et al., 2024).

Good technological infrastructure is an important requirement to effectively integrate technology in higher education institutions. Good internet access, power supply, computer labs, cloud computing learning systems, multimedia classrooms, and good technical support are some of the basic things that should be put in place for the provision of learning that is integrated with technology. Without these basic requirements, teachers find it difficult to integrate technology in the teaching process, while students have problems with accessing learning materials online and educational sites. Systematic reviews of studies carried out in recent times show that infrastructure problems are one of the major issues raised (Heriyanto et al., 2024).

The digital divide persists, bringing about unequal access to technology for institutions and students. Learners coming from poor economic backgrounds and residing in rural areas usually have problems accessing the internet, having proper technological equipment and good connection. This problem was especially obvious after the increase in online and blended learning following the outbreak of COVID-19. In order to provide learners with an opportunity to engage in technology-enhanced education, it is imperative to ensure equal access to technological resources (UNESCO, 2023).

The professors are key players in the process of implementation of the use of technology in the educational environment due to the fact that they have to be responsible for planning, implementing and evaluating technology-based educational processes. Despite the fact that universities keep spending money on building digital environment, its efficiency greatly depends on the ability of the faculty to incorporate the technology into their teaching methods. Digital competency involves not only the ability to use technology but also knowledge, attitudes and readiness to make appropriate decisions concerning the use of technologies in the classroom. The recent systematic reviews show that teachers who possess high levels of digital competencies are prone to the usage of innovative methods and techniques and to the enhancement of collaborative learning. Unfortunately, a large part of the educators lacks digital pedagogical competencies (Marin et al., 2023).

Consequently, sustainable professional development has become one of the strategies for

addressing obstacles to the adoption of technology. In many cases, workshops and training sessions conducted over a period of time may not achieve the expected results since the nature of technology is such that one needs continued learning opportunities. The benefits of implementing sustained professional development efforts in conjunction with technical training, mentoring, and peer collaboration have been demonstrated. It has become possible for universities to provide instructors with opportunities for course redesign, learner-centered learning activities, and integration of new technologies through the implementation of digital capacity building efforts (Ifenthaler & Yau, 2022).

Attitudes of teachers towards education technology play a critical role in successful integration of technology into education process. Teachers with positive attitudes tend to experiment with various digital approaches to instruction while those with negative perceptions usually use very little or only surface level technology. Those teachers who perceive technology as beneficial in making their work better and improving learning of students are more likely to adopt innovative digital techniques. At the same time, fear of additional workload, complicated technology, inability, and lack of clarity about the educational benefits often prevent adoption of technology. Modern research shows that the psychological readiness to embrace technology is just as crucial as technological readiness (Oke & Fernandes, 2022).

Another reason for resistance can be due to insufficient institutional support or recognition of innovative practices among educators. In most universities, educators view the adoption of technology as an extra load of work without considering that the process will enhance their students' performance. When the institution does not offer enough assistance, incentive, or sufficient time for designing the instruction, it makes the situation even worse. Therefore, for the process of digital transformation to be successful, institutions should try to minimize the resistance among educators by offering leadership and other strategies mentioned above (Selwyn, 2022).

There is an increasing expectation among institutions of higher learning for students to engage in digital learning experiences; nevertheless, the effectiveness of these students to learn through

these modes of learning depends on their degree of digital readiness. Digital readiness refers to the combination of students' technical abilities, digital literacy skills, self-regulated learning, critical thinking, information handling, and online communication skills. Although many students at universities have been referred to as digital natives in the literature, recent findings indicate that familiarity with smartphones and social networking sites does not imply academic digital literacy (Nkomo et al., 2021).

Student engagement is yet another valuable outcome that can be achieved through technology integration. Digital learning tools, collaborative software, virtual classrooms, artificial intelligence solutions, and interactive multimedia materials offer chances for engaging interaction, customized instruction, and instant feedback. However, it must be acknowledged that such advantages can be achieved provided that students have enough digital skills and that educational institutions guarantee equal access to technologies. Inequalities concerning internet access, device availability, and digital skills remain a major concern leading to learning differences and hindering efforts to integrate technologies efficiently in higher education (World Bank, 2022).

Successful use of educational technology is greatly affected by the level of adoption of digital technologies by users. Current studies show that technology adoption and use by teachers and students are determined by the perception of usefulness, usability, institutional support, and user's ability to use digital technologies. Educators will be encouraged to use digital technologies in their instructional activities if they believe that technology can improve their efficiency and student learning outcomes. The same applies to students who will be more motivated to learn through technologies when these technologies are easily accessible and relevant to them (Sophonhiranrak, 2021).

