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A case study of active learning implementation to develop college students' problem-solving ability in physical education

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Abstract: Active learning has gained recognition as an effective pedagogical approach in higher education, yet its application in physical education remains underexplored. This study addresses the gap by examining how active learning influences physical education undergraduates' skill development, particularly in problem-solving, communication, and critical thinking. The study aimed to investigate physical education students' perspectives on active learning integration in a specific course and assess its impact on their problem-solving abilities. From April to June 2025, semi-structured interviews were conducted with 10 physical education undergraduates (6 males, 4 females). Thematic analysis was applied to the interview transcripts to identify key patterns. Findings confirmed the effectiveness of active learning in physical education courses. Participants reported improvements in communication, critical thinking, and problem-solving skills, attributing these gains to interactive and student-centered teaching methods. The study concludes that active learning is a practical strategy for enhancing physical education undergraduates' problem-solving skills and overall academic performance, advocating for its broader adoption in physical education curricula.

Keywords: *Active learning, Interview, Physical education curriculum, Problem-solving ability, Teaching method.*

1. Research Background

The physical education (PE) curriculum is an important part of a college education as a way for students to develop the habit of exercising and enhance their physical fitness. Hence, it is important to recognise its unique role in promoting students' physical and mental health [1]. The student-centered pedagogical philosophy emphasises students' interests and needs [2] as such, it is valued by teachers in colleges as a teaching method that promotes active learning Børte et al. [3]. Bara and Xhomara [4] suggest that students learn better when student-centered teaching is adopted in classrooms. However, the "teacher-centered" model has traditionally been used in college education due to the influence of behaviorist theory [5]. As an "explanation-demonstration-practice" mode, this tends to put students in a passive state, which is contrary to the modern teaching philosophy, which requires students' active exploration, innovation, and the practice of their sports knowledge and skills by answering teachers' questions [6]. Therefore, an educational transformation and reform are needed to enable students to deal with the uncertainties of the 21st century based on new teaching methods and content-based educational objectives [7, 8]. Although some advanced technologies are applied in basketball classes, the traditional teaching method cannot effectively improve results due to the restrictions of classroom teaching [9]. Instead, it is essential to guide students to actively participate in class, practice self-directed learning, and explore the world through active learning, solving problems in the process. Akben [10] points out that the improvement of students' problem-solving ability is an important aspect of education. Hence, it is necessary to reform the PE curriculum and integrate active learning in class.

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Only by grasping the connotation of curriculum reform can the steady development of the PE curriculum and the improvement of students' problem-solving ability be ensured [11].

Active learning enables students to participate in the acquisition of their knowledge and skills and, more importantly, to use the knowledge and skills they acquire (such as reflection, critical thinking, etc.) to solve the problems they may encounter in a challenging society and achieve individual growth [12]. Equipping students with the ability to solve problems is an important goal of modern education, which serves as lifelong learning. It is a necessary quality students need to deal with future challenges and a motivation for them to progress toward future education [13]. According to Estriyanto [14], a demand-driven curriculum is essential to equip students with the abilities, knowledge and skills they need in the 21st century. Chan et al. [15] claim that active learning helps to improve college students' ability to analyze and solve problems and that they value this knowledge more than professional abilities. Therefore, the aim of this study is to obtain PE college students' feedback on the active learning teaching method and its effect on their problem-solving ability and overall performance.

2. Literature Review

2.1. Active Learning

Active Learning is recognised as a valuable teaching method in higher education Roberts [16]. Deslauriers et al. [17] believe that students can learn more by actively learning than by passively receiving instructions. Therefore, the student-centered and active learning teaching methods have become the central issues of contemporary education [18]. The core element of active learning is students' active participation in class activities, which means that students should learn in an active manner and manage their own behavior in class [19]. In this context, learning is no longer a standard procedure, but a personalised process [20] in which students develop their active learning, critical thinking and problem-solving abilities Chen et al. [21]. Styers et al. [22] state that active learning is the key to developing the other two abilities, and Kim et al. [23] confirm that students who participate in student-centered and active learning classes develop better problem-solving and critical thinking abilities. Learning to solve problems is equal to learning how to learn [24]. Active learning is defined in this study as a process that engages students in education through various activities such as applying what has been taught, exploring the connections between facts, comparing contradictory cases within students' knowledge systems, etc., in order to build knowledge in a manner that enables students to think at a higher level using critical thinking, problem-solving, and related skills [25].

