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EDITED BY
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Elisabete Barros,
Portucalense University, Portugal

*CORRESPONDENCE
Dariya Abykenova
✉ abykenovad@pspu.kz

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Preparing educators for the digital age: teacher perceptions of active teaching methods and digital integration

Gulmira Abildinova[1], Elmira Abdykerimova[2], Almagul Assainova[3], Kaussar Mukhtarkyzy[4] and Dariya Abykenova[2]*

[1]Department of Computer Sciences, L.N. Gumilyov Eurasian National University, Astana, Kazakhstan, [2]Department of Computer Sciences, Caspian University of Technology and Engineering named after Sh. Yessenov, Aktau, Kazakhstan, [3]Department of Computer Sciences, Pavlodar Pedagogical University named after A. Margulan, Pavlodar, Kazakhstan, [4]Department of Information Technologies, K. Kulazhanov Kazakh University of Technology and Business, Astana, Kazakhstan

Introduction: This study investigates higher education teachers' perceptions of active teaching methods—Case-Based Learning (CBL), Problem-Based Learning (PBL), and Team-Based Learning (TBL)—and their integration with digital technologies. These pedagogical strategies are crucial for fostering critical thinking, collaboration, and problem-solving skills among students, especially in the digital age. Despite their benefits, challenges such as resource limitations, time constraints, and insufficient training hinder their implementation.

Methods: A mixed-methods approach was adopted, involving 104 educators from various higher education institutions in Kazakhstan. Participants underwent an eight-week training program consisting of 72 h of workshops, collaborative activities, and self-paced learning. Pre- and post-training assessments measured knowledge, confidence, and practical application of active teaching methods. Surveys, feedback sessions, and peer evaluations provided qualitative and quantitative insights into participants' experiences and challenges.

Results: The training program significantly improved participants' knowledge, confidence, and ability to implement CBL, PBL, and TBL. Post-training assessments showed a 4.2-point increase in confidence and practical application scores. Most educators (66.35%) reported moderate adaptability of these methods to their current educational programs, while 27.88% achieved high adaptability. Participants identified resource limitations (43.27%) and time constraints (33.65%) as key challenges. Problem-Based Learning (PBL) was preferred for fostering critical thinking and problem-solving, with a majority (51.92%) favoring it over other methods. Digital technologies, such as Moodle and augmented reality tools, enhanced teaching effectiveness and student engagement.

Discussion: The findings highlight the transformative potential of active teaching methods and digital integration in higher education. Educators across various academic positions and institutions perceived these methods as highly effective, aligning with the Diffusion of Innovations Theory. Challenges such as insufficient resources and curriculum misalignment were significant barriers to broader adoption. Continuous professional development, institutional support, and strategic resource allocation are crucial for optimizing these methods' impact.

KEYWORDS

active learning, higher education, digital technology integration, teacher training, case-based learning, team-based learning, problem-based learning, student engagement

1 Introduction

Case-Based Learning (CBL), Problem-Based Learning (PBL), and Team-Based Learning (TBL) are three distinct pedagogical approaches that promote active engagement and critical thinking in students. These methods focus on developing problem-solving, collaboration, and communication skills, which are crucial for success in real-world contexts. CBL engages students by immersing them in real-world problems, requiring the integration of interdisciplinary knowledge to develop practical solutions. This approach enhances communicative and collaborative skills, preparing students for complex problem-solving tasks (Visscher et al., 2022). Similarly, PBL fosters self-directed learning by confronting students with real-life problems at the start of the learning process. This method encourages deeper understanding and the practical application of knowledge in context (Malik and Shakeel, 2020). TBL transforms classrooms into dynamic, team-oriented environments where students work together to solve problems and make decisions. With its emphasis on individual accountability and peer collaboration, TBL enhances student motivation and learning outcomes (Burgess et al., 2021).

These methods collectively shift traditional lecture-based approaches toward more interactive, student-centered learning experiences. CBL, PBL, and TBL promote essential skills such as critical thinking, communication, and teamwork. Zhu et al. (2022) have demonstrated the effectiveness of TBL and PBL in enhancing multidisciplinary knowledge and skills, while Yin (2023) highlights their role in cultivating higher-order thinking and independent learning. Yunikawati and Tuanani (2022) compare TBL and PBL in economics education, finding that TBL is slightly more effective at improving critical thinking.

Integrating digital technologies with these active teaching methods has expanded their impact, especially in distance learning settings. TBL, for instance, is particularly effective in large classes, improving engagement and communication across educational levels (Haidet et al., 2014; Hur et al., 2013; Kuanbayeva et al., 2024). PBL fosters autonomy and critical thinking, particularly in medical and nursing education, where students apply practical solutions to complex problems (Crawford, 2011). CBL bridges theoretical knowledge with real-world applications, effectively developing students' analytical and problem-solving abilities in diverse educational contexts (Kohlert et al., 2018). Wyszomirska et al. (2021) emphasize the role of digital tools in creating flexible, interactive learning environments, which were particularly valuable during the shift to online education due to global health crises. Additionally, Criollo et al. (2023) highlight the role of emerging technologies, such as virtual reality and web applications, in facilitating innovative teaching models. Research by Dahal (2023) highlights that ICT facilitates pedagogical engagement, thus enhancing both teaching and learning experiences.

