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TECHNOLOGICAL INNOVATION IN TEACHING-LEARNING PROCESS: A COMPARATIVE VIEW OF BELIEFS & PRACTICES OF TEACHERS

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ABSTRACT

Technology advances must be incorporated into teaching process to create dynamic, interactive learning environments that will equip students for the challenges of digital age. Examining attitudes & practices about technology developments in secondary education was the primary focus of the study. The study question "What is the impact of teachers' beliefs on their practices regarding the use of technological innovations at the secondary level?" was created to accomplish this goal. The data was gathered using an instrument based upon a five-point Likert scale. Through the use of stratified random sampling, 400 secondary school teachers were chosen as a sample. The SPSS software was used to examine gathered data. The data analysis revealed a substantial disparity in views of experienced and beginner teachers about usage of technological development. There was notable distinction between the approaches taken by inexperienced and experienced educators when implementing technology improvements. It was advised that the curriculum designers incorporate information upon the significance and application of technological developments at the secondary level based on the findings and conclusions.

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INTRODUCTION

Comprising the cognitive, emotional, and sympathetic components, attitude is a multifaceted and intricate construct that represents an individual's positive or negative view (evaluative influence) on the performance of the particular behavior. Thus, it would appear that teachers' attitudes and beliefs are crucial when it comes to adapting to changes and innovations in educational institutions, particularly those that combine technology and pedagogy (Frances, Walma & Joke, 2023). One

way to characterize attitudes is as a person's positive or negative approaches to a situation, event, or goal. Moreover, attitudes are clearly defined as cultural and psychological factors that influence an individual conduct (Kao, Wu, Chang, Chien & Mou, 2020). Attitude is form of interest that one acquires throughout life experience and which aids in the process of learning how to act in a specific scenario or career. People's complex personal traits are their attitudes (Soibamcha & Pandey 2016). Application of technical advancements in education system is directly impacted by socioeconomic position of individuals/local community, according to findings. When it came to using innovations, teachers from the higher-income areas were more confident than those from the lower-income ones (Teo, 2011).

They were more willing and self-assured to take on the task of incorporating innovations into their teaching methods to improve student learning (Cortez, 2016). Many scholarly investigations have depicted technology as the potent instrument for augmenting student learning. It was shown that there were notable differences amid teachers' real actions & beliefs when it came to implementing technological innovation. (Zhang, Aikman, & Sun, 2008). Technology progresses have completely changed the way that education is taught, improved it in previously unheard-of ways. Technology integration in the classroom encourages interactive learning, which increases student engagement and accessibility. Teachers can adapt to different learning styles with the use of dynamic resources like educational apps, interactive whiteboards, and virtual simulations. E-learning platforms also make remote education possible, removing obstacles based on geography and increasing access to knowledge (Cetinkaya, 2017). A student's needs are met using tailored instruction made possible by adaptive learning technologies. In general, technological advancements empower teachers by improving the efficiency, and adaptability of instruction to the changing demands of students in the digital age and eventually readying them for a future driven by technology (Niederhauser & Lindstrom, 2006).

It is also stated that, even though many instructors use technology appropriately for many of their lower-level daily tasks, rates of usage for higher-level professions are comparatively relatively low (Ertmer, & Newby, 2013). For several reasons, it is essential to investigate technological innovation in the teaching-learning process, with a particular emphasis on the disparate practices and beliefs of secondary school instructors. Initially, recognizing the disparities in viewpoints of teachers on the incorporation of technology might draw attention to differences between convictions and real-world teaching methods. Real-time communication is made possible by collaborative tools, which promote international idea-sharing. This understanding can help educators recognize obstacles that stand in the way of their ability to effectively use technology in the classroom, such as a lack of funding, inadequate training, or opposition to change. It can offer professional development programs and evidence-based suggestions. It is possible to create specialized training to improve teachers' digital literacy and comfort level when utilizing technology by taking into account their unique requirements and concerns. This can therefore result in the development of more creative and efficient teaching methods that accommodate a range of learning preferences and enhance student performance.

