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Preparing Teachers for a Technology Integrated Classroom through Innovative Assessment Methods

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Abstract

The current study examines how the pre-service teachers are equipped for the technology-enabled classroom through innovative assessment during teacher education programs. As education increasingly incorporates technology, teachers' digital assessment skills are evolving as well. It is detrimental when educational institutions fail to implement assessment, which is a crucial aspect of education. The present study aims to explore the preparation, challenges of pre-service teachers and teaching practices that enhance and develop the said competencies. Using qualitative research design a data was collected through interviews from 18 pre-service teachers and 7 faculty members in the Department of Education University of Narowal. Participants with experience in practices of technology-based assessment were selected through purposive sampling. The main data collecting instruments were semi structured interview. The data were analyzed manually via thematic analysis and a word cloud was generated identifying the most repeated wording and themes. This study found that teacher education programs with structured courses, task based learning, and faculty guided mentorship help pre-service teachers acquire and enhance the knowledge, skills, and confidence needed to design and implement digital assessments. This study sheds light on the ways in which pre-service teachers can be prepared for technology rich classrooms. It highlights the importance of learning through experience, mentor support and access to resources. The findings of

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the study can help develop curriculum and professional development that assist teacher readiness, assessment competence and improve student learning in the contemporary classroom.

Keywords: Prospective teacher, Technology Integrated, Innovative Assessment Methods

INTRODUCTION

Teachers require new skills for today's schools. Digital classrooms are on the rise. Teachers should employ technology to assess as well as teach student learning. Using technology in the classroom takes more than providing a world-class digital tool (Norrie, 2022). Training on technology tools must be more than simple. It is also required for teachers in technology-rich environments. Assessment literacy refers to the ability to design, administer and interpret classroom assessments. When the use of technology and assessment come together, teachers can more accurately image learning, give timely feedbacks and adapt instruction (Tondeur et al., 2023).

Innovative assessment methods include the following performance tasks, digital portfolios, adaptive tests, and automated feedback. These approaches connect assessment to authentic learning tasks. Students can display complex skills with their assistance. Numerous teacher preparation programs continue to focus on traditional assessment, such as multiple choices testing, without connecting them to technology use (Mishra & Kereluik, 2024). Teacher preparation is not effective at reducing this gap. Teachers walk into classrooms unprepared to assess learning with technology. The aim of this research was to study how teacher education can prepare teachers to use innovative assessments with technology.

Problem Statement

Teaching and learning with technology demand new assessment capability. Teachers have reported gaps in technology assessment knowledge, according to research (Akram et al., 2022; Tondeur et al., 2023). A lot of teacher education programs are focused on tool use, not assessment design for digital learning. So, even though pre service teachers may know how to use software, they do not necessarily know how to assess learning with it. Teachers are challenged in designing digital tasks by a lack of practice; inconsistent feedback about assessment plans; a shortage of modeling of innovative assessment by teacher educators (Mishra & Kereluik, 2024). Classroom activity is weakened by this gap. It hinders teachers from leveraging digital assessment data to enhance instruction. The trouble is that teacher education programs do not

adequately integrate innovative assessment and preparation technology. Future teachers aren't getting the education they need for today's digital and complex learning environments.

Rationale of the Study

This study examines innovative assessment since it shapes what and how students learn. If an assessment is conventional, digital tools will be simply an on rather than a driver for learning. Assessment methods stimulate the participation of higher order thinking, problem solving, and real-world tasks. These are more aligned with 21st-century skills. Teacher education must involve these methods as primary content, not supplementary add ones. Gaining an understanding of current teacher preparation with technology and innovative assessment supports curriculum redesign. This study will identify what teacher preparation programs are good at, and what they are not so good at. It will help educators construct programs that will make teachers ready for modern classrooms. Improving pre-service and in-service teachers' assessment practices will strengthen professional development.

Significance of the Study

Teacher educators, planners and policy makers can use this research practically. Assessment methods can be integrated with the training of technology for improving teacher preparation. The findings will assist teacher education programs in modifying their courses to include practice on assessment design using digital technology. This will prepare teachers before they enter the classroom. The research also assists in-service training as many teachers face such situations. The study focuses on assessment and thus contributes to the meaningful use that improves student outcomes rather than tool use. The insights into what teachers need to assess learning in digital environments can benefit schools and education authorities. Ultimately, when teachers assess learning continuously and adapt instruction accordingly through data from digital tools, students will benefit.

Research Objectives

1) To examine how teacher education programs prepare pre-service teachers for technology integrated assessment

practices.
2) To identify challenges pre-service teachers face in learning and applying innovative assessment methods with technology.
3) To explore effective practices teacher educators use to develop assessment skills linked to digital tools and student learning.

Research Questions

1) How do teacher education programs prepare pre-service teachers for using innovative assessment methods in technology-integrated classrooms?
2) What challenges do pre-service teachers face when learning and applying technology-supported assessment strategies?
3) What instructional practices best support pre-service teachers to develop assessment competencies for technology-rich classrooms?

Limitations of the Study

The study may focus on a few teacher education programs in a region. The generalization of the results may be limited. The study may use self-reported data from the pre-service teacher and educator, which may be subjective. Advancements in technology could occur before the study timeline ends. Some assessment tools or practices may change after data has been collected. The study may experience time and resource limitations that may prevent comprehensive observation or follow up.

