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Promoting online teaching through active learning strategies: applications and innovations

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Online teaching extends beyond the mere creation of educational materials and the broadcasting of lectures. It should be enjoyable, engaging, collaborative, and comfortable, which can be achieved through the implementation of active learning strategies in an online environment. Therefore, this study focused on the effectiveness of online active learning techniques—think-pair-sharing, timed pair sharing, three-step interviews, jigsaw, and case studies—on students' cognitive achievement and attitudes toward online learning. The study involved 23 female students enrolled in the "Methods of Teaching Physical Education (PE) and Self-Defense Sports" e-course. A quasi-experimental method was employed, creating a single group in which blackboard e-learning systems were utilized alongside online active learning strategies. A repeated-measures ANOVA was conducted to assess the effect size across pre, post, and follow-up tests. The results revealed significant differences between the pre- and post-measurements, with the post-measurements demonstrating greater effectiveness. The follow-up measurement indicated statistically significant differences compared with the premeasurement measurement ($\eta^2 = 0.98$). Despite a one-month interruption without learning or teaching, there was no statistically significant difference between the follow-up and post-measurements, suggesting that the experimental group maintained their cognitive level. Furthermore, the results indicated that students' positive attitudes toward active online learning strategies influence cognitive, emotional, and behavioral factors. In conclusion, these techniques improve information processing and working memory in online courses, enhancing cognitive outcomes, motivation, and skills for academic success. This paper advocates transforming traditional online learning into interactive, student-centered experiences that foster critical thinking and retention. Successful implementation requires careful planning, resources, and skilled educators.

KEYWORDS

e-learning, teaching, education, active learning, learning management systems

1 Introduction

Student engagement is a major challenge in both face-to-face and online courses. The COVID-19 pandemic has normalized online learning for some courses and increased the popularity of blended learning, emphasizing skill development (UNESCO, 2020a). However, platforms such as Google Meet, Webex, and Zoom yielded unsatisfactory outcomes during this period (Stephen, 2021). Singh and Meena (2024) suggested that higher education institutions create a flexible and inclusive learning environment for faculty and students post-COVID-19. Effective online learning should incorporate various learning theories tailored to content, objectives, and learner characteristics, enabling instructors to provide meaningful experiences.

Collaborative learning is beneficial for students, especially in courses that require critical thinking and problem-solving skills (Laal and Ghodsi, 2012). The implementation of online active learning strategies is crucial for preventing educational and social disparities. Enhancing distance learning effectiveness involves increasing student participation when in-person attendance is not possible (UNESCO, 2020b). UNESCO and ILO (2020) highlighted that teacher professional development (TPD) and online and blended learning (OBL) are key priorities. Teachers and students must develop technical solutions and digital literacy skills to integrate technology into education. Online teaching goes beyond creating educational materials or delivering lectures (De Pryck and Depryck, 2021); it requires fostering an engaging, collaborative, and comfortable learning environment (Al Bogami and Elyas, 2020). According to Flores et al. (2024), teachers should seriously consider allocating a portion of the online course to active student engagement, discussions, and quizzes, which can be integrated into a learning management system.

Educators can address this issue by integrating active learning strategies, which include cooperative, collaborative, and problem-based learning (Prince, 2004). The goal of these strategies is to engage students in the learning process (Lougheed et al., 2012). Although active learning is often overlooked in online or blended environments, incorporating it into assignments, discussions, and assessments to promote student participation is vital. Effective learning requires well-designed discussions, group work, and a collaborative environment.

Several studies have explored the integration of active learning into online teaching. Patel et al. (2018) reported that unsupervised online open-book tests improved student motivation and grades, thereby encouraging active engagement with key concepts. Lieser et al. (2018) emphasized effective strategies for incorporating webinar applications into blended learning environments. Khan et al. (2017) reviewed methods to increase student participation in online courses. However, Rakha (2023) cautioned that the use of tools such as Blackboard Collaborate Ultra does not guarantee educational success. According to Wagino et al. (2024), e-learning systems facilitate interaction between learners and educators through problem-based learning (PBL), which enhances engagement and encourages active learning and problem solving. Thus, online teaching should incorporate strategies that promote student engagement, such as cooperative learning and PBL.

Several studies have explored effective online teaching in physical education (PE). Butts et al. (2013) examined two engagement approaches for undergraduate health and PE students: one promoting online interaction and the other using traditional face-to-face lectures. The results showed that students can engage with course content effectively in both formats. Casey et al. (2017) suggested that focusing on emerging technologies in digital learning could enhance health and PE education. Tagimaucia et al. (2024) reported that teachers struggled with online PE because of inadequate preparation, poor internet connectivity, and a lack of emphasis during lockdowns. Despite their readiness, integrating technology remains challenging owing to limited support and fear of the unknown. The study underscores the importance of technology in creating engaging PE experiences and recommends specialized resources and personalized curriculum guidance. Murtagh et al. (2023) proposed that the online delivery of physical education teacher education programs can complement traditional methods and called for further research to improve online teaching for preservice teachers.

This study aims to bridge the gap between active learning strategies that enhance student engagement and the adaptation of these strategies for online instruction. This objective is accomplished through the implementation of innovative online active learning techniques. Additionally, the study evaluated the impact of these techniques on the cognitive achievements and attitudes of female educators enrolled in the Higher Diploma Program. The assessment is conducted during the "Methods of Teaching Physical Education and Self-Defense Sports" e-course offered on the Blackboard platform. The current study addresses two primary research questions (RQs) within a single alternative hypothesis (Ha):

RQ1: Are there significant differences at the 0.05 level among pretest, posttest, and follow-up measurements of cognitive achievement for students in the experimental group?

Ha: There are statistically significant differences at the 0.05 significance level among the repeated measurements (pretest, posttest, and follow-up) in the cognitive achievement of students in the experimental group.

RQ2: What are female students' attitudes toward online active learning strategies in e-courses?

The conceptual framework for the current study is depicted in Figure 1.

2 Theoretical framework

2.1 A brief overview of active learning and its techniques

Active learning engages students in meaningful activities and reflection (Bonwell and Eison, 1991), replacing lectures with student-centered problem-solving exercises (Apkarian et al., 2021). It requires students to take an active role (Johnson and Johnson, 2008) and includes approaches such as collaborative learning, cooperative learning, and problem-based learning (Prince, 2004). Collaborative learning involves students working together toward common goals, with evaluations at both the group and individual levels (Millis and Cottell Jr, 1997). In contrast, cooperative learning is teacher-directed, focusing on achieving specific goals (Panitz, 1999). The main difference lies in the emphasis on teacher guidance in cooperative learning vs. student interaction in collaborative learning. Both approaches aim to enhance higher-order thinking skills (HOTS) (Davidson and Major, 2014).

2.2 Cooperative learning techniques

To foster student cooperation, several cooperative learning techniques have been developed, particularly those suitable for

