

Enhancing Teaching Skills Through Electronic Resources: A Study with Prospective Primary Teachers

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Abstract

The growing recognition of the potential of electronic resources to support pedagogy in teacher education highlights the importance of empirical research, particularly within developing educational systems such as Kazakhstan. This study examines the association between the use of electronic resources and teaching skills, reflective practices, and classroom management competencies among prospective primary school teachers. A quasi-experimental pre-post-test design was employed with a sample of 154 pre-service teachers from two Kazakhstani universities. The findings indicate that participants who used electronic resources demonstrated higher post-test scores in instructional planning and used more adaptive classroom management strategies than those receiving traditional instruction. These results suggest that digital tools may support the development of core competencies in teacher preparation, particularly in under-researched educational contexts. However, the use of non-equivalent groups drawn from different institutions represents a key limitation and warrants cautious interpretation of the findings. The study offers practical recommendations for curriculum developers aiming to integrate traditional and digital pedagogical approaches.

1. Introduction

The utilization of electronic resources (ER) in teacher instruction has emerged as a transformative trend in response to the growing demand for innovative, flexible, and learner-centered pedagogies. Learning management systems (LMS), educational applications, and multimedia content are increasingly employed to promote active learning, support instructional planning, and facilitate classroom management (CM). Such technologies have shown promise in supporting the growth of core teaching abilities among pre-service primary school teachers (PPSTs), including enhanced self-reflection, personalized learning, and real-time feedback.

The development of new scenarios in teacher education as key strategies for improving the quality of teacher training encourages the introduction of innovative technologies into teacher instruction (Zhao & Shi, 2024;

Skrbinjek et al., 2024; Rodrigues, 2020). In the context of modern technologies, learning through ER has become a particularly effective method for enhancing teacher training programs (Alkhafaji & Samea, 2020; Mayuni et al., 2024). Innovative methods and ER not only improve instructional skills but also encourage reflective practice and differentiated teaching (Savithri, 2022; Halder et al., 2024). Researchers emphasize that technology-enriched environments with ER foster CM, increase learner motivation, and promote instructional flexibility (Kumpikaitė-Valiūnienė et al., 2021). Moreover, researchers believe that ER boost self-esteem, stimulate creativity, and increase student engagement (Adedoyin & Altinay, 2023; Kuo et al., 2024). Meta-analyses show that ER contribute to more effective training of future educators by supporting cognitive development, creative engagement, and instructional design capabilities (Matorevhu, 2021; Amhag et al., 2019; Gupta & Pathania, 2021). Researchers suggest that learning with ER provides personalized and timely feedback through artificial intelligence or expert assessment and facilitates the scaling of face-to-face, hybrid, and fully online teaching methods (Escalante et al., 2023; Sayed et al., 2023). Furthermore, adding e-resources to teacher preparation programs makes teachers more competent and adaptable, ready for professional practice in a range of educational environments (Huang et al., 2020; Haleem et al., 2022; Panakaje et al., 2024).

Despite widespread international evidence, empirical research in developing and transitional education systems—such as in Central Asia—remains limited. In Kazakhstan, where teacher preparation programs are undergoing digitalization, ER has shown potential for improving pedagogical outcomes (Yerezhepov et al., 2025; Nurgaliyeva et al., 2025; Zhumabayeva et al., 2025). However, studies on the measurable impact of ER on future teachers' professional competencies are largely absent (Kurebayeva et al., 2025; Abildina et al., 2024). Moreover, educators increasingly face challenges such as declining attention spans among students (Nurgaliyeva et al., 2025), emphasizing the need for engaging and responsive digital tools in the training process. Therefore, integrating ER is not only a desirable approach to increase student motivation, but it is also a fundamental necessity for delivering educational materials engagingly and practically (Karibaev et al., 2024). Although prior research has shown the benefits of using ER, researchers have not paid much attention to this format, especially in the developing educational systems of Central Asia. Unfortunately, no study on the efficient use of ER in university classrooms for teacher training has been conducted in Kazakhstan (Ospankulov et al., 2023).

