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# Effectiveness of Cooperative Learning Instructional Models in Training In-Service Physical Education Teachers in Southwest China

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**Abstract:** The provision of advanced specialized content knowledge (SCK) that facilitates in-service teachers' pedagogical content knowledge (PCK) is one aspect of physical education (PE) worth attention. To some extent, instructional models for training PE teachers on PCK implementation have been studied internationally. Cooperative learning (CL) is rarely reported in China, where direct instruction (DI) is commonly used to assist PE teachers. This study fills in the gaps and investigates whether PE in-service teachers receive proper training during short sessions to improve their PCK. We examined the effect of scaffolding procedures on in-service PE teachers' PCK, skills, and self-efficacy compared to CL and DI. Hence, the question arose as to whether this support training provided by the instructor would assist in-service teachers in their perception of their efficacy as PE teachers. We deliberately selected 72 in-service PE teachers from twelve middle schools in Chengdu, Sichuan Province, China (23, 22, and 27 teachers for CL with scaffolding, CL, and DI conditions, respectively). CL and CLS participants were divided into mixed-sex teams using the CL procedure (Jigsaw) during the training session, while DI participants practiced the same training session in tandem. Pre- and post-tests were used to measure PE in-service teachers' SCK, skills, and self-efficacy improvements. Additionally, PCK was also examined in the post-test. The mean scores for teaching self-efficacy, performance, and knowledge of practice for all three training conditions (CLS, CL, and DI) were similar at baseline. These parameters significantly differed between the three groups at the pre- and post-test. Post hoc tests revealed that participants in CLS programs improved their performance scores more from pre-test to post-test than participants in DI programs. Among CLS and CL participants, post hoc analyses indicated that their scores improved more significantly than those of DI participants between the pre- and post-tests. The correlation analysis showed positive correlations between post-test performance, PCK, and teaching self-efficacy in each condition. Direct access to teacher intervention information would be the key to developing instructional knowledge. CL training designs should incorporate scaffolding to help in-service teachers develop self-efficacy through physical activities.

**Keywords:** school education; physical education; schools in China; professional development; educational interventions; teaching methods; sustainable education



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## 1. Introduction

Physical education (PE) teachers strive to improve their pedagogical content knowledge (PCK) to provide the most effective instruction for their students [1–3]. While in-service PE teachers may have a basic understanding of the different types of sports activities due to their common knowledge (CK), they still need to acquire advanced specialized content knowledge (SCK) to instruct their students efficiently [4–6]. Keeping up with the latest standards requires the acquisition of existing information and improved methods for implementing and instructing PCK [7–9]. PE teaching methods include direct instruction (DI) [10,11]. Most teachers use this pedagogical framework to help students learn [12–14].

Despite lecturing on PCK topics, in-service teachers rarely incorporate them into practical practice sessions. Developing PCK skills requires PE teachers to possess both instructional and operational skills. Additionally, they must gain the self-efficacy necessary to bridge the gap between theory and practice [15–17]. Even though cooperative learning (CL) opportunities are limited in public schools for training PE in-service teachers, instructional standards require teachers to enhance their coaching capabilities.

Depending on the circumstances, DI may differ from traditional classroom instruction [18–20]. Despite this, the teacher determines the fundamentals of the class, regardless of whether instruction is direct, physical-focused, or guided practice [21–23]. In addition, this includes the organization of students, the beginning and end of practice segments, the implementation of class rules, and modifications to learning tasks [24–26]. Public schools often rely on DI to provide PE curriculums with valuable information. Nevertheless, most in-service teachers spend substantial time explaining and demonstrating PE and other learning techniques. In-service teachers tend to focus less on personal activities and more on PE. In addition, learners must be informed and guided regarding benchmarks during the presentation, demonstration, and regulation of upcoming trends [27–29]. Furthermore, teachers generally focus more on DI due to their inability to participate in CL. Even though the CL model could be more theoretically and professionally effective, PE in-service teachers rarely adopt this approach during practical training sessions. Moreover, the DI option is premised on the concept that in-service teachers will have the opportunity to provide preliminary evaluations of their own efficacy [30] through observation under the supervision of an experienced teacher. Despite influencing the transformation and replication of PE work practices and knowledge through conceived experiences [31–33], DI instruction may not always be the right choice to help students express their self-efficacy and accomplishment. CL would offer new opportunities for PE in-service teachers to assist self-efficacy development through active engagement, invented experiences, verbal persuasion, and physiological states.

CL relies on small and diverse groups of students collaborating to enhance both their own and each other's learning. Several PE teacher educator (PETE) programs have cited CL as an appealing option for teaching PE in-service teachers how to manage group tasks [34–36]. It has been examined whether CL training environments can contribute to teachers' self-efficacy in academic and PE settings [37,38]. Primary school teachers view CL as less essential to their professional development than other learning methods. In-service teachers agree that education should be more process-oriented than outcome-oriented [1]. Additionally, researchers found that, unlike CL participants, DI participants had increased self-efficacy from pre-test to post-test [39]. CL design may be a viable alternative to DI in PE teaching. Instructors may stress that the results apply equally to creating a stimulating, inspiring, healthy, and vibrant learning environment. CL contributes to communicating effectively with students [40]. Furthermore, CL participants appeared to be more adept at preparing for and evaluating specific social and cognitive objectives [41]. This method of teaching techniques was used effectively during some training sessions [17,42]. Although both methods of instruction have merits and weaknesses, neither is completely effective. It is apparent from this that both DI and CL participants initially rated their self-efficacy highly [39]. Additionally, some instructors may argue that CL meets today's requirements better. Learning preferences vary with time and are influenced by the environment [43].

The PETE programs suggest that instructors who are not well prepared for classroom management may be less likely to adopt creative approaches [44–46]. The question is not which instructional paradigm is the most effective. Instead, it is how CL will be incorporated into traditional classroom practice settings to enhance the learning environment. When considering how to incorporate CL scaffolding (CLS) into an in-service training program, one must assess the effectiveness of PCK techniques in terms of their ability to support teaching [47]. CL uses the Jigsaw method to structure classroom activities. This technique involves students forming small groups to master the necessary skills before returning to their original team to share their knowledge with their peers. Putting to-

gether a Jigsaw environment in any education program depends on how well a trainer trains PE teachers. The scaffolding technique is useful for in-service teachers establishing endorsement tutoring and tutee roles in novel physical activities.

