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"Digital Transformation in Education: Readiness of Prospective Teachers in Karachi"

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ABSTRACT

The emergence of digital tools and Artificial Intelligence (AI) has significantly changed the role of the teacher in the classroom. In this age of digital transformation, using digital tools in the classroom is becoming more and more important. This study looks into how prepared aspiring educators are to use technology in the classroom. The purpose of the study was to determine if age factor and teaching experience were associated with any differences. The results show that readiness for technology integration is not significantly impacted by age. Compared to the older group, which had an average mean value of 4.10, the younger group of pre-service teachers, who were between the ages of 20 and 22, had an average mean value of 4.3. In comparison to the younger group, the older group received lower overall scores. This research offers significant perspectives on the obstacles and possibilities associated with integrating technology in the classroom.

Introduction

Due to technological advancements, the widespread use of digital devices, and the constant expansion of internet connectivity, the digital transformation of education has accelerated globally (Selwyn, 2017). Globally, educational establishments are integrating digital tools and platforms to improve the quality of instruction, encourage interactive learning, and equip students for the challenges of the twenty-first century (Prensky, 2001). Digital technology use has been found to be essential for enhancing learning outcomes, pedagogy, and preparing students for a technologically advanced society. Numerous scholarly works (Gupta, 2023; Malik, 2022; Hebbar, 2020; & Jha, 2020) have emphasized the advantages of incorporating technology into educational settings, including heightened student involvement, customized learning opportunities, and the cultivation of essential digital literacy proficiencies. Gürbüz (2021) asserts that educational establishments will fall behind if they resist digital transformation. In his discussion of the effects of digital technology on society, Gülseçen (2019) also explores how digital transformation in education may enhance student-centered learning. Considering the newest frameworks and trends, Vindaa (2020) looks into how to successfully execute digital transformation in higher education. In general, these studies highlight how crucial it is for educational establishments to adjust to the digital revolution in order to enhance learning environments and stay abreast of evolving technological advancements.

Research indicates that teacher education programs are essential for equipping aspiring teachers with digital competencies (Borisenkov et al., 2021; Vezirov, 2021; Limone, 2016). To determine whether the training and curriculum offered to aspiring teachers is sufficient to enable them to successfully incorporate technology into their lesson plans, a number of studies have been carried out. Barriers to the smooth adoption of digital tools by aspiring teachers have been noted in a number of studies (Shahzad, 2021; Jan, 2020Among the obstacles that prevent technology integration in educational settings are institutional barriers, insufficient infrastructure, training gaps, and lack of access to technology. It's important to comprehend how prospective teachers feel about technology and how they see it. Research (Alonso, 2019; Gupta, 2015) has examined variables such as teachers' comfort level with technology, their adaptability, and their view of its significance in the classroom. The access to and competence with digital tools of aspiring teachers is greatly impacted by Karachi's socioeconomic environment. Research on the effects of economic inequality on teachers' proficiency and pedagogy in various parts of Karachi was carried out by Ara and Aziz (2013). In Karachi, institutional policies and cultural norms have an impact on how technology is integrated into the classroom. Research looks into how these variables affect aspiring teachers' preparedness to use digital tools efficiently (Reimann et al., 2021). Examining successful examples of digital integration in education provides useful insights. Research (Rodrigues, 2020; Hilton, 2008) suggests strategies and best practices for improving digital readiness among prospective teachers.

Addressing the need for educational reforms or policy changes in order to better prepare aspiring teachers for the coming digital transformation in education. Research (Malik, 2022; Gupta, 2023) highlights how crucial it is to alter policies in order to help teachers use technology in the classroom.

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Davis (1989) developed the Technology Acceptance Model (TAM), which offers a theoretical framework for comprehending the variables influencing people's acceptance and adoption of technology. TAM suggests two key constructs:

1. perceived ease of use
2. perceived usefulness

In the context of prospective teachers in Karachi, the application of TAM can help assess their perceptions regarding the ease of using digital tools and their beliefs about the usefulness of technology in education.