Digital technologies have been shown to enhance the effectiveness of active learning methods by increasing student engagement and collaboration (Freeman et al., 2014; Savery, 2015). These approaches promote critical thinking and problem-solving skills, but their successful implementation depends significantly on the preparedness and perceptions of the instructors (Barrows, 1996; Michaelsen, 2020). Teacher training programs that integrate digital technologies into active learning strategies improve educators' competencies in applying these tools to their teaching practices (Brownell and Tanner, 2012; Hora and Ferrare, 2013). Research by Rodrigues (2020) indicates that digital integration promotes student engagement and knowledge creation, while Kuznetsova (2022) highlights that training in digital tools fosters educators' creative potential and deepens student engagement.

Despite these benefits, educators still need help adopting digital teaching tools, citing concerns such as inadequate preparation time, limited technological resources, and student resistance to non-traditional learning methods (Michael, 2007). However, these attitudes can shift positively with proper support and evidence of effectiveness. Continuous professional development is crucial in this transformation, enabling teachers to plan and learn with dedicated time and institutional support (Sitthiworachart et al., 2022). Training programs combining CBL, PBL, and TBL with digital technologies positively impact teaching practices, positioning teachers as facilitators rather than traditional lecturers (Da Silva et al., 2022). Studies by Sitthiworachart et al. (2022) and Ertmer et al. (2012) demonstrate that educators are more inclined to integrate technology into their teaching after receiving hands-on training and support. Effective training programs are characterized by practical, hands-on experiences and continuous support for instructors (Ertmer et al., 2012; Koehler and Mishra, 2005).

The success of these training programs also depends on institutional culture, which should promote the continuous development of digital competencies among educators. Developing digital competencies requires strategic support and a comprehensive approach to professional development (Peters et al., 2022). Institutions must go beyond basic training and encourage the ongoing application of digital tools in active learning environments. Research by Cherusheva et al. (2023) and Diana et al. (2023) further supports integrating interactive learning platforms and ICT in higher education to enhance digital literacy and student engagement.

1.1 Research objectives

Given the theoretical backdrop of CBL, PBL, and TBL, this study applies Rogers et al.'s (2014) Diffusion of Innovations Theory to explore the perceptions of higher education instructors regarding these active teaching methods and their integration with digital technologies. The theory outlines how innovations are adopted within a social system based on relative advantage, compatibility, complexity, trialability, and observability. This approach provides a framework for understanding the key factors that influence the adoption of these pedagogical innovations in higher education. This study aims to understand the factors that facilitate or hinder the adoption of CBL, PBL, TBL, and digital technologies in higher education. Its focus is on improving teaching outcomes and addressing the challenges associated with these methods. The following questions guide the research inquiry:

1. How do higher education teachers perceive the impact of active teaching methods (CBL, TBL, PBL) on student engagement, critical thinking, and collaboration?
2. What are the primary challenges faced by teachers in implementing these methods?
3. To what extent are these methods integrated into current educational programs?
4. What improvements are necessary to enhance the incorporation of these methods?

2 Research design

2.1 Study design

This study employed a mixed-methods approach to examine higher education teachers' perceptions of active teaching methods and their integration with digital technologies. By combining quantitative survey data with qualitative insights, the research provides a comprehensive understanding of the training program's impact on participants' teaching practices.

2.2 Participants

The study involved 104 higher education practitioners in a specialized training program at L.N. Gumilyov Eurasian National University in Astana, Kazakhstan. Participants were selected using convenience sampling. The participants represented various roles in the higher education sector.

2.3 Training program

The training program spanned 8 weeks, totaling 72 h, and was designed to equip participants with the skills to implement CBL, TBL, and PBL in their teaching practices. The program was divided into 36 h of interactive workshops and collaborative activities and 36 h of self-paced learning. Self-paced learning involves independent study, project development, and engagement with online resources. In the self-paced hours, participants worked on assignments and reflected on their learning.

2.3.1 Objectives, outcomes, and structure of the training program

The training program was designed to enhance participants' knowledge and skills in active learning methodologies while integrating digital tools into teaching practices. The program progressed from foundational theory to practical application, allowing participants to achieve the outlined objectives. Each phase was carefully designed to build upon the previous one. The structured approach ensured that participants understood active learning principles and had the practical skills and confidence to implement these methods effectively in their teaching practices. The training program was delivered in a hybrid format, combining in-person workshops at L.N. Gumilyov Eurasian National University with online sessions. The online components were hosted through Moodle. Moodle allowed participants to engage in interactive lectures, discussions, and asynchronous learning via self-paced modules. This hybrid approach offered participants flexibility, ensuring they could engage with the program regardless of location.

The first objective was to enhance educators' understanding of CBL, TBL, and PBL principles and practices. The first objective was achieved through interactive lectures and group discussions in the program's initial phase (Weeks 1–2), where participants explored the theoretical foundations of these methods. Participants completed short quizzes and reflective exercises to assess their understanding, allowing them to demonstrate their knowledge through practical applications. By the end of this phase, participants were expected to show a solid grasp of how these active learning methods can foster student engagement, critical thinking, and collaboration.

The second objective focused on equipping educators with the skills to create engaging and effective educational materials. During Weeks 3–4, participants engaged in hands-on workshops where they applied their understanding of CBL, TBL, and PBL by developing case studies, problem scenarios, and team projects. These activities promoted teamwork and collaboration by organizing participants into groups, encouraging peer interaction and joint efforts in material creation. Peer reviews were a central part of this phase, as participants provided constructive feedback on each other's work, fostering a collaborative learning environment. The outcomes were assessed based on the quality and practicality of the materials produced, demonstrating participants' ability to create resources that support active learning.