This study is significant because it provides empirical evidence of the potential of ER-supplemented training to improve the quality of primary teacher education, an important but understudied area in Kazakhstan's primary education system (Ayapbergenova et al., 2020). The novelty of this study lies in its focus on the relationship between training using ER and the enhancement of teaching skills (TS), as well as the impact of ER on the reflective practice and CM skills of PPSTs—areas that have been largely unexplored in Kazakhstan. The study was motivated by the need to provide teacher education institutions with useful information for developing a curriculum that combines traditional methods and approaches with ER, promoting the use of innovative technologies across various institutional and cultural contexts. The purpose of this study is to evaluate the impact of ER on the TS, reflective practices, and CM skills of PPSTs in Kazakhstan. To achieve this objective, the study addresses the following research questions:

- i. How does the use of ER enhance the teaching skills of PPSTs?
- ii. What is the impact of ER on reflective practice?
- iii. How do e-resources affect CM skills?

2. Methodology

2.1 Research Designs

The quantitative research approach was employed in this study. Specifically, a quasi-experimental design with pre-test and post-test measures was used to examine differences in educational outcomes associated with teaching using electronic resources among prospective primary school teachers (Stratton, 2019). The design enabled a comparison between an experimental group (EG) that received instruction supported by electronic resources and a control group (CG) that followed traditional instructional methods.

The experimental and control groups were drawn from two different higher education institutions—Abai University and Kazakh National Women's Teacher Training University (KazNWTTU). As a result, the study employed a non-equivalent groups quasi-experimental design, which warrants caution in interpreting the findings. Figure 1 illustrates the four key phases of the study.

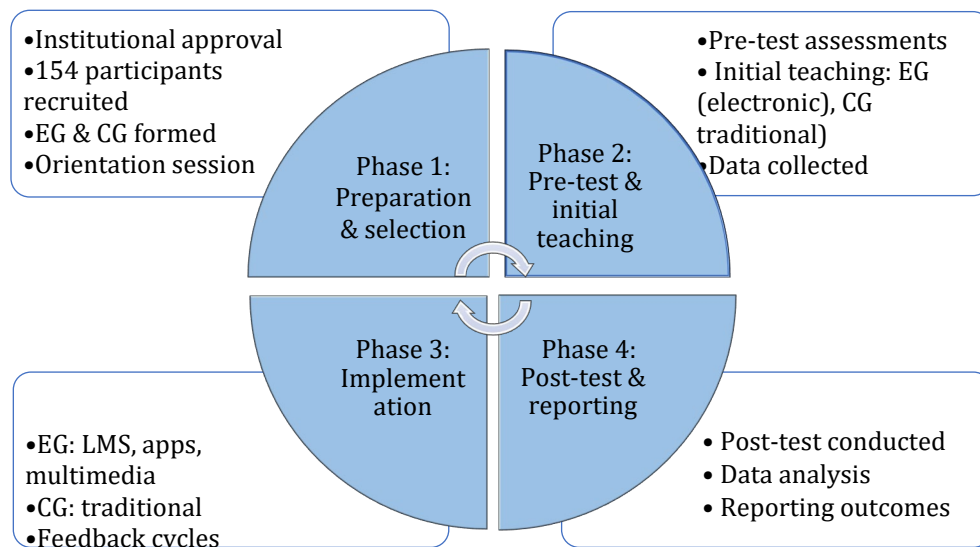


Fig. 1 Study phases

Phase 1 involved preparation and participant selection. Institutional approval was obtained from participating universities. A total of 154 participants were recruited based on eligibility criteria, and they were divided into the EG and the CG. An initial orientation session on the study objectives and procedures was conducted.

Phase 2 focused on the administration of the pre-test and the commencement of teaching sessions. Pre-test assessments were administered to measure baseline TS. Initial teaching sessions utilizing ER were conducted for both EG and CG. The EG used ER, while the CG followed traditional methods. Observational data and performance recordings were collected.

Phase 3 marked the implementation of teaching with ER. EG participants were introduced to a variety of electronic teaching resources, including LMS, educational apps, and multimedia content. Workshops and guided sessions were held weekly. CG participants continued traditional sessions without e-resources. Multiple feedback cycles were conducted, allowing EG participants to refine their TS based on insights.

Phase 4 encompassed the post-test administration, data analysis, and reporting of findings. After the instructional period concluded, post-test assessments were administered to both groups. The resulting data were then analysed to evaluate the impact of the teaching methods used.

