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Fostering critical thinking in physical education through the integration of peer, self, and teacher assessments

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Abstract

This study aimed to explore the impacts of peer assessment and self-assessment (PASA) and the integrated peer, self, and teacher assessment (IPSTA) teaching strategies on the critical thinking dispositions of physical education (PE) undergraduate students. A pre- and post-test controlled experimental design was adopted. A total of 71 students were divided into three groups, with each group receiving: traditional teaching strategy (TTS), the PASA teaching strategy, or the IPSTA teaching strategy respectively. The results indicated that four factors of critical thinking dispositions (critical thinking self-confidence, inquisitiveness, analyticity, and truth seeking) improved in the group adopted IPSTA teaching strategies ($p<0.05$). Two factors (critical thinking self-confidence and analyticity) improved in the group adopted PASA teaching strategies ($p<0.05$). While no significant difference in the TTS. The IPSTA teaching strategy had the most significant effect on enhancing students' critical thinking dispositions, followed by the PASA teaching strategy. This suggests that the integrated-assessment teaching strategy has a remarkable effect on improving students' critical thinking disposition. These research findings offer a new approach to fostering students' critical thinking dispositions. Specifically, the integrated-assessment teaching strategy not only opens up a new approach for the development of physical education teaching but also further enriches the connotation of assessment teaching strategy.

Keywords: Assessment learning activity, Critical thinking disposition, Integrated assessment teaching strategy, Physical education.

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1. Introduction

With the continuous advancement of society, the requirements for individual capabilities have been steadily increasing, rendering critical thinking more crucial than ever before. In contemporary academic discourse, an escalating number of scholars underscore the significance of developing critical thinking across diverse disciplines [1-3]. Bazhouni [4] posits that critical thinking is instrumental in problem evaluation, hypothesis analysis, and the formulation of effective solutions to intricate issues. Care, et al. [5] argue that critical thinking has emerged as a pivotal skill for personal development and adaptation to change. Widely recognized as a core educational objective globally [6], critical thinking is deemed essential for equipping students with the ability to think independently, solve problems, and make well-informed decisions [7-9].

In the field of PE, there is a growing emphasis on enhancing students' critical thinking. Pill and SueSee [10] highlighted the effectiveness of teaching methods that present students with questions, challenges, or problems as a means to foster their critical thinking and creativity. Dupri, et al. [11] attempted to cultivate critical thinking skills in PE students through problem-based models and motion learning. Evidently, integrating specific teaching strategies, reflective practices, and problem-based approaches in PE can effectively facilitate the development of critical thinking.

Multidisciplinary research has substantiated the significant role of peer assessment (PA) and self-assessment (SA) in enhancing students' critical thinking [12-14]. However, research exploring the use of PA teaching strategies in PE to enhance students' critical thinking remains limited [15]. Although Bayu, et al. [16] reported that fifth-grade students improved their critical thinking skills and physical fitness through peer observation, SA, and circuit learning in PE, most PE researchers have primarily focused on using PA to enhance students' motor skill learning [17, 18]. This indicates that the current focus of research on PA and SA in PE is still on promoting skill learning. It is of great significance to further explore how to use PA and SA teaching strategies to enhance students' critical thinking.

Therefore, this study design and employs two teaching strategies in PE: the combination of PA and SA, and the integration of PA, SA, and teacher assessment (TA). The overarching objective is to leverage the functional nature of assessment strategies to enhance students' critical thinking dispositions. The principal conceptual relationships examined in this study are illustrated in Figure 1. Guided by this framework, the study aims to address the following research questions:

RQ1: Does the implementation of the PASA teaching strategy enhance students' critical thinking dispositions compared to the TTS?

RQ2: Does the application of the IPSTA teaching strategy improve students' critical thinking dispositions compared to the TTS?

RQ3: Are students' critical thinking dispositions better fostered through the IPSTA teaching strategy than through the PASA teaching strategy?