LITERATURE REVIEW

Technological Tools

The generation's knowledge needs and requirements, which are closely linked to technology, have changed significantly over time. The growth of technology is changing both world and knowledge. Using various technological tools while learning can help students learn more effectively (Lai & Hong, 2015). Teachers are important participants in teaching and learning process and as such, they must acquire and develop professional skills that enable them to adapt to rapidly changing nature of education. To adapt their teaching methods and knowledge to the demands of the current world, educators must acquire new and contemporary abilities (Koh, Chai, & Lim, 2017). Writing, digital skills, Internet research, using computers for pleasure or reward, and hands-on exercises are among computer-related activities in which most teachers involve their pupils (Elina, 2016). The majority of teachers, it was found, do not use computers consistently or irregularly. Pupils can communicate, gather up-to-date knowledge, and use these abilities in their everyday lives (Barron, 2003). They state that teachers must have positive outlook toward student knowledge, performance & abilities with flexible creative attitude (Ihechu & Ugwuoji, 2017). Any reform-based novelty in education is always used with teacher as primary actor because they are the ones who carry out curriculum (Baradaran, 2016).

Digital Resources for Teaching Learning Process

Technological tools for the teaching-learning process encompass a variety of digital resources that enhance educational experiences. The interactive whiteboards and projectors facilitate dynamic presentations and visual learning (Arnseth, & Hatlevik, 2010). The learning management systems (LMS) like Moodle and Google Classroom organize course materials, track student progress, and enable communication. The educational apps and software, such as Khan Academy and Quizlet, provide interactive exercises and self-paced learning chances. Virtual reality (VR) and augmented reality (AR) tools create immersive learning environments, allowing students to explore subjects like history and science more engagingly. The technological innovation in the teaching-learning process has transformed education in the numerous ways, enhancing engagement, accessibility and effectiveness. According to Chien, Wu, and Hsu (2014) online teamwork platforms like Microsoft Teams and Zoom support remote learning and group projects. Additionally, the adaptive learning technologies, which personalize instruction based on student performance, help cater to individual learning needs.

The development of technological advancements in educational institutions benefits society as a whole since students can utilize these abilities to solve the variety of difficulties in their everyday lives. Capan (2012) was of the view that these tools collectively promote the active learning, foster collaboration, and provide diverse educational resources, thereby enhancing the overall teaching-learning process. Teachers' beliefs about technological innovation in the teaching-learning process are pivotal in shaping how these tools are integrated into educational settings (Türel, & Johnson, 2012). Incorporating game elements into learning activities makes the process more enjoyable and motivating. Gamified learning platforms reward progress and encourage students to achieve goals. Many educators recognize potential of technology to enhance student engagement & personalized learning experiences, and offer access to a vast array of resources. They believe that technology can

ease interactive, dynamic lessons making abstract concepts more tangible and accessible (Mahmud & Ismail, 2010).

Beliefs & Practices Regarding Technological Tools

The teachers' beliefs about technology are not uniformly positive. Ward, and Parr, (2010) pointed out that some educators' express concerns about the digital divide, fearing that unequal access to technological resources may exacerbate existing educational inequalities. There is apprehension regarding over-reliance on technology, which may undermine fundamental skills such as critical thinking and face-to-face communication. Critical thinking has become a buzzword today in the twenty-first century and focus of many recent studies like critical thinking skills perceptions and practices of secondary school science teachers (Jamil & Muhammad, 2019); Jamil et al. (2021b), perceptions and practices of teachers (Jamil et al., 2021a), analysis of science curriculum documents (Jamil et al., 2020), textbooks analysis for critical thinking (Jamil et al., 2024; Jamil, Bokhari & Ahmad, 2024; Jamil et al., 2024), curriculum-related physics, chemistry, mathematics and biology with the analysis (Jamil, Bokhari & Iqbal, 2024; Jamil, Bokhari & Rafiq, 2024; Jamil, Bokhari, & Qasim, 2024; Jamil, Faiza & Abdul, 2024). Professional sureness and familiarity with technology significantly influence teacher attitudes. Chapelle, (2011) mentioned that those with higher digital literacy and positive prior experiences tend to be enthusiastic about integrating technology into their teaching practices.