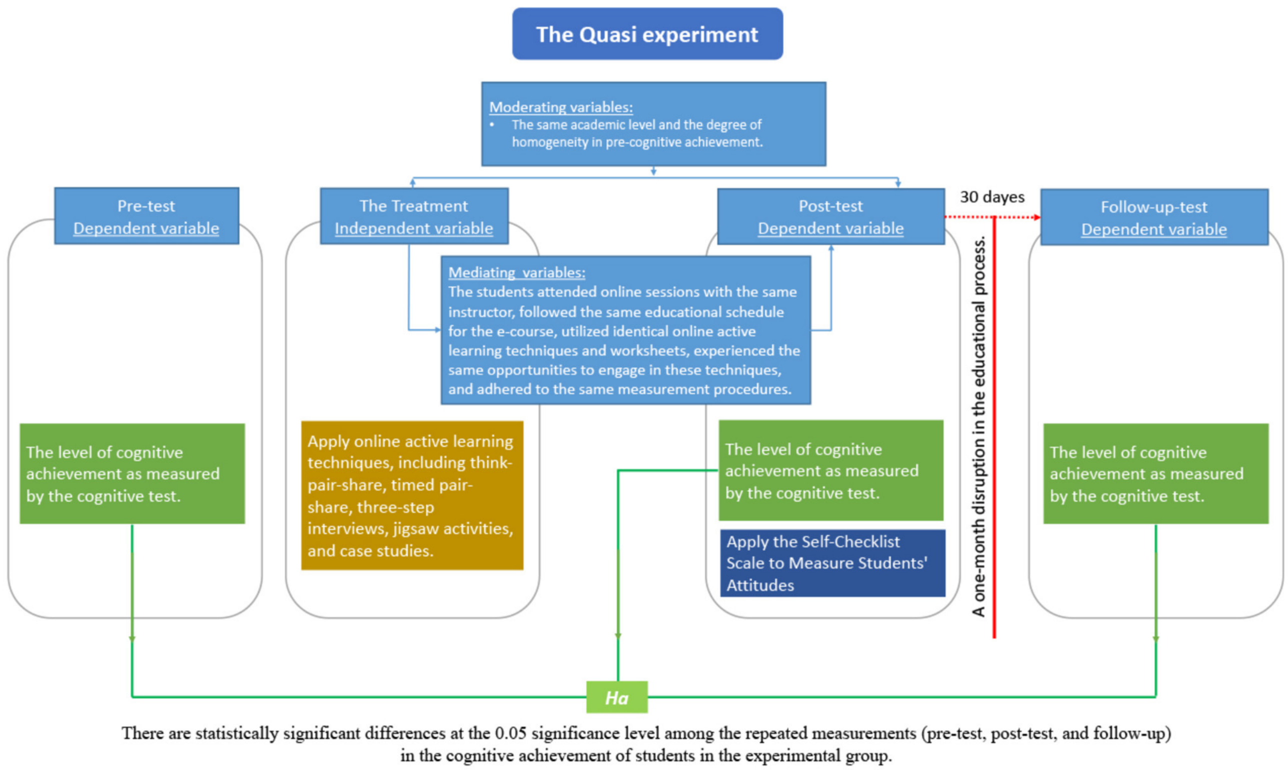

FIGURE 1
The conceptual framework.

online learning. One such technique is Think-Pair-Share, which involves asking a question, giving students time to think, and then having them share their thoughts with a partner. This method effectively initiates whole-class discussions. During the thinking phase, students reflect before speaking, allowing them to organize their ideas. This approach enables learners to compare concepts and practice responses in a low-stakes environment before they share them publicly (Lyman, 1992).

Another approach is the three-step interview, which involves dividing learners into small groups of three students. In a round-robin process, each student takes turns being the interviewer, interviewee, or note-taker (Kagan and Kagan, 2009). Similarly, the timed pair-sharing technique involves the teacher pairing students, often matching less experienced students with more knowledgeable peers. The teacher selects a discussion topic and poses a question. Student (A) discusses the topic for a set time, after which Student (B) summarizes the discussion. Student (A) can clarify misunderstandings, and Student (B) may add further insights. All the students participate by listening, responding, and summarizing. Time limits can vary on the basis of student level (Kagan and Kagan, 2009).

In the Jigsaw technique, students become “experts” on a text or body of knowledge and then impart that knowledge to a second group, known as the “home group”. Through this strategy, students can comprehend and retain information and develop collaboration skills. When students are expected to teach the updated content to their peers in their home groups, they are often motivated to learn the material. It is most effective to use Jigsaw by ensuring that students incorporate the information they learn from each other into a final project, a class discussion, or an exam (Aronson et al., 1978). Another structured technique, scripted cooperation, requires students to work in pairs, with one acting as a synthesizer and the other as a listener. When the synthesizer reaches a certain point, the teacher stops him or her from explaining. The synthesizer abstracts the information, and then the listener fills in the details. In the end, they create their own summary of the topic (O’Donnell, 1999).

Concept mapping is another effective cooperative technique that enables groups of students to clarify the connections between terms or concepts covered in the course (Clayton, 2006). In active knowledge sharing, students recall their previous knowledge and share it with peers before moving to the next subject (Silberman, 1996). The Teammates Consult technique requires that each team receive a set of activities. Members read the first activity. Their pencils are placed in the center of the table, and they discuss how to solve the problem. Once they are clear, they pick up the pencils and complete the activity individually. Each time, the process is repeated until all tasks are finished (Kagan, 1992). The numbered heads together technique involves each team member being assigned a number between one and four. Their goal is to carry out teacher-suggested activities and ensure that each member understands and can explain the solution. The teacher will then announce a number, and the student assigned the number explains the process that their team followed to find the answer (Kagan, 1992). In addition to these techniques, many other cooperative learning strategies exist, including developing academic contradiction, talking about chips, STAD, agree-disagree line-ups, Rally Coach, dyadic essays, and peer editing, all of which contribute to an engaging and interactive learning environment.

2.3 Problem-based learning (PBL) techniques

Problem-based learning (PBL) is an active learning strategy in which students solve real-world problems to enhance their understanding of concepts. It develops critical thinking, problem-solving, and communication skills while promoting group work and research evaluation (Duch et al., 2001). Although collaboration is not mandatory, students must take responsibility for their own learning (Prince, 2004). According to Duch et al. (2001), effective PBL problems should (1) motivate deeper understanding; (2) require logical decision-making; (3) connect to prior knowledge; (4) be complex enough for collaboration; and (5) include open-ended initial steps.

Several collaborative problem-solving techniques exemplify PBL. *The case study* technique provides students with a sample of problems through their experiences. For example, students may propose a solution to a problem that pertains to teaching physical education, such as learning complex skills, suggesting a set of teaching methods, testing the effectiveness of those methods or conducting research studies related to that problem (Popil, 2011). *Pair-thinking aloud problem solving* assigns students' roles (solvers and listeners) as they are presented with several problems of varying complexity. Each problem involves the exchange of roles. During the process of solving the problem, the analyst speaks aloud and thinks aloud. The listeners follow these steps, try to understand them, and suggest solutions if errors are identified (Barkley et al., 2014).

Another approach, Send a Problem, involves an envelope containing a problem given to each team. As a team, the members collaborate to solve the problem, write their respective solutions in envelopes, and then pass them on to the next team. As soon as the next team obtains the answer, it will create its own solution and pass it along to the next team without reviewing the answer. Once all teams have solved the problem, each initial team reviews the answers to its "problem" and evaluates the methods that the other teams used to solve it (Kagan, 1992).

Team-Pair-Solo involves three problems presented to students. In the first problem, teams of four are formed. In the second problem, couples are formed. In the third problem, students work individually. Support is gradually withdrawn (Cuseo, 2002). *Guided design* techniques lead students through structured steps, as they produce a solution. A group may conduct preliminary research and report simultaneously, identify stakeholders and report simultaneously, and suggest compromises (Newsome and Tillman, 1990). These PBL strategies encourage students to engage actively with content, develop autonomy, and refine their critical thinking abilities, making learning more meaningful and applicable to real-world scenarios.

2.4 Applications and innovations in active e-learning

This section reviews online teaching innovations that incorporate key active learning techniques used in the current study.

2.4.1 Think-Pair-Share (online)

The Thinking-Pair-Share technique was adapted for application in online teaching through the following steps of the initiative (University of Central Florida, 2022; Center For Teaching, LMC, 2022; Indiana University, 2022):

Think: The teacher uses webinar tools and the breakout room tool to explain topics through whiteboard presentations, screen sharing, and video conferencing. After a teacher asks a question, the teacher gives students time to think.
Pair: The "assign automatically" function pairs students in breakout rooms to compare ideas and rehearse responses before sharing with the larger group, while the teacher can check in on them.
Share: After student pairs finish their discussions, the teacher closes the breakout rooms and returns to the main room. Each pair then shares their insights with the class to promote discussion.

2.4.2 Timed-Pair-Share (online)

The use of webinar tools with breakout rooms can enhance the learning experience. During the main session, the teacher introduces the topic and poses questions before pairing students. In the breakout rooms, each student is paired with a partner who has expertise in the subject matter. The expert student (A) discusses the topic, whereas the attentive student (B) summarizes the information. Student (A) addresses any misunderstandings, after which Student (B) contributes to the discussion. This cycle continues until all the students have had the opportunity to participate. Time limits may vary depending on the students' proficiency levels.

2.4.3 Three-step interview (online)

Teachers use webinar tools to explain topics during general meetings. A preliminary plan is essential for improving the effectiveness of breakout groups. The teacher poses questions to students regarding the topic, such as their priority and what they hope to learn. Using the breakout group feature, students are divided into three groups of three, with roles assigned as interviewer, interviewee, or note-taker. Note-takers are responsible for recording key points for later presentations, and a round-robin format facilitates turn-taking. Racheva (2022) reviewed a similar technique but limited it to pairs, where the interviewee took notes for class presentation.