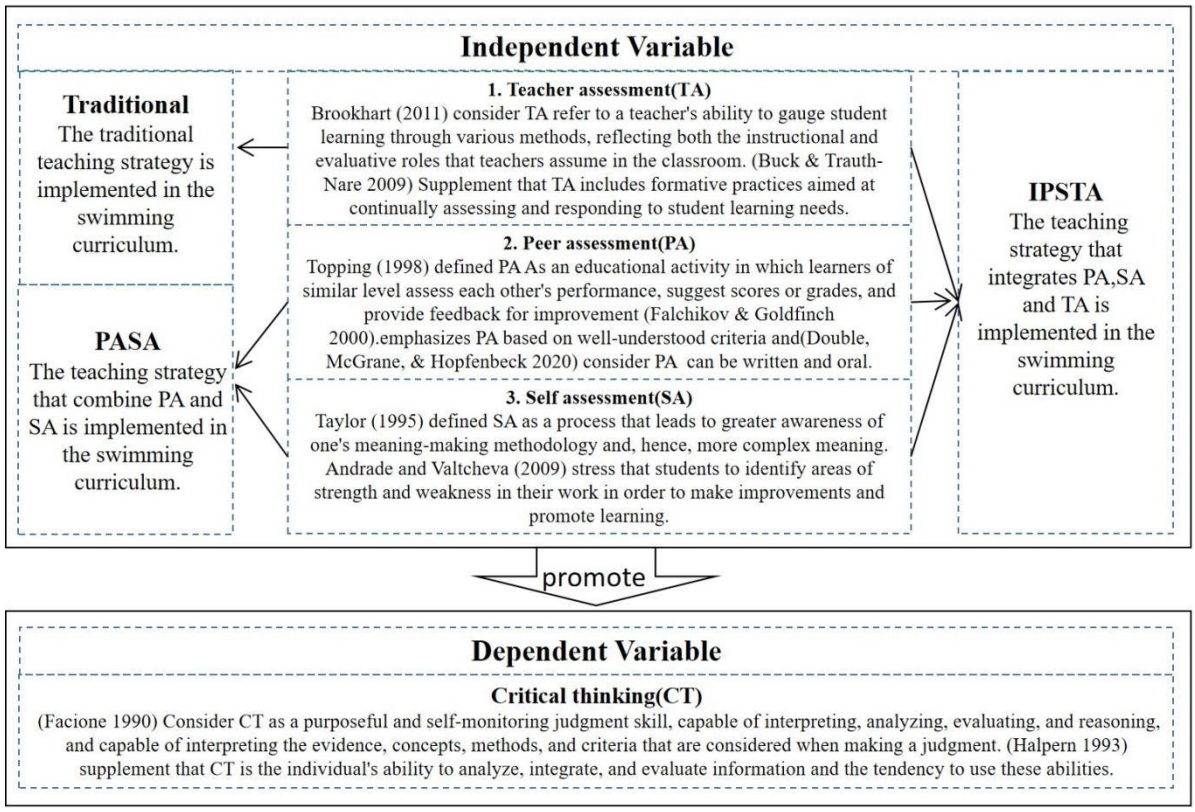

Figure 1.
Conceptual framework.
Source: Brookhart [19],Buck and Trauth-Nare [20],Topping [21],Falchikov and Goldfinch [22],Andrade and Valtcheva [23],Taylor [24],Halpern [25], Double, et al. [26] and Facione [27].

2. Literature Review

2.1. Critical Thinking

Since Dewey proposed the concept of critical thinking, it has triggered extensive and lasting discussions in the academic community, and scholars have defined it from multiple perspectives. Taylor [24] defined critical thinking as "the ability to think with the aim of improving thinking," emphasizing its role in enhancing the quality of thinking. Paul and Elder [28] regarded critical thinking as a thinking ability with criteria such as clarity, accuracy, precision, relevance, depth, breadth, and logic. This perspective views critical thinking as an ability, focusing on individuals' practical skills of using logical analysis, reasoning, and judgment to solve problems.

Some other scholars consider critical thinking from the perspective of people's attitudes and dispositions. Halpern [25] believed that critical thinking is an individual's ability to analyze, integrate, and evaluate information, as well as the propensity to apply these skills. Griggs, et al. [29] pointed out that critical thinkers usually possess openness, inclusiveness, and skepticism. This view holds that critical thinking is an inherent trait of individuals to habitually use critical thinking when facing problems. It reflects a habit and attitude of thinking, representing an individual's potential and persistent psychological tendency.

In the field of motor skills teaching, as the curriculum content mainly focuses on motor skill training, there is relatively less thought - provoking learning content. Students mainly form the automation of motor skills through repeated practice [30]. The development of students' critical thinking depends more on the cultivation of thinking habits. Therefore, this study selects critical thinking disposition questionnaire as a measurement tool to verify whether the PASA and IPSTA teaching strategies can enhance students' critical thinking dispositions in swimming courses.

2.2. Peer, Self, And Teacher Assessment

PA has been defined by Topping [21] as an educational activity where learners of a similar level assess each other’s performance, assign scores or grades, and provide feedback for improvement. This is further elaborated by Topping [31], who added that learning is deepened through providing detailed feedback and engaging in discussions about their judgments with peers. Falchikov and Goldfinch [22] emphasized the importance of PA being grounded in well-understood criteria. In this study, PA is recognized as a teaching activity where learners at the same level collaborate to offer detailed written or oral feedback on job performance based on assessment criteria.

Taylor [24] described SA as a process that enhances awareness of one’s methodology in creating meaning, leading to a more sophisticated understanding. Andrade and Valtcheva [23] underlined the importance of students identifying their strengths and weaknesses to facilitate improvement and learning. In this study, SA is primarily viewed as a teaching activity where students evaluate and reflect on the quality of their own work, thereby enhancing their learning through the examination of their work processes.

TA generally refers to a teacher's ability to gauge student learning through various methods, reflecting both the instructional and evaluative roles that teachers assume in the classroom [19]. TA includes formative practices aimed at continually assessing and responding to student learning needs to inform instructional practice [20]. On this basis, TA in this study focuses on the assessment of students' PA homework and providing feedback.

2.3. Integrated Assessment Strategy

Many reports have documented the efficacy of PA and SA in fostering students' critical thinking skills [32-34]. Ma and Kong [35] argue that PA and SA are complementary strategies that, when integrated effectively, can significantly improve students' abilities to provide and utilize feedback for ongoing enhancement. Li, et al. [33] and Tai, et al. [36] demonstrated that integrating SA and PA promotes reflective practice and cultivates critical thinking capabilities. University of Pamukkale and Bozkurt [37] and Ndoye [38] have implemented both PA and SA in their research, achieving noteworthy results. Bores-García, et al. [15] introduced the concept of a triadic assessment integrating peer, self, and teacher triadic assessments based on Pérez Pueyo and Hortigüela Alcalá [39]. However, specific evidence supporting their argument remains scarce. Some studies have juxtaposed SA, PA, and TA merely to compare the three methods [40, 41]. Constructing a teaching strategy that integrates PA, SA, and TA and exploring the synergistic effects of the advantages of the three assessment strategies has great practical significance.

3. Methods

A pre- and post-test controlled experimental design was employed in this study to quantitatively assess the phenomena under investigation. Figure 2 illustrates the experimental design. Here, the instructional strategy functioned as the independent variable. The control group received TTS, while Experimental Group A was exposed to the PASA teaching strategy and Experimental Group B to the IPSTA teaching strategy. The dependent variable was measured using the post-test Simplified Version-Critical Thinking Disposition Inventory (SV-CTDI), which assesses participants' critical thinking dispositions [42]. To facilitate a smooth execution of the experiment, the study has undergone the ethics approval of the Hansan Normal University Ethics Committee. Additionally, before the experiment began, we provided the participants with detailed informed consent forms and collected their signed copies.