2.2 Participants

To assess how electronic resources can enhance the TS of PPSTs, participants were recruited from two universities in Kazakhstan offering accredited undergraduate programs in primary education. These institutions were Abai Kazakh National Pedagogical University (Abai University) and the Kazakh National Women's Teacher Training University (KazNWTTU). The initial target population comprised 178 students across both institutions. However, due to accessibility and scheduling constraints, a total of 154 students were selected for participation using purposive sampling, with equal allocation to the EG and the CG, each containing 77 students aged from 20 to 27 years, with a mean age: 23.54 years (SD = 4.2). All participants were female, reflecting the enrollment demographics of the KazNWTTU, which formed the CG. The gender uniformity, reflecting the demographic composition of the KazNWTTU cohort, also ensured group comparability and eliminated gender as a confounding variable. Demographic and educational backgrounds of participants are shown in Table 1.

Table 1 Demographic and educational background of respondents

Characteristic	EG - Abai University	CG - KazNWTTU
Number of participants	77	77
Percentage (%)	50%	50%
Mean age (years $\pm$ SD)	23.54 (SD = 4.2)	23.54 (SD = 4.2)
Gender	Female	Female
Educational program	Primary education	Primary education

2.3 Instruments

Several instruments were developed and employed to measure changes in participants' teaching skills, reflective capacity, and CM skills (see Table 2).

Table 2 *Instruments used in the study*

Instrument	Description	Purpose
Multiple-choice questions (MCQs)	30 items on pedagogy, lesson planning, and instructional strategies	Measure cognitive understanding of teaching principles before and after the intervention
Case-based scenario questions	5 open-ended scenarios simulating classroom teaching situations	Assess application of pedagogical knowledge and reflective decision-making
Likert-scale self-assessment	20 items on instructional competence, use of technology, and self-reflection	Measure perceived growth in instructional practice and integration of ER
CM subtest	10 MCQs and case-based questions on discipline and student behavior	Evaluate participants' skills in managing diverse classroom situations

2.4 Instrument Validation and Reliability

The instruments used in this study were developed by the authors based on an analysis of relevant literature on teacher education, instructional planning, reflective practice, classroom management, and the pedagogical use of electronic resources. To ensure the quality and trustworthiness of the measurements, procedures for establishing content validity and reliability were undertaken.

Content validity was established through expert review. Three faculty members with expertise in teacher education, educational technology, and instructional methodology independently evaluated the instruments for relevance, clarity, and alignment with the study objectives. Based on their feedback, minor revisions were made to item wording and scenario descriptions to improve clarity and contextual appropriateness.

Reliability analysis was conducted using Cronbach's alpha (α) to assess internal consistency. The Likert-scale self-assessment instrument demonstrated good reliability, with a Cronbach's alpha of $\alpha = 0.87$. The multiple-choice questions (MCQs) assessing pedagogical knowledge yielded an acceptable reliability coefficient ($\alpha = 0.79$). The classroom management subtest, which combined MCQs and case-based items, also showed satisfactory internal consistency ($\alpha = 0.81$). These values indicate acceptable to good reliability for educational research.

The case-based scenario questions were evaluated using an analytic scoring rubric developed for this study. To enhance scoring consistency, clear criteria were defined for each performance level. While formal inter-rater reliability coefficients were not calculated, scoring procedures were standardized prior to analysis to reduce subjectivity. Overall, the validation and reliability procedures support the adequacy of the instruments for examining associations between the use of electronic resources and teaching-related outcomes among prospective primary school teachers.

2.5 Intervention

The intervention was designed to compare the effects of technology-enhanced instruction with traditional teaching approaches on the development of TS among prospective primary school teachers. Participants in the EG received structured training supported by specific electronic resources, while the control CG continued with conventional face-to-face instruction without the use of digital tools. The intervention lasted eight weeks and was integrated into regular coursework. In the EG, learning activities were delivered through a blended format combining in-person instruction with structured online components hosted on the Moodle learning management system. Moodle was used to distribute learning materials, administer quizzes, collect assignments, and facilitate asynchronous discussions. Educational applications used in the EG included lesson-planning and interactive teaching tools such as Google Classroom for assignment management, Canva for designing visual teaching materials, and Kahoot for formative assessment through digital quizzes. These applications were selected to support instructional planning, student engagement, and formative feedback. Multimedia content consisted of short instructional videos demonstrating effective teaching strategies, classroom management scenarios, and model lessons aligned with primary education standards. In addition, screen-recorded demonstrations and video-based case studies were used to prompt reflection and discussion during workshops. Practice activities involved microteaching sessions in which EG participants designed and delivered short lessons using digital tools. These sessions were recorded using mobile devices or built-in LMS recording functions and uploaded to Moodle for review. The continuous feedback mechanism in the EG operated through multiple channels. Instructors provided written and audio feedback on uploaded lesson plans and recorded microteaching sessions via the LMS. Peer feedback was facilitated through structured online discussion forums using guiding questions and evaluation rubrics. This iterative feedback cycle allowed participants to revise and improve their instructional practices