The third objective was to improve educators' proficiency in using digital tools to support active learning. In Weeks 5–6, participants were introduced to various digital technologies to enhance classroom instruction and student engagement. The primary digital platform used was Moodle, a Learning Management System (LMS) that facilitated video conferencing, virtual classrooms, and multimedia resources for content delivery. Additional tools such as augmented reality, digital storytelling, infographics, and electronic whiteboards were introduced to make learning more interactive and visually engaging. By the end of this phase, participants demonstrated their ability to effectively integrate these digital tools into their lesson plans, showcasing their technical proficiency and innovation in educational settings.

The fourth objective sought to foster a collaborative learning environment among educators emphasized during Weeks 7–8 through application and mock teaching sessions. In this phase, participants developed lesson plans that integrated CBL, TBL, and PBL methodologies with the digital tools they had learned to use. These plans were applied in mock teaching sessions, where participants delivered lessons in a simulated classroom environment. These sessions were evaluated by peers and instructors, who provided feedback based on active learning methods, the effectiveness of digital tools, and overall student engagement. The feedback was used to refine participants' teaching strategies, fostering continuous improvement. Engagement in these collaborative activities demonstrated enhanced teamwork and communication skills.

2.3.2 Post-course support

Following the completion of the training program, participants received post-course support. This support included mentoring from experts in active learning methods and ongoing guidance through follow-up webinars and seminars. The study participants also had access to an online forum to continue collaborating, sharing resources, and discussing their experiences implementing the methods and tools they had learned during the training.

2.4 Assessment of training outcomes

The effectiveness of the training program was evaluated through a combination of pre-and post-training assessments, feedback sessions, and peer evaluations designed to measure the program's

impact on participants' knowledge, skills, and confidence in applying active learning methods. Pre-training assessments were used to establish a baseline for participants' knowledge of CBL, TBL, and PBL and their familiarity with digital tools. Post-training assessments measured improvements in these areas, particularly participants' ability to integrate digital technologies into their teaching practices. Surveys, feedback sessions, and peer evaluations provided qualitative insights, capturing participants' experiences and the perceived benefits and challenges of the training program.

2.4.1 Survey instrument

The survey instrument in this study was carefully designed to capture a broad understanding of higher education teachers' perceptions of active teaching methods (CBL, TBL, and PBL) and the integration of digital technology into teaching practices. A range of question formats was employed to gather diverse insights into participants' experiences, perceived effectiveness, and the challenges faced. The survey instrument was validated through a content validity process by ensuring the questions aligned with the training program's objectives. The survey instrument underwent expert review by three specialists in educational methodology and instructional design to ensure alignment with study objectives and content relevance. In addition, a pilot test involving educators who were not part of the main study helped refine the instrument for clarity. The instrument's reliability was assessed through Cronbach's alpha, which yielded a satisfactory coefficient of 0.85, indicating high internal consistency.

Questions 1–6 assess the perceived effectiveness of each teaching method. These questions use a mix of yes/no and rating scale responses to measure participants' confidence and perceptions of each method's effectiveness. The approach allows the study to capture immediate responses and nuanced variations in perceived impact. Questions 7–10 identify common challenges that educators encounter when implementing active teaching methods. Primarily multiple-choice, these questions allow respondents to select from a range of common issues, such as resource limitations and time constraints, highlighting specific barriers that may impede adoption.

Questions 13–16 focus on participants' experiences with and confidence in integrating digital tools alongside active teaching methods. This section includes both yes/no and Likert scale formats to capture general attitudes toward digital technology in teaching, as well as the intensity of agreement on its effectiveness in enhancing active learning. Questions 11–12 and 17–18 gather demographic details and contextual background on teaching practices. These are mostly multiple-choice or open-ended questions.

The survey questions addressed key areas such as the effectiveness of CBL, TBL, and PBL (Questions 1, 2, 3, 5, 6), the necessity and integration of these methods into educational programs (Questions 2, 8), and the availability of resources and training (Questions 7, 9). Additionally, questions related to student engagement and preferences (Question 6) and the main challenges and potential improvements (Questions 7, 10) provided a comprehensive assessment of the program's impact.

By structuring the survey across key focus areas and using varied question types, the instrument offers a detailed understanding of educators' experiences with active teaching methods and digital technology. This approach ensures that both general and specific aspects of implementation are explored, offering valuable insights into the factors influencing these teaching methods' effectiveness and adoption in higher education.

2.4.2 Pre- and post-training assessments

The pre-and post-training assessments were developed to measure participants' knowledge, confidence, and practical application of active learning methods and digital tools, serving as benchmarks to evaluate the immediate effects of the training program. The pre-training assessment was administered immediately before the program to establish a baseline. The post-training assessment followed directly after program completion, allowing for a comparative measure of changes in participants' skills and confidence levels.

Each assessment focused on three main constructs: (1) understanding of Case-Based Learning (CBL), Team-Based Learning (TBL), and Problem-Based Learning (PBL); (2) confidence in applying these methods; (3) familiarity with digital tools to support active learning. Participants responded to multiple-choice questions assessing knowledge, rated their confidence on a Likert scale, and self-reported their ability to apply these methods and tools practically. The pre-and post-training assessments provided a descriptive overview of the immediate impact of the training program, allowing for an analysis of general trends in educators' readiness to implement active teaching methods and digital tools. This approach to assessment supports the study's descriptive goals by quantifying shifts in participants' knowledge, confidence, and practical application within the context of the training program.