2.4.4 Jigsaw (online)

Teaching English to Speakers of Other Languages (TESOL, 2022) explains how to implement Jigsaw technology via Zoom. The teacher explains the activity, objectives, and expected outcomes. Each subject area has worksheets. A group of 4–5 students is called a "home group", with each member assigned a specific subject. Teachers record the names of "home group" members. During the first "home group" meeting, the students discuss their assigned topics. Home group sessions end after a designated time. After that, students' knowledge of each topic is used to form "expert groups". In these expert groups, students prepare presentations on their assigned topics. After working in expert groups, the teacher reconstitutes the original home groups, allowing each student to present their expert topic. The previous steps can be implemented with webinar tools and Learning Management Systems (LMS) to facilitate the Jigsaw method asynchronously. The teacher uploads resources such as PDFs and videos, while students form home and expert groups for discussion. The teacher monitors interactions, and social networking learning (SNL) can enhance knowledge exchange through group posts.

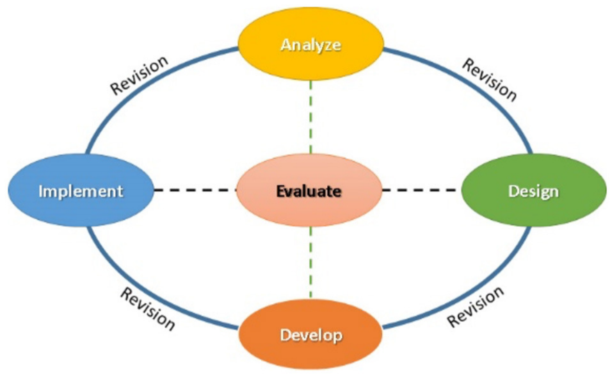

FIGURE 2
ADDIE Model (Branch, 2009).

2.4.5 Case study (online)

The previous explanation describes a problem-based learning (PBL) strategy in which case studies are used to analyze real-life situations and identify solutions. In small groups, participants evaluate alternatives, select alternatives, and present a drafted solution. Racheva (2022) highlights the use of webinar tools for online teaching, featuring breakout rooms for group work. Texts are displayed on a whiteboard for discussion, and each room has a timer for monitoring. After time expires, content is presented by a designated speaker. The case study may include videos to enhance creativity and problem solving, whereas learning management systems (LMSs) can facilitate group discussions through forums or media posts.

2.5 Instructional design (ID) models

ID models assist educators in integrating technology into education by providing a framework for learner-centered programs that enhance student engagement. Koper (2006) defines ID as the systematic explanation of teaching and learning processes. A key aspect of ID is outlining the learning framework and support activities for both learners and teachers, thereby facilitating active learning in online environments. Most ID models are based on the ADDIE model, which stands for analyze, design, develop, implement, and evaluate. This model improves learning through stages such as analyzing learners, developing strategies, creating materials, and evaluating effectiveness (Chen, 2011). This study utilized the ADDIE model.

2.5.1 ADDIE model

The ADDIE model is a widely used framework for developing educational materials and consists of five stages, as illustrated in Figure 2: (1) analyze objectives and student characteristics; (2) design learning outcomes and strategies; (3) develop technology-based learning environments; (4) implement the program; and (5) evaluate effectiveness and adapt as needed (Allen, 2006; Branch, 2009). It helps instructional designers identify project entry points and is adaptable to various curricula, helping teachers meet student needs (Hsu et al., 2014; Cheung, 2016; Durak et al., 2016; Wahyuni et al., 2019).

2.6 The use of learning management systems (LMSs) and webinar tools

2.6.1 Learning management systems (LMSs)

Srichanyachon (2014) and Foreman (2018) define LMSs as web-based tools that manage training programs, self-study courses, and blended learning. They automate resource management, student engagement, assessments, and progress tracking. Educational institutions typically use open-source LMSs such as Moodle or closed-source options such as Blackboard, Microsoft Teams for Education, Canvas, or A Tutor.

Table 1 details asynchronous distance learning features based on LMS functionalities, including course descriptions, content uploads (e-books, videos), assignments, discussion forums, and quizzes. Some companies offer mobile apps for Android and iOS. Blackboard and Microsoft Teams for Education excel in synchronous learning with integrated webinar applications—Blackboard's Collaborate Ultra and Teams' Meeting—supporting third-party integrations such as Zoom and live PowerPoint presentations. The Canvas and Tutor LMSs offer similar capabilities but depend on third-party tools (Microsoft, 2022b; Thmeum, 2022; Blackboard, 2025; Instructure Inc., 2022; Moodle B Corporation, 2022). The Moodle system, backed by studies (Antonoff et al., 2016; Kc, 2017; Badia et al., 2019; Athaya et al., 2021), is an effective open-source platform that allows free course delivery. It excels in asynchronous learning and has a mobile app but needs further development for synchronous learning.

2.6.2 Webinar tools

A "webinar" is a synchronous online lecture, seminar, presentation, or workshop. Its convenience and affordability have increased in popularity. Wang and Hsu (2008) classify webinars as real-time e-learning that uses voice-over-Internet Protocol (VoIP), instant messaging, and video conferencing.

TABLE 1 LMS functionalities.

LMSs	Asynchronous													Synchronous		
	Course descriptions	Course content	Assignments	Course messages	Discussion boards	Blogs and wikis	Polls	Tests	Full-grade center	Event calendar	Mobile learning	Notifications	Certificate builder	Webinar app	Integration webinar app	Instant message
Blackboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA*	✓	✓	✓
Microsoft teams for education	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓	✓	✓
Tutor LMS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓	✓
Canvas	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	✓	✓
Moodle	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA	NA

*Not applicable.

TABLE 2 Webinars tools functionalities.

Webinars Apps	Whiteboard	Share content, & screen	Voice and video	Session roles	Raise hand	Chat system	Polling	Breakout room	Recording session	Session report	Mobile learning
Blackboard collaborate ultra	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Microsoft teams meeting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zoom events and webinars	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Powerpoint presentation live	✓	✓	✓	×	×	×	×	×	×	✓	✓
Webex	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GoTo	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 2 lists webinar tools that enhance educational activities. The whiteboard and presentation window support collaborative video conferencing, whereas a chat system allows students to communicate without disrupting class. Polling gathers student opinions, and recorded sessions are available for later access. Breakout rooms encourage teamwork by randomly grouping students for peer interaction, enabling teachers to monitor progress and provide guidance (Thmeum, 2022; Blackboard, 2025; CISCO, 2022; GOTO, 2022; Zoom Support, 2025). PowerPoint Presentations Live, which is exclusive to Microsoft Office 365, allows participants to join via barcodes, links, or organizational membership and provides feedback during the presentation, along with reports and statistics for teachers (Microsoft, 2022a).

Erasmus+ projects are European Union-funded initiatives aimed at enhancing education, training, youth engagement, and sports across Europe and beyond. These projects focus on improving skills, increasing employability, and modernizing education systems through cooperation and mobility among participating countries. In the context of online education, Erasmus+ projects have played a pivotal role in fostering innovation and accessibility, particularly during the COVID-19 pandemic (Castro and García-Peñalvo, 2021).

During the pandemic, information and communication technology (ICT) tools became essential for supporting Erasmus+ e-learning initiatives. Video conferencing platforms such as Zoom, Microsoft Teams, and Google Meet facilitated remote collaboration and instruction, whereas LMSs such as Moodle and Google Classroom provided structured environments for content organization. Collaborative tools such as Trello and Padlet support teamwork, and interactive platforms such as Kahoot and H5P enhance student engagement. Furthermore, cloud storage solutions, including Google Drive and OneDrive, enabled seamless file sharing, whereas virtual reality (VR) and augmented reality (AR) applications, such as Google Expeditions, created immersive learning experiences. Erasmus+ projects such as DIG-I-Ready, E-DigiLit, and VIRAL skills have contributed significantly to the advancement of digital education, ensuring greater accessibility and innovation (Castro and Peñalvo, 2021; Alonso De Castro and García-Peñalvo, 2023; Ferrándiz Bou et al., 2023; Moukaa et al., 2023; Projekti, 2022; Rodríguez Rosell et al., 2022).

The effectiveness of LMSs in online education is influenced by several key factors. Nicoleta and Octavian (2020) identified six essential components that correlate with successful LMS implementation: automation of the evaluation process, customized content delivery, interactive engagement with online tutors or mentors, high-quality administrative services, reliable and comprehensive information dissemination, and the integration of video content. These factors are further shaped by the sociocultural and educational contexts in which LMS platforms are deployed.