throughout the intervention period. In contrast, the CG received the same curricular content through traditional lectures, printed materials, and in-person microteaching activities. Feedback in the CG was provided periodically in oral or written form during class sessions, without the use of digital platforms. A summary of the intervention components by group is presented in Table 3.

Table 3 Description of intervention components by group

Component	EG	CG
Teaching approach	Integration of electronic teaching resources	Traditional face-to-face instruction without digital tools
Training format	Weekly workshops and guided sessions on digital pedagogy	Regular lectures and classroom-based sessions
Instructional tools	LMS (Moodle), commonly used educational apps for lesson planning and formative assessment, multimedia instructional content (videos, presentations), digital quizzes	Chalk-and-talk method, textbooks, printed handouts, paper assessments
Content delivery	Blended learning (online modules + in-person facilitation)	Fully in-person instruction
Practice activities	Microteaching with digital tools, interactive lesson planning using digital templates and applications	Microteaching using printed materials and oral presentations
Feedback mechanism	Continuous feedback via digital platforms (recordings, peer/instructor review)	Periodic oral or written feedback from instructors only
Duration	8 weeks	8 weeks

2.6 Study Procedure

Figure 2 provides an 8-week study procedure that outlines the experimental process using ER software.

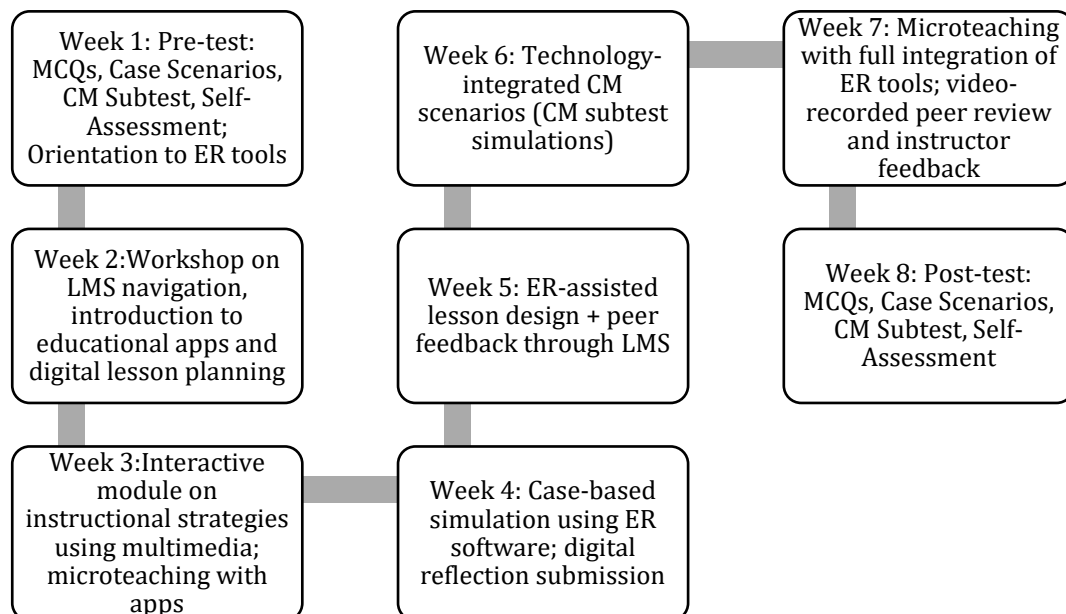


Fig. 2 The experimental design and learning activities

2.7 Data Analysis

Quantitative data were analyzed using descriptive and inferential statistics. Inferential statistical analyses were conducted using paired sample t-tests, independent sample t-tests, and chi-square tests, selected based on the level of measurement and research design. Paired sample t-tests were applied to examine within-group differences between pre-test and post-test scores for continuous variables. Independent sample t-tests were used to compare post-test mean scores between the experimental and control groups. The chi-square test was employed to analyze group differences in categorical performance levels. Statistical significance was determined at an alpha level of $p < 0.05$. All tests were two-tailed. The selection and interpretation of these statistical procedures follow established guidelines for quasi-experimental educational research (Gopalan et al., 2020; Miller et al., 2020). Each research question was mapped to the corresponding data sources and statistical techniques, as shown in Table 4.