Literature Review

Teachers' readiness research aimed at technology integrated classrooms has grown considerably in the past decade. Most studies broadly focus on technology integration, teacher professional development, and technology competence, but only a few studies investigate the innovative use of assessment along with technology in teacher preparation. A substantial amount of work shows that technology integration within teaching enhances the engagement and outcome of student teaching (Akram et al., 2022). A systematic review has demonstrated that one of the keys to never-ending technology integration is teachers' attitude, skill, and training. This research shows great disparity in context in terms of infrastructure,

teacher training and assessment methods (Akram et al., 2022; Tondeur et al., 2023).

Researchers also emphasize that innovative assessment including performance tasks and digital portfolios provides a deeper understanding of student learning than traditional assessment practices. The immediate feedback and continuous assessment afforded by digital assessment tools allows for the transfer of assessment from summative to formative practices. Tools helping us assess 21st century skills have increasingly focused on digital literacies and complex problem solving (Care, Griffin, & Wilson, 2018). Most digital assessment research focuses on student outcomes and not on teacher preparation to use them.

A prominent theme in the literature is the use of the Technological, Pedagogical and Content Knowledge (TPACK) to explain technology integration. TPACK is a model that adds technology as another designing concept of knowledge in the pedagogical content knowledge a working model that draws from Shulman's notion of pedagogical and content knowledge (Fernández-Sánchez et al., 2025). Research indicates that increased TPACK levels lead to more beneficial technology use in the educational setting. However, in reality, several studies reported that the teacher education programs usually measure TPACK with self-report instruments and TPACK development is rarely linked to assessment practices. Most instruments emphasize selecting and using digital resources but rarely address how teachers design and interpret assessment activities in such contexts (Rosyida & Prahani, 2025).

Research involving professional development shows that preparation needs to be embedded in practice and continuous. Feedback from various professional development programs reveals that training teachers to integrate technology increases teacher self-efficacy and confidence, however, little is known about its impact on assessment design (Frontiers in Education, 2025). It provides evidence that one-off workshops or courses do not produce sustained change. In other words, ongoing context specific professional development is necessary if deeper integration skills are ever to be attained. The gap in teacher preparation programs for technology integration is a failure to treat assessment innovation as a central concern but as a peripheral one (Britten & Cassady, 2012).

Existing literature also tends to overlook the culture and context pertinent to the teachers adopting technology and assessment strategies. Research from Pakistan and similar contexts reveals that lack of availability of resources, training opportunities and policy support affects teachers' ability to integrate technology (Investigating Teacher Educators' Perceptions, 2023). Innovation assessment practices are restricted because of these barriers, which also impacts the use of technology. In addition, research seems to treat technology and assessment as separate domains, not how they interact in holistic classroom practice. Studies that focus on teacher preparation about data informed assessment practices are also absent (Zou et al., 2025).

Teachers can access rich performance data with new tools powered by AI and analytics. Yet, there is a lack of research on ethical use, interpretation and feedback strategies particularly in a pre-service teacher education context. A recent review notes the issues like bias, transparency and equity in the AI based assessment tools. It further addresses the need of preparing teachers with such tools (Bulut et al., 2024). With these limitations in mind, there has been recent work on digital assessment in science education and adaptive testing. Research indicates that technology has the potential to personalize assessment and provide real-time scaffolding. Research indicates that new methods, once integrated into teacher training, will convert periods of assessment from static assessment of learning to inventories of learning which are dynamic and regular (Khadijah et al., 2025). The research done to study the implementation of these methods into pre service programs is not sufficient yet. In light of these gaps, the present research will examine development of innovative assessment techniques for preparation of teachers for technology integrated classrooms (Siyam et al., 2025). The report seeks to look not only at how technology is taught but how assessment a key driver of instruction is embedded within technology training. The text also highlights teacher readiness and assessment literacy, which literature mentions but does not examine in-depth.

Theoretical Framework

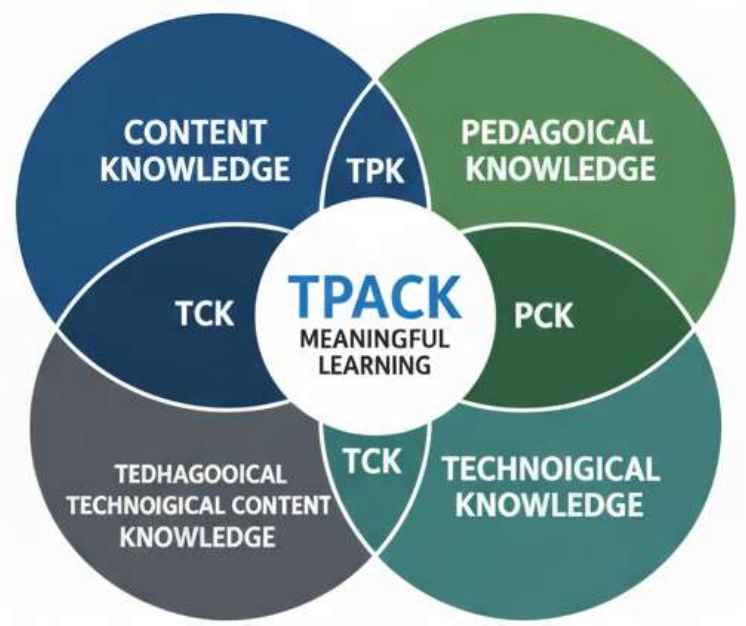

Figure 1: Technological Pedagogical and Content Knowledge (TPACK)Theoretical framework