Equally, teachers who lack training or support may view technological innovation with skepticism or anxiety, worrying about additional time and effort required to learn and implement new tools effectively (Johanna & Maryke, 2018). Ultimately, teachers' beliefs about technological innovation are shaped by their experiences, training, and perceptions of its impact on student learning. Talking these beliefs through targeted professional development and support is essential to fostering a more positive and effective integration of technology in education. Likewise, teachers' practices about technological innovation in the teaching-learning process vary widely, reflecting differences in training, access to resources, and individual attitudes toward technology. Many teachers actively integrate digital tools into classrooms to create more engaging and effective learning experiences. For instance, they use interactive whiteboards to present multimedia content, employ educational software to offer personalized learning paths, and utilize online assessment tools to monitor student progress in real time (Kuo, 2018). However, the extent and manner of technology integration can vary significantly. Some teachers may feel less confident or face challenges such as the inadequate infrastructure, lack of professional development, or time constraints, which can limit the effective use of technology.

In contrast, others who receive adequate support and training are more likely to experiment with innovative teaching methods, like flipped classrooms/gamified learning. Overall, technological innovation holds the great potential to transform education, its successful implementation largely depends on teachers' readiness and support systems in place to aid their integration efforts (Tezci, 2011). Some have been conducted different studies regarding the current topic like innovation in teaching and learning (Oke & Fernandes, 2020), artificial intelligence in education (Guan et al., 2020; Liu et al., 2020), teachers' perspective regarding technological integration in the teaching-

learning (Akram et al., 2022); blended learning in twenty-first century (Dakhi et al., 2020); robots replacement for teachers (Alam, 2021). In Pakistani context, a different study is conducted like recent study Tariq et. al, (2019) related to innovative teaching and technology integration, mobile learning expertise in Covid-19 (Asghar et al., 2021), teacher lookout on the technology integration (Akram et al., 2022), e-learning knowhows for interactive teaching (Asad et al., 2021), internet use for education learning for female students (Safdar et al., 2020), use of technology in online classes (Rehman et al., 2021).

RESEARCH METHODOLOGY

Using a survey research methodology, this study collected the data from 400 secondary school teachers in a representative sample through a methodical process. Survey research is a prevalent approach in educational studies to collect data systematically from a sample to identify trends and patterns (Creswell & Creswell, 2017). Thus, a random selection process was used to guarantee a representative and diverse group. An instrument with the rating scale was created to assess the methods employed for technical advancements. The ANOVA and t-tests were among the statistical methods used to determine the significance of the responses' variations between the groups. When comparing two groups, male and female, experienced and novice, urban and rural the t-test was thus useful in determining whether there were any significant differences. An ANOVA was used to compare groups with different characteristics, such as the professional qualifications. Similarly, the study approach was reinforced by the use of random selection, a thorough rating scale instrument, and sophisticated statistical analyses, assuring a thorough and reliable examination of secondary school teachers' perspectives and experiences. The following tables provide an analysis of the data that was gathered.

RESULTS OF STUDY

Table 1 Comparison of Novice & Veteran Teachers' Perceptions about UTI

Category	Teachers	M.	SD	t-value	p.
Veteran	294	3.768	.402	-4.318	.003
Novice	106	4.022	.397		

A comparison between beginner and veteran teachers' perspectives of technological innovation use practices is shown in Table 1. There is a statistically significant difference between two groups, as indicated by t-value of -4.318. The statistical significance of the data is confirmed by the p-value, which is 003, which is less than traditional significance level of.05. Compared to rookie instructors (M = 4.022), senior teachers have lower mean perception score (M = 3.768). This indicates that when compared to experienced peers, inexperienced educators view technological innovation-based methods more favorably. The discrepancy is further supported by negative t-value, which shows that newer teachers' mean perception is higher. These results point to a significant difference amid the perspectives of inexperienced and seasoned educators about use of technology developments in their instruction.