Bandura (1977) developed the idea of self-efficacy, which is the belief in one's own capacity to carry out certain actions or realize specific objectives. According to self-efficacy theory, people who have higher levels of digital self-efficacy are more likely to accept and use technology in educational settings successfully (Compeau & Higgins, 1995). In the context of this study, digital self-efficacy refers to the assurance and conviction that aspiring teachers in Karachi have in their ability to use digital technology for teaching.

Determining how prepared future teachers are for the digital transformation is crucial in Karachi, where problems with education are common. The literature review highlights the vital significance of evaluating the preparedness of aspiring teachers in Karachi for the digital shift in education. It highlights how crucial it is to enhance programs for teacher preparation, deal with obstacles, comprehend socioeconomic effects, and update regulations to foster an atmosphere that is conducive to the use of digital tools in the classroom.

This review highlights the gaps in the literature and the need for more empirical study to explore the complex opportunities and challenges of educating future teachers in Karachi's changing digital environment.

Research Questions

1. To what extent are prospective teachers perceiving themselves as prepared to integrate digital technology in their classrooms?
2. How do prospective teachers differ in terms of their perceived digital readiness based on demographic characteristics?
3. What factors influence the readiness of prospective teachers to integrate digital tools and technologies into their teaching and learning practices?

Methodology

Participants: This study included 96 participants, 24 males and 72 females ranging in age from 20 to 46 years. Participants were chosen from the Education Departments of two public universities and two private universities in Karachi. All participants were B.Ed. students enrolled in 4-year, 2.5-year, and 1.5-year courses, with 32 participants chosen from each program.

Research Design: The data collected from the participants were analyzed and interpreted using a quantitative research design in this study.

Instrument: The study used a quantitative methodology, with a tool consisting of 38 statements. On a 5-point Likert scale, participants rated statements from "strongly agree" to "strongly disagree." The instrument addressed ten aspects of educational technology:

1. Perceived Ease of Use (3 items)
2. Perceived Usefulness (3 items)
3. Behavioral Intention (3 items)
4. Digital Self-Efficacy (3 items)

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5. Outcome Expectancy (3 items)
6. Self-Regulation (3 items)
7. Digital Comfort and Proficiency (6 items)
8. Challenges and Concerns (6 items)
9. Belief in the Educational Value of Technology (4 items)
10. Engagement and Collaboration (4 items)

Each factor encompassed specific items measuring perceptions, abilities, and attitudes toward technology use in educational settings.

Data Collection: Data collection was conducted through personal visits to the universities. The researchers visited the campuses and administered the study instruments to the selected participants. The data collection process involved utilizing structured questionnaires or surveys specifically designed to assess the participants' digital self-efficacy in utilizing technology for educational purposes.

Data Analysis: The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 22. The software was employed to manage and perform statistical analyses on the gathered data, enabling the researchers to examine and interpret the findings effectively.

Ethical Considerations: Prior to the commencement of the study, all ethical guidelines and regulations concerning human subjects' research were strictly adhered to. Informed consent was obtained from all participants, ensuring voluntary participation and confidentiality of their responses.

Findings

Based on both descriptive and inferential statistics, the current study found that prospective teachers (B.Ed. students) felt ready to use digital technology in their instruction. The results are compiled and the research questions are addressed in Tables 1-6 below. To aid in the analysis and understanding of the responses, descriptive statistics measures are included in each table.

Table 1

Results of One-Way ANOVA on digital readiness of students of B.Ed. (4-years), B.Ed. (2.5-years), and B.Ed. (1.5-years)

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3031.622	2	1515.811	46.6222	0.008	3.101296
Within Groups	2828.6	93	32.51264			
Total	5860.222	95				

The results of the post hoc analysis showed that the digital preparedness scores of B.Ed. 4-year students (M = 86.50, SD = 4.21) were significantly higher than those of B.Ed. 2.5-year students (M = 82.17, SD = 3.15) and B.Ed. 1.5-year students (M = 78.45, SD = 4.94). According to these results, there are differences in prospective teachers' levels of digital readiness, and younger students (B.Ed. 4-years) are more prepared than older students (B.Ed. 1.5-years). Moreover, B.Ed. students who have no prior teaching experience are better equipped to welcome digital innovation than experienced educators.