Despite these advancements, significant challenges emerged during the adaptation of LMSs and webinar tools in online learning. Makhachashvili and Semenist (2021) highlighted critical barriers, including social and psychological challenges such as stress, burnout, fatigue, and time constraints imposed by quarantine measures. Technical issues, including unstable internet connections, insufficient digital infrastructure, and limited experience with online tools, further hinder effective remote learning. Additionally, gaps in soft skills, such as self-organization, adaptability, and communication, pose further obstacles to productive online engagement.

To address these challenges, educational designers must integrate online active learning strategies that foster positive and collaborative interactions among students and instructors. Online active learning strategies can enhance engagement and improve learning outcomes in online settings. By leveraging innovative ICT tools and pedagogical strategies, educators can create a more dynamic and effective online learning environment that supports student success and long-term digital literacy.

2.7 Current study context

The Blackboard Collaborate Ultra webinar tool was chosen for its official status at Qassim University, allowing seamless integration with the university's academic infrastructure. It enables students to access various educational resources, including eBooks, presentations, images, and videos. The breakout groups feature supports active learning strategies online. Oraif and Elyas (2021), Metscher et al. (2021), and Rakha (2023) demonstrated that breakout rooms on Blackboard collaboratively provide a sense of privacy, which helps students feel more comfortable within their groups and reduces their fear of making mistakes. This supportive environment promotes collaboration, allowing students to share solutions and offering feedback on one another's work, thereby enhancing productivity and achieving learning objectives. Pre-prepared worksheets facilitate group activities by enabling role assignments, such as presenters and dialog leaders, even in the absence of the teacher.

Following the ADDIE model, several techniques were developed in the current study for these groups, including think-pair-sharing, timed pair sharing, three-step interviews, jigsaw, and case studies, as follows.

2.7.1 Online think-pair-sharing

Using this technique at the beginning of a new topic has several benefits. It gives students time to think independently, encourages idea sharing, enhances oral communication skills, and engages them in understanding the reading material. Figure 3 shows its application in the Blackboard Collaborate Ultra webinar tool.

2.7.2 Online timed pair sharing

The technique resembles the Think-Pair-Share method but focuses on a challenging topic that requires higher-order thinking. The teacher categorized the students into expert and beginner groups on the basis of a brief quiz. In breakout rooms, expert students teach beginners, switching roles after a designated time. The beginner student shared his or her thoughts in the main room for the teacher and all the students. This technique enhances listening skills and fosters critical thinking. This technique was utilized in the current study, as illustrated in Figure 4.

2.7.3 Online three-step interviews

Students can use this technique to engage with the topic and activate their prior knowledge in an introductory activity, as an intermediate activity for in-depth analysis and comprehension of the subject matter, or as a concluding activity for reviewing information. Through this approach, students are encouraged to reflect on their learning, develop their ability to think critically, generate answers, and express their views. Moreover, it fosters equitable participation and promotes student accountability. Through the three-step interview learning strategy, students develop essential skills such as active listening, questioning, and answering by leveraging their natural curiosity. This technique was utilized in the current study, as illustrated in Figure 5.

2.7.4 Online jigsaw

The jigsaw technique encourages students to actively participate in their home groups and expert groups, as they are responsible for gaining more experience in their topics and sharing that knowledge with their classmates. If a teacher is struggling with student engagement in group activities, the Jigsaw technique is an effective solution. It provides a mechanism for differentiated instruction, accommodating students who need more interaction with peers, additional time, or the opportunity to ask questions from the instructor. Furthermore, it benefits students who have grasped the material and may otherwise disengage, as they are expected to assist their group members in understanding the content. The keys to a successful Jigsaw session are alignment and arrangement. The prompts for the groups must align with the essential properties of effective group work: a challenging topic that requires multiple approaches or one that benefits from diverse perspectives. This technique was utilized in the current study, as illustrated in Figure 6.

2.7.5 Online case study

The case study is a pedagogical technique in which students are presented with a real-world challenge and tasked with devising

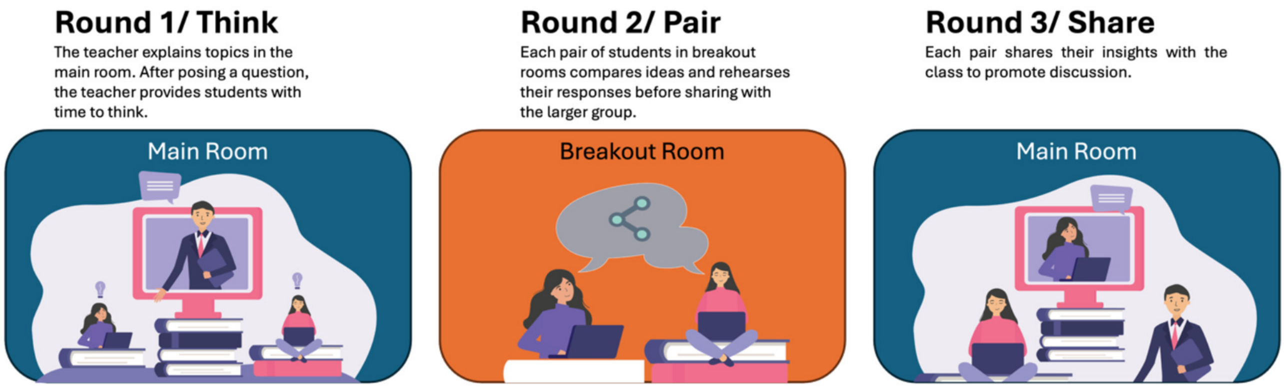

FIGURE 3
Online think-pair-sharing.

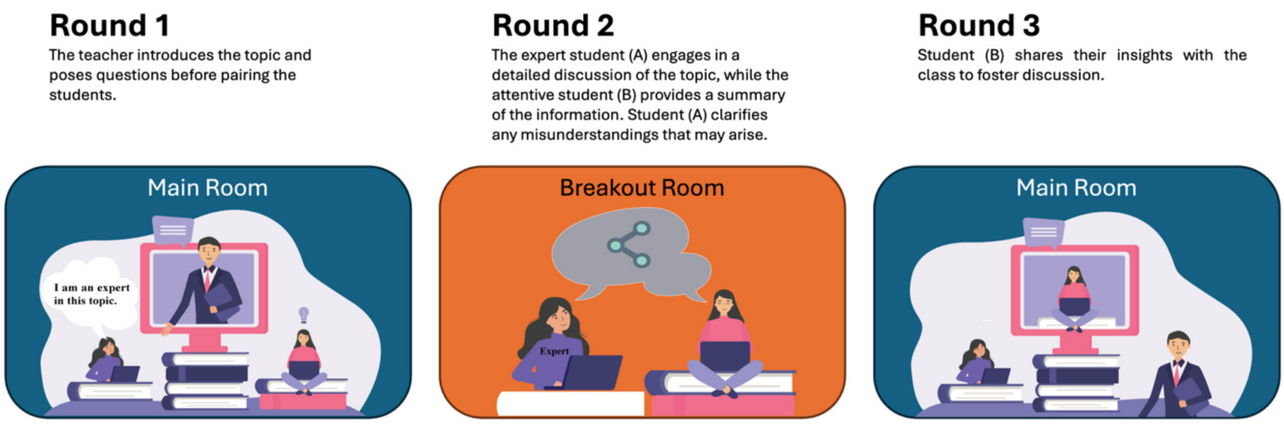

FIGURE 4
Online timed pair sharing.