The figure 1 Technological Pedagogical and Content Knowledge (TPACK) framework is the most appropriate theory for this study. TPACK believes effective teaching with technology demands the congregating of content knowledge, pedagogical knowledge and knowledge of technology. This statement states that technology should be integrated with the pedagogical and content decisions which will help achieve a meaningful learning experience (Mishra & Koehler, TPACK literature). Some teachers easily integrate technology while others do not. The difference in outcomes depends on whether a teacher can create a proper blend between play technical, pedagogical and assessment strategies. For this research study, the TPACK is extended to assessment literacy with respect to integration of technology. Traditional TPACK model of Tompson et al (2015) focuses on instruction but assessment practices are also a part of all pedagogical decisions. Assessment of learning approaches demand from teachers to interpret digital data, design

authentic tasks and offer feedback in time. In this sense, TPACK underpins a view of teacher knowledge that incorporates assessment as part of pedagogical practice. Alternative theoretical lenses for professional development include the Diffusion of Innovations Theory and Adult Learning Theory (Haleem et al., 2024). The study of Diffusion of Innovations focuses on how new practice spread through communities. This theory may explain the difficulty or challenge in adopting geothermal energy. The design of PD could use Adult Learning Theory. TPACK is most appropriate because it directly integrates technology with teaching and assessment knowledge. Thus, the TPACK framework closely aligns with the study which looks to teacher preparation.

Research Methodology

This study used qualitative research methods to examine how teachers were prepared for technology-integrated classrooms through innovative assessments. Creswell and Creswell (2023) deemed qualitative research appropriate in this study as it allowed in-depth access to participants' experiences, perceptions, and obstacles in integrating technology and assessment practices. This design helps to assess the viewpoints of pre-service teachers and faculty members to generate qualitative and context-specific data.

Participants and Sampling

The Department of Education, University of Narowal conducted the research work. Pre-service teachers in teacher training courses, and faculty members who teach educational technology and assessment courses, were the participants. Participants were selected using a purposive sampling technique that have first-hand experience with technology-integrated instruction and assessment practices (Patton, 2015).The final sample included 25 participants: 18 pre-service teachers and 7 faculty members. This sample was appropriate to capture sufficiently diverse opinions while being manageable for qualitative analysis.

Data Collection

Only semi-structured interviews were used for collect the data. Using open-ended questions in the interviews gave participants the

possibility to express their experiences and difficulties in their own words. The questions asked of participants were open-ended in nature, aimed at participants' experiences with integrating technology in the classroom, application of innovative assessments and any challenges faced along with suggestions for the improvement of teacher preparation programs. Due to the consent, each interview was audio recorded and later transcribed verbatim for analysis. Each interview lasted 40–60 minutes.

Data Analysis

As per Braun and Clarke (2021), an analysis of data was done manually. The transcripts were read, units of meaning were coded, patterns were identified, themes were developed and themes were refined for clarity and coherence. A Word Cloud was created to highlight common references in the literature and assist with the thematic analysis (Heimerl et al., 2014). This dual approach, therefore, added depth and also made the analysis more accessible.

Ethical Considerations

The Department of Education at Narowal University approved the ethical clearance. Participants were informed and gave their consent and confidentiality was assured as well as the right to withdraw from the study. Information kept private while transcription and analysis.

Advantages of the methodology

The methodology used provided rich and contextual insights about the preparations of teachers. The use of semi-structured interviews helped to explore the experiences and perceptions along with a thematic analysis that chapter patterns across participants. The Word Cloud visualization generated a clear visual overview of important ideas, aiding interpretation and presentation of findings.

Limitations

The findings of the study have limited applicability as it was conducted specifically at the University of Narowal. Using own words can introduce a response bias. Manual thematic analysis is time consuming. Word Cloud visualization, while having meaning, is not meaningful by itself.

Data Analysis

This section deals with the interview data obtained from the 18 pre-service teachers and 7 faculty members regarding how teacher education prepares the pre-service teachers for innovative assessment in technology integrated classroom. Thematic analysis was employed for manual data analysis, while generation of Word Cloud was done for the frequently used words.

RQ 1: ***How do teacher education programs prepare pre-service teachers for using innovative assessment methods in technology-integrated classrooms?***

Theme 1: Structured Integration of Technology and Assessment in Curriculum

Participants noted that teacher education programs had particular courses for educational technology and assessment procedure in relation to the use of technology for evaluation.

Subtheme 1.1: Specific Courses on Technology Integration

Many pre-service teachers stated they took courses where they learned to put digital technologies into practice. According to the new curriculum, we had a course on ICT in education in which we learnt how to create quizzes and e-portfolio for students. Quote 11: "It was very practical and directly linked to assessment." – PT5. "The use of Google Classroom and Kahoot for designing assessments was taught to us by our Faculty. This gave us an understanding of how evaluation can be supported through technology." - PT12.

Sub-theme 1.2: Embedded Assessment Practices

According to faculty members, assessment practices were deliberately incorporated within technology-focused courses. *"We always assess technology and never offload it with one of the assessments we do. For example, students prepare lesson plans based on digital assessment techniques."* – FM3. *"Pre-service teachers often create a digital rubric or use an online tool for peer assessment in their assignments. This prepares them for actual classroom situations*," – FM7.

Theme 2: Hands-on Experience with Innovative Assessment Tools

Participants expressed the need for hands-on practice with digital assessment tools.