The scaffolding concept is derived from the zone of proximal development (ZPD), which is grounded in socio-cognitive and socio-cultural perspectives on learning [39]. From this theoretical viewpoint, an individual who acquires skills from partners with more experience can accomplish what they could not accomplish on their own [48,49]. It has long been recognized that ZPD and scaffolding are closely related in education [39]. This allows in-service teachers to gradually eliminate shortcomings under experienced instructors' guidance, fostering enhanced teacher competence. Studies indicate that instructors struggle to integrate CL into the classroom [45]. There may be variations in the types of scaffolding used to support PE in-service teachers' instructional activities in CL. In-service teachers can benefit from conceptual scaffolding by recognizing and modifying their approach to solving specific problems based on visual representations of situations. The concept of procedural scaffolding refers to the introduction of explanatory materials and demonstrations that help teachers understand how to solve a particular problem. Instructors can help in-service teachers strengthen their self-image by providing multiple opportunities to practice essential PCK skills and strategies for managing group interactions through peer modeling and role-playing [50–52].

Even though diversity of experience in CL configurations like Jigsaw promotes teaching competence and self-efficacy, in-service teachers rarely train in these settings during training sessions. Furthermore, little research has been conducted to develop scaffolding techniques to facilitate the acquisition of PCK, teaching abilities, and self-efficacy by in-service teachers in CL settings. Regarding social development, teachers' importance should be considered [30]. This study aims to determine if CL environments affect self-efficacy perceptions among PE in-service teachers. Direct and indirect instruction is key to influencing learners' beliefs and attitudes. Small groups are encouraged to use persuasive communication techniques properly. Chinese Tai Chi is a traditional Chinese martial art [53] and physical exercise taught in Chinese schools. It has been widely acknowledged for its positive effects on human health [54]. Teacher expertise is required to instruct students about Tai Chi techniques (TCTs) and Tai Chi movements (TCMs). PE teachers can benefit from the research by strengthening their skills. Specifically, the present study explores how in-service PE teachers acquire SCK, improve their skills and teach self-efficacy in teaching distinct forms of physical activity. This study prepares in-service PE teachers for further learning through advanced training. More precisely, (1) this study compares the efficacy of CL and DI experiences with CL and scaffolding methods. (2) We also aim to determine whether exposure to the Jigsaw environment is superior to exposure to the DI environment. We intend to develop skills and acquire SCK for in-service PE teachers. Nevertheless, the Jigsaw training condition alone does not provide sufficient evidence of PCK and self-efficacy in teaching. In-service PE teachers with a basic understanding of TCTs relating to physical activities would benefit from instructor scaffolding.

## 2. Methods

### *2.1. Description of Participants and Study Design*

Seventy-two in-service PE teachers were deliberately selected from twelve public middle schools in Chengdu, Sichuan Province, China. Most teachers belong to the Han ethnic group (95%), while the remaining 5% belong to other minority groups. There were 53% male teachers and 47% female teachers. The mean age of these male and female teachers was 47.5 $\pm$ 11.23 (mean $\pm$ standard deviation) years old and 42.85 $\pm$ 9.63 years old, respectively (Figure 1). These individuals participated in this SCK training voluntarily during their in-service period. The study was conducted in 2022 and involved a training program designed to introduce Tai Chi activities to in-service PE teachers with basic sports understanding. Tai Chi is a traditional Chinese sport where individuals can participate alone, but teachers cooperated during breaks between training sessions and rounds to share

their experiences. When learning requires advanced skills, having a coach who can provide helpful demonstrations and instructions is vital [55], particularly when the coach has been trained professionally [56]. The decision to engage in this PE activity was made based on the SCK associated with it and the cooperation of other partners. Institutional review boards at the faculty level approved this investigation on ethical grounds with explicit written authorization. Participants were informed that they would be filmed in connection with this study. It was also assured to them that their personal data would be protected through appropriate confidentiality and privacy measures. In addition, the participants were assured that the training period would not be evaluated regarding its impact on their service. No penalty would be imposed on them for refusing to participate, and they could withdraw from the research without explanation.