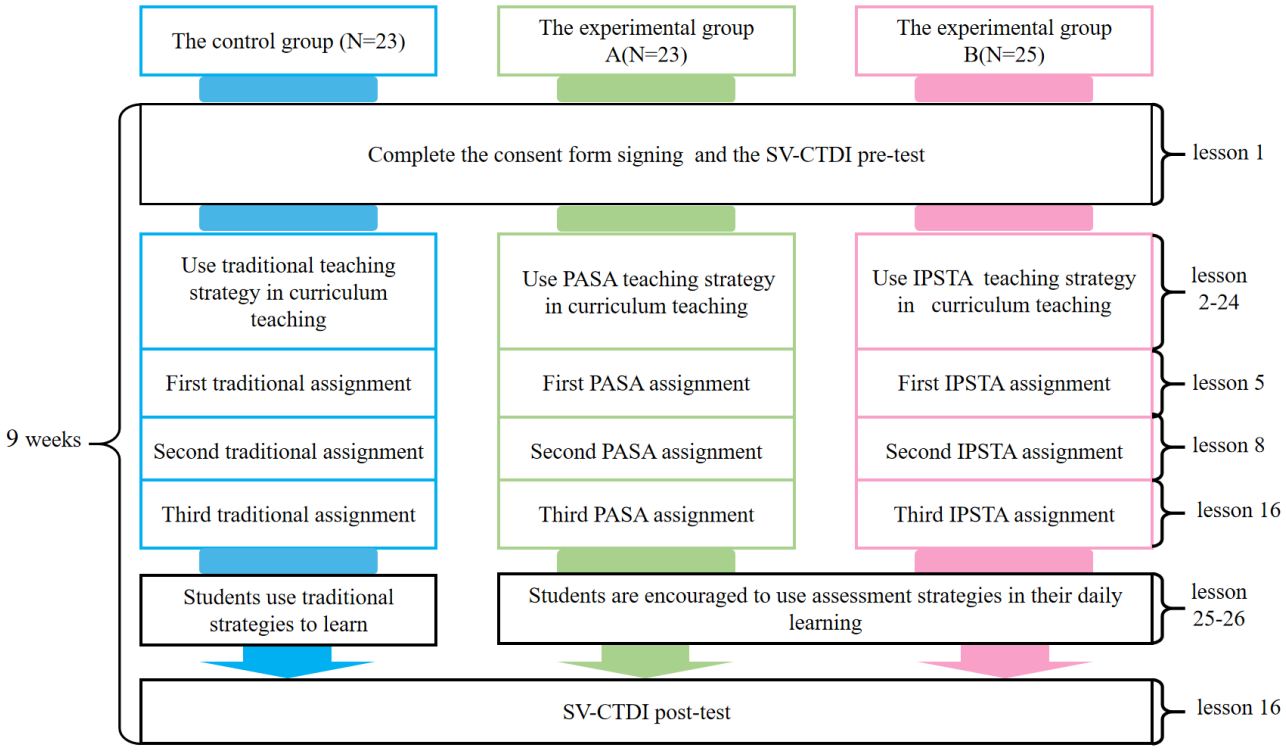

Figure 2.
Experimental procedure.

3.1. Experimental Procedure

The duration of the experimental study was 9 weeks, with sessions occurring three times weekly, each lasting 1.5 hours. The scheduling of the experimental duration and frequency followed the original course schedule to ensure that the experiment spanned the entire course. We conducted a preliminary test on all students before the experiment began and excluded those who had previously received swimming training to ensure that the swimming techniques of the participants were at the same level. The course focused on swimming skills. It was necessary to focus on a single physical skill in order to gain comparable data from the groups. Table 1 presents the distribution of class activities and time allocations among the groups. To ensure instructional fidelity, we developed detailed lesson plans that included the content, teaching methods,

time allocation, and teaching materials for each class session, in order to maintain the stability of the course's main structure and core content. Although there are differences in teaching strategies among the three classes, the course content, pace, and evaluation criteria remained consistent across all groups.

3.2. Participants

The experiment was conducted at a university's college of PE in southern China, with both the participating teachers and students drawn from the same institution. Three sophomore classes from the college PE were selected as the subjects for this experiment, designated as the control group, Experimental Group A, and Experimental Group B, respectively. Given that all students were admitted through both the Chinese college entrance examination and the sports college entrance examination, their intellectual and physical capabilities were considered equivalent. The control group comprised 17 male and 6 female students; Experimental Group A included 16 male and 7 female students; and Experimental Group B consisted of 18 male and 7 female students. The majority of male participants in this study reflect the gender distribution typically found in college-level sports majors.

Table 1.
Instructional content and time allocations.

Class	Instructional Content	Control group activities (TTS)	Experimental group A activities (PASA)	Experimental group B activities (IPSTA)
2-Jan	· Curriculum introduction; Familiarization with water; Basic swimming theory			
10-Mar	· Breaststroke leg movement skills	· Teaching breaststroke skills	· Teaching breaststroke skills	· Teaching breaststroke skills
	· Breaststroke arm movements and breathing skills	· Share breaststroke videos on Chaoxing	· Analyze the assessment criteria of breaststroke skills;	· Analyze the assessment criteria of breaststroke skills;
	· Complete match skills for breaststroke	· Assign traditional homework	· Teach swimming video shooting;	· Teach swimming video shooting;
			· Explain operating guide of Chaoxing.	· Explain operating guide of Chaoxing.
			· Assign PASA homework	· Assign IPSTA homework
12-Nov	· Teach breaststroke turn and start dive skills; treading water and diving skills; and swimming competition rules			
13-24	· Crawl stroke leg movement skills	· Teaching crawl stroke skill	· Teaching crawl stroke skill	· Teaching crawl stroke skill
	· Crawl stroke hand movements and breathing skills	· Share crawl stroke videos on Chaoxing	· Analyze the assessment standard of crawl stroke skill	· Analyze the assessment standard of crawl stroke skill
	· Complete match skills for crawl stroke	· Assign traditional homework	· Assign PASA homework	· Assign IPSTA homework
25-26	· Examination	· All examinations are assessed by three teachers	· Speed and length examinations by three teachers	· Speed and length examinations by three teachers
			· Skill assessment via PA and SA	· Skill assessment via PA, SA, and TA
27	· SV-CTDI post-test			