Sub-theme 2.1: Simulation and Practice Activities
Pre-service teachers claimed many opportunities to practice technology use in assessment simulations. *"We practiced in-class mock sessions where we assessed each other along with the help of online surveys and quizzes. The practical work was very beneficial ." – PT9*. *"Having seen how students can track their learning progress, use of digital portfolio during the course is definitely good. PT3*

Sub-theme 2.2: Exposure to Formative Assessment Methods
Participants mentioned learning innovative formative assessment methods via technology. The faculty members demonstrated to us the procedures involved in rapidly giving feedback with the use of Google Forms and Edmodo. According to PT14, it reflected student learning unlike the typical examination. The use of digital platforms in designing performance tasks and project-based assessments, were discussed. *"It was demanding yet highly realistic."* – PT6.
Participants highlighted learning innovative formative assessment methods using technology. *"Faculty showed us how to give immediate feedback using Google Forms and Edmodo. This was different from traditional exams and more reflective of student learning." – PT14 "We were encouraged to design performance tasks and project-based assessments using digital platforms. It was challenging but very realistic." – PT6*

Theme 3: Faculty Support and Professional Guidance
According to the research, guidance and mentorship from faculty are vital for acquiring competence in technology integration in assessments.

Sub-theme 3.1: Continuous Feedback
Participants indicated that they receive timely feedback from the instructor while practicing assessment innovations. *"Whenever we designed a digital assessment task, the faculty would review and give detailed feedback. The use of technology and improved understanding assessment design were achieved using ..." PT1.* According to PT10, *"Using digital in alignment with assessment is a necessary condition for meaningful feedback."*

Sub-theme 3.2: Encouragement for Independent Exploration
Participants appreciated staff encouragement of new tools and methods.

The teaching staff encouraged the use of various applications. *"They said innovation comes from experimenting. This gave me the confidence to use new digital assessment methods." – PT17*
"Our teachers told us how to do things but also gave us choice of tools with which to do it. We acquired flexible tools that we can use in our future classroom." – FM5.

Theme 4: Challenges and Gaps in Preparation
Participants highlighted gaps in teacher preparation programs but felt positively.

Sub-theme 4.1: Limited Time for Technology Training
"We just had a few weeks of ICT classes on Education. If we could have had more time and practice we could have understood it better" – PT8.

Sub-theme 4.2: Need for Advanced Tools and Support
There was mention about some advanced tools such as AI-based assessment platforms but not taught. *"We need exposure to such tools to be fully prepared."* – PT11. The analysis shows that a teacher education program partially prepares the pre-service teachers for using innovative assessment in integrated classrooms. The curriculum structure, practical exposure, and guidance from faculty were key enablers. However, the limited time and no exposure to advanced tools are key constraints.



Figure 2: ***innovative assessment methods in technology-integrated classrooms***

The figure 2 Word Cloud created using the interview transcripts contained the most mentioned words which include “assessment,” “technology,” “feedback,” “digital tools,” “practice,” “rubrics,” and “portfolio”, indicating how commonly they came up in the interviews. The teacher education programs organized by the University of Narowal extend foundational assistance for technology integration with innovative assessment. Nevertheless, a greater exposure to advanced DAs platforms and years of practice through appropriate mentorship will enhance their professional preparation. The insights provide a foundation for reassessing the curriculum and targeted professional development to support assessment of teachers in classrooms rich in technology.

RQ 2: ***What challenges do pre-service teachers face when learning and applying technology-supported assessment strategies?***

Theme 1: Limited Exposure to Advanced Digital Assessment Tools

Pre-service teachers experienced difficulty with sophisticated technological platforms for assessment.

Sub-theme 1.1: Lack of Familiarity with Innovative Tools

A lot of participants reported that they trained on basic tools and could not use the advanced one. *"Our predominant learning involved utilizing Kahoot and Google forms. "AI software for assessment purposes or some kind of learning analytics software was mentioned, but not explored" – PT4. "I'm hesitant to design digital portfolios because we were never taught to use professional-level software." -PT11*.

Sub-theme 1.2: Limited Hands-on Practice

Participants pointed to lack of exercises with TPA.*" We only had a couple of sessions to try these tools. One or two exercises can't make us confident to use them in real classrooms." -PT9* According to the PT15 stated, *"I required more hands-on sessions to learn how online rubrics or formative assessment tools work effectively."*

Theme 2: Challenges Related to Assessment Literacy

When tools were available, pre-service teachers struggled to utilize

technology towards authentic assessment.

Sub-theme 2.1: Difficulty Designing Effective Assessment Tasks
Participants encountered challenges in utilizing digital tools for creating assessments that truly measure learning outcomes. *"I had the software but found it difficult to create tasks that reflected students' understanding." – PT6. "Making quizzes was simple.However, conceptualizing performance-based assessment on digital platform was baffling" – PT2.*

Sub-theme 2.2: Interpreting Digital Assessment Data
Some pre-service teachers could not analyze and act on data generated from digital assessments. According to PT13, *"I always don't know what to do or how to interpret the results even when we used online quizzes in teaching with a view improve the teaching." "Learning analytics from digital platforms is new for me. "I would like to be shown how to turn data into a comment." – PT7.*

Theme 3: Infrastructural and Resource Limitations
Participants highlighted external issues impacting the use of technology assessment.