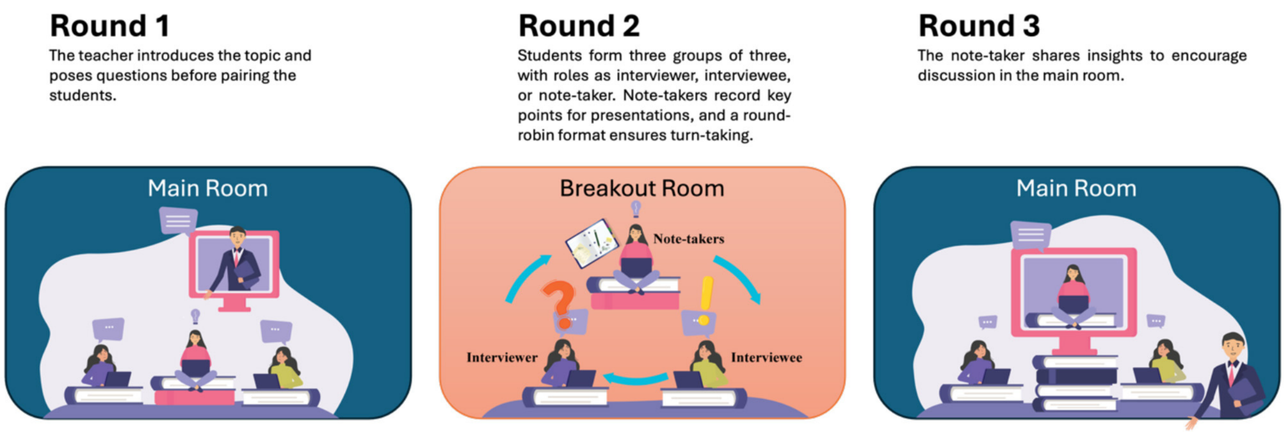

FIGURE 5
Online three-step interviews.

a solution. After they collaborate with their peers to analyze the case, the students engage in discussions about how the scenario unfolded. This method encourages students to view the situation from the perspectives of their classmates, fostering a deeper understanding of diverse viewpoints. Additionally, it enhances their ability to make effective decisions. As students work together

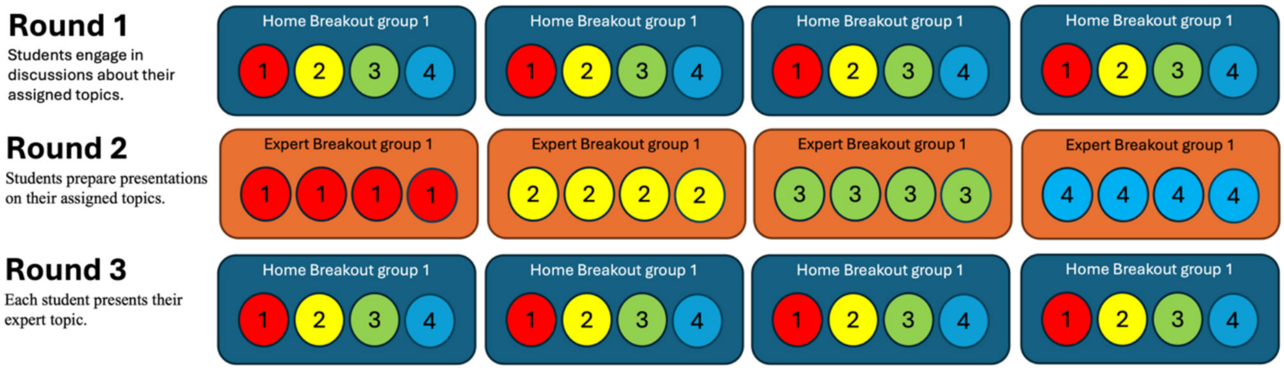

FIGURE 6
Online jigsaw.

to formulate responses, it becomes clear that individuals approach problem solving in different ways. Exposure to various strategies and perspectives can help students become more open-minded professionals. This technique can be utilized as an intermediate activity for in-depth analysis and comprehension of the subject matter or as a concluding activity to enrich their understanding of the topic. This technique was utilized in the current study, as illustrated in Figure 7.

3 Materials and methods

3.1 Design

A quasi-experimental approach was used with a single group. The experimental group implemented active learning strategies in the blackboard e-learning system, including think-pair sharing, timed pair sharing, three-step interviews, jigsaw, and a case study. To assess the long-term impact on cognitive achievement, students were evaluated at the pretest, posttest, and follow-up 1 month after teaching concluded. An online questionnaire was used to study female students' attitudes toward online active learning strategies in the e-course "Methods of Teaching PE and Self-Defense Sports".

3.2 Study population and sample

The study involved female teachers participating in the Optimal Investment Program for Educational Personnel at Qassim University, which offers a higher diploma in physical education and self-defense sports. In accordance with the directives of the Ministry of Education in Saudi Arabia, 26 students engaged in a blended learning system designed to increase teacher effectiveness and improve educational outcomes (Ministry of Education in KSA, 2023). After three participants withdrew, 23 female participants remained in the "Methods of Teaching Physical Education and Self-Defense Sports" e-course, which was chosen because the researcher was the instructor.

Purposive sampling was utilized because the "Methods of Teaching Physical Education and Self-Defense Sports" e-course is approved by the university as a fully online course offered to students through the Blackboard system, which aligns with the objectives of the current study. Since the researcher was also the instructor of this course, several stringent procedures were implemented to minimize bias, as described below:

- The Scientific Research Committee of the Department of Physical Education and Kinesiology at Qassim University approved the study (Approval No. 1051444–04122022). The participants provided informed consent via an online Google form that outlined the study's objectives, significance, procedures, voluntary participation, withdrawal rights, and confidentiality. The form included the following question: "Would you like to participate in this study?" with options to agree or disagree.
- The course was offered in accordance with the university's academic system and consisted of 3 h per week for a duration of 10 weeks (a full semester).
- The pretest responses regarding cognitive achievement levels were evaluated by an independent colleague from the same department who specializes in physical education teaching methods. This evaluation utilized an answer form prepared by the researcher specifically for this purpose.
- The posttest was administered concurrently with the semester exam, which was approved by the university and overseen by the examination committee within the scientific department. The test responses were also evaluated by the same independent colleague.
- The follow-up test assessing cognitive achievement levels was administered after the students completed the course and the official results were announced, ensuring that there was no pressure on the students. The test was also graded by the same independent colleague.
- The Self-Checklist Scale for Students' Attitudes Toward Online Active Techniques was administered to the study sample via a Google Form. The participants were not required to provide their names, ensuring the anonymity of their responses. This approach allowed them to express their opinions candidly, transparently, and objectively.

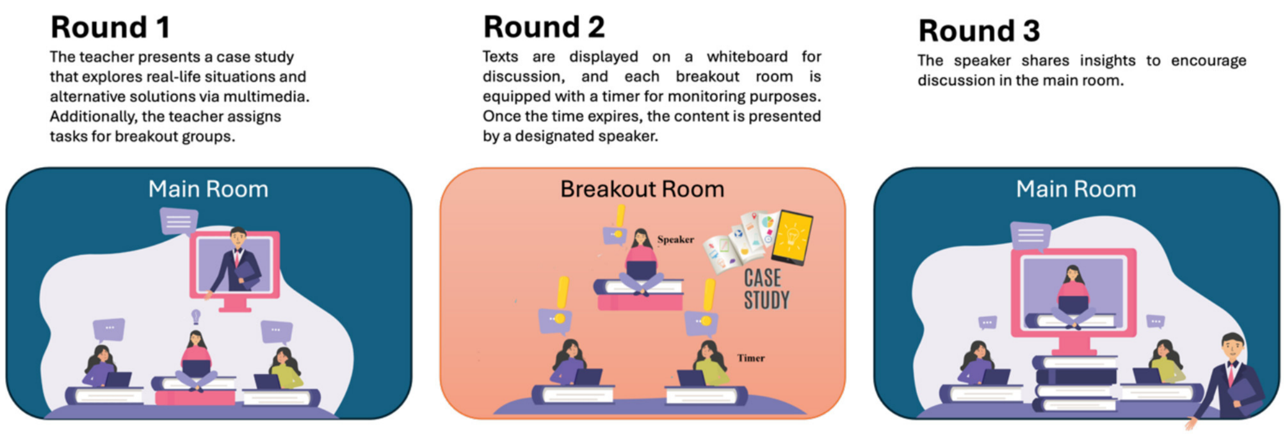

FIGURE 7
Online case study.

– The quasi-experimental design employed a single experimental group to ensure that all the students in the course had equal opportunities and advantages in their learning. Consequently, a repeated-measures ANOVA for paired samples was utilized.

3.3 Data collection tools and equipment

3.3.1 The cognitive achievement test

A cognitive achievement test was developed for this study on the basis of the e-course "Methods of Teaching PE and Self-Defense Sports. The test was conducted as follows:

3.3.1.1 The table of specifications (TOS)

Gronlund (1998) stated that instructors can achieve balance through TOSs by aligning learning outcomes, content, evaluative purposes, and cognitive–behavioral objectives. The following formulas calculate the number of topic questions and their scores (Rakha, 2023).