3.3. Assessment Design

In this study, the assessment assignment of the two experimental groups was carried out by random group anonymous assessment. The course consists of three homework assessments and two in-class examinations, with each assignment group composed of 2–3 people. The assignment for the control group was the traditional task of finding and copying passages related to swimming skills from a swimming textbook. The distinct teaching strategies were manifested through the assessment design. Assessments within the control group primarily fulfilled a diagnostic role, whereas in Experimental Groups A and B, they predominantly facilitated learning.

3.4. IPSTA Implementation

IPSTA integrates PA, SA and TA into a cooperative framework, transforming these once independent evaluations into a comprehensive system. Beginning with PA, IPSTA engages students in evaluative activities where both providing and receiving peer feedback solidifies their acquired knowledge and skills, thereby widening their cognitive understanding. The subsequent step, SA, entails students scrutinizing their own knowledge and skills to identify shortcomings and initiate self-improvement. This phase further deepens their learning. The final stage, TA, evaluates the students' PAs and SAs, enhancing the value of their engagement in the process and addressing any gaps left by peer evaluation. Moreover, TAs monitor the quality of student evaluations, ensure grading fairness, and alleviate students' concerns about assessment. Each assessment type plays a distinct role within the teaching strategy, contributing not only to the progression of student learning but also to the development of critical thinking disposition. This study incorporated three such assignments throughout the course. Despite the uniform process, each serves a unique function (Figure 3). The aim of these tasks is to progressively guide and push students to engage more deeply in assessment activities, rather than merely completing assignments. Through assessment, educational tasks, and daily learning and practice, students are afforded numerous opportunities to apply and refine their critical thinking disposition.

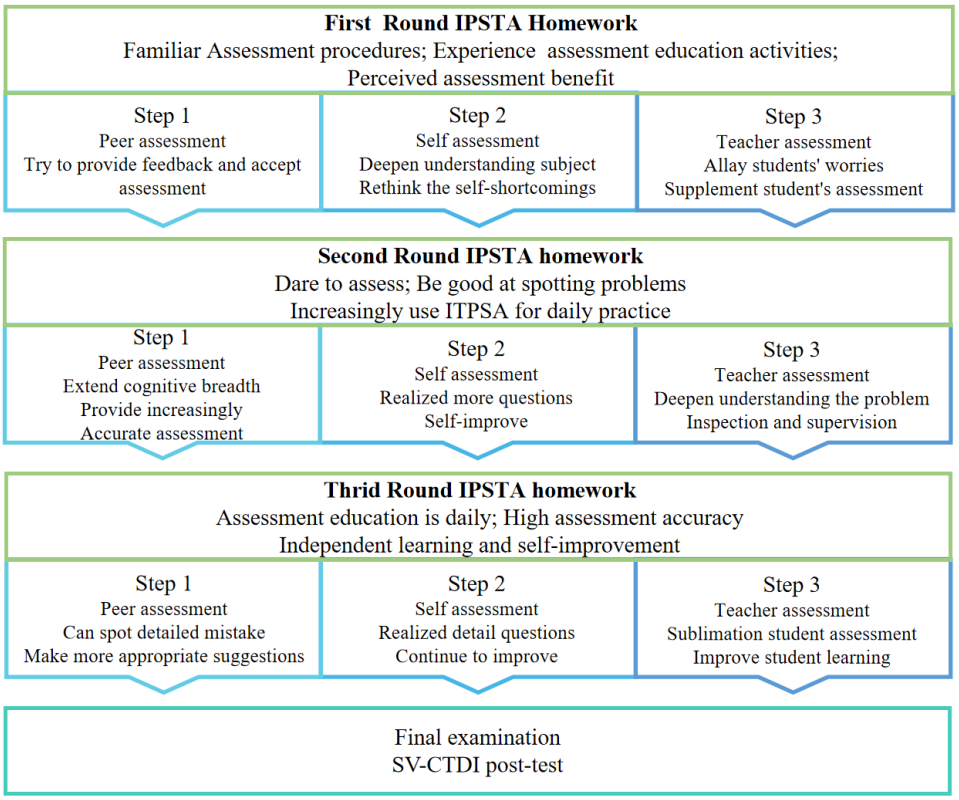

Figure 3.
The IPSTA teaching strategy process

3.5. PASA versus IPSTA

The contrasts between the PASA and IPSTA teaching strategies primarily manifest in three areas, as illustrated in Figure 4. Initially, during the PA phase of assignments, students in Group A evaluate swimming videos recorded by their peers in class. Conversely, the videos for Group B's assessments are supplied by the teacher, who films them to meet specific instructional requirements, effectively creating a scenario where Group B evaluates a virtual peer. For each session, two distinct swimming videos are prepared for Group B by the teacher. Furthermore, the teacher's role in Group A is primarily supervisory, overseeing and checking the students' completion status, whereas in Group B, the teacher acts as both a guide and a participant, evaluating the outcomes of the students' assessments and offering feedback. Lastly, for the final exam's skill assessment components, Group A utilizes PASA, while Group B employs PA, SA, and TA, with the process detailed in Figure 4.