Sub-theme 3.1: Limited Access to Devices and Internet
The lack of resources prevented some participants to utilize the practices effectively. According to PT10*," the students did not have a laptop or stable internet connection because the lab was overcrowded at times." "The restricted availability of devices made it difficult to try out these digital assessment platforms independently." – PT1.*

Sub-theme 3.2: Software and Technical Barriers
Technical issues or obsolete software stood in our way. *"Some tools were either not updated or blocked in the university network; hence, we could not explore them fully"– PT12. "I frequently faced errors in software that prevented me from creating online portfolios. I find this frustrating and it slows down my learning". - PT16*

Theme 4: Psychological and Confidence-Related Barriers
Pre-service teachers reported that the lack of confidence affected their technology-supported assessment implementation.

Sub-theme 4.1: Anxiety About Using Technology in Real Classrooms

"I feel nervous to use these tools when I begin teaching as I have only practiced in labs and not the actual classroom". – PT5. "I sometimes fear that students will see me as incapable just because I do not manage the digital tests well." – PT18.

Sub-theme 4.2: Dependence on Faculty Guidance

"I constantly need support from teachers for feeling confident in their use assessment methods "Independent application is hard." – PT3. "Without support from faculty, I don't think I will design any meaningful digital assessments." – PT14



Figure 3: *challenges do pre-service teachers face when learning and applying technology-supported assessment strategies*

According to findings, pre-service teachers face multiple challenges in practicing and implementing technology-based assessment. Some of the key hurdles are limited exposure to digital tools, assessment literacy, infrastructure issues, and confidence. The figure 3 Word Cloud visualization which was created from the transcripts showed the words "tools", "practice", "feedback", "confidence", "data", "design", "internet", etc. which supports the themes identified by the research team. Teacher preparation programs prepare pre-service teachers to use assessment strategies supported by technology. While we are undoubtedly taught the foundational skills, a deeper understanding and hands-on practice also leads to confidence within a child. Overcoming such difficulties entails

extended practice sessions, access to sophisticated tools, help interpreting digital assessment feedback, and strategies to boost teacher confidence before stepping into real classrooms.

RQ 3: ***What instructional practices best support pre-service teachers to develop assessment competencies for technology-rich classrooms?***

Theme 1: Hands-On Technology Integration in Practice Sessions

Participants emphasized that the direct experiences with tools favored the development of assessment competences.

Sub-theme 1.1: Simulation of Real Classroom Scenarios

This has been an important assignment as we had mock classroom sessions where we could apply the use of an assessment tool in the classroom. *"In teaching practice sessions, we assessed our peers' work using Google Forms, Kahoot and digital portfolios. I became more confident using these tools after this experience." – PT4. According to PT9, "participating in simulated activities relayed the importance of technology integration and evaluating learning outcomes."*

Sub-theme 1.2: Task-Based Learning with Digital Assessments

Faculty recommended that concrete, technology-related tasks may be assigned for better assessment capability building. *"We make pre-service teachers design online quizzes, e-portfolios and performance tasks."Through these activities, technical skills and assessment knowledge is developed" – FM3.* The FM6 says that *"task-based assessments help designers link learning goal to measurable outcomes using digital tools."*

Theme 2: Guided Mentorship and Feedback

Ongoing feedback from faculty was found to be critical in helping pre-service teachers' competencies.

Sub-theme 2.1: Continuous, Structured Feedback

Participants stated that feedback could enhance ability to improve digital assessment practices. *"Each online assessment exercise underwent careful scrutiny, and suggestions were given in detail by the faculty members." PT2.* It helped me to improve design phase and appraisal process." According to PT11, *"it is very helpful to receive feedback from the faculty to align assessment tasks with learning objectives".*

Sub-theme 2.2: Personalized Support
One-on-one support assisted pre-service teachers in addressing challenges and implementing assessment strategies. *"When I faced difficulties while making an online rubric, the faculty helped me step by step. That tailored assistance was a game changer". – PT15*. According to FM5, *"the mentoring sessions provided us the freedom to explore various tools, the faculty encouraged us to think and devise new material"*

Theme 3: Collaborative Learning and Peer Interaction
Participants noted that working together and peer-based activities enhanced assessment competency learning.

Sub-theme 3.1: Peer Assessment and Group Projects
Pre-service teachers worked in groups to design, implement, and evaluate assessments. *"In groups, we created digital assessments and gave feedback to one another. I learnt different ways to assess student work." – PT6.* According to PT8, *"peer conversations enabled us to refine and critique our designs of digital assessments before trying in a dummy classroom."*

Sub-theme 3.2: Sharing Best Practices
Sharing their thoughts on innovative assessment strategies was something that participants valued. *"Faculty motivated us to share our assessment designs and discuss challenges. Hearing my peers' ideas helped me broaden my understanding. "– PT13*. According to FM7, *"collaborative sessions created a community of practice where we learned from each other's strengths."*

Theme 4: Integration of Formative Assessment Techniques
According to pre-service teachers, being exposed to formative assessment methods helped them develop competencies.

Sub-theme 4.1: Real-Time Feedback Practices
Participants liked learning to provide instant feedback using digital tools. *"Using online quizzes and instant polls taught me how to give feedback quickly and adjust design." PT1*. The constant formative assessments *"I was able to carry out using Google Classroom enabled me to closely monitor student learning instead of waiting for exams." – PT12.*

Sub-theme 4.2: Reflective and Iterative Assessment Design
Emphasized creating assessment tasks that prompted reflection. *"We instructed teachers to modify their assessment plans conveniently based on students' performance data." This reflective process reinforced their competencies." – FM4.* According to PT10 stated that "*they learned how to improve the task to achieve desired learning outcomes with iterative design of assessment using digital tools".* The analysis indicates that the use of assessment competencies for technology-rich classrooms is most effective instructional practices include.