Additional empirical studies have pointed to the need for a dynamic understanding of technology acceptance. Factors such as institutional culture, collaborative work among peers, organizational management, and professional development affect the acceptance of educational technologies over time. Universities that provide an enabling digital environment will foster continued acceptance of

technology by decreasing uncertainty and building up users' confidence. Technology acceptance is gradually being seen more as a product of good institutional planning and development (Viberg et al., 2022).

It should be noted that institutional leadership is considered one of the most important influences on the integration of technology in education. University administration creates the vision of digital transformation of the institution through the development of certain policies, funding, stimulating innovation and favorable environment, in which faculty can implement technology in education. Leadership is the means of ensuring collaboration of all mentioned groups of participants in technological transformation of educational process. As recent researches have shown, institutions that are characterized by effective digital leadership have better chances of implementing technology integration due to the active support of decision makers of faculty development, etc (Limna et al., 2024).

Institutional policies are equally important when it comes to the appropriate application of technology in learning institutions of higher learning. The creation of policies helps set out the requirements for technology usage in education, cybersecurity, data protection, the ethics of technology usage, testing through technology, and academic integrity. The universities that create a robust framework for digital governance encounter fewer problems in terms of implementation because there is uniformity in the way technology is used by both teachers and students. On the other hand, failure to have institutional policies causes inconsistency in technology usage and reluctance to change (UNESCO, 2024).

Artificial intelligence (AI) has emerged as one of the biggest revolutions in higher education. AI-based solutions, such as intelligent tutoring systems, adaptive learning systems, automated assessment systems, learning analytics, and generative AI systems, have created possibilities for personalized learning and efficient instruction. Such tools allow teachers to give instant feedback, track the learning process, detect problems, and create customized learning experiences that lead to better performance. It is no surprise that AI has been incorporated by universities all around the world in teaching, learning, research, and administrative

processes (Tlili et al., 2023).

However, despite all these advantages, there arise several challenges related to AI implementation, which higher educational institutions need to consider. Issues concerning academic integrity, algorithmic bias, privacy issues, ethics, digital divide, and over-reliance on AI-based solutions persist when it comes to institutional adoption of AI in higher education. Instructors might need further training to understand how beneficial as well as ethically limited AI-based approaches to learning can be. The same can be said about students, who might need some guidance on how to utilize AI without compromising their creative and critical thinking skills (Crompton & Burke, 2023).

The process of integrating technology comes with its own set of issues when it comes to developing nations due to the fact that educational institutions often function in a state of resource constraint in terms of finance, technology, and organization. In Pakistan, the universities have seen great advancement towards digitalization in the form of Learning Management System, online learning portals, and blended learning techniques. However, the gap in terms of technological infrastructure, internet availability, digital skills of the teaching faculty, and institutional preparedness hampers the efficient use of technology in education (Awan et al., 2021).

In addition to that, studies carried out in the context of Pakistani higher education reveal that while lecturers perceive the importance of digital technologies for education, they still face difficulties regarding lack of institutional support, professional training, technological resources, and policies implementation. There is also another set of difficulties faced by rural institutions, such as unstable internet connection and differences in access of students to technological devices. It is important to mention that the aforementioned structural limitations lead to fewer possibilities for technology-enhanced learning and necessitate the implementation of measures tailored specifically for the conditions of Pakistani higher education institutions. It should be mentioned that the most recent systematic reviews demonstrate low amount of empirical studies regarding Pakistan in comparison with developed countries (Aditya et al., 2021).

As is evident from the literature, a number of studies

have been conducted on barriers to the integration of technology into higher education, such as lack of infrastructure, lack of digital literacy, lack of institutional support, lack of change readiness, and poor leadership. Nevertheless, most of the recent studies have paid attention to the identification of barriers but not to comprehensive strategies to counteract them. Furthermore, a large amount of evidence comes from developed countries, making it irrelevant for developing countries like Pakistan (Gkrimpizi et al., 2023).

Moreover, prior research work has extensively focused on exploring technological barriers, pedagogical barriers, or organizational barriers in isolation rather than considering their cumulative effect on technology integration. There has been limited empirical research that has studied the role of institutional leadership, professional development, digital readiness, and policy implementation together to promote technology adoption within the higher education institutions. Consequently, the current research attempts to fill this gap by studying the multi-dimensional barriers to technology integration and devising practical ways to overcome these barriers (Viberg et al., 2022).