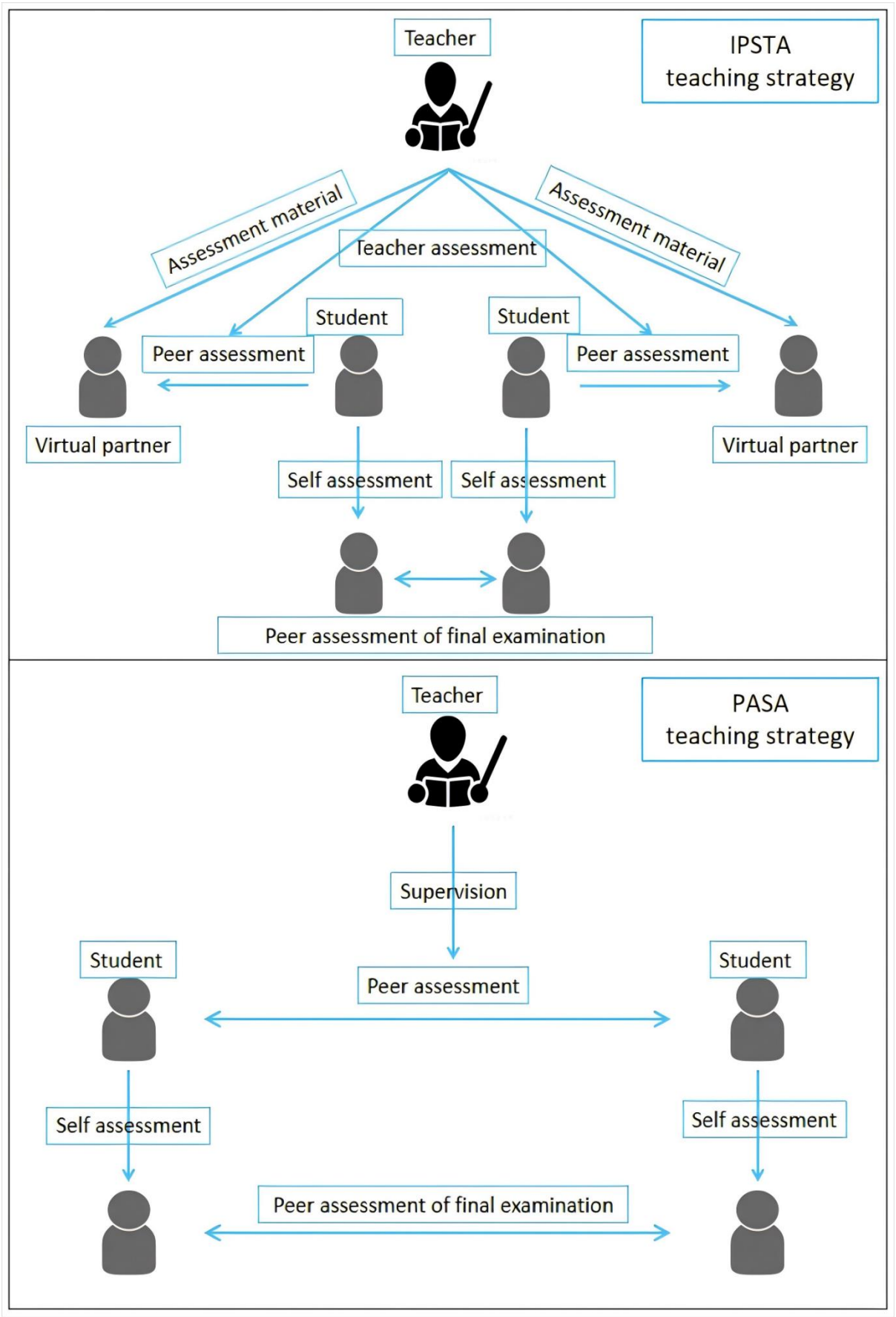

Figure 4.
Differences between PASA and IPSTA.

Unlike the homework phase, Group B's PA process in the final exam mirrors that of Group A. Teachers assign scores based on the precision and objectivity of the PA, including students' written feedback and peer evaluations. Accuracy and

objectivity in student assessments lead to higher scores from teachers, and the reverse is also true. Notably, assessment criteria are not provided as references during the exam, and all swimming videos are filmed live, with assessments completed on the spot.

The characteristics of IPSTA teaching strategies enable teachers to leverage their extensive experience by focusing on students' learning priorities and challenges within the PA videos. This approach ensures that student feedback remains highly relevant to the key content. It is very important for assessment educational activities [43]. Teachers may adjust the assessment tasks' difficulty based on the students' familiarity with and capability with assessment activities, tailoring the homework to match the students' skills. When evaluating the results of student assessments, teachers need not view every individual's video. This differentiation is evident in Group A, where students assess varying videos, complicating the teacher's ability to provide individualized feedback and broadening the scope of student assignments beyond practical evaluation, thus relegating the teacher to a supervisory role.

An additional benefit of the IPSTA teaching strategy is the unique ability of teachers to identify and address misconceptions held by some students. Feedback from teachers on students' PAs presents opportunities to bridge knowledge gaps, fostering a more comprehensive and systematic learning experience. Furthermore, the inclusion of TAs in the final examination has been shown to effectively engage students' enthusiasm for assessment [44]. Monitoring the accuracy of PA not only alleviates students' concerns regarding the fairness of assessments but also encourages students to enhance their assessed skills [45].

3.6. Learning Platform

Chaoxing, a versatile and user-friendly online learning platform, is preferred for its adaptability, convenience, and simplicity, making it an ideal choice for blended learning approaches [46]. Figure 5 illustrates the Chaoxing's group assignment interface, which offers Word-like functionality enabling the incorporation of images, videos, tables, and external links. The platform allows for various grouping methods, including fixed, self-selection, leader creation, random, face-to-face, and ungrouped. Evaluation settings offer two types and four combinations of assessments, which can be mixed or applied individually. Time settings facilitate task management with options for specifying start and end times, scheduling releases, and sending reminders to students. These options provide a wealth of options for organizing educational assessment activities.