1. Engaging with digital tools and techniques used in classrooms
2. Support and structured feedback from the faculty
3. Using group learning and interaction with peers to reflect
4. Exposure to formative and iterative assessment techniques to enhance practical utilization



Figure 4: *Instructional practices best support pre-service teachers to develop assessment competencies for technology-rich classrooms*

The figure 4 Word Cloud of the interview transcripts showed commonly mentioned words such as feedback, practice, digital tools, collaborative, assessment design and formative, all of which indicate a key theme among participant responses. According to recent research, when pre-service teachers in teacher education program are exposed to practice teaching, mentoring, peer learning, and formative assessment, they are well prepare. Engaging in these

activities improves technical and pedagogical skills, enabling the teacher to assess students' learning in tech-rich classrooms.

Discussion

This research investigated how pre-service teachers are being prepared for technology-interfaced classrooms through innovative use of assessments, the challenges they face, and the instructional practices that help foster assessment capabilities. The results are interpreted using the Social Cognitive Theory (SCT), which holds that learning is a mutually influencing personal factor, behavior, and environmental factor (Bandura, 1986; 1997). The discussion relates empirical findings to research objectives, theoretical framework or perspectives, and existing literature.

Preparation of Pre-Service Teachers for Technology-Integrated Assessment

As per the findings pre-service teachers are essentially prepared by teacher education program through a structure of the course, activities and task-oriented engagements. The participants stated their practical experience with the use of Google Forms, Kahoot, and e-portfolios in simulated classrooms in order to be able to apply the assessment (theory) in practice. Guidance from faculty ensured that these digital assessments were aligned with the learning objectives, helping the participants apply theoretical knowledge into practical skills. Pre-service teachers said this experience helped enhance their confidence and self-efficacy. As an illustration, PT5 stated*, "We were taught to create quizzes and e-portfolios in our ICT course."* Practicing these tools made me feel prepared to use them in real classrooms. From Social Cognitive Theory, this helped users to know you have to observe, model and practice in the system to become proficient (Bandura, 1986). Another previous study states that pre-service teachers in teacher education program are made familiar to educational technology and assessing education in a structured manner by evaluation through technology integration basically improvised such technology skill and competence. The participants noted that they were not frequently exposed to advanced digital assessment tools like AI-supported analyses and adaptive assessment tools. The existence of this gap suggests the necessity for programs to focus on the provision of more mastery experiences

to foster sense of efficacy and competency about the mentioned emerging technologies, in line with SCT that values experiential learning and enhancing self-efficacy (Bandura, 1997).

Challenges Faced by Pre-Service Teachers

Several issues were recognized in the study faced by pre-service teachers in learning and implementing technology-supported assessment strategies. Participants noted a lack of familiarity with certain tools, assessment literacy, infrastructure, and confidence, among other issues. The individual who identified as PT11 indicated as follows: *"I was hesitant to design digital portfolios because we were never trained on software at a professional level."* On the other hand, PT5 expressed, *"I get nervous thinking about using these tools in real classrooms because we only tried them in labs."* Many of these challenges appear to reflect reciprocal determinism (SCT) (Bandura, 1986). Thus, it may be that personal factors (e.g., anxiety, self-efficacy), behavior (e.g., ability to design assessment), and environmental factors (e.g., access to technology, faculty support) interact. Insufficient exposure and practical experience constrained the participants' abilities to apply digital assessment strategies confidently. To bring down these barriers will require structured mentorship, scaffold support and enhanced access to technology to create the right environment.

Instructional Practices Supporting Competency Development

Analysis shows some teaching practices impact assessment competencies for technology-rich classrooms positively. Pre-service teachers received hands-on practice and simulation experiences with digital assessment tools to provide them mastery experiences that enhance their learning's. According to PT4, *"practice sessions were done on Google Forms, Kahoot and e-portfolios. Using these tools in real classrooms empowered me to be more confident."* Mentorship is great but it's better under guidance and structure. Participants refined their assessments to be more in line with the learning outcomes with continuous feedback from the faculty. According to FM6, *"pre-service teachers were able to connect objectives to measurable outcomes through the use of digital tools when designing a task-based assessment".* The process of collaborative learning and the interaction with peers ensured their competence development. Group work and

peer assessment were appreciated for chances to observe, reflect and resolve. According to PT6, *"Working in group to make digital assessments and give another person feedback helped me learn different ways of assessing."* Ultimately, formative and iterative assessment techniques enabled pre-service teachers to give feedback that reflects a learning trajectory and engage in learning. Using online quizzes and instant polls has taught PT1 how to provide feedback and adapt instruction based on the responses of the students. These instructional practices would appear to align with SCT principles when learning occurs through guided practice, observation and reinforcement within supportive environments (Bandura, 1986; 1997).