2.5 Data analysis

A descriptive approach was adopted to explore and document educators' perceptions of active teaching methods and digital integration in higher education. The primary objective of the research was to capture general trends, experiences, and perceived challenges. Descriptive statistics, including mean scores, standard deviation, and frequency distributions, were employed to summarize participants' responses, providing a clear overview of common patterns and observations within the dataset. The approach gathered insights into subjective experiences and identified prevailing themes. By focusing on descriptive analysis, this study highlights educators' attitudes and self-reported impacts of training, allowing for a detailed view of factors influencing the adoption of active teaching methods in the educational context.

3 Findings

The findings of this study are presented thematically. The reported data includes quantitative data from survey responses and qualitative data from peer evaluations and feedback sessions. The findings are structured around key themes of the effectiveness of active teaching methods, challenges in implementation, digital tool integration, and adaptation into educational programs.

3.1 Teacher perceptions of the effectiveness of active teaching methods and digital technologies

A primary objective of this study was to assess higher education teachers' perceptions of the effectiveness of Case-Based Learning (CBL), Problem-Based Learning (PBL), Team-Based Learning (TBL), and digital

TABLE 1 Question 1 responses.

Rating interval	Percentage
1–3	5%
4–6	10%
7–9	60%
10	25%

TABLE 2 Question 2 responses.

Rating Interval	Percentage
1–3	5%
4–6	10%
7–9	60%
10	25%

TABLE 3 Question 3 responses.

Rating interval	Percentage
1–3	10%
4–6	20%
7–9	50%
10	20%

technologies. The responses to the effectiveness of CBL methods (Question 1) showed high scores, with a mean of 8.3, median of eight, and standard deviation of 1.1. The frequency distribution is shown in Table 1.

The effectiveness rating of PBL methods (Question 2) showed high scores, with a mean of 8.5, a median of eight, and a standard deviation of 1.2. Table 2 demonstrates the frequency distribution.

The responses to the effectiveness of TBL methods (Question 3) showed a mean of 8.0, a median of eight, and a standard deviation of 1.3. The frequency distribution is represented in Table 3.

The frequency distribution analysis for the effectiveness of various teaching methods reveals that active teaching approaches such as Case-Based Learning, Problem-Based Learning, and Team-Based Learning are generally perceived positively by educators (see Figure 1). For CBL, most responses (60%) fall within the 7–9 rating interval, with a mean score of 8.3 and a standard deviation of 1.1, indicating strong approval and consistency among respondents. Similarly, PBL methods received a mean score of 8.5 with a standard deviation of 1.2, with 60% of responses also in the 7–9 range, highlighting its perceived effectiveness. While still viewed favorably, TBL methods showed a slightly broader spread with a mean score of 8.0 and a standard deviation of 1.3, with 50% of responses falling in the 7–9 range.

In response to question 5 about the most effective educational method, the data highlights the prominence of Problem-Based Learning, which was preferred by 54 respondents, accounting for about 51.92% of total responses (see Figure 2). Case-based learning was next, with 14 responses or approximately 13.46% of the total responses. Team-based learning garnered support from seven respondents, making up roughly 6.73%. Notably, mixed methods also saw considerable preference: Case and Problem-Based Learning (CPBL) was reported by nine respondents (8.65%), Case and Team-Based Learning (CTBL) was chosen by four respondents (3.85%), and Case, Team, and Problem-Based Learning (CTPBL) were selected by 16 respondents (15.38%). These findings emphasize the effectiveness of PBL in fostering critical thinking and problem-solving skills and highlight the relevance of mixed-method approaches in higher education.

The responses to question 6 reveal significant approval of the methods evaluated for engaging students (see Figure 3). The primary objective was to assess how higher education teachers perceive the effectiveness of active teaching methods (CBL, TBL, and PBL) and digital technologies in enhancing student engagement and learning outcomes. The category "Yes" was selected 103 times, comprising approximately 99.05% of the total responses. "No" was reported in zero responses. Only one response was categorized as "Neutral," making up roughly 0.95% of the total. This distribution of responses underscores a predominantly positive evaluation from educators on the effectiveness of these methods in meeting student interests.

3.2 Challenges in implementing these methods

The survey sought to identify teachers' main challenges in implementing these active teaching methods. In responses to Question 9, 65% of teachers felt they needed more resources and training to implement these methods effectively (see Figure 4). In response to Question 7, investigating the main problems identified in using active teaching methods, the answers were predominantly centered around resource limitations and time constraints. Specifically, 45 respondents, accounting for 43.27%, cited a lack of resources as a significant issue, while 35 respondents, representing 33.65%, reported time limits as a major hindrance. Additionally, 20 participants, equaling 19.23% of the responses, highlighted difficulties in evaluation as a critical challenge. A small percentage of respondents noted other issues, with one respondent (0.96%) indicating a heavy workload. One respondent (0.96%) said they had not used these methods before. One respondent (0.96%) faced difficulties in responding. Only one participant did not provide any response, accounting for 0.96% of the total. These findings underscore the need to effectively address resource availability and time management to implement active teaching methods.

The feedback sessions revealed that participants frequently mentioned resource limitations and time constraints as significant challenges in implementing active teaching methods. One participant noted, "While the training was excellent, applying these methods without sufficient resources is quite challenging." Another echoed this sentiment: "The lack of time to plan and implement these methods properly is a major obstacle." Peer evaluations highlighted similar concerns, with peers observing that while participants were enthusiastic and more confident after the training, they often struggled with the practical aspects of implementation due to resource and time constraints. One peer commented, "I have seen a positive change in my colleague's approach, but they are often frustrated by the lack of resources to implement what they learned fully."