- *The relative weight of the topic % = Teaching hours or days allocated to a particular topic/Amount of time allotted to teaching the course's topics × 100.*
- *The Relative weight of the learning outcomes category % = The number of objectives in the category The Total Learning Outcomes in the course × 100.*
- *For each topic, The number of items in the learning outcomes category = The total number of items × The relative weight of the topic × The relative weight of the Learning Outcomes category.*
- *For each topic, The score of Learning outcomes category = Test final score × The relative weight of the topic × The Relative weight of the Learning Outcomes category.*

The TOS for the cognitive test is shown in Table 3.

3.3.1.2 Test item formulation and content validity

The TOS indicates that the test items were designed to assess different levels of thinking through true–false questions, pairings, and multiple-choice questions. Five experts reviewed the items to ensure scientific and content validity (Hays and Revicki, 2005).

3.3.1.3 Indices of difficulty and discrimination

Gregory (2015) reported that the difficulty index is a useful tool for identifying items that require modification or removal, with an ideal level of ∼0.50, between 0.30 and 0.70. The index is calculated as $P = R/N$, where P is the difficulty index, R is the number of correct responses, and N is the total number of examinees (Bichi, 2016).

Discrimination indices measure a test item's ability to differentiate between high- and low-scoring examinees, denoted as (d). The upper and lower bands are typically defined as the top and bottom 10% to 33% of the scores. For normally distributed scores, comparing the top 27% with the bottom 27% is advisable; otherwise, a percentage closer to 33% is preferred. The index is calculated using $d = (U - L)/N$, where U is the number of top quartile respondents answering correctly, L is the number of bottom quartile respondents answering correctly, and N is the total number of respondents in either quartile (Gregory, 2015). Acceptable values for the discrimination index range from −1.00 to +1.00, with negative values resulting in item rejection. A value above 0.20 is generally acceptable in cognitive achievement tests (Gregory, 2015). Bichi (2016) interprets (d):

- $d \geq 0.40$, the item functions well.
- 0.30–0.39 shows that the item is adequate and needs minimal adjustment.
- 0.20 and 0.29 needs revision for being marginal.
- If $d \geq 0.19$, the item is removed or rewritten.

Twenty-four female students who completed the "Methods of Teaching Physical Education and Self-Defense Sports" e-course in the last semester of the 2022 academic year and who were not part of the main sample took the cognitive achievement test. The difficulty indices (P) ranged from 0.30 to 0.60, whereas the discrimination indices (d) ranged from 0.5 to 0.75. These values are considered acceptable according to Gregory (2015).

3.3.1.4 Reliability

Cronbach's alpha was used to assess the reliability of the cognitive achievement test, resulting in a score of 0.82, indicating

TABLE 3 Table of specifications (TOS).

Topics	Items and scores	Learning Outcomes (LOs)						Total number of items	Test final score	Relative weight of the topics (30 h) %
		Remembering	Understanding	Applying	Analyzing	Evaluating	Creating			
		11 LOs	5 LOs	4 LOs	6 LOs	2 LOs	2 LOs			
Concept of teaching PE (3 h)	Items	1.10	0.50	0.40	0.60	0.20	0.20	3	6	10
	Scores	2.20	1.00	0.80	1.20	0.40	0.40			
PE classroom management (3 h)	Items	1.10	0.50	0.40	0.60	0.20	0.20	3	6	10
	Scores	2.20	1.00	0.80	1.20	0.40	0.40			
Methods of teaching PE (12 h)	Items	4.40	2.00	1.60	2.40	0.80	0.80	12	24	40
	Scores	8.80	4.00	3.20	4.80	1.60	1.60			
Styles of teaching PE (6 h)	Items	2.20	1.00	0.80	1.20	0.40	0.40	6	12	20
	Scores	4.40	2.00	1.60	2.40	0.80	0.80			
Methods of implementing PE exercises for children (6 h)	Items	2.20	1.00	0.80	1.20	0.40	0.40	6	12	20
	Scores	4.40	2.00	1.60	2.40	0.80	0.80			
Total number of items		10	6	4	6	3	1	30		
Test final score		20	10	7	15	6	2		60	
Relative weight of the learning outcomes (30 LOs) %		36.67	16.67	13.13	20	6.67	6.67			100

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high reliability (Taber, 2018). The final test version is presented in Appendix A.

3.3.2 Self-checklist scale for students' attitudes toward online active strategies

A self-checklist scale was developed to assess students' attitudes toward online active strategies in three dimensions: cognitive, emotional, and behavioral (Conner et al., 2021). The final scale included 13 items scored on a Likert scale with five response options ranging from 5 (strongly agree) to 1 (strongly disagree). Validity and reliability were calculated as follows:

- **Content validity**: The scale was presented to five PhD arbitrators in educational technology and physical education, whose feedback prompted revisions.
- **Internal consistency validity**: A random sample of 24 students who previously used the same online active learning strategies was selected to explore the correlation between each item and its axis. Responses were collected via an online Google form. The Pearson correlation coefficients showed a positive correlation of $r(22) = 0.70–0.92$, $p < 0.01$, indicating strong internal consistency validity (Schober et al., 2018).
- **Reliability**: Cronbach's alpha test was used to assess the scale's reliability, with values ranging from 0.82 to 0.94, indicating good reliability, as they exceed 0.70.

3.4 Creating an online education program via active learning strategies based on the ADDIE model

The following active learning strategies—think-pair-sharing, timed pair sharing, three-step interviews, jigsaw, and case studies—were developed on the basis of the ADDIE model for breakout groups in Blackboard Collaborate.

3.4.1 Analysis

In this phase, the program's goals, student characteristics, and instructional activities were defined.

- *The primary objective*: This course enhances students' cognitive achievement in the "Methods of Teaching PE and Self-Defense Sports" e-course.
- *Characteristics of the students*: Participants aged 27–36 years face challenges such as grieving a parent, single parenting, and caring for elderly parents (Lazzara, 2020). While formal education may have ended, new ways of thinking can emerge. Post-formal thinking embraces diverse perspectives and is pragmatic. Those nearing their late 30 s often rely on personal experience for decision-making, demonstrating a strong work ethic and responsibility.
- *Educational activities:* In blackboard collaboration, students engage in active learning through virtual classes, breakout groups, and assignments. The teacher provides task sheets outlining techniques and interactions. Groups must submit tasks on time and present them in the main room as directed.

3.4.2 Design

The purpose of this stage is to set behavioral objectives, design an active online learning technique, design an assessment strategy, and create task sheets for the experimental group.

- **Forming behavioral objectives**: In accordance with Bloom (1956), thirty LOs have been created and are categorized into six cognitive levels.
- **Online active learning strategies**: Students in the experimental group utilized task sheets and breakout group features to reinforce online active learning strategies, including Jigsaw, case studies, think-pair-sharing, timed pair sharing, and three-step interviews. These techniques were thoroughly detailed in the literature of the current study in the "Applications and Innovations in Active eLearning" section.
- **Assessment strategy**: To evaluate the cognitive capabilities of the subjects, the TOS test is an online cognitive test.
- **Designing task sheets**: Task sheets with instructions, learning outcomes, tasks, and performance times were created for the experimental group to streamline the breakout group administration Mosston and Ashworth (1986), and Rakha (2023) suggested that these sheets promote active student participation, reducing the need for excessive teacher explanations and enhancing guideline adherence.
- **Time framework**: The experimental group attended one lecture per week, earning three theoretical credit hours (CRs) per session, with one CR equating to fifty contact minutes. Over 10 weeks, the group received ten lectures.

3.4.3 Development

The Blackboard Collaborate Ultra webinar tool was employed to augment virtual learning experiences. It provides real-time video conferencing, breakout rooms for group activities, and interactive features such as polls and chat functionalities. These tools promote enhanced engagement and collaboration among participants. Furthermore, the recording feature allows students to revisit sessions for review and reinforcement of their learning. The breakout group functionality is crucial for the implementation of active learning techniques within an online environment.

3.4.4 Implementation

The experimental group study was conducted every Tuesday from December 13, 2022, to February 14, 2023, utilizing the Blackboard Collaborate Ultra platform with the breakout group feature to facilitate online active learning techniques. A pretest was administered on December 6, 2022, and a posttest was conducted on February 21, 2023. Following the posttest, the Self-Checklist Scale for Students' Attitudes was distributed. Additionally, a follow-up assessment was conducted 1 month later, on March 21, 2023, after a break from the instructions. Figure 8 shows the timeline of the experimental workflow.