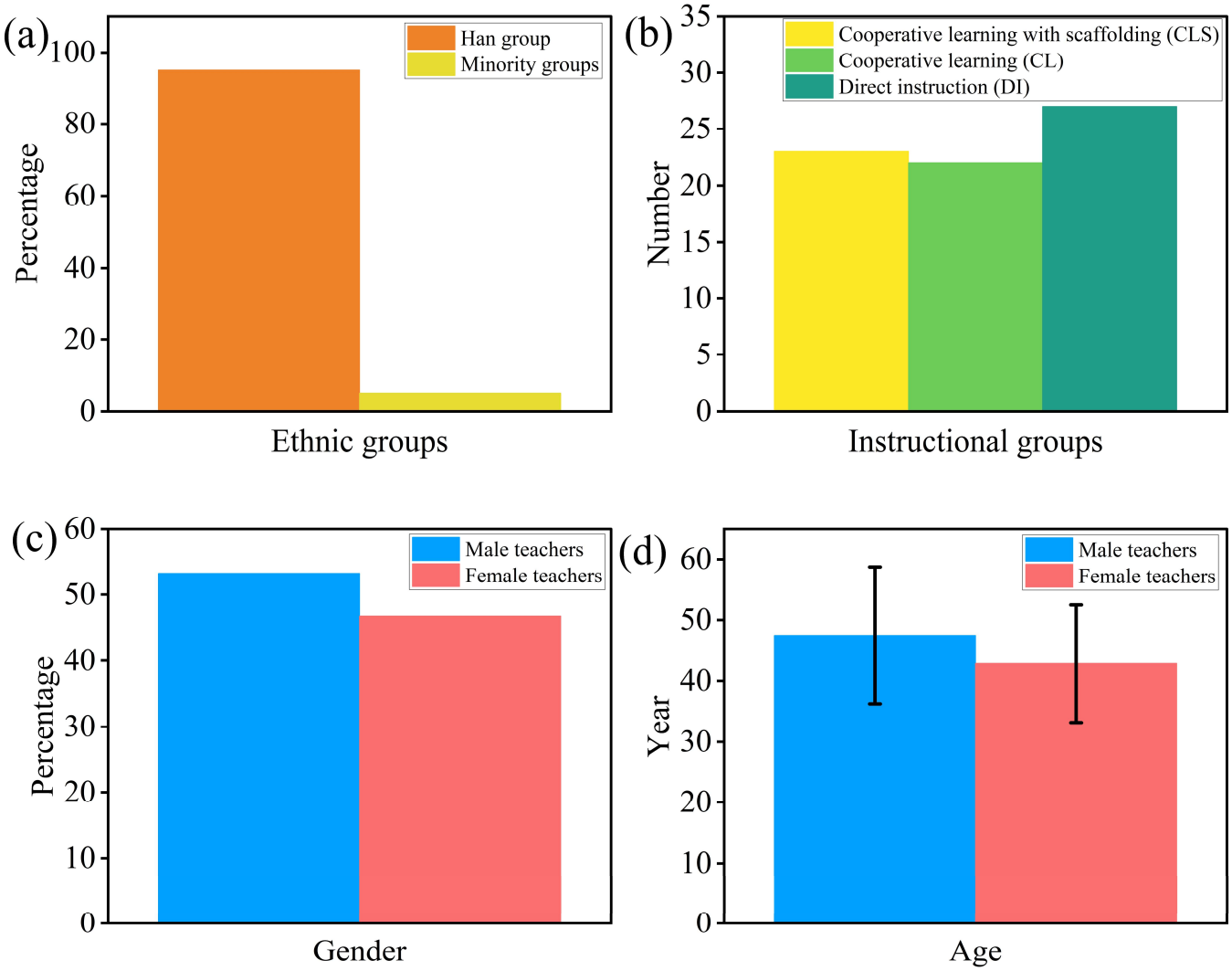


**Figure 1.** Teachers' sociodemographic characteristics (**a**–**d**).

### *2.2. Study Procedure*

Our study procedure is summarized in Figure 2. This figure shows five major components of this procedure (a–e). CLS, CL, and DI condition groups were randomly assigned to 23, 22, and 27 teachers. The training results were compared between two groups: comparison (T1) and experimental (T2).

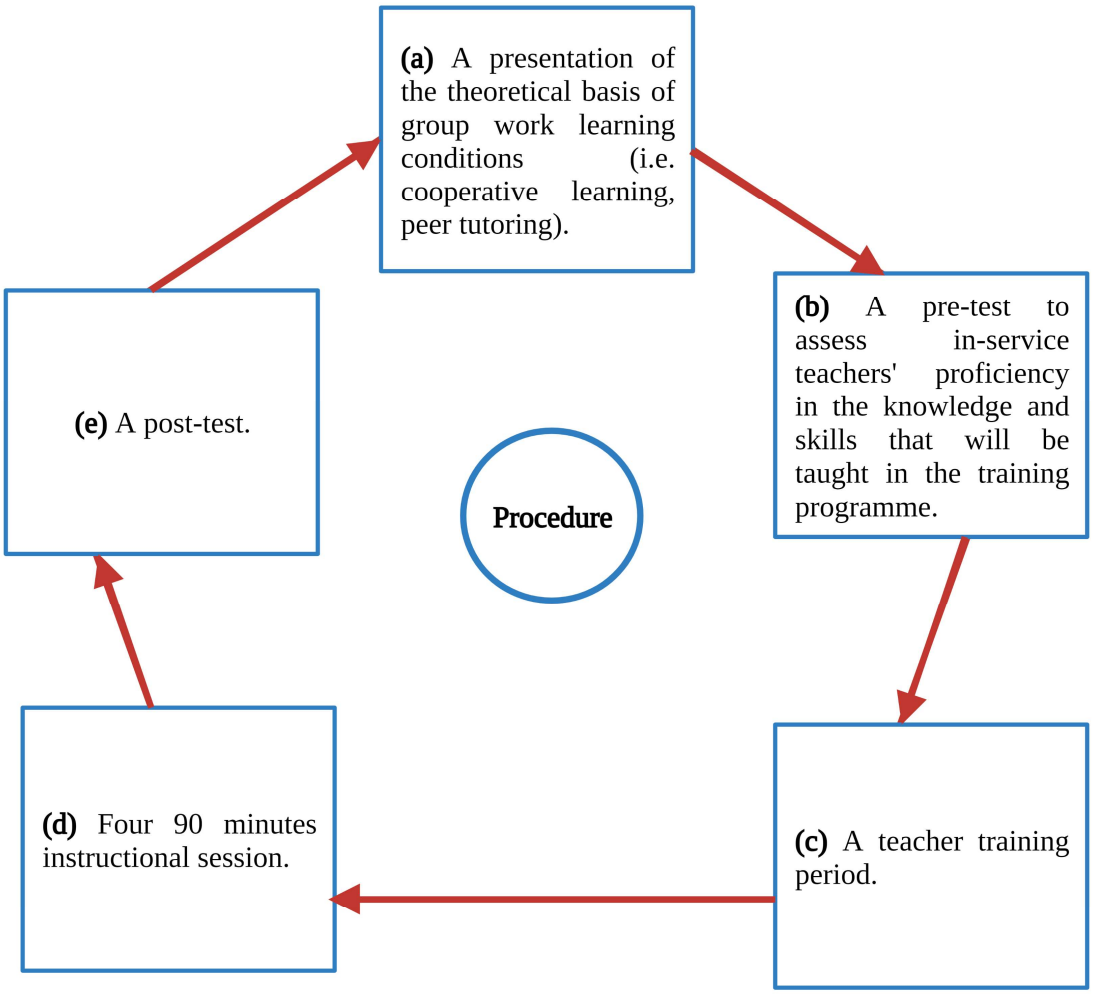


**Figure 2.** The procedure followed in the study.

#### 2.2.1. Theoretical Underpinnings of Group Work Learning

Each of the four sessions lasted 90 min and provided participants with the foundations of constructivist and social cognitive theories around developmental cognitive psychology [57,58]. A Tai Chi expert led these four sessions. In addition to comparing the two theories [59], the researcher introduced the Vygotskyan paradigm of ZPD and its application in an educational context through peer-assisted learning. The session concluded by emphasizing the importance of teachers preparing their students for CL in PE through practical examples from several studies [60,61]. The same expert trainer presented the session's Tai Chi history to all participants.