Broadhead [26] used the three key elements summarized in Laerplan 97 (L97 for short, a curriculum reform in Norway), namely, thematic teaching, active pupils, and learners' autonomy, to study the relationship between educational policy making and classroom practice effectiveness. When Wiltbank et al. [27] interviewed 15 biology students, they and found links between active learning and the students' feedback. Reilly and Reeves [28] investigated online classes and found that real tasks and student-centered principles affected active learning. Lerum et al. [29] conducted interviews and summarized the reasons for adopting the active learning teaching method based on the results. Extensive research has shown that the active learning teaching method is more effective than the traditional method [30]. Therefore, an attempt is made in this study to incorporate active learning into the PE curriculum to assess students' problem-solving ability and performance.

2.2. Problem-Solving Ability

If people are faced with obstacles when attempting to achieve a goal, these obstacles are called problems [31]. If individuals encounter a difficult situation and cannot immediately and effectively respond using their existing knowledge, experience, or methods, and need to reorganize their knowledge and cognitive structure to do so, this is considered to be a problem [32]. All kinds of problems arise throughout a lifetime and need to be solved [33] and enabling people to effectively solve these problems is the exact purpose of education [34].

Heppner et al. [35] define problem solving as a goal-oriented cognitive and operative process, and a

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complex psychological process that acts as a bridge between cognition and behavior. Meanwhile, Kopparla et al. [36] describe the problem as the behavior of making various problems that can be solved by using one's knowledge. Besides, Wirth and Klieme [37] propose that the ability to solve problems can be viewed from a specific or a more complex level, or even from a mindset level. According to Van Merrienboer [38], problem-solving ability is the ability to find a way to achieve a goal when there is no obvious choice of methods, while Siu and Shek [39] describe problem-solving ability as the capacity to identify problems, set goals, decide strategies, take action, and evaluate the outcome. In this study, problem-solving ability is defined as the ability and performance of students to think using their knowledge to overcome difficulties and solve problems in the process of learning and tests.

Students' problem-solving ability has been found to improve in some subjects through the use of the active learning teaching method. For instance, Jia et al. [40] used a student-centered approach and found that students' ability to identify problems greatly improved in terms of fluency, flexibility, and innovation. Meanwhile, Hsu [41] established a website to act as a communication platform for student teachers to enhance their understanding of problems and acquire the ability to solve them. Rubenstein et al. [42] designed the flipped classroom to cultivate college students' critical thinking ability and improve their innovation through active participation in cooperative practice in class, in order to enhance their problem-solving ability.

However, although there is a variety of related studies, few focus on the application of the active learning teaching method in the PE curriculum compared to other curricula Bryan and Solmon [43]. Yang and Ostrosky [44] used semi-structured interviews to understand the various perspectives of initial teachers and preschool teachers to explore the application of active learning in preschool education, while Tosun and Taskesenligil [45] used qualitative and quantitative methods to study the effectiveness of the problem-solving ability in relation to the science curriculum. By referring to these methods, this study aims to ascertain the opinions of college PE students regarding the application of active learning teaching methods in PE classes and the impact of incorporating active learning into the PE curriculum on students' problem-solving abilities.

3. Methodology

3.1. Research Design

Semi-structured interviews were conducted to collect the qualitative data for this study [46]. The interviewees were conducted in an active learning class of physical education courses. The interview outline was based on previous research and advice from experts [47]. This process could enable students to reflect on and discuss problems based on their experience, which provided more extensive information for the study [48].

3.2. Participants

The interviewees consisted of 10 college students from a comprehensive university in Zhejiang, China, who were majoring in physical education. Ten students (6 male and 4 female) were allocated to the 8-week (32 class hours) active-learning PE class, which was aimed at developing their problem-solving ability through active learning. All the participants signed a consent form before being interviewed.

3.3. Implementation of Active Learning

This study is guided by the notion of active learning teaching and learning, as well as the redesign of the layout of teaching activities, the selection of teaching techniques, and the identification of learning styles to meet the teaching objectives [49]. The constructed active learning PE curriculum mobilizes students' learning motivation and initiative, guiding them to apply their constructed knowledge to develop problem-solving abilities [50]. This study's course experiment was a validation experiment designed to verify the efficacy of the active learning PE course. In other words, whether the active learning PE course enhances PE undergraduates' problem-solving abilities.

