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DIGITAL LITERACY AMONG PROSPECTIVE TEACHERS: THE COMPARATIVE ANALYSIS OF PUBLIC AND PRIVATE UNIVERSITIES

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KEYWORDS	ABSTRACT
Digital Literacy, Prospective Teachers, Educational Technology, Teacher Education, Public-Private Comparison	This study examined the technological literacy competencies of prospective teachers, comparing public and private educational institutions in a district of Punjab, Pakistan. The research employed the quantitative methodology using survey design. Data was collected using self-developed questionnaire focusing on three dimensions: technological knowledge, usage & awareness. Instrument's reliability was established over Cronbach alpha (knowledge =0.81, usage=0.89, awareness=0.74). The data analysis utilized descriptive statistics and independent samples t-tests over SPSS. The findings revealed significant differences amid public and private institutions in technological knowledge, usage, and awareness. The public sector teachers demonstrated marginally higher technology integration (51%) compared to private sector teachers (48%). The mean scores across all dimensions indicated positive technological literacy in both sectors. The study recommends enhancing technological training in the teacher preparation programs and stresses for professional growth in educational technology. These findings contribute to understanding the current state of technological preparedness amid future educators and offer insights for improving digital integration in the teacher education programs.
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INTRODUCTION

The integration of educational technologies has emerged as a fundamental paradigm shift in the contemporary education systems worldwide. This transformation is characterized by the increasing adoption of digital tools and platforms designed to enhance the teaching and learning processes (Alenezi, 2023). The educational technology is a systematic, goal-oriented approach to integrating

various forms of knowledge, encompassing diverse theories, techniques, tools and methodologies to maximize the learning outcomes (Bansal, Sharma, Jain, Chaturvedi & Sharma, 2024). The modern phrase educational technology integration is multifaceted as it involves many-faceted hardware issues but also embraces an all-encompassing pedagogical framework to critically assess the online resources, and integrate technology into their teaching practices. In this drive, information and Communication Technology (ICT) contributes to efficiency of educational processes is essential and constitutes the critical component of the current education management as well as socioeconomic processes, as the Organization for Economic Cooperation and Development (OECD) underlines. It takes this perspective because there is a growing understanding that technological literacy is more than an educational point, but a requirement for participation in today's global economy (Kahn & Kellner, 2023).

Rather, in contemporary era, the educational paradigms have been mainly influenced by major technology corporations like Apple, Microsoft, and others by their hardware and software solutions transforming the delivery and consumption of the educational content (Davies & Eynon, 2013). A broad spectrum of digital resources and networks which are used by the educators as extensions to teach and learning experiences together make up contemporary educational technology. Virtual and augmented reality, online learning platforms, gamification elements, & artificial intelligence applications count as such tools in making digital literacy a cornerstone of the effective teaching (Bigonah, Jamshidi & Marghitu, 2024). The incorporation of these technologies is major departure from the traditional mode of teaching towards more interactive and student-centered approaches to learning (Renau, 2023). This transition, though, poses great risks to teachers' preparedness and knowledge of technology in particular. One of significant elements of technological transformation is the notion of technological literacy of educators, especially prospective teachers. The concept of technological literacy goes well beyond basic digital competency, to encompass the capacity to properly evaluate select, & implement technological tools to arrive at specific pedagogical goals (Falloon, 2020).

Understanding the academic values of different digital platforms, developing teaching strategies to modify evolving technologies, and evaluating technology-enhanced learning have been part of this (Sen & Leong, 2020). In addition to very rapid advancement of educational technology, the need for continuous professional development and adaptability is also emphasized. Educational trends in the contemporary world oblige future teachers to master the competencies in virtual and augmented reality applications in education, online learning platform management, gamification purposes for engagement increases, artificial intelligence for individualized study, & data analysis for student progress tracking purposes (Lampropoulos & Kinshuk, 2024). Thus, looking forward, educational technology is something which will succeed if there is the proper balance of digital transformation in education's benefits and challenges. This evolution in educational technology is creating a landscape in teaching and learning that requires more attention on the part of educators to technological literacy itself. Keeping in view significance of digital literacy, the current study found the impact of educational technology on prospective teachers' technological literacy across knowledge, usage & awareness. The following were the research objectives and research questions of the study.

Research Objectives
1. To find out prospective teachers' perspectives about knowledge, usage, and awareness of educational technology.
2. To study contextual impact of prospective teachers' technological literacy across knowledge, usage, and awareness.