3.3 Digital tool integration and professional development

Comparison of the pre-and post-training assessments showed improvements across three constructs: knowledge, confidence, and practical application (see Table 4).

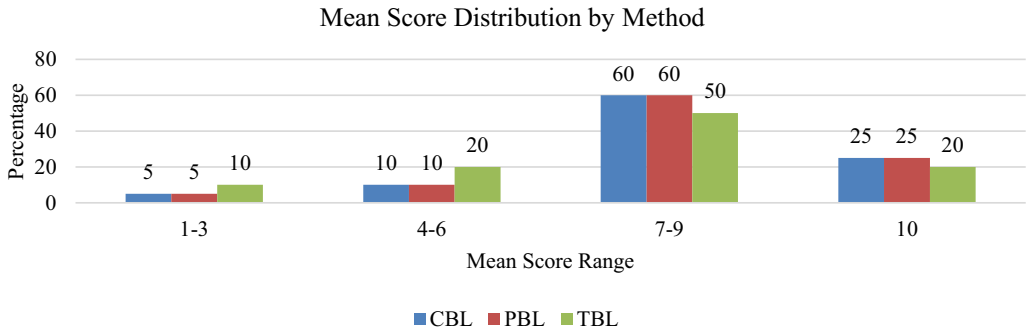

FIGURE 1
Frequency distribution of interval ratings assigned to each method (Questions 1–3).

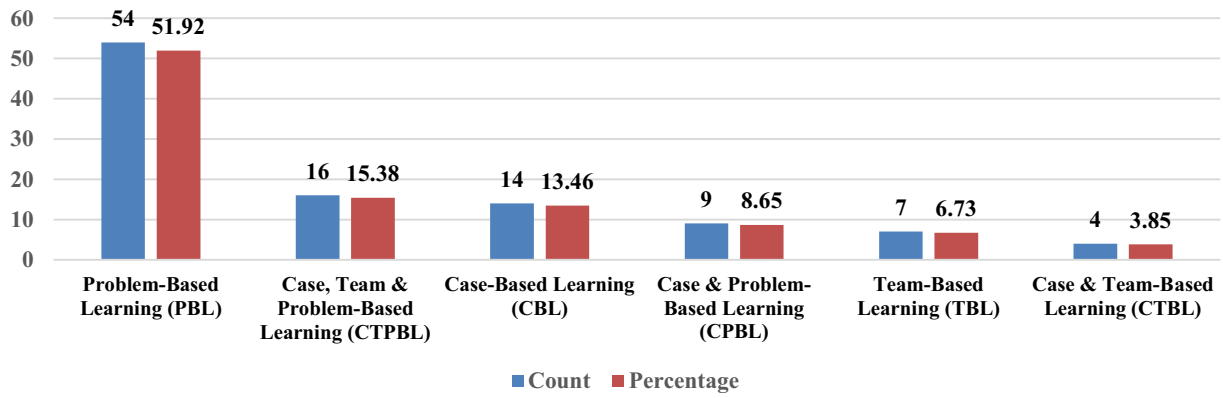

FIGURE 2
Perceptions of teaching method effectiveness (Question 5).

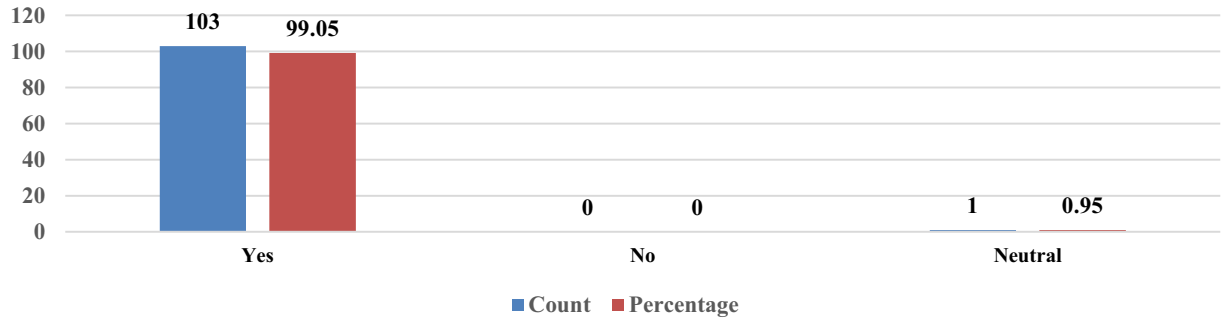

FIGURE 3
Perceived effectiveness of active teaching methods (Question 6).

The pre-training mean score for knowledge was 3.5 (SD = 1.0), which increased to 7.8 (SD = 0.8) in the post-training assessments. Additionally, the reported participants' confidence in applying active learning methods increased substantially from a pre-training mean of 4.0 (SD = 1.2) to a post-training mean of 8.2 (SD = 0.7). Furthermore, on the aspect of the practical application of active teaching methods and digital technologies, the mean scores increased from 3.8 (SD = 1.1) pre-training to 8.0 (SD = 0.9) post-training.