3.5 Statistical analysis

Statistical analyses were conducted via IBM SPSS Statistics for Windows (2017; version 25; IBM Corp, Armonk, NY, USA),

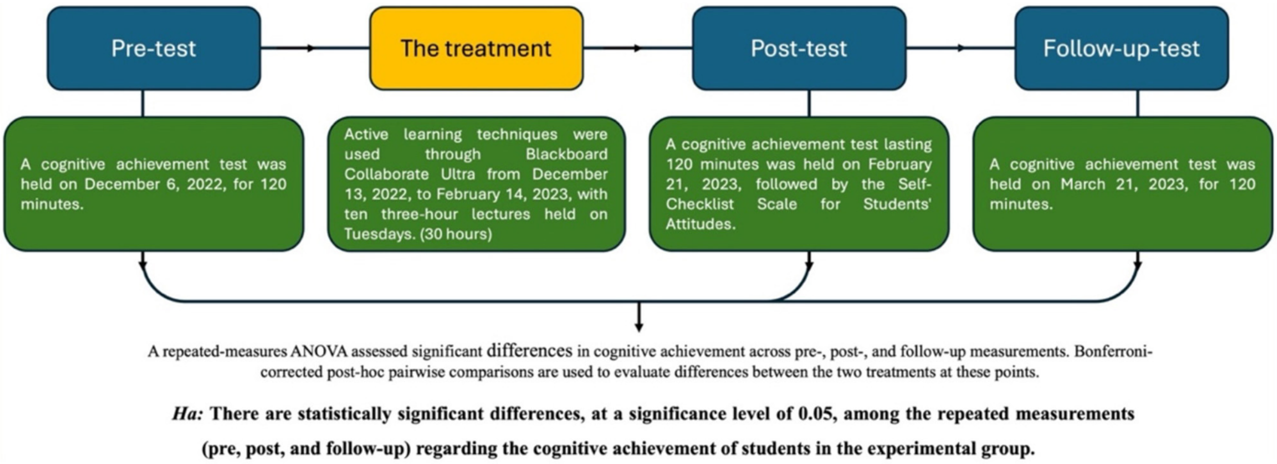

FIGURE 8
The timeline of the experimental workflow.

including frequencies, percentages, means, standard deviations, the Shapiro–Wilk test, repeated-measures ANOVA, Mauchly's test of sphericity, and the Bonferroni *post-hoc* correction. A *post-hoc* power analysis was also performed via G*Power 3.1.

Repeated-measures ANOVA is suitable for analyzing data from multiple measurements of the same subjects across different conditions, controlling for individual differences and minimizing variability. However, it has limitations, such as the assumption of sphericity, which may not always be met (Girden, 1992). Violations of this assumption can significantly impact Type I error rates (Blanca et al., 2023). To address this, *post-hoc* tests such as Bonferroni corrections are necessary. The Bonferroni method is robust and effectively controls alpha levels, making it the most effective method for managing Type I error rates (Field, 2024).

4 Results

4.1 Research question 1. Are there significant differences at the 0.05 level among the pre, post, and follow-up learning effect measurements for students in the experimental group regarding cognitive achievement?

Ha: There are statistically significant differences, at a significance level of 0.05, among the repeated measurements (pre, post, and follow-up) regarding the cognitive achievement of students in the experimental group.

A repeated-measures ANOVA was conducted to determine the effect size (low, medium, high) of online active learning techniques on cognitive achievement.

The Shapiro–Wilk test in Table 4 was used to assess the normality of cognitive achievement across repeated measures (pre, post, and follow-up), and the results were as follows: $W = 0.95$, $p = 0.27$; $W = 0.94$, $p = 0.15$; and $W = 0.96$, $p = 0.39$.

TABLE 4 Tests of normality.

Measurements	*M*	*SD*	Shapiro–Wilk		
			W	*df*	*P*
Pre	14.91	2.78	0.948	23	0.268
Post	50.61	3.67	0.937	23	0.154
Follow-up	51.87	4.81	0.956	23	0.395

The *p*-values exceed 0.05, indicating that the null hypothesis cannot be rejected, suggesting a normal distribution of cognitive achievement measures.

As shown in Table 5, Mauchly's test was used to test the sphericity assumption, and it was significant, $\chi^2_{(2)} = 6.54$, $p = 0.04$. Therefore, the degrees of freedom were adjusted via the Huynh–Feldt method.

According to Table 6, there were statistically significant main effects of online active learning techniques on cognitive achievement [$F_{(1.58,34.71)} = 978.31$, $p< 0.001$, $\eta^2 = 0.98$]. This finding indicates that participants' cognitive achievement varied across repeated measurements.

Table 7 and Figure 9 show that *post-hoc* pairwise comparisons with a Bonferroni correction revealed no significant difference in cognitive achievement scores between post- and follow-up measurements ($p = 0.26$). However, both the post-measurement and follow-up scores were significantly higher than the premeasurement scores were ($p < 0.001$).

A *post-hoc* power analysis was performed via G*Power 3.1 (Faul et al., 2009; Verma and Verma, 2020). This analysis evaluates alpha (α) parameters, effect size, and sample size to calculate power ($1 - \beta$) (Cohen, 1988) and assesses the ability to reject an incorrect null hypothesis (H_0). It computes the true effect size and observed power from sample data, exploring the debate over whether the sample effect size (n) equals the population effect size (N) (Faul et al., 2009).

TABLE 5 Mauchly's test of sphericity.

Within subjects effect	Mauchly's W	Approx. χ^2	df	P	Epsilon		
					Greenhouse–Geisser	Huynh-Feldt	Lower-bound
Cognitive achievement	0.732	6.542	2	0.038	0.79	0.84	0.50

TABLE 6 Tests of within-subjects effects.

Huynh-Feldt	Type III sum of squares	df	Mean square	F	P	Partial η^2
Cognitive achievement	20,251.91	1.58	12,836.450	978.31	0.00	0.98
Error	455.42	34.71	13.121			

TABLE 7 Pairwise comparisons.

(I) Cognitive achievement	(J) Cognitive achievement	Bonferroni *post-hoc* correction		
		Mean difference (I–J)	Std. error	P
Pre	Post	−35.70*	0.95	0.00
	Follow-up	−36.96*	1.12	0.00
Post	Pre	35.70*	0.95	0.00
	Follow-up	−1.26	0.70	0.26
Follow-up	Pre	36.96*	1.14	0.00
	Post	1.26	0.70	0.26

*The mean difference is significant at the 0.05 level.

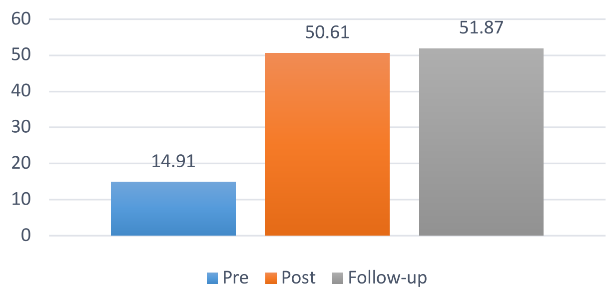

FIGURE 9
The difference between the means of repeated measurements.

This study used G*Power 3.1 for *post-hoc* analysis with a sample size of 23 in a one-way repeated-measures ANOVA (within-subjects ANOVA). The effect size was $\eta^2 = 0.98$ at a significance level of 0.05, and the power $(1 - \beta)$ was 1.00, indicating a true effect size >0.80 (Faul et al., 2009). Therefore, the results can be confidently extrapolated to the entire population, as shown in Figure 10.

4.2 Research question 2. What are female students' attitudes toward online active learning strategies in e-courses?

The student attitudes questionnaire was administered via Google Form after the post cognitive achievement test to assess attitudes toward the online active learning strategies used in the e-course. The results are as follows:

Table 8 shows that the experimental group has strong cognitive attitudes toward online active learning strategies in the e-course. Item five ranks highest ($M = 4.26$, $SD = 1.01$), indicating that students use these strategies for feedback from peers and instructors, reinforcing their learning. Items one and two also rank well ($M = 4.17$, $SD = 1.03$ and $M = 4.17$, $SD = 1.07$), demonstrating that these strategies simplify scientific content, enhancing retention and comprehension. The affective and cognitive results align, with the experimental group showing a positive attitude. Item six ($M = 4.30$, $SD = 1.02$) ranks first, indicating enjoyment of online active learning techniques, whereas item nine ($M = 4.22$, $SD = 1.04$) suggests that these strategies increase motivation. Behavioral attitudes range from strongly agree to agree, with item ten ($M = 4.26$, $SD = 1.05$), indicating that online active learning strategies allow access to the virtual classroom anytime and anywhere. Item 13 ($M = 4.22$, $SD = 1.04$) shows that students can easily complete assignments by writing or uploading files. Although item eight ($M = 3.70$, $SD = 1.26$) ranks lowest, it still received agreement, suggesting that online active learning strategies facilitate some level of equal participation in lessons.