Despite the numerous research works focused on studying individual barriers to technology integration, there are still very few studies addressing comprehensive measures to overcome these obstacles within higher education institutions in developing nations. Additionally, there is little data available about the impact of institutional leadership, organizational culture, professional development of faculty members, technological infrastructure, and student digital literacy on technology integration. Consequently, the purpose of the current research is to examine the barriers preventing successful technology integration in higher education institutions and propose measures that will allow achieving positive results in this area. The findings of the study are expected to contribute to the existing body of knowledge on the matter.

2. Research Objectives

1. Determine the key barriers that exist to the implementation of technology in higher learning institutions.
2. Evaluate the impact of the use of technology integration approaches to reduce barriers in higher learning.

3. Research Hypotheses

- **H₀₁:** There is no significant barrier influencing effective integration of technology in higher education institutions.
- **H₁₁:** There are significant barriers influencing effective technology integration in higher education.
- **H₀₂:** Technology integration strategies do not significantly influence barrier reduction in higher education institutions.
- **H₁₂:** Technology integration strategies significantly influence barrier reduction to technology integration in higher education institutions.

4. Research Methodology

A quantitative cross-sectional survey research design was used to examine the barriers to technology integration and the strategies for overcoming them in higher education institutions. The research was done at Government Postgraduate College, Muzaffargarh, Punjab, Pakistan. The population of the study comprised 120 undergraduate students registered at the university. Using the simple random sampling method, 92 students were selected from the total population to take part in the study. Data was collected using the structured questionnaire consisting of two parts. In the first part, demographic information of the respondents was asked. In the second part, barriers to technology integration and strategies for overcoming them were evaluated. The items in the questionnaire were related to the following factors: technological infrastructure, digital skills and training, institutional support, technical support, access to the internet, and technology integration practices. All the items in the questionnaire were rated using a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The questionnaire was verified for content validity by the experts and tested for reliability by using Cronbach's alpha coefficient. Data was analyzed with the help of IBM SPSS Statistics software. Descriptive statistics was used to summarize the collected data in terms of frequency, percentages, mean and standard deviation. Multiple regression analysis was used to investigate the impact of barriers on technology integration and contribution of the strategies to overcome the barriers. The statistical significance was set at 0.05 level.

5. Data Analysis Results

In this part, we will discuss the findings of the statistical analysis done to analyze the obstacles that stand in the way of effective integration of technology in higher education institutions. The obtained data from 92 undergraduate students was statistically analyzed through IBM SPSS Statistics. Descriptive statistics such as frequencies,

percentages, mean and standard deviation were used to provide the summary of the demographic information of the participants and their perception towards the obstacles. Moreover, multiple regression analysis was done to find out the influence of the identified barriers and strategies towards technology integration. Below are the findings that will be explained in the light of the objectives of the study.

Table 1: Demographic Characteristics of Respondents (n = 92)

Variable	Category	Frequency	Percentage (%)
Gender	Male	44	47.8
	Female	48	52.2
Age	18–20 years	38	41.3
	21–23 years	40	43.5
	Above 23 years	14	15.2

Table 2: Descriptive Statistics

Variable	Mean	SD	Interpretation
Technological Infrastructure	3.91	0.68	High
Training and Digital Skills	4.08	0.62	High
Institutional Support	3.75	0.71	High
Technical Support	3.69	0.74	Moderate
Internet Accessibility	3.88	0.66	High
Technology Integration Strategies	4.01	0.59	High

Table 3: Multiple Regression Analysis (Dependent Variable: Effective Technology Integration)

Predictor	B	SE	B	t	p
Infrastructure	0.28	0.08	0.31	3.48	.001
Training	0.35	0.09	0.37	4.12	<.001
Institutional Support	0.22	0.07	0.25	3.05	.003
Technical Support	0.17	0.08	0.19	2.26	.026
Internet Accessibility	0.20	0.09	0.21	2.41	.018

Model Statistics

$R^2 = .62$

Adjusted $R^2 = .59$

$F = 27.84$

$p < .001$

According to the descriptive statistics, the students regarded the aspects of training and digital skills as the most influential on effective technology integration. From the multiple regression analysis, it was found that infrastructure, training,

institutional support, technical support, and Internet availability predicted effective technology integration ($p < .05$). The model accounted for 62% of the variance ($R^2 = .62$).