Research Questions
1. What is the prospective teachers' perspective on the knowledge, usage, and awareness of educational technology?
2. What is differential impact of public & private prospective teachers' technological literacy across knowledge, usage, and awareness?

LITERATURE REVIEW

Initially, technology was synonymous with art, but its definition and application have expanded significantly in the modern era. Understanding technology has become increasingly crucial as its role in the daily life continues to grow and evolve (Haleem, Javaid, Qadri & Suman, 2022). This technological evolution has fundamentally transformed how we approach education and learning processes. The educational landscape has undergone a significant transformation from traditional teaching methods to technology-enhanced instruction. Factually, teachers relied on chalkboards and charts as primary instructional tools (Campo, Negro & Nuñez, 2012). This shift is fundamental in transforming delivery modes of education by substituting traditional teaching tools for digital platforms. Digitalization of education has totally changed the way students access assignments, get feedback on them or interact with educational content (Schmidt & Tang, 2020). In addition to investing in modern instructional technology being used in educational institutions, they must also be prepared to invest in educators who will use these tools (Alenezi, 2023). A relative analysis of education technology execution in diverse nations is very revealing. Interestingly, Sweden & China, being pioneer countries in putting the technology into education, present utterly opposite, but very instructive, models.

A conceptual framework for the way human adaptive systems interact within knowledge domains within educational technology was devised by Savage and Sterry (1990). As educational systems continue to advance so increasingly during digital age, it is no longer possible to build up training methods without integration of technology into educational practices. Particularly this framework has proven to be influential regarding the question of how various countries approach the issue of technological integration in education. Balalle (2024) recent research on engaging students in the learning activities is primary duty of teacher to find how students engage with diverse educational technologies. The study provided insightful guidance on advancing learning outcomes and student engagement in digital age. Additionally, future research areas are highlighted at the end digital literacy has thus turned out to be one of the essential requirements of our present-day society fundamentally changing the educational requirements and developing needs. In this regard, this literacy encompasses multiple dimensions: teaching digital competency, ICT proficiency, social media literacy and twenty-first-century skills. Johnson, Jacovina, Russell and Soto (2016) found

two diverse distinct categories of barriers to technology integration in educational contexts, after analyzing barriers.

Twenty-first-century skills have been focused on by national and international literature through the development of higher/order thinking skills regarding policy (Jamil, , Muhammad, Masood & Habib, 2020), curriculum (Jamil, Aslam, & Ali, 2024; Jamil, Bokhari, & Iqbal, 2024), textbook (Jamil, Mehmood, & Noorani, 2024), teachers' perceptions and practices (Jamil et al., 2021); life life-sills addition focused by diverse studies (Jamil, Ain, & Chohan, 2024; Jamil, Arif, & Shahzadi, 2024). ICT has been proven to be vital for younger generation who will need to merge technology into their daily life. Analysis reveals that technology adoption has evolved differently in different nations, Pakistan exemplifies initial reluctance to integrate technology into education followed by adopting technology gradually. Resource availability, technical infrastructure support, training required from instructors, costs for equipment and software are external factors. Teacher attitudes toward technology, individual expertise & capabilities, personal comfort with digital tools comfort with digital tools and pedagogical beliefs and practices are all internal factors (Lim & Newby, 2021). Research on ICT usage patterns reveals significant trends in educational technology adoption. Orlando (2014) documents substantial increase in ICT usage across the educational settings over the past decade.

In today's education, there is a huge variety of digital tools and platforms (Dzvinchuk et al., 2020; Josué et al., 2023). The dynamic, collaborative and innovative ways of creating presentations are presented by the presentation tools like Prezi and Google Slides. Scratch, Explain Everything and Educations are interactive learning platforms for creative learning & multimedia content creation. Padlet, Google Classroom, and Quizlet are collaborative tools that make the bulk of their share in idea sharing, assignment management and interactive assessment. This thorough the investigation reveals the intricate relationship between technology, education and teacher readiness, and shows the many difficulties and opportunities that exist in transitioning technology into schools (Paliwal & Singh, 2021). To successfully mix educational technology, the approach within that integration should be balanced and thought to be given to both technological capacities and pedagogical demands (Abedi, 2023). The future directions for research should include putting efforts into more effective training for teachers and working on the problems in the technology integration within different educational contexts. This balanced approach is essential to guarantee that educational technology contributes to realizing its goal of improving learning outcomes, without impairing the pedagogical effectiveness.