Table 4 Research questions mapped to data and statistical analysis methods

Research question	Data collected	Paired Sample <i>t</i> -Test	Independent Sample <i>t</i> -Test	Chi-Square Test
How does the use of ER enhance the teaching skills of PPSTs?	Pre- and post-test scores (MCQs, case-based items); categorical skill levels	✓	✓	✓
What is the impact of ER on reflective practice?	Likert-scale self-assessment scores; scenario-based reflective responses	✓	✓	—
How do e-resources affect CM skills?	MCQ subtest scores on CM; relevant case-based responses	✓	—	—

3. Results and Discussion

The results of a paired sample t-test evaluating within-group improvements are shown in Table 6. The EG exhibited a statistically significant increase in test scores following the intervention. The difference in post-test outcomes between the groups is consistent with the view that technology-integrated instruction may support the development of teaching skills.

Table 5 Paired sample *t*-test: Within-group improvements (pre- vs. post-test)

Group	Pre-test mean (SD)	Post-test mean (SD)	t-value	df	p-value
EG	61.4 (7.8)	80.9 (6.3)	15.23	76	< 0.001
CG	60.1 (8.2)	63.4 (7.9)	2.15	76	0.035

These results align with previous studies demonstrating the benefits of integrating modern ER into educational settings. For instance, studies by Serrano et al. (2019) and Adiyono et al. (2024) revealed that the use of digital tools significantly enhanced students' pedagogical knowledge and engagement in teacher training. Similarly, Carol-Julian (2021) observed improvements in lesson planning and CM skills among teacher trainees using structured e-learning modules. The significant improvements observed in the EG are consistent with the potential of ER to support meaningful improvements when intentionally integrated into teacher training. Furthermore, these results are consistent with constructivist approaches to teach (Pratiwi & Yulia, 2024), which indicate that learning is more effective when students actively interact with engaging and multimodal content.

Table 6 and Figure 3 present the results of the between-group comparison: performance after the test.

Table 6 Independent sample *t*-Test: Teaching skills (post-test)

Measure	EG mean (SD)	CG mean (SD)	t	p
TS (post-test)	80.9 (6.3)	63.4 (7.9)	14.11, df = 152	< 0.001

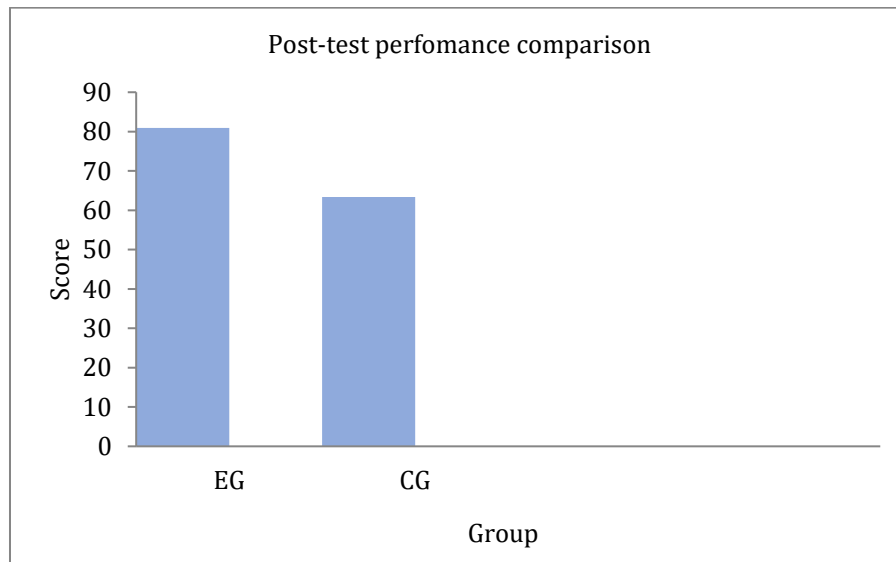


Fig. 3 Post-test performance comparison between EG and CG

The post-test scores were significantly higher in the EG ($M = 80.9$, $SD = 6.3$) compared to the CG ($M = 63.4$, $SD = 7.9$), $t(152) = 14.11$, $p < 0.001$. Higher post-test scores among EG participants suggest that technology integration may be associated with improved teaching skills among PPSTs. These findings align with a growing body of literature affirming the transformative role of digital technologies in teacher education (Adeshina, 2024; Brevik et al., 2019).