The feedback sessions revealed several key themes. Participants frequently mentioned the practical applicability of the training content, with many appreciating the hands-on workshops and collaborative activities. One participant noted, "The training provided me with practical tools and techniques that I can immediately apply in my teaching." Feedback sessions indicated that the training program was well-received, with participants highlighting the relevance and applicability of the content. The practical nature of the training, which allowed

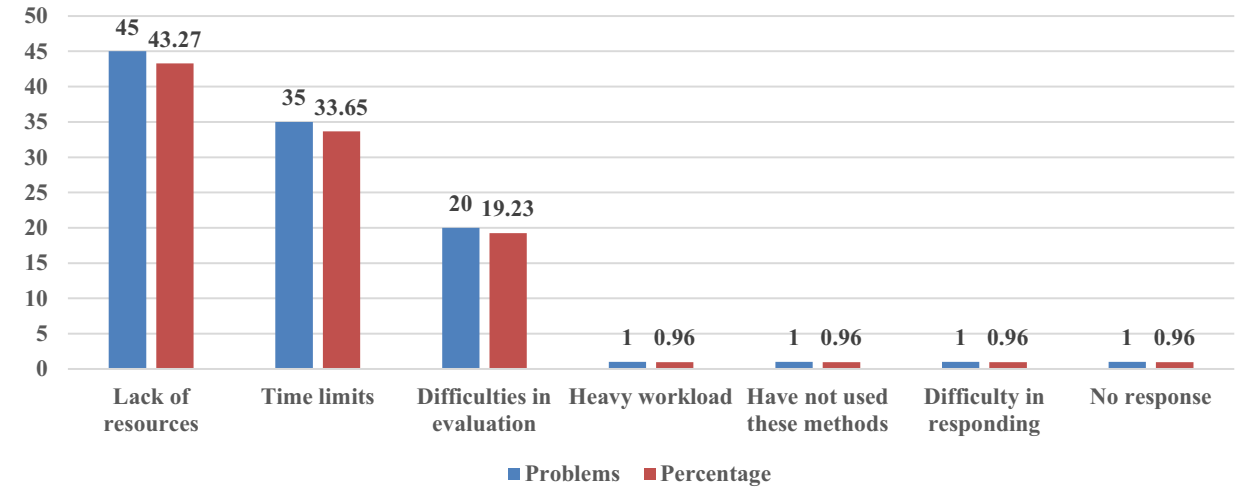

FIGURE 4
Problems reported by respondents (Question 7).

TABLE 4 Pre- and Post-training test results.

Construct	Pre-training mean (SD)	Post-training mean (SD)	Improvement
Knowledge	3.5 (1.0)	7.8 (0.8)	+4.3
Confidence	4.0 (1.2)	8.2 (0.7)	+4.2
Practical application	3.8 (1.1)	8.0 (0.9)	+4.2

participants to engage with the material actively and collaborate with peers, was particularly valued.

Peer evaluations highlighted the positive changes in participants' teaching practices. Peers observed that participants were more confident and effective in implementing active teaching methods and digital tools. One peer commented, "I noticed a significant improvement in how my colleague engages students and integrates technology into lessons." The peer evaluations provided an external validation of the improvements reported by the study participants themselves. Observations from peers indicated that the training had a tangible impact on participants' teaching practices.

3.4 Adaptation and integration of active teaching methods into educational programs

Despite the reported challenges, the educators generally felt that these methods were adaptable to their current educational programs (Question 8) (see Figure 5). A low level of adaptation was observed in six out of 104 cases, representing approximately 5.77% of the responses. In contrast, most methods, totaling 69 out of 104 cases or 66.35%, were rated as moderately adaptive. High levels of adaptation were seen in 29 out of 104 cases or about 27.88%. Feedback sessions indicated that while many participants found these methods adaptable, they suggested more structured integration into curricula. One participant noted, "The methods are good, but they need better alignment with our existing curriculum." Another participant recommended, "We need more support to adapt these methods to our specific program requirements." Peer evaluations corroborated these findings. Peers observed that although participants were integrating the methods into their teaching, the level of integration varied. One peer commented, "I have seen improvements in teaching methods, but there is still a need for more comprehensive integration into the overall program."

3.5 Suggested improvements for incorporating these methods

The survey identified areas for improvement in incorporating active teaching methods. Despite the positive feedback, participants reported several challenges and gave suggestions for improvement. The distribution of respondents is listed in Figure 6.

The survey data indicates that 46.15% of educators emphasized the need for more resources to support the implementation of active teaching methods. Good preparation and ongoing support were mentioned by 29.81% of participants. Additionally, 14.42% of the respondents called for changes in the curriculum to facilitate the integration of these methods more seamlessly. Improvements in attracting students to engage with these innovative approaches were noted by 8.65% of the respondents. A small percentage (0.96%) had no specific suggestions or expressed difficulty responding.

Feedback sessions revealed a strong demand for increased resources and better training. One participant noted, "We need more access to digital tools and ongoing support to make these methods work effectively." Another suggested, "Curriculum changes are necessary to incorporate these active teaching methods better." Peer evaluations

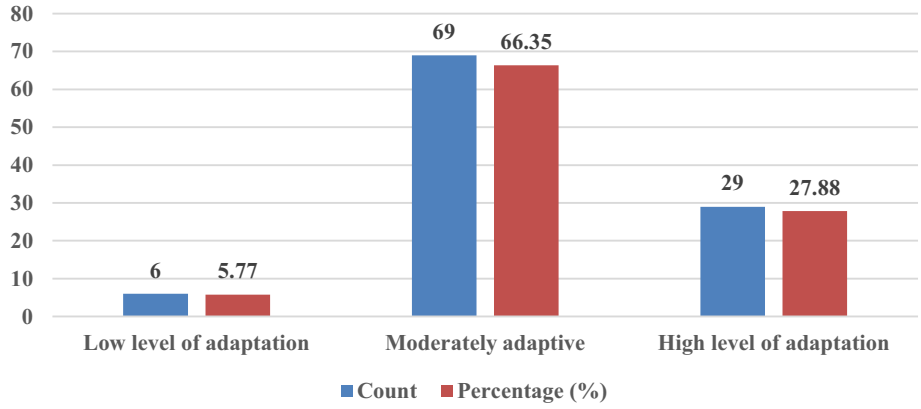

FIGURE 5
Level of adaptation (Question 8).