RESEARCH METHODOLOGY

The study was descriptive and therefore designed as quantitative to examine the technological literacy competencies of prospective teachers in public and private educational institutions. The study utilized a systematic approach to gathering and analyzing the quantitative data related to technological knowledge, usage and the levels of awareness among the prospective teachers. For differences in technological literacy between public and private sector educational institutions, a descriptive research design using a survey was adopted as this design is efficient in collecting data from a large sample population and providing comparative analysis. B.Ed. Honors students from

two public and private universities in Punjab, Pakistan, were the study population. Through random sampling technique, a total of 501 prospective teachers were selected as participants (258 from public and 243 from private universities). Data was collected using a self-developed questionnaire keeping in view the objectives of the study and previous literature. The instrument's reliability was established through the Cronbach's alpha coefficient testing with (Knowledge dimension: α = 0.81, Usage dimension: α = 0.89, and Awareness dimension: α = 0.74). These reliability coefficients indicate the strong internal consistency of the instrument. Statistical analysis was conducted using SPSS version 21. The descriptive statistics were used for demographic analysis and overall patterns, independent samples t-tests to compare public and private sector differences, mean scores and standard deviations to assess levels of technological literacy and frequency analysis were used for categorical variables.

FINDINGS OF STUDY

Table 1 Descriptive Statistics for Knowledge, Usage, and Awareness of Technology

Construct	N	M	SD
Knowledge	501	4.329	0.667
Usage	501	4.061	0.632
Awareness	501	4.007	0.740

The descriptive statistical analysis of technological literacy constructs among 501 prospective teachers revealed notable patterns across all three dimensions. Knowledge of technology verified the highest mean score (M = 4.329, SD = 0.667), suggesting that the participants possess a strong theoretical understanding of the educational technology. Technology usage showed a moderately high mean score (M = 4.061, SD = 0.632), indicating relatively frequent application of technology in educational settings. Awareness of technology recorded the lowest mean score among the three constructs (M = 4.007, SD = 0.740), though still maintaining a positive level above scale's midpoint. The standard deviations across all three constructs were relatively consistent, with the awareness showing slightly more variation in responses (SD = 0.740) compared to knowledge (SD = 0.667) & usage (SD = 0.632). These results suggest that while prospective teachers generally demonstrate the strong technological literacy across all the dimensions, there may be room for improvement, particularly in bridging the gap between theoretical knowledge and practical awareness of the educational technology.

Table 2 Comparison of Knowledge, Usage, and Awareness Between Private & Public Institution

Variable	Institute Type	n	M	SD	SE	t	df	p
Knowledge	Private 1	145	4.53	0.581	0.048	3.29	241.0	.040
	Private 2	98	4.27	0.614	0.062	3.26	200.4	
	Public 1	190	4.37	0.641	0.046	2.52	256.0	.017
	Public 2	68	4.58	0.412	0.049	3.07	184.4	
Usage	Private 1	145	4.21	0.554	0.046	2.54	241.0	.029
	Private 2	98	4.01	0.632	0.064	2.48	189.6	
	Public 1	190	4.08	0.624	0.045	2.29	256.0	.031

Awareness	Public 2	68	4.27	0.428	0.052	2.73	172.1	
	Private 1	145	4.13	0.682	0.056	1.73	241.0	.028
	Private 2	98	3.96	0.758	0.076	1.69	193.1	
	Public 1	190	4.01	0.743	0.054	2.44	256.0	.079
	Public 2	68	4.24	0.586	0.071	2.73	148.7	

The statistical analysis from above table revealed significant differences in technological literacy between prospective teachers of private & public institutions across three dimensions: knowledge, usage, and awareness. In the knowledge dimension, private institution teachers demonstrated high mean scores (M = 4.53, SD = 0.581) in the first group and slightly lower scores in the second group (M = 4.27, SD = 0.614). Their public institution counterparts showed comparable but varying means (M = 4.37, SD = 0.641; M = 4.58, SD = 0.412). The differences were statistically significant (t = 3.29, df = 241, p = .040), suggesting meaningful variations in the technological knowledge between sectors. Regarding technology usage, private institution teachers showed mean scores of 4.21 (SD = 0.554) and 4.01 (SD = 0.632) for their respective groups, while the public institution teachers demonstrated means of 4.08 (SD = 0.624) and 4.27 (SD = 0.428). The differences were statistically significant (t = 2.54, df = 241, p = .029), indicating meaningful differences in how technology is utilized across the institutional types.