The results of the post-test distribution of TS levels between the EG and the CG are shown in Table 7 and Figure 4.

Table 7 Chi-square test: TS levels (categorical data)

TS levels	EG	CG	χ^2 -value	df	p-value
Basic (<65)	12	32	16.45	2	< 0.001
Proficient (65–79)	45	35			
Advanced (80+)	20	10			

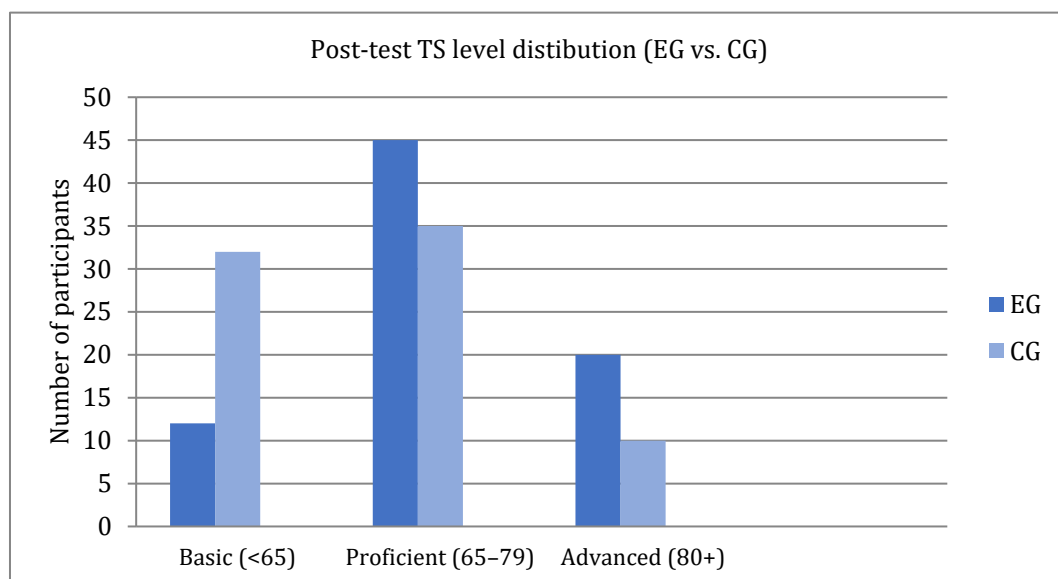


Fig. 4 TS skills level distribution by group

The analysis revealed a significantly higher proportion of EG participants reaching the “Proficient” and “Advanced” categories compared to those in the CG. Specifically, only 12 students in the EG remained at the “Basic” level (<65), in contrast to 32 in the CG. The chi-square test confirmed that this distributional difference was statistically significant, $\chi^2(2, N = 154) = 16.45$, $p < 0.001$. The research on differentiated learning outcomes in digital learning environments is consistent with these findings. For instance, technology-supported learning

environments have been shown to influence learners' progression into higher performance categories and enhance test scores (Batdi et al., 2018). Studies by Jerrim et al. (2023) and Gameil & Al-Abdullatif (2019), suggest that upward movement in assessed skill levels enhances teachers' confidence, motivation, and engagement—factors that contribute to sustained growth and long-term commitment to the profession. The gains observed in the EG thus reflect not only cognitive advancement but also positive psychosocial outcomes critical to high-quality teacher preparation. This result indicates not only a mean score improvement (as shown previously) but also a qualitative shift in performance categories, reflecting a distributional shift in teaching skill levels associated with participation in the ER-supported instructional context.

Table 8 presents the results of Paired sample t-tests conducted within each group.