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In the preparation phase of the experiment, a systematic study of students' perceptions, abilities, and course content was conducted with the course objectives [51]. Then, active learning could be implemented more effectively to develop university students' problem-solving skills. As a result, the experimental project has six components in the active learning course: skills training, physical training, breakthrough techniques, tactical training, mental training, and sporting events. The course was taught during the experimental implementation phase according to the active learning PE course objectives and content. The course objectives emphasized the improvement of students' problem-solving and basketball skills. The course topic was selected by adding active learning-related teaching principles to the original syllabus's core themes. Furthermore, to attain the ability to integrate information and skills through active learning, the course content was selected to include active learning ideas in addition to the original curriculum. As a result, students can tackle numerous basketball difficulties independently [52]. At the experiment's conclusion, the results are collected and assessed per the designed curriculum [53].

3.4. Students' Interview

The semi-structured interviews contained the following five questions focused on "active learning" and "problem-solving ability," which were adjusted during the interview process [54]. Considering the homogeneity of the interviewees, the number of interviewees should be determined based on the study [55]. In this study, the students were informed during the interview that they could express themselves freely and discuss any concerns they had with the teacher. In fact, they were encouraged to do so to ensure the reliability and validity of the study [56]. The interview contents were transcribed, interpreted, and subjected to a thematic analysis.

3.5. Data Collection

Semi-structured interviews were conducted between April and June 2022, and the entire process was recorded by an assistant teacher. Each interviewee was informed of the purpose and theme of the research before the interview. Ten individual interviews were conducted, each lasting approximately 15 minutes.

The qualitative data collected during the interviews were analyzed thematically to gain a deeper insight [57]. The interview recordings were transcribed and coded before being categorized into themes. Each student was marked with one code. A teaching assistant who was not involved in the study checked the reliability of the whole data analysis process [58] to avoid error messages, the authors analyzed the data separately to avoid subjectivity, to lay a foundation for the study, and to ensure that the data was reliable, precise, and detailed [59].

4. Research Results

After being categorised and coded, the interview data was analysed thematically. Kiger and Varpio [60] observe that thematic analyses are widely used to analyze qualitative data. According to the qualitative analysis procedure in NVivo, the analysis should be conducted in four steps: 1) import files; 2) code data; 3) summarize in a framework matrix; and 4) report results [61]. After taking these steps, 64 codes in 9 categories at different levels were obtained in this study, and 5 first-level themes were selected according to the research purpose, as shown in Table 1.

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Table 1.
Results of interviews.

Categories	Number of Occurrences	Theme
Voluntary training	5	Positive effect of active learning
Active thinking	4	
Strong interest	3	
Problem sensing	6	Performance of problem-solving ability
Communication	5	
Critical thinking	3	
Decision making	3	
Positive emotion	6	Factors that affect problem-solving ability
Type of problem	5	
Previous knowledge	3	
Responding problem	6	Assessment of problem-solving ability
Understanding problem	3	
Using initiative	8	Suggestion for developing problem-solving ability
Thinking more	3	
Asking more questions	1	

Note: Summarised in this study.

As shown in Table 1, there were three categories in the first theme called *positive effect of active learning*: voluntary training, independent and active thinking, and strong interest; there were four in the *performance of problem-solving ability*: problem sensing, communication, critical thinking, and decision making. *Factors that affect problem-solving ability* had three categories: positive emotion, type of problem, and previous knowledge; *assessment of problem-solving ability* had two categories: solving problems and understanding problems; and *suggestions to develop problem-solving ability* had three: using initiative, thinking more, and asking more questions. The participants in the control group who were not taught by the active learning method said that they did not like the way the teacher explained knowledge and skills and hoped for more diversified teaching methods to enrich their knowledge and enhance their skills.

The effects of the active learning teaching method observed in the study and suggestions to develop students' problem-solving ability based on active learning are listed in Table 2.

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Table 2.
Effects of active learning and suggestions to develop problem-solving ability.