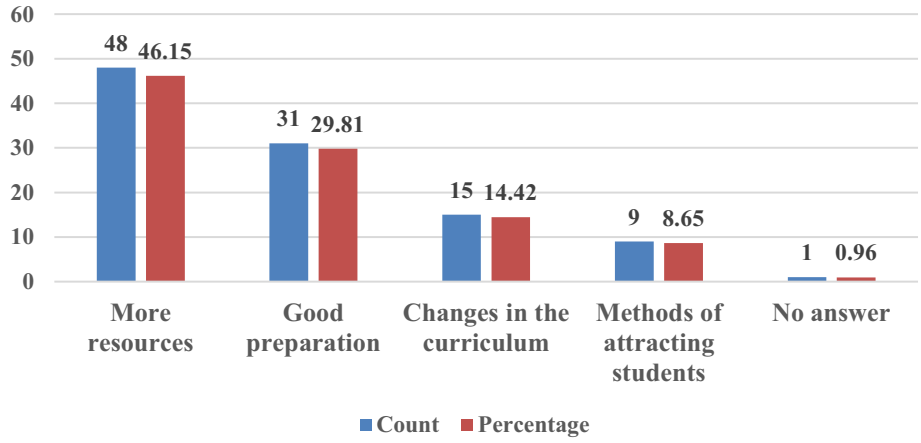

FIGURE 6
Distribution of suggested improvements for incorporating teaching methods (Question 10).

indicated that while participants showed improved teaching practices, they often faced challenges due to lacking resources and support. One peer commented, "My colleague has improved their teaching approach, but more institutional support is needed to sustain these changes."

4 Discussion

The findings from this study reveal educators' perceptions of active teaching methods (CBL, TBL, and PBL) and digital technologies in higher education, providing insight into their perceived effectiveness, challenges in implementation, and integration into educational programs. Using the Diffusion of Innovations Theory by Everett Rogers, this study examines the adoption process and challenges associated with these methods (Rogers et al., 2014).

4.1 Effectiveness of active teaching methods and digital technologies

The reported mean effectiveness scores for CBL, PBL, and TBL were 8.3, 8.5, and 8.0. According to the Diffusion of Innovations Theory, educators' perceptions of the relative advantage of these methods over traditional approaches influence their willingness to adopt them. Educators reported that active teaching methods improved student engagement, critical thinking, and problem-solving skills, aligning with previous studies that emphasize the benefits of active learning (Freeman et al., 2014; Michael, 2007). High self-reported effectiveness ratings suggest that these methods align with educators' teaching goals. The training program likely reduced the complexity of these methods through hands-on workshops, making them easier to understand and implement. The finding is supported by Burgess et al. (2021), who observed that scaffolding students' knowledge through TBL and CBL is highly effective. Pre- and post-training assessments indicated increases in participants' knowledge, confidence, and practical application scores. Feedback sessions revealed themes related to the practical relevance of the training content, with participants frequently highlighting the utility of hands-on workshops and collaborative activities. Peer evaluations also observed that participants were more confident and effective in applying active teaching methods and digital tools after the training.

These findings indicate that educators perceive active teaching methods and digital technologies as highly beneficial for enhancing student engagement, critical thinking, and collaborative learning. The

strong effectiveness ratings for methods like CBL and PBL reflect a general alignment between educators' teaching goals and the capabilities of active learning strategies. The observed improvements in confidence and practical application suggest that hands-on training effectively supports educators in integrating these methods, potentially boosting their willingness to adopt them in varied educational settings.

4.2 Challenges in implementing these methods

The study explored the primary challenges educators face in implementing active teaching methods, focusing on resource limitations and time constraints. These challenges align with the concept of complexity in the Diffusion of Innovations Theory, as higher complexity can hinder the adoption process. Participants expressed concerns regarding resource availability and the time required to plan and implement these methods. Effective communication channels are crucial for disseminating knowledge about these methods and reducing perceived complexity. The training program's role in addressing these challenges emphasizes the need for ongoing support and resources for educators. The needs align with Brownell and Tanner (2012), who identified lack of training, time, and incentives as barriers to pedagogical change. Feedback sessions confirmed that participants consistently noted resource limitations and time constraints as obstacles. At the same time, peer evaluations indicated that although participants were more confident post-training, they faced challenges with practical implementation due to limited resources and time. The survey responses underscore that resource limitations and time constraints remain significant challenges in adopting active teaching methods. Educators' consistent feedback on these obstacles highlights the need for institutional support and resource allocation to ease the integration of these methods. Addressing these constraints may enhance the practicality of active teaching strategies, enabling broader and more effective implementation.