Table 8 *Paired sample t-test: Self-reflection improvement (pre vs. post-test)*

Measure	Group	Pre-test mean (SD)	Post-test mean (SD)	t-value	df	p-value
Likert self-assessment	EG	3.1 (0.5)	4.2 (0.4)	13.65	76	< 0.001
	CG	3.2 (0.6)	3.5 (0.5)	3.11	76	0.003
Scenario reflection score	EG	12.5 (2.1)	17.8 (2.0)	14.02	76	< 0.001
	CG	12.3 (2.4)	13.4 (2.5)	2.19	76	0.032

Participants in the EG demonstrated significant gains in both self-assessed teaching development and scenario-based reflective thinking. The mean self-assessment score increased from 3.1 (SD = 0.5) to 4.2 (SD = 0.4), $t(76) = 13.65$, $p < 0.001$. Their scenario-based reflection scores improved from 12.5 to 17.8, $t(76) = 14.02$, $p < 0.001$. In contrast, the CG showed modest but statistically significant gains in both measures ($p < 0.05$), though their overall improvement was less pronounced. Further analysis using independent sample t-tests (see Table 9) confirmed statistically significant differences between the EG and CG in post-test scores for both measures.

Table 9 *Independent sample T-test: Self-assessment and reflection*

Measure	EG mean (SD)	CG mean (SD)	t	df	p
Likert self-assessment	4.2 (0.4)	3.5 (0.5)	9.17	152	< 0.001
Scenario reflection score	17.8 (2.0)	13.4 (2.5)	10.21	152	< 0.001

The EG outperformed the CG in self-perceived growth and reflective scenario responses, reinforcing the role of ER in enhancing instructional awareness and critical pedagogical thinking. These results support the view that technology-enhanced environments can promote metacognitive development and foster deeper reflective practices. For instance, Lloyd (2019) emphasizes the importance of reflection in enabling novice teachers to make context-responsive instructional decisions. The substantial gains in scenario-based reflection among EG participants suggest that the digital tools employed—such as structured case studies, video prompts, and guided feedback—enabled a more robust internalization of pedagogical reasoning. This aligns with Yuan & Mak (2018), who highlighted the transformative effect of scaffolded reflection on teacher identity formation. Likert-based improvements in perceived instructional competency can also be attributed to ongoing digital feedback and modeling, which likely enhanced self-monitoring and confidence. Yeh et al. (2017) similarly noted that multimedia-supported reflection tasks—such as simulations and interactive lesson evaluations—led to more thoughtful, layered responses among novice teachers. Taken together, the findings of this study affirm that digital pedagogical tools not only support technical skill acquisition but also facilitate professional identity development through structured reflective engagement.

Table 10 and Figure 5 present the findings of the t-test within-group improvement in the CM skills group

Table 10 *Paired sample t-test: Within-group improvement in CM skills*

Group	Pre-test mean (SD)	Post-test mean (SD)	t-value	df	p-value
EG	59.8 (7.5)	78.3 (6.1)	14.72	76	< 0.001
CG	58.9 (7.9)	63.7 (7.6)	3.12	76	0.003