Implications for Teacher Education Programs

The findings could help teacher education programs prepare pre-service teachers for classrooms that integrate technology. Future teachers will be able to use basic and advanced digital assessment tools with confidence and ease as the programs will have extended hands-on experiences. Learning is built upon continuous feedback and structured mentoring for self-efficacy. This means that there should be learning programs that allow learners to learn from one another and devise their assessments. It is necessary to address structural limitations such as access to devices, software, and stable internet. The study confirms the SCT could be applied in teacher training. In addition, personal efficacy, observational learning, and environmental support affect pre-service teachers' capability to implement innovative assessment practices. Programs that incorporate these elements will produce teachers who can use technology to enhance both assessment quality and learning outcomes.

Integration with Research Objectives

According to the discussion, teacher preparation programs use various strategies in preparing pre-service teachers for technology-supported assessment, identify major constraints that impede these programs from developing the competence, and apply teaching practices that enhance assessment competencies. According to the findings, while the pre-service teacher education programs lay beneficial bedrock, the pre-service teachers lack adequate practical exposure, confidence, and sophisticated tools to be fully prepared for technology-rich classrooms and inclusive practices. Programs

for teacher education at the University of Narowal prepare candidate teacher for technology-supported assessment through structuring courses, practical work, coaching and group learning. In keeping with the tenets of Social Cognitive Theory, these teaching practices will enhance the efficacy and competence of pre-service teachers. Despite the accessibility of various classroom assessment practice strategies, there remain gaps in technology assessing advanced assessment tools and growth opportunities to experience them in real classroom environments. Bridging these Identified gaps through diversified practice, scaffold support and equitable access to technology will ensure that the teachers-to-be are completely armed to implement innovative assessment in technology-enabled classrooms.

Conclusion

This study examines the readiness of pre-service teachers for technology-integrated classrooms by teacher education programs through assessment practices and the challenges faced by these teachers. It also investigates instructional practices that develop assessment competencies. By utilizing qualitative data as interpreted by Social Cognitive Theory (SCT) through interviews that were analyzed thematically, this study shows us the state of teacher preparation and scope for improvement. The findings underscore the importance of structured courses on teaching with technology and assessments, activity-based simulations, and mentorship from faculty in equipping pre-service teachers for technology-enhanced assessments.

According to Bandura (1986; 1997), SCT refers to the interaction of personal, environmental and behavioral factors. Personal factors can be further broken down into cognitive, motivational, affective and developmental processes. People saw a positive change in their confidence to design a digital assessments using Google forms, Kahoot, e- portfolios and aligning assessments with learning objectives. The findings of the current research show that the combined effect of theory practice and guided support can effectively improve readiness. The study revealed various challenges in spite of these. Participants encountered major barriers to the implementation of new assessments, including limited exposure and low confidence in assessments. Through these

challenges, we can find reciprocal interaction between the personal, behavioral and environmental factors as described in SCT. The anxiety and reluctance of participants to apply digital assessment strategies in actual classrooms show the demand for enhanced experiential learning, scaffold mentorship and equal access to technological resources. It is essential that any issues they may face are solved so that pre-service teachers have the readiness to meet demands. The study also revealed which instructional practices best nurture competency development. Consistently recognized as strategies that enhance competence and the confidence to design and use technology-supported assessment were hands-on simulations, guided mentoring, collaborative practices, formative assessment methods, and reflections. Through repeated mastery experiences and opportunities to observe and give and receive feedback, these practices reflect SCT principles and enable teachers to internalize effective assessment practices.

The research demonstrates that Social Cognitive Theory can be applied to understand teacher preparation in theoretical terms. It illustrates how environmental support, as well as the modeling and mastery experiences, interacts with self-efficacy mechanism to determine behavior. The findings supported earlier studies that highlight explicit, experiential and collaborative ways of preparing teachers to use technology (Ertmer & Ottenbreit, Leftwich, 2010; Inan & Lowther, 2010; Koehler & Mishra, 2009). This research has important consequences for policy and practice. In teacher education programs, there should be more 'hands-on' experiences on basic and more advanced digital assessment tools, structured mentoring and ongoing formative feedback, and collaborative and reflective learning opportunities. Another key aspect to change is resource constraints from hardware and software to stable internet access and user-friendly professional software. The research fills the gap in knowledge by elucidating the qualitative evidence of the pre-service teachers' experience of preparation for technology-supported assessment in classrooms. This study focuses on innovative assessment strategies as a key point for teacher preparation, while previous research has mainly focused on general technology use. This document also discusses the barriers to effective instruction and instructional strategies that work in a local context. It is intended to assist program designers, faculty, and policymakers.

The research provides directions for future studies. Future research may examine the longer-term benefits of technology-based assessment training for in-service teachers on their practices; examine specific advanced digital tools for assessment for learning, or a comparative study in different universities and cultures. Mixed method designs could also be adopted to quantify the association of mastery experiences and mentorship on self-efficacy and implementation outcomes in the classroom. As a whole, teacher education schemes are essential in training the pre-service teachers to have the assurance and skills to use new age assessments using technology. Even though background preparation is effective more practical experience, more mentorship more resources and accessibility to state-of-the-art technology are required to help teachers fully cope with today's classrooms. The results of the research present a clear prescription for improving teacher preparation programs, assisting pre-service teachers' ongoing professional learning, and ultimately improving students' assessment related learning in technology-rich settings.

Recommendations

From the results of this study, a number of recommendations are made to improve the preparation of pre-service teachers for technology ready classrooms with innovative assessments.