Table 2

Descriptive statistics and independent sample t-test results for digital readiness of public and private university B.Ed. students

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	Public Universities	Private Universities	F-value	t-value	df	p-value
Mean	80.9	82.4				
SD	5.13	6.31				
N	40	56				
F-test			1.513			.135
t-test				1.72	94	.07

The t-test results show that there is a marginally higher mean score for private university students than for public university students in terms of digital readiness, but there is no statistically significant difference between the means of these scores for B.Ed. students at public and private universities (t (94) = 1.72, p =.07).

Table 3

Digital Readiness (N = 96)

S. No	Statement	M	SD
Digital Comfort and Proficiency (DCP)			
DCP1	I feel at ease utilising modern gadgets like smartphones, tablets, and PCs.	4.36	0.890
DCP2	I am proficient in using and navigating a variety of software programmes.	3.68	0.898
DCP3	I am confident to use digital technology to enhance classroom instruction.	4.04	0.791
DCP4	I have the necessary training to use digital technology in the classroom.	3.34	1.019
DCP5	I regularly look for chances to enhance my digital abilities for academic goals.	4.14	0.795
DCP6	I continually research new developments in educational technology to improve my teaching methods.	3.92	0.990
Challenges and Concerns (CC)			
CC1	It can be difficult for me at times to adjust to new digital tools and technologies.	2.49	1.000
CC2	I occasionally feel overwhelmed by how quickly technology is developing.	2.33	0.944
CC3	I occasionally worry that I won't be able to use technology in the classroom properly.	2.74	1.141
CC4	I sometimes feel cautious when introducing new digital tools into my classroom.	2.78	1.066
CC5	The diversity of digital teaching resources available often overwhelms me.	2.14	0.895
CC6	I sometimes have doubts about the accuracy of the data I get online.	2.26	0.943

The Digital Comfort and Proficiency (DCP) scale has six items, with mean scores ranging from 3.34 to 4.36. This suggests that most participants feel proficient and at ease when using digital technology. DCP1 has the highest mean score, indicating that participants are most comfortable using contemporary devices like PCs, tablets, and smartphones. DCP4 has the lowest mean score, indicating that participants might not be adequately trained to use digital technology in the classroom.

The standard deviations for each of the six items show that there is some variation in the responses from the participants. These range from 0.791 to 1.019. The fact that DCP4 has the highest standard deviation suggests that participant answers to this particular item are less consistent than those to the others. The fact that DCP5's standard deviation is the lowest suggests that participant reactions to it are less erratic than those to the other items.

While participant responses may differ slightly, overall, the data show that participants are comfortable and proficient with digital technology. This illustrates that some participants may need extra support or direction in order to use digital technology in the classroom effectively. Participant initiative in seeking opportunities to advance their digital skills may also be required.

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The Challenges and Concerns (CC) scale has six items, with mean scores ranging from 2.14 to 2.78. These results show that participants generally have some challenges and concerns when using digital technology. With CC4 having the highest mean score, it appears that participants occasionally experience caution when implementing new digital tools in the classroom. The fact that CC5 has the lowest mean score indicates that participants are not as frequently overwhelmed by the variety of digital teaching resources that are available.

The standard deviations, which vary from 0.895 to 1.141 for each of the six items, show that there is some variation in the participants' responses. The fact that participant responses to CC3 are more erratic than those to the other items is indicated by the fact that this item has the highest standard deviation. In comparison to the other items, participant responses to CC5 have the lowest standard deviation, suggesting that participant responses to this item are less variable.

The majority of participants experience some challenges and concerns when using digital technology, according to the data. This illustrates that students may need extra help in order to successfully use digital technology in the classroom. Additionally, participants may need to have more confidence in their technological skills and comprehension of the reliability of the information they find online.