Theme	Example	Effect	Result	Suggestion
A. Positive effect of active learning	…one of the meanings of active learning is that you want to learn instead of being asked to learn. It spawned my interest in exploring the world… (Student A) …My parents taught me to learn actively and think independently. Knowledge is a precious gift. You should strive for spiritual richness on your own… (Student E) ...I learned new skills like swerving dribble. It's not only a learning process, but also an exercise. I exercised and had fun... (Student B)	Students who participated in active-learning PE classes acquired more knowledge. Most students actively participated in class activities. The teachers asked students to solve problems and encouraged them to reflect and share what they knew.	Teachers should help students to improve their movement skills if time permits. The active learning teaching method requires some after-class instruction and support (time, place). Students' awareness of active participation in class activities has improved.	Students can enjoy the fun of problem-solving with topics and questions in mind, and can master techniques faster. Students should think and answer the questions actively. New knowledge should be associated with previous knowledge to expand students' knowledge system.
B. Performance of problem-solving ability	...The core of problem-solving lies in how to think about problems... (Student B) ...We need to know more about others' abilities and others need to know more about mine. Judgement should be avoided in communication... (Student H) ...If we pay more attention to our surroundings, we will have our own experience and ideas. ... (Student D) ...We can discuss and make decisions together to solve problems for the same purpose... (Student C)	Improving the ability to think compensates for unknown knowledge. It requires continuous thinking and learning. Communication can lead to more opportunities to cooperate and enhance the cohesion of the team. Students can sense and observe the problems more effectively. Students can identify and understand problems, compare various information, and take effective action to address the problem.	Decision-making is assessed when I have to solve issues or problems. Communication is the answer for improving work efficiency. Effective communication can help students acquire a lot of knowledge to improve their ability to solve problems and make final decisions.	Results are assessed by checking the evidence that can prove the problem has been solved.
C. Factors that affect problem-solving ability	...We can analyse and find solutions by adopting a fixed mindset… (Student I) ...The influence of previous knowledge on problem-solving ability... (Student C)	Students can obtain new information from new knowledge and skills.	The closer a problem is to previous knowledge, the easier it is to solve it.	Teachers encourage students to assess their own performance.
D. Assessment of problem-solving ability	...Faced with problems, we can seek solutions actively... (Student K) ...having the ability to observe and respond to problems in classes... (Student B)	Students analyse and interpret the problems in classes.	Students can come up with multiple solutions to a problem and choose the most appropriate one.	Students are advised to accumulate knowledge as a habit.

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Theme	Example	Effect	Result	Suggestion
E. Suggestions to develop problem-solving ability	... It leads to cognitive conflicts and a desire to learn, and stimulates interest in learning... (Student D) ... it arouses interest in actively exploring problems... (Student A)	Students are good at analysing problems and finding solutions.	Teachers encourage students to ask questions.	Students can make full use of their previous knowledge and form a new knowledge structure as they learn. The solution to the problem can be grasped by analysing the formation of the problem. Teachers can change problems flexibly and teach various problem-solving strategies.

Note: Summarised in this study.

As shown in Table 2, the effects of active learning in PE classes and suggestions are as follows:

A. *Positive effect of active learning:* The first question was related to the effect of applying the active learning teaching method on students' performance in PE classes. It can be seen from Table 2 that 5 of the 10 interviewees thought that active learning could lead to voluntary training. All the participants believed that active learning had a positive impact on improving their performance, and they stressed the importance of interest and independent thinking. Student B learned new skills like swerving dribble and believed that it is not only a learning process but also an exercise, which is good for health and the enjoyment of sports.

B. *Performance of problem-solving ability:* All the students said that the active learning teaching method encouraged them to hone their skills and learn more, and guided them to successfully solve various problems. Student C commented that he had learned to reflect on what he had done and express what he knew in class. Student H said that he now knew how to learn more about the abilities of others and let others know more about his. Six of the ten students mentioned the importance of the ability to sense problems. The problem-solving ability refers to the capacity to use multidisciplinary knowledge to solve problems encountered in life. Student E believed that the ability to solve problems can be mastered by combining active learning with problem-solving skills.

C. *Factors that affect problem-solving ability:* All the interviewees expressed the belief that previous knowledge, the type of problem, and positive emotion would affect their problem-solving ability. Six of the ten respondents mentioned the importance of positive emotion. Student C said that he had revised his knowledge many times in the process of active learning and found the task to be challenging; hence, his knowledge and skills were improved. Student, I said that analyzing and addressing problems with a fixed mindset would affect the trend of subsequent activities; therefore, he tended to learn actively in class, think, and explore effectively.

D. *Assessment of problem-solving ability*: The interviewees commented that their understanding of the questions and responses would affect the assessment of their problem-solving ability, which, in turn, would influence their judgment and responses to problems. All the interviewees mentioned effective ways to incorporate active learning into the PE curriculum, and six of them emphasized the importance of understanding problems. Student K stated that the best way to evaluate students' problem-solving ability is to assess their understanding of problems and suggested that teachers use more materials in teaching activities and projects in class to further develop students' knowledge and skills.