#### 2.2.2. Assessment of Pre-Test

The participants were required to complete a written assessment in which they were assessed on their knowledge and compliance with the sport's rules, as mentioned by others [39]. They were then required to respond to four questions regarding eight items on the PETE questionnaire provided by other researchers [62]. It has been found that items on the teacher self-efficacy scale correlate with knowledge of strategies for challenging and motivating learning and successful teaching. After the group was divided into same-sex dyads, participants were instructed to exchange roles in two introduction scenarios. Their assignment was to perform TCTs and TCMs. In addition to describing each move, the instructor demonstrated each move, showing each participant where to position the targets relative to one another. Video recordings and questionnaire responses were used to gather information about participants' performances.

2.2.3. Providing Instructional Training

The same trained expert with 22 years' PE experience instructed all participants in Tai Chi theory and practice. Each lesson began with participants receiving specific information regarding PE class administration (Figure 3). As part of the pre-practice warm-up, DI participants were given instructions on safety measures. While participating in the CL program Jigsaw [47], participants also had access to Jigsaw CL materials. The instructor stressed several points. These included (a) the technique for mixed group composition; (b) the most efficient way to allocate roles and responsibilities in small groups; and (c) precise timing that ensures equal participation for everyone. While the instructor addressed norms, the instructor did not examine CL instruction's qualitative nature. Conversely, Jigsaw's CLS participants gained a more comprehensive understanding of the teaching intervention implemented in the training program. Initially, they studied the guidelines written by the instructor for (a) showing and telling learners how they should behave as tutors and (b) watching and providing feedback on learning performance to help learners understand what was put into their performance. It was evident from audio-visual recordings of instructional sequences from the preceding year that the instructor emphasized (a) verbal presentation of scenarios, (b) demonstration of movements, (c) observation of learners' actions, and (d) regulations. The training period lasted six hours across all three conditions (CLS, CL, and DI).

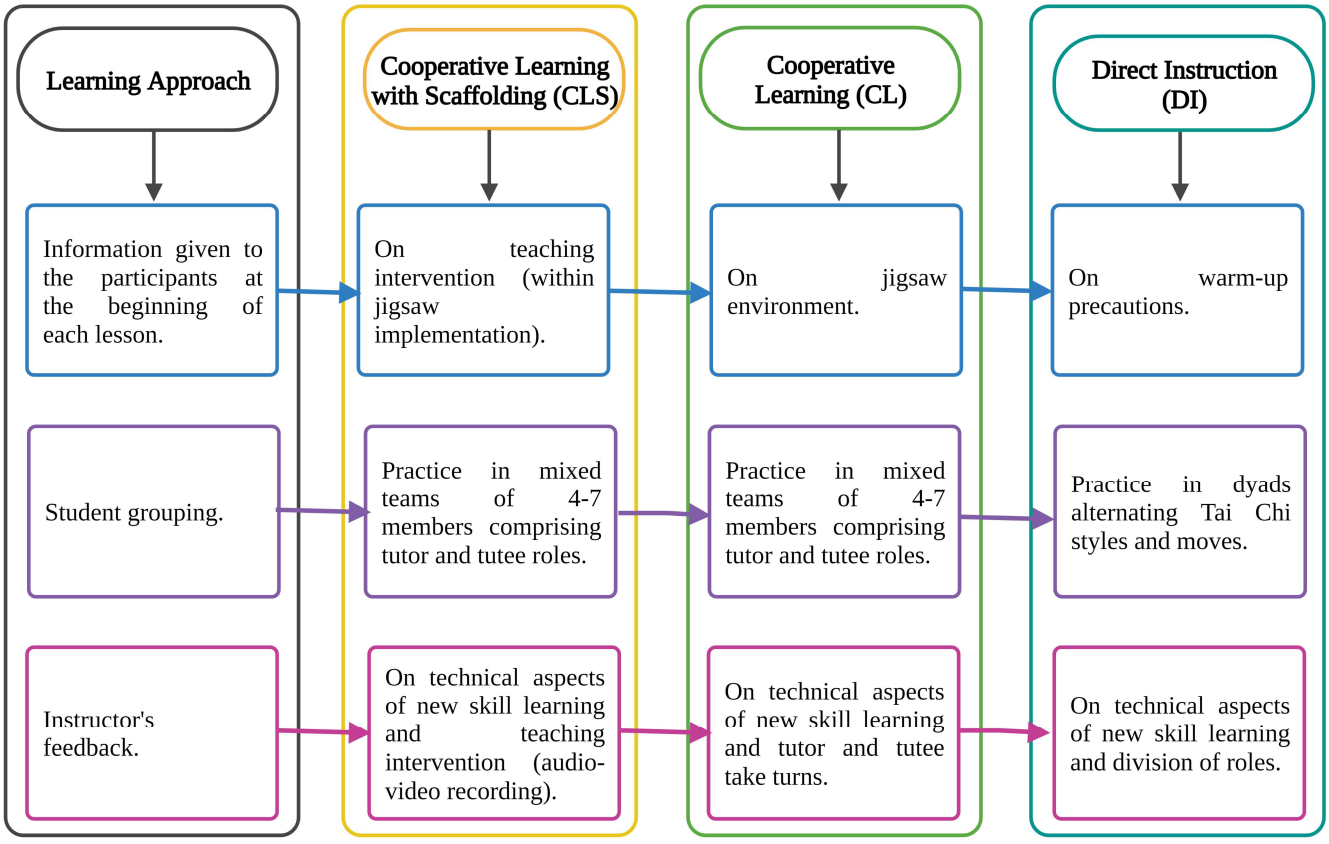


**Figure 3.** Study design followed three conditions (i.e., CLS, CL, and DI).

2.2.4. Session of Physical Practice

A 15 min warm-up session was followed by three weeks of physical practice with the same instructor for each condition. When participants worked in dyads in the DI condition, the instructor guided them. This helped them develop the technical skills necessary to do the assignment. For both the CL and CLS conditions, participants were divided into five mixed-sex teams comprising four to seven individuals, following customary group size

considerations [39]. The Jigsaw technique instructed each team to distribute its members evenly among distinct major challenges. This was to practice the same activities as DI. During the initial phase, they were informed that they would be required to guide their colleagues in a set of movements. They were to practice an exercise to complete it easily, and they were to describe and demonstrate the procedure to their teammates. Once they completed the first phase, they were to return to their teams to instruct each member in turn during the second phase. In this aspect, technical remarks and rewards can encourage performance. Additionally, they would learn when their fellow group members arrived for their lesson.