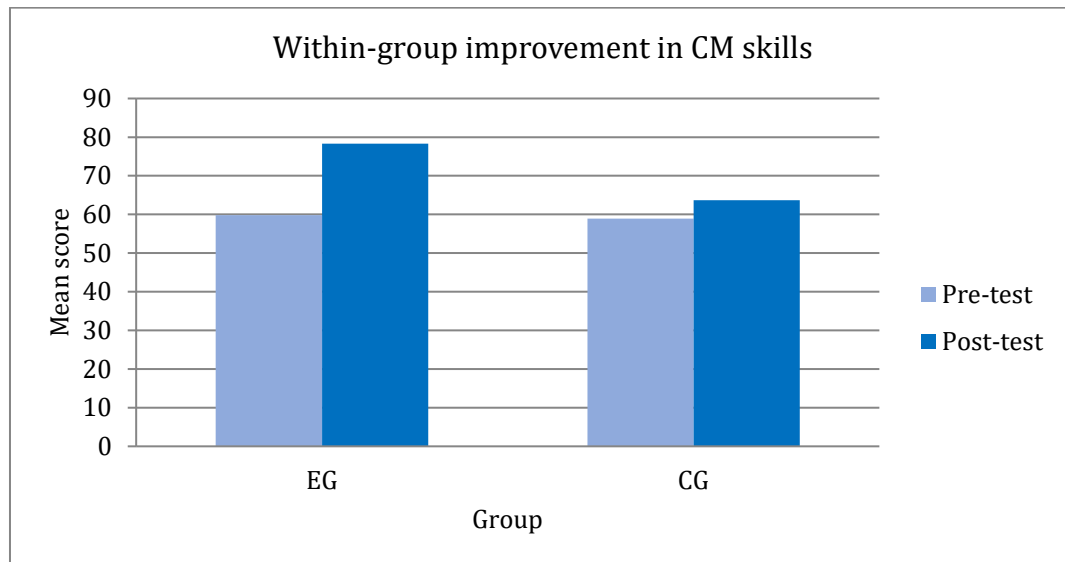


Fig. 5 Within-group improvement in CM skills

The impact of ER on CM skills was evaluated using MCQ scores and case-based assessments. EG significantly outperformed the CG ($t(152) = 12.84, p < .001$), indicating that participation in ER-supported instruction was associated with greater gains in CM skills compared to traditional instruction. In contrast, the relatively smaller improvement in the CG highlights the limitations of traditional instructional methods in this domain. These findings are consistent with prior studies emphasizing the value of interactive and scenario-based digital resources in enhancing CM skills (Farokhi et al., 2023). For example, McGarr (2021) found that multimedia tools, particularly those involving classroom simulations and behavioral modeling, improved pre-service teachers' understanding and application of proactive classroom management strategies. The notable performance gains in the EG reinforce this perspective and demonstrate how digitally enriched environments foster deeper engagement with complex pedagogical challenges. Further, Thiel et al. (2023) reported that pre-service teachers using video-based case studies developed more nuanced strategies for addressing disruptive behaviour and maintaining instructional flow. This is echoed in the current study's case-based assessment component, where EG participants showed significant growth—suggesting not only knowledge acquisition but also the ability to analyse, synthesize, and apply classroom management principles in contextually rich scenarios. Our findings resonate with this, particularly given the use of scenario-based reflection and assessment tools, which allowed participants to demonstrate their readiness for complex teaching contexts. The progression of EG participants from lower to higher levels of skill suggests that ER support not only cognitive advancement but also reflective engagement, metacognitive growth, and professional identity development. These outcomes collectively reinforce the transformative role of educational technology in preparing confident and competent educators.

4. Limitations

This study examines the association between the use of ER and teaching skills, reflective practices, and classroom management skills among PPSTs in Kazakhstan. However, several important limitations must be acknowledged. The most significant limitation concerns the quasi-experimental design employing non-equivalent groups drawn from two different higher education institutions. While this design enabled the implementation of the intervention in authentic educational settings, it did not allow for full control over pre-existing institutional differences. Variations in curriculum structure, instructional practices, faculty expertise, student admission criteria, and institutional culture may have influenced learning outcomes independently of the electronic resource intervention. As a result, the observed differences in post-test performance cannot be attributed solely to the intervention, and the findings should be interpreted as indicative of associations rather than causal effects. An additional limitation relates to the use of study-specific instruments developed for this research. Although acceptable content validity and internal consistency were established, the absence of externally standardized measurement tools may limit the comparability and generalizability of the results. Other constraints include the relatively short duration of the intervention (eight weeks), the gender homogeneity of the sample, and the confinement of the study to two institutions within a single national context. Collectively, these factors may restrict the broader applicability of the findings.

5. Conclusion

This study provides empirical evidence of an association between the integration of ER and enhanced teaching skills, reflective practices, and classroom management skills among PPSTs. The findings suggest that technology-enhanced learning environments can support the development of key professional competencies in teacher education by facilitating interactive learning, structured feedback, and reflective engagement with pedagogical content. However, the findings must be interpreted with methodological caution. The use of a quasi-experimental design with non-equivalent groups from different institutions limits causal inference, and pre-existing institutional differences may have contributed to the observed outcomes. In addition, although the measurement instruments demonstrated acceptable validity and reliability, their study-specific nature may affect the robustness and comparability of the results. Further limitations include the short intervention period, gender homogeneity of participants, and the national and institutional specificity of the sample. Future research should employ randomized or matched-group designs, utilize standardized and externally validated instruments, and adopt longitudinal and cross-institutional approaches to strengthen causal interpretation and enhance generalizability. Such efforts would contribute to a more comprehensive understanding of how electronic resources can be effectively integrated into teacher education programs across diverse contexts.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

*The authors confirm contribution to the paper as follows: **study conception and design:** Bauyrzhan Zhankushkov, Amina Amirova; **data collection:** Gulshat Bakhtiyarova; **analysis and interpretation of results:** Gulsara Zhussupbekova, **draft manuscript preparation:** Saniya Nurgaliyeva. All authors reviewed the results and approved the final version of the manuscript.*

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