E. *Suggestions to develop problem-solving ability:* The interviewees believed that active learning teaching methods are suitable for the PE curriculum. They emphasized that teachers should enable students to experience cognitive conflict and stimulate their desire to learn, thereby cultivating their problem-solving skills. Student H stated that teamwork and presentations in class would help students

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acquire more knowledge and enhance their skills. Student, I mentioned that students could utilize various tools to gather essential information and apply skills learned across different disciplines through participation in projects and presentations, providing practical experience in solving problems. Two students highlighted that brainstorming is an effective method to implement active learning in PE classes, while Student J suggested that collaboration with other teachers or educators could yield better results.

In summary, the above points represent the views of the interviewees regarding active learning and problem-solving ability. All 10 students answered all the questions related to the five themes listed below.

A. *Positive effect of active learning*. All ten participants verified that the application of active learning in PE courses was effective and affirmed that the active learning teaching method helped them to learn by increasing their willingness to think independently and find solutions, which greatly improved their ability to think critically and practice effectively.

B. *Performance of problem-solving ability*. All the participants expressed that they had mastered some skills and improved their problem-solving ability through active learning.

C. *Factors that affect problem-solving ability*. All the participants identified factors such as previous knowledge, type of problem, etc.

D. *Assessment of problem-solving ability*. All the participants said that the understanding of problems and the response affected the assessment.

E. *Suggestions to develop problem-solving ability*. Students in the experimental group proposed that the training time should be extended and that problems should be flexibly changed.

They also mentioned that active learning can provide suitable tasks to satisfy the needs of students at different levels, and teaching plans can be adjusted based on the target skills to be nurtured for all students. This approach can offer a new perspective for future related research. In summary, it was demonstrated in this study that active learning is highly effective in improving the problem-solving ability and performance of PE students in college, which aligns with the research objectives.

5. Discussion

College PE students' opinions on the influence of active learning on their problem-solving ability and study performance were obtained through qualitative research. During the interviews, students asserted that active learning had a positive impact on their problem-solving skills and professional development. Van den Bergh et al. [62] also observed that active learning had a positive effect on professional performance, and the students who participated in this study verified that the active learning teaching method helped them to learn in a more efficient way.

The participants believed that the active learning teaching method had a positive impact on their interest in learning, independent thinking, voluntary exercise, and so on. According to Niemi et al. [63], teachers tend to spend more time helping students develop their skills and knowledge when the active learning teaching method is applied, and this results in increased students' knowledge and interest. Zahir [64] emphasizes the important role of the active learning teaching method in cultivating students' professional and life skills due to its positive influence on their self-management, self-confidence, and problem-solving ability. This is consistent with Baeten et al. [65], which focused on the relationship between learning methods and independent thinking.

The participants thought that the problem-solving ability is mainly manifested in problem sensing, critical thinking, etc. Gilar-Corbi et al. [66] found that the ability to sense and predict problems was related to the ability to respond to them, and in their quasi-experimental research, Azzouzi and Gantare [67] discovered that specialist student nurses became more confident in communicating after active learning training. Rodzalan and Saat [68] explored the critical thinking and problem-solving abilities of 2,000 undergraduates from public universities in Malaysia and found that male students outperformed their female counterparts. According to Kanbay and Okanlı [69], students' critical thinking can

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improve their problem-solving ability.

The students who participated in this study proved the importance of critical thinking due to its role in analyzing information, which leads to a choice of solutions [70]. Although other mindsets are needed to analyze, evaluate, and reflect on the process of problem solving [71], it is essential that college students cultivate their critical thinking and problem-solving abilities in order to meet the demands of the future world as the main force of its development.

The participants identified the main factors that affected their problem-solving ability as positive emotions, the type of problem, previous knowledge, etc. Zhou [72] also found that students' positive emotions influenced their ability to solve difficult problems. Sum and Bădescu [73] found that previous knowledge is transformed into an active state when it is considered to be useful for a cognitive task. This is consistent with the study of Crooks and Alibali [74], who determined that previous knowledge is the most important element of problem solving because it enables students to connect what they already know to new knowledge through assimilation or adaptation. This makes it easier to learn and retain knowledge.

In their assessment of the problem-solving ability, the students suggested that it involves understanding and responding to problems. Mehrabi Boshrabadi and Hosseini [75] propose designing projects and activities to assess students' problem-solving and feedback abilities when it is challenging for them to answer questions. Zhang et al. [76] explored the relationship between the understanding of problems, response strategies, and problem-solving ability based on logical analysis. 21st-century students cannot succeed with knowledge alone; they also need problem-solving, innovation, and communication skills. When faced with hard tasks and no clear solution in mind, it is essential to understand the problem and choose an appropriate solution to achieve the expected goal [77].