Participants were then shown and instructed on how to perform advanced Tai Chi performances in dyads at each station. This was done during the first period of the session. Each participant received access to technical worksheets that included images and brief remarks regarding key aspects of normal conduct norms. For the CL and CLS conditions, the instructor returned to the station differently. While watching the TCT and TCM performances for CL participants, the instructor focused on technical issues, offering individual critiques as needed. Participants in the CLS condition were asked to (a) deliver the task and demonstrate it, emphasizing its essential elements; (b) monitor peers to identify specific types of wrong conduct; or (c) assist peers in making progress by advising them. Afterwards, CL and CLS members were given five minutes to rejoin the team. Finally, each team member approved a tutor role using the Jigsaw process to impart knowledge to their colleagues. In order to accomplish this, the participants followed the same sequence. Following the initial physical practice session, two more sessions were conducted, each involving enhanced abilities in learning and teaching. Team composition, station assignment, and scheduling aspects were observed during these sessions.

#### 2.2.5. Assessment of Post-Test

Prior to taking the pre-test, participants completed written questions concerning their skills and the teacher self-efficacy form. Similarly to the pre-test, the post-test performance was recorded on camera. Participants were selected for these technical activities based on their abilities during the physical practice session. Participants in the Tai Chi performance were instructed to mimic their partners' movements and perform quickly and accurately. Each step was intended to achieve the goals indicated. Several strategies were coordinated to accomplish the task. At the end of the session, participants completed their PCK test.

### *2.3. Measures of Variables and Their Statistical Analysis*

The pre- and post-tests assessed PE in-service teachers' self-efficacy, skill, and SCK. Participants were asked to complete post-tests to assess their PCK. Researchers conducted a pilot study to accomplish this successfully. The participants received explanations of the four factors of the self-efficacy questionnaire and recorded Tai Chi performances, and took both pre- and post-tests for exercise sessions.

#### 2.3.1. Self-Efficacy Variable

Self-efficacy relates to beliefs about the ability to carry out specific objectives, tasks, or activities, rather than broader beliefs or attitudes. This statement states that scales of perceived self-efficacy must be customized to the specific functional area under investigation [63]. The PETE questionnaire was used to assess the self-efficacy of in-service teachers over six hours, corresponding to the duration of the introductory session. Specifically, eight items [62] were chosen from the PETE questionnaire to assess the self-efficacy of in-service teachers. Developing advanced skills and maintaining a positive rapport with students are significant components of verbally presenting a learning task. It has been argued that *demonstrating movement* in front of the entire class focuses on performance quality. This motivates participants to strive for excellence. By identifying skill deficits and providing constructive comments, *novice behaviors* can be corrected. A teaching method that *provides additional guidance* allows attention to each participant during the session based on the

scenario development. This involves persuading them to continue with the activity associated with the specific condition. The PETE questionnaire was conducted to assess the overall degree of expertise that participants expected to acquire in Tai Chi learning sessions. Participants were asked to rate the level of proficiency on a 10-point scale (i.e., 'I fully master', 'I master,' 'I do not master'). A high level of internal consistency was found in the reliability study conducted on the four items (Cronbach's $\alpha$ = 0.88 for the pre-test and =0.81 for the post-test).

#### 2.3.2. Assessment of Performance

Other researchers [39] identified key features that were averaged and used to grade Tai Chi performance skills recorded on film. We rated the stability of the performance on a 5-point scale, with 5 representing the most stable performance and 1 representing the least stable performance. The study involved two PE teachers, both Tai Chi specialists and blind to the study's aims and conditions (T1 and T2). The scoring method was rehearsed using pilot videotapes of 12 individuals. After viewing the videos independently, the researchers produced two distinct technical scales for the pre-test and post-test. Any discrepancy in the coding of the videos was clarified. The pilot videotapes indicated that TCTs (92%) and TCMs (89%) had been agreed upon. It was determined that interclass reliability for performance assessments could be evaluated using a two-way analysis of variance (ANOVA) with repeated measurements (RM) on the last component, which determined the percentage of agreement between the two judges and the intra-class correlation coefficient ($r$). It was found that these analyses generated acceptable findings and good intra-class correlation values for TCTs and TCMs ($r$ = 0.74 and 0.69, respectively). The averages of the judges' performance evaluations were then calculated. Furthermore, an intra-rater reliability test was conducted with six participants via videotape. Approximately six months later, the performance ratings were reevaluated for each participant, and 88% of the time, both coders agreed with each other.

#### 2.3.3. Assessment of Knowledge for Practice

Pre-tests and post-tests included questions about what was considered appropriate for TCTs and TCMs to assess each participant's understanding. Differences were scored using the same method. They were instructed to include both TCT and TCM scores in their written responses. Two assessors created a grid used to calculate an overall score. We also considered the response's accuracy and precision.

#### 2.3.4. Pedagogical Content Knowledge

Participants were presented with three questions based on the instructional classification of design characteristics that influence the development of specialized skills in PE [64]. Initially, there would be a need to present examples of Tai Chi performances incorporating TCTs and TCMs in PE classes for beginning middle school students. Participants were asked to elaborate on safety measures before demonstrating specific exercises to the rest of the class. Second, they were required to provide details regarding the task requirements. As a final prompt, we requested that they explain how newcomers would be informed of the criteria. In addition, we asked them how they intended to address behavioral challenges. For three specific scenarios (CLS, CI, and DI), the above raters assessed the accuracy and usefulness of participants' responses using a grid with a 10-point scale. The technique could be demonstrated at different positions, with the goal explained in terms of displacement between the two techniques. In addition, the priorities for stability, control, and protection could be questioned.

Each RM variable (teaching self-efficacy, knowledge for practice, and performance) was analyzed by a multivariate (M) ANOVA. We conducted RM-ANOVAs and post hoc Tukey HSD test sizes [65] to examine the differences among the three conditions (CLS, CI, and DI). Only post-test data were used for MANOVA and ANOVA, since PCK was assessed

at the end of the program. As part of determining effect sizes (*d*), we also used standard deviations from the samples [66]. SPSS 28.0 was used to conduct the statistical analysis.