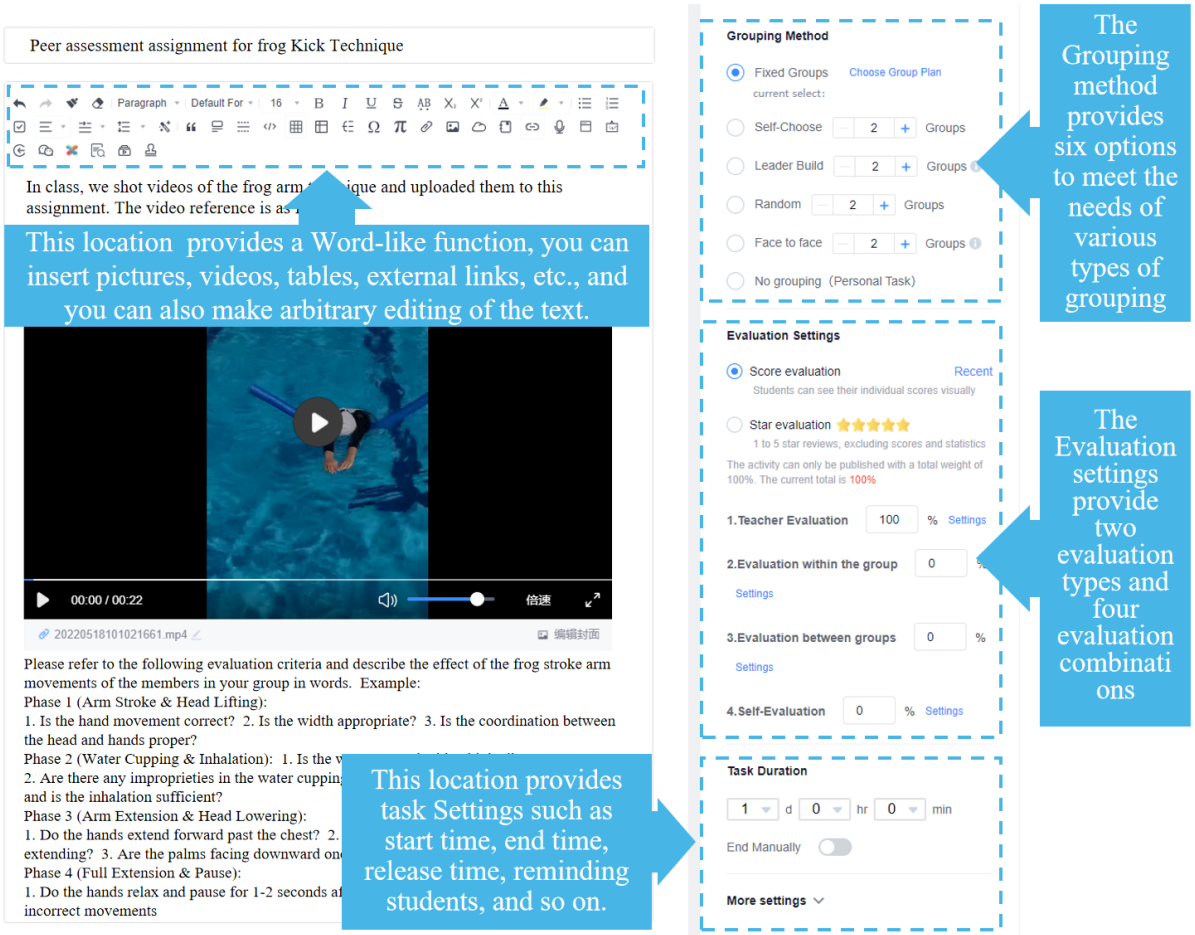

Figure 5.
Chaoxing's group assignment interface.

In contrast to the comprehensive functions of Chaoxing's group task settings, the interface remains intuitive and straightforward upon accessing an assessment assignment. The group list displays each group's completion status, with options to delve into the specific assessments and feedback for each group. PA, SA, and TA are consolidated within a single platform, enabling teachers to effortlessly retrieve this information (Figure 6). All activities and assessments conducted through PASA and IPSTA throughout the study are archived within the Chaoxing platform, with data readily accessible for review. The Chaoxing group task feature aligns with the experimental requirements, offering robust support for the seamless execution of the study.