In the awareness dimension, private institution teachers recorded mean scores of 4.13 (SD = 0.682) and 3.96 (SD = 0.758), while their public institution counterparts showed means of 4.01 (SD = 0.743) and 4.24 (SD = 0.586). Statistical significance was found for private institutions (t = 1.73, df = 241, p = .028), though public institutions showed a non-significant difference (p = .079). This suggests that technological awareness varies more consistently among private institution teachers than among public institution teachers. Overall, findings indicate that while both private and public institution teachers maintain relatively high levels of technological literacy (with means generally above 4.0 on a 5-point scale), there are significant sector-based diverse differences in how they approach and implement technology in their teaching practice. While private universities often have an edge in infrastructure, public universities cultivate adaptability and innovation. A balanced approach combining resource enhancement and skill-building initiatives is essential for fostering the digital literacy across institutions. Thus, the analysis suggests that institutional context plays a meaningful role in shaping the teachers' diverse technological competencies and their approach to educational technology integration.

DISCUSSION

These findings are critical to acquiring insight into the technological literacy competencies of the prospective teachers from the public and private educational institutions. It demonstrates several important patterns which justify further action in terms of the current integration of educational technology. The findings are with a higher mean score about technological knowledge compared to technological usage and awareness illustrating the persisting chasm between knowledge and application of educational technology. Such a disparity implies that teacher education programs successfully disclose theoretical knowledge and are likely insufficient in practice of incorporating technological skills. Interestingly, we find that public sector teachers marginally have a higher

technology integration rate (51%) than the private sector teachers (48%), contrary to the general assumption that private institutions are superior. Echoing the findings of Sharma et al. (2021), the institutional type may be less important in technology adoption has been commonly suggested. Rather, teacher characteristics & institutional support structures are more important to technology integration success in the individual cases. Thus, this digital ecosystem is rounded out by Learning Management Systems (LMS) which provide course management, support for student collaboration and remote learning. It holds important and multi-faceted implications for the future education (Sudibjo et al., 2022).

Academic key considerations concern the continuous adaptation of teaching methodologies, the further importance of professional development, role of technological literacy in teacher education addressing the digital divide and balancing of the traditional and the digital in teaching. Analysis of these differences across public & private institutions tells significant differences in technological knowledge, usage, and awareness, suggesting systematic differences between institutional types concerning technology for purposes of integrating into classroom teaching. Erümit (2021) research on institutional differences in the adoption of technology during the pandemic period also supports these findings and confirms how the organizational structure impacts technology implementation. Compared to technology awareness, there is still scope to boost prospective teachers' knowledge of the latest technological educational tools. In this linking, these study results are valuable towards education policymakers and teacher education program developers and provide a rich illustration of the complex nature of technology integration in educational settings. Given the rapid changes in educational technology, current teachers must keep up a high level of technological literacy so that prospective teachers who are current teachers that can bring this knowledge towards the 21st century education.

CONCLUSION

This study investigated technological literacy among prospective teachers in public and private educational institutions, focusing on three key dimensions: Knowledge, usage and awareness. The analysis shows that prospective teachers in sectors possess relatively high levels of technological literacy with knowledge scores having the highest mean, next to which were usage and awareness. Differences were hardly noticeable, as public sector teachers integrated more technology than their private sector counterparts (51% vs 48%) blurring assumption of private sector technological superiority. Technological knowledge, usage & awareness showed significant differences between public and private institutions. This difference indicates different applications of the technology in general education and reveals the necessity of creating compiled technology training programs in teacher education. The findings from the study show that prospective teachers generally displayed strong theoretical educational knowledge of educational technology, but there is a gap between knowledge and practical application. Thus, evidence of this fact is shown by higher mean scores in knowledge than the usage and awareness dimensions, which implies that there is a need for more hands-on practical training in educational technology. The outcomes are useful in understanding both the current level of technological preparedness among future teachers and serve as a starting point for strengthening digital integration in teacher education programs throughout the public and private sectors.

Recommendations

1. Educational institutions should plan for structured hands-on technology training programs that will fill the gap between theoretical knowledge and practical usage of educational technology.
2. To close the gaps in technology knowledge, usage as well as awareness, teacher education programs should enrol standardized technology integration frameworks across the public and private sectors.
3. There is a need to improving the awareness scores of prospective teachers should require universities to develop even professional development workshops on emerging educational technologies.
4. Institutions may offer technology mentoring programs so that veteran teachers can mentor new teachers for application of technology in practice, that will help to overcome the usage knowledge gap uncovered in the study.
5. There should be scrutiny of the best methods to tackle challenges, including the concept of allocating resources for equalization of technology accessibility, and training opportunities for technology integration rates.

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