## 3. Results

The scenarios of teaching self-efficacy (Figure 4a), knowledge for practice (Figure 4b), and performance (Figure 4c) were evaluated through RM-MANOVA analyses. In order to determine whether there was a difference between the three conditions (CLS, CI, and DI), follow-up tests were conducted using RM-ANOVA. Moreover, post hoc Tukey HSD tests were used for unequal sample comparison. ANOVAs and MANOVAs were performed on only the post-test measure of PCK shown in Figure 5. We also calculated effect sizes (*d*) based on the standard deviations of the polled samples.

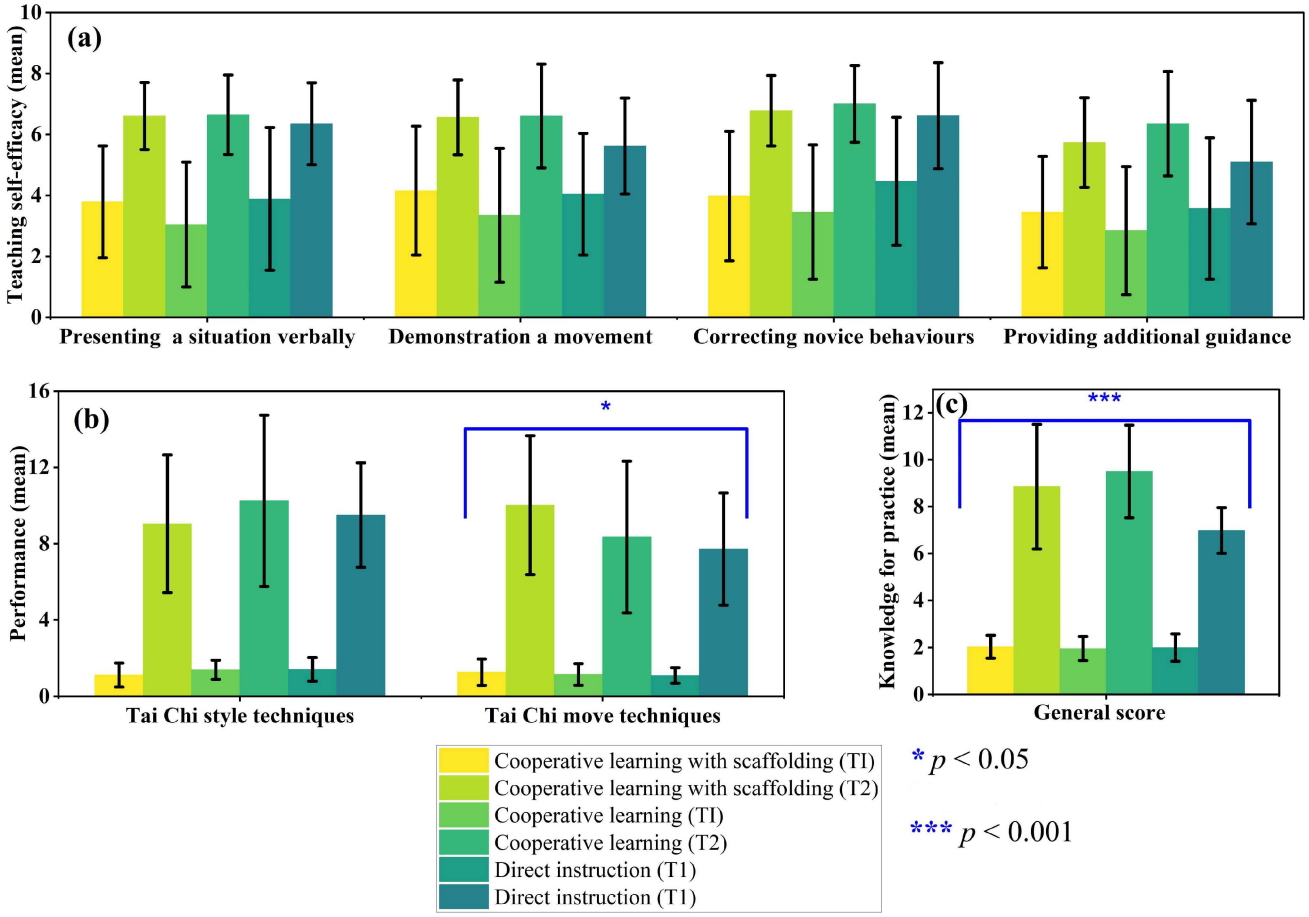


**Figure 4.** Bar graphs comparing three types of training conditions for teaching self-efficacy (**a**), performance (**b**), and knowledge (**c**). The *y*-axis denotes the mean value. Standard deviations are represented by vertical bars. Note: A multivariate analyses of variance test was conducted to determine the significance of differences (at * $p < 0.05$, and *** $p < 0.001$) between conditions.

### *3.1. Measuring Variables*

#### 3.1.1. Indicators of Teaching Self-Efficacy

The mean scores were similar (Wilks' Lambda ($\lambda$) = 0.91, $p = 0.79$, $F(11, 15) = 0.45$) for all three training conditions (CLS, CI, and DI) at baseline. Based upon the results of the RM-MANOVA on participants' self-efficacy scores, it was evident that there was a significant difference (Wilks' $\lambda = 0.23$, $p < 0.001$, $F(5, 59) = 38.78$) in participants' scores between pre- and post-tests for the three groups. Despite this, no interaction (Wilks' $\lambda = 0.83$, $p = 0.27$, $F(11, 15) = 1.13$) was observed between the training condition and time.