4.3 Integration of methods into educational programs

The survey responses also investigated the extent to which active teaching methods are integrated into current educational programs. Approximately 66.35% of participants reported moderate integration, while 27.88% reported high levels of integration. This variation reflects the stages of adoption knowledge, persuasion, decision, implementation, and confirmation outlined in the Diffusion of Innovations Theory. Educators are at different points in this adoption process, with some fully integrating these methods while others are still in the persuasion or implementation stages. The institutional culture and support system plays a critical role in facilitating successful adoption. This finding is consistent with Zhu et al. (2022), who found significant integration and positive educational outcomes through the TBL-PBL teaching model in medical education. Feedback sessions indicated that while participants found these methods adaptable, they suggested more structured integration into curricula to support adoption further. Peer evaluations observed varied levels of integration, reflecting the different adoption stages among participants.

The findings show a moderate to high degree of integration of active teaching methods within educational programs, indicating gradual adoption. Differences in integration levels among educators suggest that institutional support and an innovation-friendly culture are influential in facilitating the successful use of these methods. Ensuring a supportive environment that encourages experimentation and gradual adoption could foster greater consistency in method integration across programs.

4.4 Improvements for incorporating these methods

Educators in the survey suggested improvements to support the adoption of active teaching methods, including increased resources and enhanced training. These suggestions align with the innovation-decision process in the Diffusion of Innovations Theory, where trialability and observability can facilitate adoption. Providing educators with more resources and continuous professional development opportunities allows them to experiment with these methods on a smaller scale, observe their effectiveness, and build confidence for broader applications. Ongoing support mechanisms such as mentoring and peer collaboration further assist educators in overcoming challenges and refining their teaching practices. These findings align with Ertmer et al. (2012), who emphasized that teacher beliefs and technology integration are closely linked, with continuous support being critical for successful implementation. Feedback sessions showed a strong demand for more resources and training. At the same time, peer evaluations indicated that, although participants improved their teaching practices, they still faced obstacles due to limited resources and support.

Educators' suggestions for more resources and ongoing professional development indicate a strong desire for enhanced support in adopting active teaching practices. Trialability and observability, as emphasized by the Diffusion of Innovations Theory, may be key in empowering educators to experiment with these methods on a manageable scale, thereby fostering greater comfort and confidence. Structured mentorship and peer collaboration can further support educators, creating a community of practice around these methods.

4.5 Implications and recommendations for professional development

The positive reception of the training program highlights the need for sustained investment in training initiatives that combine theory with practical application. The reported success of hands-on, interactive program components suggests that future programs should incorporate similar approaches. Addressing resource limitations and time constraints is essential for maximizing the potential of these methods. Institutions are encouraged to provide adequate resources and continuous support and foster a culture that values innovation and professional development. These recommendations align with Darling-Hammond et al. (2017), who emphasize the importance of institutional support in effective teacher professional development. Study participants suggested curriculum adjustments to better accommodate active teaching methods, with many educators calling for enhanced preparation and continuous support, consistent with Ertmer et al. (2012), who found that sustained support is essential for effective technology integration and teaching development. The positive reception of the training program highlights the importance of combining theoretical and practical

elements in professional development for educators. Addressing resource limitations and promoting a culture of continuous support may be essential for maximizing the adoption of active teaching methods. Tailored training programs that include collaborative and hands-on components could increase educators' confidence and efficacy in applying these methods, suggesting a promising direction for future professional development initiatives.

4.6 Limitations and future research

While this study provides valuable insights into educators' perceptions and experiences with active teaching methods and digital integration, it is limited by its descriptive analysis and the robustness of the survey instrument. The reliance on self-reported survey data, composed of yes/no, multiple-choice, and rating scale questions, restricts the study's ability to make inferential claims about causation or predictive relationships. Additionally, the convenience sampling method, though practical, introduces potential biases due to the non-random selection of participants and findings in a relatively homogeneous sample, as participants shared a recent training experience. These factors constrain the generalizability of findings across different populations and contexts.

To further enhance the understanding of active teaching methods' long-term impacts on teaching practices and student outcomes, future research could benefit from longitudinal studies, which would provide insights into how sustained use of these methods and digital tools affects student engagement, learning outcomes, and teaching effectiveness over time. For instance, Freeman et al. (2014) indicated that active learning fosters both immediate student performance improvements and long-term critical thinking skills. Additionally, a larger, more diverse sample with a fully validated survey instrument, potentially using stratified random sampling, would enhance the generalizability and rigor of the findings, allowing for more robust inferential analysis and establishing stronger conclusions on the effectiveness of active teaching methods in higher education.

5 Conclusion

This study reveals that higher education teachers perceive active teaching methods and digital integration as beneficial in enhancing student engagement, collaboration, and critical thinking. The specialized training program significantly improved teachers' confidence and readiness to implement these methods, with Problem-Based Learning (PBL) being particularly valued for its impact on critical thinking and problem-solving. Despite challenges such as resource limitations and time constraints, the adaptability of these methods suggests their potential for broader experimentation across educational contexts. Addressing these challenges and providing additional support will further enhance the adoption and effectiveness of innovative teaching practices. Framing the discussion within the Diffusion of Innovations Theory provided a comprehensive understanding of the factors influencing adoption, including perceived relative advantage, complexity, and the importance of supportive environments. These insights can guide future research and professional development initiatives, ultimately fostering a more effective integration of active learning in higher education.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Ethical Commission of the NAO "Pavlodar Pedagogical University named after A. Margulan" dated 15.01.2024, under the approval code 1. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

GA: Formal analysis, Funding acquisition, Writing – review & editing. EA: Supervision, Validation, Writing – review & editing. AA: Investigation, Visualization, Writing – review & editing. KM: Methodology, Writing – original draft. DA: Methodology, Writing – original draft, Data curation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1473766/full#supplementary-material

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