Table 4

Digital Readiness (N = 96)

S. No	Statement	M	SD
Belief in the Educational Value of Technology (BEVT)			
BEVT1	I think that digital technologies can greatly improve students' educational experiences.	4.36	0.831
BEVT2	I think that for today's instructors, digital literacy is crucial.	4.54	0.791
BEVT3	Today's pupils, in my opinion, demand that teachers be proficient in technology	4.39	0.784
BEVT4	I think that using digital technology can assist address problems and disparities in schooling.	4.16	0.767
Engagement and Collaboration (EC)			
EC1	I actively work with other students to learn about cutting-edge teaching methods.	4.110	0.826
EC2	I have enjoyed success in creating and disseminating educational content online.	3.48	1.183
EC3	I'm willing to hear what students have to say about how I use technology in my classes.	3.93	0.957

Belief in the Educational Value of Technology (BEVT) scale has four items, with mean scores ranging from 4.16 to 4.54. These mean scores suggest that most participants hold an opinion regarding the educational value of technology. The BEVT2 test has the highest mean score, indicating that respondents firmly think that digital literacy is essential for today's educators. BEVT4 has the lowest mean score, indicating that participants may be somewhat skeptic about digital technology's capacity to address issues and inequalities in education.

The standard deviations of the four items range from 0.767 to 0.831, indicating that participant responses are not consistent. With the highest standard deviation among the four items, BEVT4 suggests that participant responses to it are more erratic than those to the other questions. The fact that BEVT2's standard deviation is the lowest suggests that participant reactions to it are less erratic than those to the other items.

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Engagement and Collaboration (EC) scale has three items with mean scores ranging from 3.48 to 4.11. This suggests that participants generally collaborate and are receptive to criticism regarding their technology use. EC1 has the highest mean score, indicating that students actively collaborate with one another to gain knowledge of innovative teaching techniques. With EC2 having the lowest mean score, it appears that participants may not have had much luck producing and sharing instructional content online.

The standard deviations, which vary from 0.957 to 1.183 for each of the three items, show that there is some variation in the participants' responses. The fact that EC2 has the highest standard deviation in relation to the other items suggests that participant responses to it are more erratic. With the lowest standard deviation, EC1 shows less variation in participant responses compared to the other items.

The data show that most participants accept the value of technology in education and are willing to collaborate with others to learn new teaching methods. Participants may need extra support in order to produce and share educational content online. In addition, participants may have doubts about digital technology's ability to address problems and disparities in education.

Table 5

Digital Readiness (N = 96)

S. No	Statement	M	SD
Perceived Usefulness (PU)			
PU1	I think that improving student learning outcomes through the use of digital technology in the classroom.	4.46	0.937
PU2	My instruction is more successful because of digital technologies.	4.83	0.921
PU3	My students are more engaged when I use digital technology in my teaching.	4.90	0.884
Perceived Ease of Use (PEU)			
PEU1	I have no trouble using software and digital tools in the classroom.	4.31	0.722
PEU2	I have no trouble picking up new instructional technology.	4.08	1.173
PEU3	Digital technologies make it easier for me to teach, in my opinion	4.03	0.861
Behavioral Intention (BI)			
BI1	I want to include technology into my lessons in the future.	4.60	0.901
BI2	I plan to incorporate digital tools into my curriculum.	4.48	0.813
BI3	I'm motivated to actively incorporate digital technology into my classroom.	4.33	0.907
Digital Self-Efficacy (DSE)			
DSE1	I'm motivated to actively incorporate digital technology into my classroom.	4.10	0.425
DSE2	I am sure that I can successfully use digital tools into my lesson plans.	3.98	1.103
DSE3	I am equipped to use educational software in the classroom.	3.92	0.701
Self-Regulation (SR)			
SR1	When I use digital technology to teach, I can efficiently manage my time.	4.33	0.865
SR2	I am capable of adjusting to new digital tools and technology as they emerge.	4.18	0.713
SR3	I am able to self-regulate and modify how I use technology in my classroom.	4.02	0.816
Outcome Expectancy (OE)			
OE1	For today's teachers, I think digital literacy is crucial to effectively engage students.	4.35	1.231
OE2	Today's students, in my opinion, demand that their teachers be proficient in technology.	4.29	1.103
OE3	I think that using digital technology can assist address problems and disparities in schooling.	4.02	0.911

Descriptive Analysis

Perceived Utility (PU): The perceived utility of digital technology received high scores, ranging from 4.46 to 4.90 on average. This suggests that teachers think digital technology can improve learning outcomes for students, make instruction more effective, and increase student engagement.