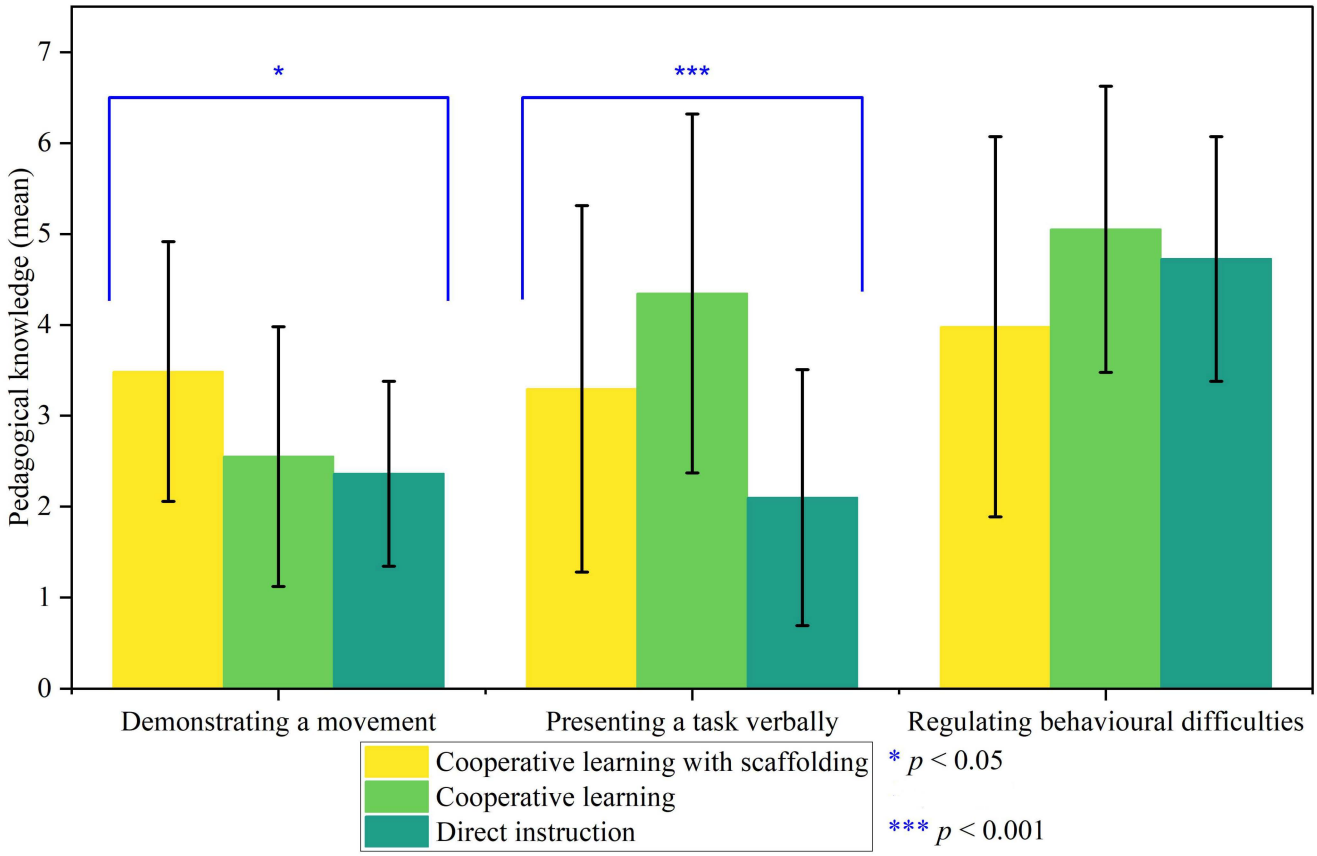


**Figure 5.** Bar graphs comparing three types of training conditions for pedagogical knowledge. The *y*-axis denotes the mean value. Standard deviations are represented by vertical bars. Note: A multivariate analysis of variance test was conducted to determine the significance of differences (at * $p < 0.05$, and *** $p < 0.001$) between conditions.

#### 3.1.2. Indicators of Performance

The mean scores of the three training conditions (CLS, CI, and DI) were not significantly different (Wilks' $\lambda = 0.89$, $p = 0.19$, $F(5, 11) = 1.39$) at baseline. After RM-MANOVA tests, significant differences (Wilks' $\lambda = 0.11$, $p < 0.000$, $F(3, 71) = 299.93$) were observed between the pre- and post-test scores for the three groups in Tai Chi performance. The interaction between training condition and time was also found to be partial (Wilks' $\lambda = 0.91$, $p < 0.07$, $F(5, 11) = 1.89$). Only Tai Chi technique scores were significantly different ($p = 0.05$; $d = 0.07$, $F(3, 57) = 3.05$) between the training conditions over time, as determined by the RM-MANOVA. In the post hoc tests, it was found that participants in the CLS program improved their Tai Chi performance scores more from pre-test to post-test than participants in the DI program. CLS participants did not differ significantly ($p = 0.31$) from CL participants, nor did CL participants differ significantly ($p = 0.94$) from DI participants.

#### 3.1.3. Indicators of Knowledge for Practice

The mean scores for knowledge of practice were not different ($p = 0.91$, $F(3, 72) = 0.21$) between the three training conditions (CLS, CI, and DI) at baseline. According to the RM-MANOVA results, the scores of participants in all three groups were significantly different ($p < 0.001$, $F(2, 72) = 599.68$) from the pre-tests to the post-tests. Additionally, a significant interaction ($p < 0.001$, $d = 0.23$, $F(3, 57) = 7.93$) was found between training conditions and time. Based on the results of the post hoc analyses, CLS and CL participants' scores improved more significantly ($p < 0.001$) between pre-test and post-test than DI participants.

### *3.2. Indicators of Pedagogical Knowledge*

An analysis of the MANOVA calculated on the three items (Wilks' $\lambda = 0.69$, $p = 0.001$, $F(5, 15) = 5.01$) relative to teaching knowledge revealed a substantial training effect. The outcome of the ANOVA demonstrated the differences between the three training conditions in terms of verbal presentation ($p < 0.001$, $d = 0.19$, $F(2, 66) = 7.61$) and demonstration of a movement ($p < 0.01$, $d = 0.13$, $F(2, 66) = 5.12$). The difference in regulating behavioral difficulties was not significant. Post hoc analyses concluded that CLS participants provided significantly more detailed precautions about movement demonstrations than DI participants ($p = 0.02$). CLS participants showed a partial difference ($p = 0.06$) from DI participants. In contrast, CL and DI participants did not show any difference ($p = 0.79$). Post hoc analyses also revealed that CL and CLS participants provided more relevant details when presenting a task verbally ($p < 0.001$ and $p < 0.11$) as compared to DI participants. Correlation analysis performed on the three conditions indicated that post-test performance was positively correlated with PCK ($r = 0.26$, $p < 0.05$) and teaching self-efficacy ($r = 0.23$, $p < 0.05$).