5 Discussion

The research hypothesis for the first question indicated that online active learning styles significantly enhance cognitive achievement, with participants showing improved performance in post-measurements. This suggests that the active learning strategies

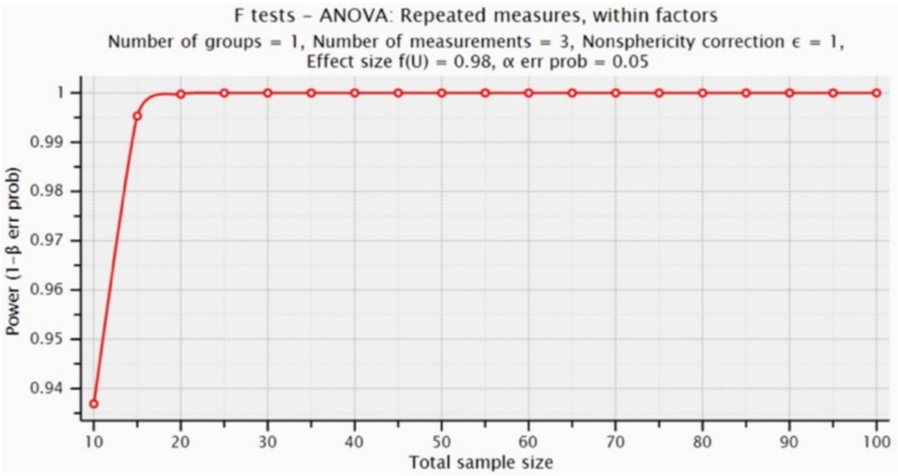

FIGURE 10
Analyzing power on the basis of sample size.

TABLE 8 Descriptive statistics of students' attitudes toward online active learning strategies in the e-course.

Items	*M SD*	Rank	Level
Axis 1. Cognitive attitude			
1- Scientific content is simplified through online active learning strategies.	4.17 1.03	4	High
2- Learning with online active learning strategies makes it easier for you to remember and understand the topics in your e-course.	4.17 1.07	4	High
3- Through your experience with online active learning strategies, you can apply PE teaching methods skills and overcome technical challenges.	3.96 1.02	6	High
4- Through online active learning strategies, students benefit from more hands-on learning time.	3.96 1.11	6	High
5- You can gain feedback and reinforcement from your peers and lecturer through online active learning strategies.	4.26 1.01	2	High
Axis 2. Affective attitude			
6- The online active learning strategies were enjoyable for you.	4.30 1.02	1	High
7- Engaging in online active learning strategies allows you to communicate more with your peers.	4.17 1.07	4	High
8- The online active learning strategies allows students to participate in the lessons equally.	3.70 1.26	8	High
9- The use of online active learning strategies motivates you to learn more.	4.22 1.04	3	High
Axis 3. Behavioral attitude			
10- The virtual classroom can be accessed from anywhere and at any time via mobile or computer with online active learning strategies.	4.26 1.05	2	High
11- Collaborating in-group activities through online active learning strategies is easy.	4.00 1.13	5	High
12- Active learning strategies in the online environment can help you track your progress.	3.91 1.16	7	High
13- Online active learning strategies let you respond to assignments easily by writing or uploading files.	4.22 1.04	3	High

in the e-course "Methods of Teaching Physical Education and Self-Defense Sports" are effective. Notable differences were observed between pre- and follow-up measurements, favoring the latter. These results support the Nurkhin and Pramusinto (2020) view that active learning engages students and enhances critical thinking. Apkarian et al. (2021) and Junejo et al. (2022) noted that online active learning facilitates student-centered activities, replacing traditional lectures. Johnson and Johnson (2008) emphasized that active learning promotes engagement. Techniques such as Jigsaw and Think-Pair-Share were used in the e-course to illustrate this shift. Hang and Van (2020) reported that innovative teaching methods increase student creativity, highlighting the need for active and creative learning strategies.

The results of the present study are consistent with those of Wang et al. (2020), Cho et al. (2021), and Warsah et al. (2021), who reported that active learning strategies improve academic achievement, interpersonal relationships, diversity awareness, and critical thinking. These findings are also supported by Walker (2003), Johnson and Johnson (2009), Harris and Bacon (2019), Rossi et al. (2021), and Chen et al. (2022), who highlight that active learning enhances communication skills and promotes independent knowledge acquisition through positive social interactions, leading to greater student engagement.

Blackboard's breakout groups and user-friendly interface promote online active learning. Students engage in peer interactions, submit work, and present in the main room, fostering competition. Research by Van Heuvelen et al. (2020), Wenzel (2020), Douglas (2023), and Rakha (2023) shows that breakout rooms enhance cooperation and participation. Douglas emphasized the task setting, whereas Rakha (2023) stressed thoughtful instructional design. Consequently, active learning in breakout groups improves collaboration and peer feedback, boosting productivity and achieving learning objectives. Worksheets guide students toward academic goals and facilitate role assignments, supporting Yamagata-Lynch et al. (2015) and Read et al. (2022) in advocating for effective active learning strategies and organized roles and enhancing group efficiency and flexibility.

The results revealed no significant difference in cognitive achievement between the posttest and follow-up measurements of the experimental group after a one-month teaching break. This aligns with cognitive load theory (Stiller, 2007; Sweller, 2010; Costley and Fanguy, 2021), which emphasizes the role of a supportive learning environment in developing cognitive abilities. These abilities create schemas that improve information processing and working memory, allowing the experimental group to maintain their cognitive level despite interruption.

In response to the second question, students in the e-course "Methods of Teaching PE and Self-Defense Sports" showed a positive attitude. Research by Hakami (2020), Al-Ghamdi and Al-Oweidi (2021), and Mohammed and Al-Hassan (2023) indicates that active learning strategies enhance motivation, attitudes, abilities, and skills while also promoting positive behavior and academic achievement. The study emphasized the importance of planning active learning strategies that ensure equal opportunities for all students, as noted by Al-Amery (2020), who noted that such strategies may not provide equal participation in large classes.

6 Conclusions

This study examined the impact of online active learning strategies on students' cognitive achievement and attitudes in the "Methods of Teaching PE and Self-Defense Sports" e-course. The results revealed significant improvements from pre- to post-intervention measurements, with follow-up assessments confirming their effectiveness. After a 1-month break, the experimental group maintained cognitive achievement, with no significant differences between the follow-up and post-intervention measurements. The students reported positive attitudes toward active online learning, highlighting cognitive, emotional, and behavioral factors. To enhance distance learning, it is vital to assess learners' needs, provide training in active learning strategies, ensure access to appropriate devices and reliable internet, and equip teachers to effectively integrate active learning into online instruction.

7 Limitations

The Optimal Investment Program for Educational Personnel at Qassim University offers a higher diploma in physical education and self-defense sports exclusively for female educators, making this study focus solely on women. Future research could examine effective online active learning strategies for male students in other courses and compare male and female students. A key challenge is the time needed to design and implement these strategies, as online teaching environments present obstacles that require patience and skill. For example, inadequate internet bandwidth can frustrate both students and instructors. Moreover, students must understand their responsibilities and expectations to meet educators' objectives for improving the online learning environment.

8 Implications

To enhance student engagement and the effectiveness of online teaching, it is essential to develop more active learning techniques that motivate students to participate in online learning in the future. The current study utilizes the breakout group feature of Blackboard Collaborate Ultra. Other webinar tools, such as Microsoft Teams Meetings, Zoom Events and Webinars, Webex, and GoTo, should be explored in future research to assess their impact on student engagement and to facilitate comparisons among these platforms. Furthermore, the application of online active learning techniques in future research across various disciplines may enhance the evaluation of their effects on cognitive, psychomotor, and emotional development.

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 the Scientific Research Committee of Department of Physical Education and Kinesiology at Qassim University approved the study (Approval no. 1051444-04122022). 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

AR: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology,

Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

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

Generative AI statement

The author declares that no Gen AI was used in the creation of this manuscript.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2025.1546208/full#supplementary-material

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