Perceived Ease of Use (PEU): A moderate range of ratings, from 4.03 to 4.31, were given for how easy it was to use digital technology. This suggests that teachers are reasonably confident in their digital technology skills, but more support and training may be needed to help them feel more comfortable using it.

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Behavioral Intention (BI): The behavioral intention to use digital technology was highly scored, with mean scores ranging from 4.33 to 4.60. It would seem from this that teachers are motivated to use digital technology in the classroom.

Digital Self-Efficacy (DSE): The DSE was determined to be moderate, with mean scores ranging from 3.92 to 4.10. This demonstrates that teachers are reasonably confident in their use of digital tools, but they may need more support and training to feel more at ease.

Self-Regulation (SR): Self-regulation scores ranged from 4.02 to 4.33 on a mean scale, which is considered moderate. This suggests that teachers are capable of handling their time well and adjusting to new technologies, though they may need additional support to improve these skills.

Outcome Expectancy (OE): The results showed that the outcome expectancy was moderate, with mean scores ranging from 4.02 to 4.35. This demonstrates that educators believe using digital technology can help them address problems, boost student engagement, and reduce educational disparities.

The study's conclusions suggest that teachers are motivated to use digital technology in the classroom and have a positive outlook on it. However, they may need additional help and training to feel more comfortable and confident using it. Additionally, teachers may need to focus on developing their self-regulation skills in order to use digital technology in the classroom effectively.

It is important to note that because these results are based on a small sample of teachers, more research is necessary before applying them to a larger population. Since this study did not measure teachers' actual use of digital technology, it is also possible that their perceptions of it differ from their actual use.

The study's findings suggest that despite these disadvantages, digital technology might improve student learning outcomes. To realize this potential, though, teachers need to get the support and training they need to successfully incorporate digital technology into the classroom.

Table 6

Descriptive Statistics and Correlations for Study Variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. DCP	23.46	3.47	—									
2. CC	14.76	3.43	−.61**	—								
3. BEVT	17.56	2.46	.15	−.43*	—							
4. EC	11.52	2.42	.78**	−.47*	.14	—						
5. PU	14.19	0.96	.69**	−.59**	.07	.05	—					
6. PEU	12.42	0.45	.75**	−.38*	.04	.28	.79**	—				
7. BI	13.41	0.39	.86*	−.33*	.30*	.36*	.76*	.88**	—			
8. DSE	12.00	0.27	.37*	−.39*	.47*	.08	.66**	.76**	.83**	—		
9. SR	12.54	0.33	.20	−.48**	.08	.11	.54*	.84*	.85**	.80**	—	
10. OE	12.60	0.54	.63*	−.24*	.12	.03	.71**	.68**	.91*	.78**	.75*	—

Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are positively correlated with DCP (Digital Comfort and Proficiency (DCP). This implies that educators are more likely to view digital technology as practical and user-friendly if they are better equipped to use it.

Challenges and Concerns (CC) has a strong negative correlation with DCP and a moderately negative correlation with PU and PEU. This suggests that educators with higher computer literacy levels are also less likely to perceive digital technology as something they should be prepared for or to view it as easy to use or beneficial.

Between EC and BEVT (Belief in the Educational Value of Technology), there is a

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moderate positive correlation; however, there is a moderate negative correlation with CC. This indicates a negative correlation between computer literacy and comfort level with instructional video technology in the classroom.

EC (Engagement & Collaboration) has a strong positive correlation with DCP and a moderately positive correlation with PU. This demonstrates that educators who use educational technology more frequently are more likely to believe that it's a useful tool and that they should be prepared to use it.

PU (Perceived Usefulness) and DCP, EC, PEU, BI, DSE, SR, and OE have strong positive correlations. This means that positive attitudes toward digital technology are associated with educators who are more likely to be ready, integrated, comfortable, driven, self-assured, able to exercise self-control when using it, and convinced that it can improve student outcomes.

There is a significant positive correlation between PEU (Perceived Ease of Use) and DCP, EC, BI, DSE, SR, and OE. According to this, educators who think digital technology is simple to use are more likely to be ready to use it, integrated with it, driven to use it, self-assured in their skills, able to control how they use it, and convinced that it can enhance student outcomes.