1) Teacher education programs should provide pre-service teachers with extended opportunities to practice more sophisticated digital assessment tools; including assessment tools that are AI-supported, learning management systems, and adaptive assessment tools. The impact of organized practical exercises and simulated classroom scenarios on technical competence, assessment literacy and confidence in effective use of technology.
2) Programs should include ongoing faculty mentorship and feedback on the design and implementation of assessments and strategies for reflection. The purpose of scaffold guidance is to support pre-service teachers in creating assessment tasks for learning outcomes, establishing self-efficacy, and overcoming problems encountered in technology-supported assessment practices.

3) Trainee teachers need to work on group projects, peer assessment and collaborative problem-solving. Peer feedback exercises and reflective practices encourage peer to peer learning, promote the practice of good practices and encourage critical use of technology for assessment.
4) The curricula for teacher education must have emphasis on assessment theory and digital assessment design along with data interpretation capabilities. As a result of having assessment literacy, the pre-service teachers will be able to construct valid, reliable, and meaningful digital assessments as well as analyses the performance of students.
5) Institutions must provide proper infrastructure with a laptop, internet, software and other digital tools. Provision of resources and support can ensure that pre-service teachers of all backgrounds develop skills and confidence in a use of technology supported assessment.
6) A formative assessment use should be encouraged by programs along with real-time feedback. Student performance evaluation helps to improve pedagogical decision-making. Pre-service teachers are better prepared once they are trained in these techniques.
7) Institutions should be developed continuous professional development program for faculty and pre-service teachers so as to keep them abreast with the new assessment technologies, pedagogical innovations and research-based best practices of technology integration.
8) Pre-service teachers should be encouraged to discover inventive assessment methods, implement class action research, and test new digital devices. By employing this method, a culture of innovation and adaptability with technology will be created among educators.

With these recommendations, teacher education programs can strengthen the preparation of pre-service teachers and enhance self-efficacy as well as technology-supported assessment. All of these strategies will improve teaching quality, learning outcomes and the teacher workforce with technology.

REFERENCES

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology,13*,920317. https://doi.org/10.3389/fpsyg.2022. 920317 PMC

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman. Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide*. Sage.

Britten, J. S., & Cassady, J. C. (2012). The technology integration assessment instrument: Understanding planned use of technology by classroom teachers. Classroom Integration of Type II Uses of Technology in Education, 49–62.https://doi.org/10.1300/J025v22n 03_05

Bulut, O., Beiting-Parrish, M., Casabianca, J. M., Slater, S. C., Jiao, H., & Song, D. (2024). The rise of AI in educational measurement. *arXiv*. arXiv

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). Sage Publications.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551

Fernández-Sánchez, A., Lorenzo-Castiñeiras, J. J., & Sánchez-Bello, A. (2025). Navigating the Future of Pedagogy: The Integration of AI Tools in Developing Educational Assessment Rubrics. European Journal of Education, 60(1). https://doi.org/10. 1111/ejed.12826

Frontiers | A systematic review on the impact of teacher professional development on digital instructional integration and teaching practices. (2025). *Frontiers in Education*. Frontiers

Haleem, D. B., Fakhar-Ul-Zaman, & Anwer, D. M. (2024). Developing Assessment Competencies in Pre-Service Teachers through Digital Literacy Framework. *PJE*, *41*(2). https://doi.org/10.30971/pje.v41i2 .3344

Heimerl, F., Lohmann, S., Lange, S., & Ertl, T. (2014). Word Cloud Explorer: Text analytics based on word clouds. *2014 IEEE 14th International Conference on Knowledge Management and Knowledge Technologies(i-KNOW)*,1–8.https://doi.org/10.1109/i-KNOW.2014.69305 62

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K–12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137–154. https://doi.org/10.1007/s11423-009-9132-y

Investigating Teacher Educators' Perceptions on Technology Integration in Teacher Preparation Programs. (2023). *Journal of Social Sciences Review*. jssr.com.pk

Khadijah, I., Nurhamidah, N., Mulyani, L., Amanah, S. N., & Sukmanawati, N. (2025). Improving Learning Outcomes through Innovative Pedagogical Approaches in Modern Education. Journal of English Language and Education, 10(1), 423–433. https://doi.org/10.31004/jele.v10i1.661

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70.

Mishra, P., & Kereluik, K. (2024). Assessment design in technology-supported learning: Issues and perspectives. *Journal of Educational Technology, 50*(1), 45-60.

Patton, M. Q. (2015). *Qualitative research & evaluation methods* (4th ed.). Sage Publications.

Rosyida, K. M. I., & Prahani, B. K. (2025). Enhancing students' critical thinking skills in physics: Exploring problem-based learning and mobile technology integration in rotational dynamics education. Advances in Mobile Learning Educational Research, 5(1), 1301–1313. https://doi.org/10.25082/amler.2025. 01.006

Siyam, Y., Siyam, N., Hussain, M., & Alqaryouti, O. (2025). Evaluating technology integration in education: a framework for professional development. Discover Education, 4(1). https://doi. org/10.1007/s44217-025-00448-z

Systematic literature review of TPACK instruments used with pre-service teachers from 2017 to 2023. (2025). *Journal of Computers in Education*. Springer

Tondeur, J., Scherer, R., Baran, E., & Siddiq, F. (2023). Preparing teachers to integrate technology: A systematic review of qualitative evidence. *Teaching and Teacher Education,112*,1037 00.

Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: trends, challenges, and innovations in technology integration. Frontiers in Education, 10. https://doi.org/ 10.3389/feduc.2025.1562391