Table 2 Comparing the Use of Technological Innovations about Gender

Category	Teachers	M.	SD	t	p.

Male	196	3.860	.523	-4.144	.001
Female	204	4.148	.464		

Table 2 presents a comparison of opinions held by male and female educators about the application of technology developments in the classroom. The t-value showed a significant difference between two genders, coming in at -4.144. Corresponding p-value of.001 is less than traditional significance threshold of.05, indicating that the results are statistically significant. Male instructors have a lower mean perception score (M = 3.860) than female teachers (M = 4.148). This indicates that compared to male counterparts, female teachers generally have more favorable opinion of activities utilizing technology breakthroughs. The difference is further supported by negative t-value, which points to greater mean perception among female professors. These results underline significance of taking gender into account when developing education technology initiatives by accent notable gender-based difference in teachers' perceptions of incorporation of technological advancements in their teaching methods.

Table 3 Use of Technological Innovations Practices Between Urban & Rural Teachers

Category	Teachers	M.	S.D.	t-value	p.
Urban	177	4.210	.530	4.219	.001
Rural	223	3.781	.636		

Table 3 presents a comparison amid urban and rural teachers regarding their practices. The urban teachers (n=177) exhibit a higher mean (M=4.210) compared to rural teachers (n=223) with a mean of (M=3.781). The standard deviation for urban teachers is .530, while for rural teachers, it is slightly higher at .636. The t-value is 4.219, indicating a significant difference in technological innovation practices between urban and rural teachers. The statistical significance is supported by the p-value of.001 that is linked with it. Urban educators appear to be more technologically innovative than their rural counterparts, on average. This suggests that educational policymakers and practitioners should consider this when addressing potential disparities in the technology integration based on geographic contexts.

Table 4 Comparison of Views of Male Teachers Possessing Diverse Qualifications

Comparison	Sum of Square	DF	M. Square	F-value	P.
Between Groups	3.592	2	1.826	7.873	.000
Within Groups	48.716	194	.196		
Total	52.308	196			

Likewise, with an F-value of 7.873 and a p-value of.000, the groups were found to vary statistically significantly. This implies that the male educators with varying professional backgrounds have differing perspectives on technological innovation techniques. Thus, the results offer a significant understanding of how views on the use of technology in the classroom may be influenced by the professional credentials.

Table 5 Male Teachers' Perception Having Different Professional Qualifications

	Teachers' PQ	Teachers	M.	S. D.	MD	p.
1	B. Ed.	42	3.799	.648	.082*	.000

	M. Ed.	136	4.205	.429		
2	B. Ed.	42	3.799	.648	.132*	.039
	M. A. Edu.	19	4.202	.382		
3	M. A. Edu.	19	4.202	.382	.120	.893
	M. Ed.	136	4.205	.429		

The findings of a post hoc study comparing male teachers' judgments of practices after an ANOVA test are shown in Table 5. For first comparison, B.Ed. teachers (n=42) have a mean perception score of 3.799, significantly lower than M.Ed. teachers (n=136) with mean of 4.205, with mean difference of 0.082 and a p-value of .000. In the second comparison, B.Ed. teachers' mean is again 3.799, lower than M.A. Education teachers' (n=19) mean of 4.202, with a mean difference of 0.132 and a p-value of .039, indicating significance. The third comparison between M.A. Education and M.Ed. teachers shows no significant difference in mean perception scores (mean difference = 0.120, p = 0.893). These findings suggest that, after the initial ANOVA identified a significant difference between groups, the post hoc analysis pinpoints specific group differences. B.Ed. teachers consistently show lower perceptions compared to M.Ed. and M.A. Education teachers. The results provide nuanced insights into how different professional qualifications may influence male teachers' perceptions of technological innovation practices, aiding educators and policymakers in targeted interventions or training programs.