## 4. Discussion

The present study aimed to determine whether scaffolding techniques based on the teaching intervention incorporated into CL designs could improve in-service PE teachers' PCK abilities and confidence. This aided instructional condition was compared to DI and CL conditions, which similarly focused on exploring novel outcomes within PE settings. This was done over four 90 min instructional training sessions. Pre-activity scaffolds were incorporated into the CL design. Consequently, engaging in CL environments was expected to facilitate acquiring skills and knowledge for practical application [39]. Furthermore, it was expected to foster the self-efficacy and PCK of in-service PE teachers. Unlike other studies [13,62,67], the CL design was more narratively focused, emphasizing a Jigsaw setting with educational skills integrated into collaborative small group settings.

Participants in all three circumstances (CLS, CL, and DI) improved across the board (Figure 4). There is evidence that the benefits of structured CL settings extend beyond learners who instruct their classmates [42,61,68]. Further, unlike DI settings, CL environments encourage learning applications. The implications of this finding for combat sports inclusion in the curriculum are very intriguing for in-service PE teachers [17,39,51]. In addition, both CL and CLS in-service PE teachers gathered more valuable teaching materials than DI participants during this study (Figure 5). Pedagogy can be learned in a Jigsaw setting, since advanced training significantly impacts PE teaching concepts and methods [69,70]. The participants shared helpful information, which helped them overcome abstract motion presentations challenges.

It was found that the conceptual and procedural framework provided by the CLS condition had the greatest impact on the ability to communicate the safety measures that must be adhered to in order to demonstrate precise movements. Data gathered on the effectiveness of teacher interventions [41,71,72] for CLS in-service PE teachers suggest that they have improved their movement demonstrations (Figure 5). This study shows that in-service PE teachers need to be regularly trained on how to create an advanced learning environment for their students. This ultimately promotes student growth and development. Additionally, it indicates that the scaffolding process was intended to focus on a few specific components of PE teacher instruction. Specifically, this was intended to "motivate participants to do their finest work" [11,52,62].

CLS provides an excellent learning environment for advanced performance skills [73]. The CLS participants demonstrated improved proficiency in fundamental actions compared to those in the other two training scenarios (CL and DI). This was especially true in the TCT and TCM areas compared to the other two training scenarios (CL and DI). It was concluded that pre-activity scaffolds incorporated into the CL design positively impacted in-service teachers' performance in TCTs and TCMs and their preparedness to teach fundamental movement skills through demonstration [73] successfully. In a Jigsaw design, PE in-service teachers' learner and instructor roles may have resulted in personal and conceptual

experiences that contributed to knowledge acquisition and improved practice [44,64,74]. Considering ideas aimed at bridging the gap between theory and practice [47,75,76], this discovery is particularly intriguing. Participants' expectations for PCK and instructor self-efficacy increased as they attained more advanced skills. We conclude that using CL positively affects motivation, cognition, and physical health in the context of in-service teacher training in PE. We conclude that CL positively impacts motivation, cognition, and physical well-being, as reported by others [45,46,77].

We expected that in-service PE teachers' expectations of their own abilities would increase after attending the CLS training session. The determinants of teaching self-efficacy did not differ significantly between the three conditions over time (CLS, CL, and DI). Although our results contradict other studies [67], we do not find a substantial advantage for DI conditions. This substantiates the hypothesis that in-service PE teachers who participated in training sessions designed to uncover novel physical practices would be more confident in themselves following the CLS condition. The reasons for this may be categorized into three categories: First, the evidence suggests that CL training strategies must be implemented frequently [62,77] for different physical activities to affect in-service teachers' self-efficacy. The scaffolding technique that CLS participants used is a second explanation. Throughout the research, it may have been possible that the method created a chasm between instructor knowledge and in-service teachers' perceptions of their own abilities. Deviations from the model may negatively impact observers' self-efficacy in the long run. This aligns with a socially constructivist view of teacher education [48,49]. Video clips demonstrating both the teachers' and their colleagues' instructional strategies would benefit in-service PE instructors. It follows that more time should be dedicated in the future to peer coaching and observational activities [47]. Finally, a third rationale that aligns with previous research findings is our self-efficacy test to evaluate PE in-service teachers [62,67]. The PETE questionnaire contained eight questions that were selected to determine changes in self-efficacy, considering the participants' general experience and the characteristics of the session designed to introduce the participants to various types of advanced physical activities. Modern times call for this choice. It is likely to be necessary to conduct additional studies using the full questionnaire and provide longer training sessions. Considering this last restriction, further research is required to better understand the conditions under which scaffolding might improve instructional outcomes for PE in-service teachers in a CL environment. Additional training program studies incorporating other physical activities would be beneficial globally [78], because in-service PE teachers need to acquire the knowledge and skills necessary to implement CL in PE, as well as develop a favorable attitude toward the strategy as a teaching strategy. In addition, this issue is especially pertinent because it increases the interest of in-service teachers in acquiring the advanced knowledge and skills they need to implement CL in PE.

## 5. Conclusions

This study concluded that pre-activity scaffolds incorporated into the CL design positively influenced in-service teachers' performance in TCTs and TCMs and their ability to teach fundamental movement skills through demonstration effectively. In this regard, all three training conditions (CLS, CI, and DI) had similar mean scores regarding teaching self-efficacy, performance, and knowledge of practice at baseline. The three groups differed significantly on these parameters. The TCT performance scores differed significantly between training conditions over time. The tests revealed that CLS program participants improved their Tai Chi performance scores more than DI program participants. Among the CLS and CL participants, the analyses indicated that their scores improved more significantly between the pre-test and post-test than those of DI participants. Ultimately, the three training conditions differed primarily in verbal presentation and demonstration. Despite this, the difference in regulating behavioral difficulties was not significant. The analyses concluded that CLS participants provided significantly more careful precautions regarding movement demonstrations than DI participants. The CLS participants showed a partial dif-

ference from the DI participants, whereas the CL and DI participants showed no difference. Furthermore, the analyses revealed that CL and CLS participants provided more relevant details when presenting tasks verbally than DI participants. Correlation analysis revealed positive correlations between post-test performance, PCK, and teaching self-efficacy in each condition. It is suggested that advanced training programs be implemented in the future to help in-service PE teachers acquire the new skills necessary to meet modern demands.

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