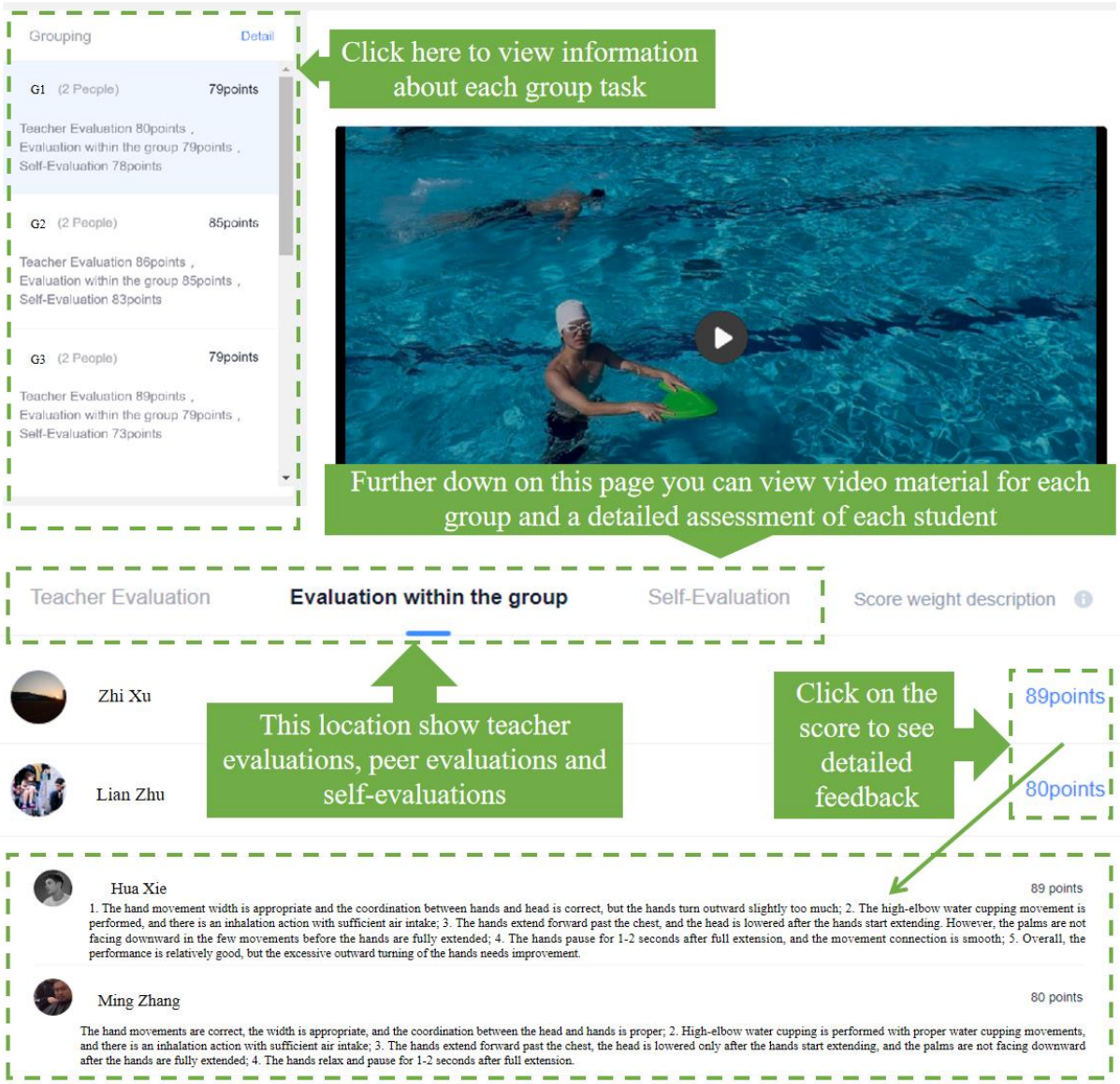

Figure 6.
Assignment status interface

3.7. Measurements

The (SV-CTDI) is a streamlined and adapted version of the California Critical Thinking Disposition Inventory (CCTDI) and its Chinese version (CTDI-CV), derived from data collected from 383 valid samples [42]. This scale consists of 6 dimensions and 28 items, employing more localized language to ensure clearer comprehension of the questions for students. The reliability and validity of the SV-CTDI have been verified through repeated testing and the Item-Objective Congruence Index (IOC). The six dimensions of the scale—Critical Thinking Self-confidence, Inquisitiveness, Systematicity, Cognitive Maturity, Analyticity, and Truth-seeking—yielded retest reliability coefficients of 0.697, 0.873, 0.827, 0.589, 0.657, and 0.729, respectively, with an average IOC score of 1. These outcomes affirm the high reliability and validity of the SV-CTDI. Additionally, we have modified the items of the SV-CTDI to fit the context of swimming instruction, making it more applicable to the current research.

3.8. Data Collection and Analysis

Data were collected via questionnaires and on-site examination results. A One-way ANOVA was employed to assess if significant differences existed among the groups in students' critical thinking dispositions before and after the intervention.

The paired t-test was utilized to examine differences in the mean scores of critical thinking disposition factors (Critical Thinking Self-confidence, Inquisitiveness, Systematicity, Cognitive Maturity, Analyticity, and Truth-seeking) in the post-test.

4. Results

Critical thinking dispositions was evaluated using One-way ANOVA. Table 2 shows the results for the pre-test comparison of critical thinking dispositions dimensions. The *p*-values for Critical thinking self-confidence, Inquisitiveness, Systematicity, Cognitive Maturity, Analyticity, and Truth-seeking were 0.598, 0.701, 0.896, 0.568, 0.437, and 0.069, respectively, all above the standard significance level of 0.05. This indicates no significant difference among the three classes in critical thinking dispositions pre-test levels.

Table 2.
One-way ANOVA results for critical thinking disposition pre-test comparison.

	Groups (M±SD)			*F*	*p*
	Class 5 (*n*=23)	**Class 6 (*n*=23)**	**Class 7 (*n*=25)**		
Critical Thinking Self-confidence	4.35±0.75	4.15±0.66	4.29±0.68	0.518	0.598
Inquisitiveness	4.65±0.57	4.51±0.67	4.53±0.60	0.358	0.701
Systematicity	4.34±0.57	4.30±0.48	4.27±0.44	0.110	0.896
Cognitive Maturity	3.42±1.18	3.75±1.14	3.57±0.82	0.570	0.568
Analyticity	4.43±0.68	4.26±0.70	4.53±0.81	0.837	0.437
Truth-seeking	2.70±0.97	3.22±0.86	3.28±0.96	2.784	0.069

The paired *t*-test results (Table 3) for class 5 (Control group/TTS) indicated *p*-values for critical thinking disposition factors were 0.815, 0.929, 0.485, 0.335, 0.657, and 0.243 in the pre/post-test comparison, suggesting no significant change in critical thinking dispositions between the pre-test and post-test for class 5 students.

Table 3.
Paired *t*-test results for critical thinking dispositions of TTS group.