Table 6 Comparison of Female Teachers' Perception Having Different PQ

Comparison	Sum of Sq.	d. f.	M. Sq.	F-value	p.
Between Groups	.440	2	.310	.399	.665
Within Groups	104.217	202	.608		
Total	104.657	204			

F-value of 0.399 and p-value of.665 shows that there was no significant variation between groups. This implies that there is little change in opinions of female instructors on technological innovation techniques based on their professional qualifications. The results suggest that attitudes regarding technology integration in classroom amid female instructors may be influenced by variables other than professional qualification.

Table 7 Comparing the Views of Female Teachers Various Professional Qualifications

	Teachers' PQ	Teachers	M.	S. D.	MD	p.
1	B. Ed.	25	3.739	.587	-.091	.833
	M. Ed.	150	3.840	.761		
2	B. Ed.	25	3.739	.587	-.181	.630
	M. A. Education	30	3.870	.652		
3	M. A. Education	30	3.870	.652	-.089	.807
	M. Ed.	150	3.840	.761		

The results of a post hoc study comparing female instructors' views of having different qualifications after an ANOVA test are shown in Table 7. In all three comparisons, mean differences are negative, indicating lower perception scores for the first group (B.Ed.) compared to the second group (M.Ed.)

and third group (M.A. Education). However, none of these differences are statistically significant, as indicated by the p-values ($p > 0.05$). For instance, in first comparison, B.Ed. teachers (n=25) have a mean perception score of 3.739, while M.Ed. teachers (n=150) have a higher mean of 3.840, with a non-significant mean difference of -0.091 and p-value of 0.833. Alike non-significant differences are observed in second and third comparisons. In this connection, these results imply that, despite observing differences in mean perception scores, the post hoc analysis does not find statistically significant variations in female teachers' perceptions based upon their professional qualifications. Thus, other factors not considered in this analysis may contribute to the observed differences in perception scores.

Table 8 Comparison of Teachers' perceptions Having Different PQ

Comparison	Sum of Sq.	d. f.	M. Square	F-value	p.
Between Groups	20.932	2	10.506	25.886	.000
Within Groups	162.886	398	.378		
Total	183.818	400			

The p-value of.000 and the F-value of 25.886 show a significant difference between the groups. This implies that instructors' views of technological innovation techniques differ greatly depending on their professional background. The results emphasize how critical it is to take into account varied backgrounds and experiences of educators when analyzing attitudes and practices surrounding use of technology in classroom.

Table 9 Comparison of Teachers' Perceptions Having Different PQ

	Teachers' PQ	Teachers	M.	S. D.	MD	p.
1	B. Ed.	66	3.623	.743	-.494*	.000
	M. Ed.	286	4.116	.633		
2	B. Ed.	66	3.623	.743	-.828*	.000
	M. A. Edu.	49	4.290	.439		
3	M. A. Edu.	49	4.290	.439	-.334*	.002
	M. Ed.	286	4.116	.633		

In the first comparison, B.Ed. teachers (n=66) exhibit the lower mean perception score of 3.623 compared to M.Ed. teachers (n=286) with a mean of 4.116, resulting in a significant mean difference of -0.494 and a p-value of .000. Similar significant differences are observed in the second and third comparisons, where B.Ed. teachers have lower mean scores compared to M.Ed. and M.A. Education teachers, with mean differences of -0.828 (p=.000) & -0.334 (p=.002) respectively. These findings indicate a consistent pattern of significantly lower perceptions among B.Ed. teachers compared to their counterparts with M.Ed. and M.A. Education qualifications. The negative mean differences suggest that B.Ed. teachers, on average, hold less favorable perceptions about use of technological innovations in teaching. Policymakers and educators can utilize these insights to tailor professional development programs for B.Ed. teachers to enhance their confidence, competence in integrating technology into their teaching practices. Consequently, the main findings from above data analysis are as under:

DISCUSSION

Novice teachers (with less experience) have a more positive perception of technological innovation practices (M = 4.022) compared to veteran teachers (M = 3.768). The statistically significant t-value (-4.318, p = .003) indicates noteworthy difference, emphasizing potential influence of experience on teachers' views on technology integration. Female teachers (M = 4.148) express a positive perception of technological innovation practices than male teachers (M = 3.860). Significant t-value (-4.144, p = .001) underlines a gender-based disparity, highlighting the importance of considering gender-related factors in education technology initiatives. Urban teachers (M = 4.210) exhibit significantly higher mean perception score than their rural counterparts (M = 3.781) in terms of the technological innovation practices. The t-value of the 4.219 and p-value of .001 highlight geographic disparities, suggesting the need for targeted interventions to bridge urban-rural gap in technology integration. Based on professional credentials, male teachers' perceptions differ significantly, according to the results of the ANOVA test. Post hoc study highlights how credentials shape teachers' impressions of technological developments, with B.Ed. instructors consistently have worse perceptions than M.Ed. and M.A. Education teachers. The post hoc analysis indicates non-significant variations, despite the ANOVA for female teachers' judgments based on professional degrees not revealing the vital and significant differences.

This suggests that professional credentials might not be the only element determining how female teachers are seen, necessitating more research into other relevant variables. ANOVA for educators, irrespective of gender, highlights noteworthy influence of professional qualifications on attitudes toward technological innovation methods. In this linking, B.Ed. teachers' opinions are continuously lower, according to post hoc analysis, which highlights need for focused interventions and training initiatives to increase their competence and confidence in using technology in their lesson plans. Consequently, previous studies have been conducted about technology from diverse perspectives like innovation in the teaching and learning (Oke & Fernandes, 2020), artificial intelligence in education (Guan et al., 2020; Liu et al., 2020), teachers' perspective on technological integration (Akram et al., 2022); use of blended learning in the teaching (Dakhi et al., 2020); use of robots in teaching (Alam, 2021), by Tariq et. al, (2019) the innovative teaching and technology integration, mobile learning technology (Asghar et al., 2021), the teachers' perspective (Akram et al., 2022), e-learning technologies for interactive teaching (Asad et al., 2021), internet usage for educational learning for the female students (Safdar et al., 2020), and technological usage in the online classes (Rehman et al., 2021).

CONCLUSION

The purpose of this research was to explore the effects of teachers' beliefs on their integration of technological innovations at the secondary level. Differences in teacher perceptions and practices across groups such as experience, gender, geographical location, and professional qualifications were found to be significant. Notably, novice teachers revealed a positive perspective of technical innovations. On other hand, more experienced teachers with fixing to deeply established learning processes will adjust with difficulty to the introduction of comprehension of scientific and technical advancement. Furthermore, significant difference between genders was observed, wherein females

generally reported more positive perspective on technological innovation applications compared to male teachers, highlighting need to consider gender-related factors in educational technology initiatives and promote inclusive conducive environment that welcomes the adoption of creative pedagogical practices.

Additionally, the analysis revealed the gap between rural and urban areas regarding technical integration. in this connection, the urban teachers demonstrated a considerably higher perception score, which corroborates their superior disposition of implementing technical innovations in their pedagogical techniques. Thus, this difference can be attributed to the issues of source availability, infrastructural requirements, and occupational chances that are usually more at hand in urban areas in contrast to rural areas. When it comes to professional qualifications, the research displayed that teacher with more advanced qualifications, such as M.Ed. and M.A. Education, had more positive insights of innovative technological practices than individuals with B.Ed. qualifications. This implies that there should be specific professional development programs and support services that target the unique needs and challenges of teachers with different educational qualifications in the academic field.

Recommendations

1. The main goal of professional programs ought to be to increase comfort level and proficiency level of B.Ed. instructors in incorporating new technologies into their lesson plans. These programs' content and delivery should be specially designed to meet the requirements and difficulties that this particular segment of educators faces.
2. Educational institutions and legislators should put gender-inclusive technology initiatives into place to address gender-based discrepancies. This entails specialized training courses, mentorship programs, and public awareness efforts that push male educators to adopt and skillfully incorporate technology advancements into their pedagogy.
3. Policymakers should carry out geographically tailored interventions in light of differences between urban & rural educators' opinions on innovation practices. These efforts might focus on building infrastructure, providing access to technological resources, and offering training courses created especially for teachers working in remote areas.

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