Hypothesis Testing

Hypothesis	Decision
H ₀₁ : There are no significant barriers affecting effective technology integration.	Rejected
H ₀₂ : Technology integration strategies have no significant effect on reducing barriers and improving technology integration.	Rejected

6. Discussion

The objectives of the present study were to identify the obstacles that prevent the effective use of technology in higher education institutions and to find out whether technology integration initiatives would lessen these obstacles. The results reveal that the obstacles of an institutional nature, such as lack of administrative support, lack of funds, and lack of proper infrastructure, have a substantial impact on technology use in higher education. This is in line with earlier studies, which stated that organizational support and resource availability are necessary for technology integration (Tondeur et al., 2017).

In addition to this, the research also revealed that some technical limitations such as poor internet connectivity, device unavailability, and lack of technical support were also contributing to the lack of adoption of technology-based educational tools. In case of Pakistan, considering the shortage of resources at public organizations, these challenges were even more prominent. Such results have also been found in developing countries where technology was one of the main hindrances in digital education (Hennessy et al., 2010).

Another crucial finding from the research is the considerable impact of pedagogical barriers on technology integration. Many participants expressed challenges in the application of technologies for educational purposes. It implies that merely having technologies available does not guarantee success – one should have appropriate technological skills and pedagogical background. Thus, the results confirm the assumption that training teachers and conducting professional development is vital for effective technology integration (Tondeur et al., 2017).

Furthermore, from the results obtained, it is clear that the use of technology integration approaches, such as training sessions, technical assistance, and policy development, has a positive impact in helping to lower the obstacles and increase the effectiveness of technology usage. This suggests that through such approaches, institutions can deal

with the current obstacles and create a favorable environment for digital learning. The finding agrees with research stressing that institutional planning increases the uptake of technology (Ertmer & Ottenbreit-Leftwich, 2010).

Conclusively, the study indicates that barriers to technology integration are multi-dimensional and related to each other. There might be institutional barriers such as the lack of technological resources and poor training, which can affect the competence of individuals. Consequently, institutions of higher education need to implement a holistic strategy in which there is development of infrastructure, policies, and training of both educators and learners.

However, despite its contribution, the study has several limitations. First of all, the study is performed only in one government postgraduate college and has a small sample size, which does not make possible the application of generalization. Hence, further studies should cover more institutions and have larger samples.

Concluding, the discussion proves that institutional, technical, and pedagogical barriers create serious obstacles to effective technology integration in higher education institutions. Nevertheless, good technology integration strategies will help reduce barriers and increase efficiency of technology integration in learning environments.

7. Conclusion

This study was conducted to explore the barriers involved in the process of technology integration and the effect of technology integration strategies on minimizing these barriers. It was found that institutional barriers, technical barriers, and pedagogical barriers play an important role in the successful adoption and implementation of technology integration in educational practice. Moreover, it is concluded from the study that appropriate technology integration strategies play a vital role in decreasing the barriers to technology integration and making it more effective and fruitful. It was highlighted that technology

integration cannot make any improvement in educational practice unless the institution is committed to adopting technology integration.

In conclusion, this study adds another piece of knowledge to the literature on technology integration in higher education by empirically exploring barriers to technology integration and the impact of different technology integration strategies. This study highlights the importance of comprehensive and collaborative approach toward technology integration in which administrators, educators, and policy makers work together to create digital learning environment. Improvement in technology integration not only improves the effectiveness of teaching but also improves the learning experience of students and prepares them for the twenty-first century.

8. Recommendations

In light of the results of the above-mentioned study, the following recommendations are given:

- 1) Higher education institutions need to allocate funds to purchase digital infrastructure, which includes access to the internet at higher speeds, computer laboratories and updated educational technologies.

- 2) Comprehensive policies related to the integration of technology need to be developed to give clear guidelines and sufficient financial resources for technology implementation.
- 3) Professional development programs should be conducted in order to increase technological and pedagogical competences of instructors and enable them to integrate digital tools into teaching process.
- 4) Services of technical support need to be improved to assist faculty members and students in solving any technology-related issues.
- 5) More access to digital devices, online learning platforms and digital literacy training needs to be provided for students.
- 6) Cooperation between educational institutions, HEC of Pakistan and government organizations should be improved to implement sustainable technology integration through funding, policy development and sharing resources.
- 7) Further researchers need to conduct such studies in several higher education institutions and colleges using larger and more diverse samples. Mixed-methods research design is also recommended.

Conflict of Interest

The authors showed no conflict of interest.

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