PU (Perceived Usefulness), PEU (Perceived Ease of Use), DSE (Digital Self-Efficacy), SR (Self-Regulation), and OE (Outcome Expectancy) are all strongly positively correlated with BI (Behavioral Intention). This shows that educators who are more likely to incorporate digital technology into their lessons also tend to think that it can help students achieve better results. They also tend to think that it is easy to use and beneficial.

There is a significant positive correlation between DSE (Digital Self-Efficacy) and PU, PEU, SR, and OE. This implies that educators who have greater faith in their capacity to employ digital technology in the classroom are also more likely to think that it can enhance student outcomes, see it as practical and simple to use, and be able to self-regulate their use of it.

PU, PEU, DSE, OE, and SR (self-regulation) have a strong positive correlation with one another. This demonstrates that teachers who have more self-control over how they use digital technology in the classroom are also more likely to believe that the tool can improve student outcomes, that it is helpful and easy to use, and that they can feel confident using it.

A noteworthy positive correlation has been observed between PU, PEU, DSE, SR, and OE (Outcome Expectancy). This suggests that teachers who believe that digital technology can help students perform better are also more likely to believe that it is useful and easy to use, to have faith in their own abilities, and to have control over how they use it.

Overall, the correlations suggest that teachers who have a more positive attitude toward the use of digital technology in the classroom are more likely to do so successfully. This demonstrates how important it is for programs preparing teachers to focus on improving their self-efficacy, capacity for self-regulation, and attitudes toward digital technology.

Discussion

The current study examined the attitudes and readiness of aspiring teachers to integrate

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digital technology into their lesson plans. The findings demonstrated that while participants' attitudes toward digital technology were generally positive, they also acknowledged its potential to enhance student learning. They were enthusiastic about incorporating technology into the classroom and acknowledged the significance of digital literacy for today's teachers. It seems from these positive comments that future teachers are amenable to integrating technology into the classroom. These outcomes are consistent with Belda's (2021) findings.

Though generally optimistic, the participants' levels of preparedness for using digital technology varied. Younger participants (B.Ed. 4 years) and those without prior teaching experience demonstrated greater preparedness for technology integration than older participants (B.Ed. 1.5 years) and those with prior teaching experience. This study suggests that the timing and environment of digital literacy training may have an effect on readiness levels. These outcomes corroborate the findings of Gerasimova (2020).

Even with their optimistic outlooks and differing degrees of readiness, participants had trouble using digital technology efficiently. They expressed worries about their capacity to successfully incorporate technology into the classroom, struggled to adjust to new digital tools and technologies, and felt overtaken by the speed at which technology was developing. They also admitted that they lacked the essential training for producing and disseminating instructional content online. These results are consistent with what Altena (2017) reported.

These challenges demonstrate how important it is to offer specialized support and training to advance the digital literacy skills and confidence of future teachers. These courses should emphasize real-world applications in the classroom, address challenges related to technology integration, and provide students with hands-on experience using a variety of digital tools. Jan (2020) and Shahzad (2021) published comparable findings.

The study also revealed the participants' skepticism about digital technology's ability to lessen educational challenges and disparities. This demonstrates how important it is to use technology in a way that maintains equity and inclusion in order to ensure that all students can benefit from it. Kaarakainen (2022) reported similar results.

Furthermore, the study revealed participants' willingness to collaborate with others to learn about new teaching methodologies. This demonstrates the potential of collaborative learning communities in supporting teachers' professional development and technology integration efforts.

Conclusion

The study provides valuable insights into prospective teachers' attitudes, beliefs, and challenges regarding digital technology. According to the findings, while prospective teachers have generally positive attitudes toward technology, they may require additional support and training to effectively use it in their teaching practices. Furthermore, there is a need to address equity and inclusion concerns in the use of technology, as well as to foster collaborative learning communities among teachers. We can empower prospective teachers to

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harness the power of technology to enhance student learning and promote a more equitable and inclusive educational experience for all by addressing these challenges and providing the necessary support.

Recommendations

- More assistance and training should be given to educators so they can produce and share instructional materials online.
- Educators should be assisted in deepening their comprehension of how digital technology can be leveraged to tackle issues and inequalities in education.
- To acquire new teaching techniques, teachers should be actively involved in collaborative learning with others.

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