The participants suggested that students should be proactive, think more and ask more questions. Lazakidou and Retalis [78] designed a model to investigate students' problem-solving and independent learning abilities from the perspective of the efficiency of teaching methods and students' initiative to promote their learning outcomes. Cavanagh et al. [79] advocate a problem-based learning method as a cognitive and professional skill, which can help to solve complex and multi-disciplinary problems. Therefore, students should think more and ask more questions when learning to become more effective problem solvers. Competencies such as critical thinking, innovation, collaboration, and communication are essential for the ability to solve problems in the acquisition of professional skills in the 21st century [80].

In summary, it is proposed that the application of the learning teaching method in the PE curriculum will help college PE students to develop their problem-solving ability due to the positive impact of teachers' professional knowledge and organizational skills De Wever et al. [81]. Burke and Stewart [82] integrated the problem-solving model into assignments and lectures to explore teaching strategies for active learning, and found that problem-based teaching can help students perform better in class and overcome challenges they may encounter in their studies and daily life. The students who participated in this study said that they felt motivated to take action in class to improve their critical thinking, communication, collaboration, and their ability to solve problems.

6. Conclusion

This qualitative descriptive study was based on interviews to explore the application of the active learning teaching method in the college PE curriculum and its impact on students' problem-solving abilities. The results proved the importance of the role of active learning in improving students' performance in class and their ability to solve problems [83]. All the students confirmed the effectiveness of the active learning teaching method. The performance of their problem-solving abilities includes problem sensing, critical thinking, etc., and they all stated that their problem-solving abilities had been enhanced by active learning.

The factors that affected the ability of college students majoring in physical education to solve problems were their previous knowledge, the type of problem, etc., which may enhance or hinder

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students' ability to achieve their expected performance. It is proposed that all these factors should be balanced and controlled; for example, adopting active learning teaching methods and introducing activities with exploration tasks into the class will improve teaching efficiency and maintain students' interest. The curriculum should be designed to achieve a balance among teaching objectives, class activities, and teaching methods, so that students can experience more balanced active learning [84].

The implementation of the active learning teaching method and the lifelong education of teachers and students is essential to ensure the sustainable development of the active learning teaching method in college courses. It was found in this study that the students' performance, self-confidence, communication skills, critical thinking ability, and problem-solving ability had all improved as a result of implementing active learning in their PE classes. Therefore, the active learning teaching method is critical for enhancing the quality of teaching and the effectiveness of learning [85].

6.1. Implications

6.1.1. Theoretical Contribution

This study provides theoretical support for enriching the design of the PE curriculum by applying the active learning teaching method to improve students' problem-solving ability. The students who participated in the study confirmed the effectiveness of the active learning teaching method in enhancing their problem-solving ability in qualitative interviews. Most of the previous studies focused on the attitude and practice of college students' physical exercise and their problem-solving ability after entering society [86] and the problem-solving ability of PE students [87], but few are devoted to observing the problem-solving ability of college PE students after being exposed to active learning in PE classes. The results of this research clearly demonstrate that the active learning teaching method is extremely effective in improving college PE students' ability to solve problems, which confirms the research of Calderón et al. [88] who found that the application of the student-centered approach can stimulate students' initiative and affect their performance, internal motivation, and problem-solving ability.

6.1.2. Practical Contribution

By combining the active learning teaching method in the PE curriculum with students' problem-solving abilities, it was demonstrated in this study that students' problem-solving skills are enhanced through this teaching approach. Therefore, the active learning teaching method can be adopted in other courses within PE majors, and teachers can set specific and measurable goals for students, designing effective teaching plans to achieve those goals and ultimately improve students' problem-solving abilities [89].

6.2. Limitations

This study was limited by the short time span of the experiment and the leading questions, which may have affected the interviewees' answers and opinions because different questions may lead to different opinions from respondents [90]. According to Rubenstein et al. [42], future studies should further explore how to improve students' problem-solving abilities from the perspective of planning activities to enhance the efficiency of teaching and learning. Hence, it is suggested that future research should focus on two aspects: 1) the frequency of use of active learning teaching methods in classes [91] and 2) to further explore the design and integration of active learning physical education courses within the entire curriculum structure of the basketball major, and to develop more complete and creative courses to enhance students' problem-solving abilities [92].

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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