Dependent variable	**Paired (M±SD)**		**Mean difference (Pre- *vs* Post-test)**	***t***	***p***
	Pre-test	**Post-test**			
Critical Thinking Self-confidence	4.35±0.75	4.40±0.45	0.04	0.236	0.815
Inquisitiveness	4.65±0.57	4.67±0.61	0.02	0.091	0.929
Systematicity	4.34±0.57	4.46±0.52	0.12	0.71	0.485
Cognitive Maturity	3.42±1.18	3.78±1.03	0.37	0.986	0.335
Analyticity	4.43±0.68	4.51±0.62	0.07	0.45	0.657
Truth-seeking	2.70±0.97	3.03±0.79	0.33	1.199	0.243

For Class 6 (Experimental group A/PASA), the paired *t*-test (referenced in Table 4) revealed significant improvements in critical thinking self-confidence and analyticity, with *p*-values of 0.015 and <0.001, respectively. Conversely, the attributes of inquisitiveness, systematicity, cognitive maturity, and truth-seeking, exhibiting *p*-values of 0.426, 0.446, 0.770, and 0.877, respectively, did not demonstrate statistically significant changes between the pre-test and post-test phases. These results underscore the enhanced proficiency in critical thinking self-confidence and analyticity among Class 6 students, while suggesting stability in the levels of inquisitiveness, systematicity, cognitive maturity, and truth-seeking throughout the experiment.

Table 4.
Paired *t*-test results for critical thinking disposition class of PASA group.

Dependent variable	**Paired (M±SD)**		**Mean difference (Pre- *vs* Post-test)**	***t***	***p***
	Pre-test	**Post-test**			
Critical Thinking Self-confidence	4.15±0.66	4.63±0.51	0.48	2.652	0.015
Inquisitiveness	4.51±0.67	4.66±0.0.44	0.14	0.809	0.426
Systematicity	4.30±0.48	4.42±0.539	0.12	0.776	0.446
Cognitive Maturity	3.75±1.14	3.84±0.92	0.87	0.296	0.770
Analyticity	4.26±0.70	5.17±0.53	0.91	4.419	<0.001
Truth-seeking	3.22±0.86	3.26±0.81	0.04	0.156	0.877

For class 7 (Experimental group B/IPSTA), the paired *t*-test results (Table 5) revealed significant improvements in four critical thinking disposition factors, with *p*-values for critical thinking self-confidence, Inquisitiveness, Analyticity, and Truth-seeking at 0.029, <0.001, 0.001, and <0.001, respectively. This demonstrates notable enhancement in these areas, while Systematicity and Cognitive Maturity showed no significant change

Table 5.
Paired *t*-test results for critical thinking dispositions of IPSTA group.

Dependent variable	Paired (M±SD)		Mean difference (Pre- *vs* Post-test)	*t*	*p*
	Pre-test	Post-test			
Critical Thinking Self-confidence	4.29±0.68	4.75±0.62	0.46	2.320	0.029
Inquisitiveness	4.53±0.60	5.05±0.38	0.52	4.294	<0.00
Systematicity	4.27±0.44	4.40±0.47	0.13	1.082	0.290
Cognitive Maturity	3.57±0.82	3.78±0.71	0.42	1.013	0.321
Analyticity	4.53±0.81	5.28±0.48	0.75	3.729	0.001
Truth-seeking	3.28±0.96	4.22±0.62	0.95	4.048	<0.001

A one-way analysis of variance (ANOVA) was conducted to examine the post-test scores of the six factors across different groups. Table 6 shows the results that three factors (Post-test Factor 1, Post-test Factor 3, and Post-test Factor 4) did not exhibit significant differences in scores among the three classes ($p > 0.05$). This indicates no statistically significant disparity in Critical Thinking Self-confidence, Systematicity, and Cognitive Maturity across the three classes.

In contrast, the post-test scores of the other three factors were significantly different among the groups ($p < 0.05$), indicating that Inquisitiveness, Analyticity, and Truth-seeking varied significantly across the three classes. Detailed comparisons of mean scores for these significant factors are as follows: For Inquisitiveness, Class 7 (Experimental group B/IPSTA) had a significantly higher post-test mean score than Class 5 and Class 6 (Class 7> Class 5; Class 7 > Class 6). For Analyticity, both Class 7 (Experimental group B/IPSTA) and Class 6 (Experimental group A/PASA) had a significantly higher post-test mean score than Class 5 (Class 7 > Class 5; Class 6 > Class 5). For Truth-seeking, Class 7 (Experimental group B/IPSTA) had a significantly higher mean score than Class 5 and Class 6 (Class 7 > Class 5; Class 7 > Class 6).

Table 6.
One-way ANOVA results for critical thinking disposition pro-test comparison.

	Groups (M±SD)			*F*	*p*
	Class 5 (*n*=23)	Class 6 (*n*=23)	Class 7 (*n*=25)		
Critical Thinking Self-confidence	4.40±0.45	4.63±0.51	4.75±0.62	2.47	0.092
Inquisitiveness	4.67±0.61	4.66±0.0.44	5.05±0.38	5.54	0.006
Systematicity	4.46±0.52	4.42±0.539	4.40±0.47	0.09	0.914
Cognitive Maturity	3.78±1.03	3.84±0.92	3.78±0.71	0.08	0.923
Analyticity	4.51±0.62	5.17±0.53	5.28±0.48	13.67	<0.001
Truth-seeking	3.03±0.79	3.26±0.81	4.22±0.62	14.19	<0.001

5. Discussions

The enhancement of critical thinking dispositions through teaching activities has increasingly been emphasized and explored by scholars [32, 47, 48]. The findings from this study confirm that the IPSTA teaching strategy significantly improved four dimensions of critical thinking disposition in students, while the PASA teaching strategy enhanced two dimensions. The positive development in students' critical thinking dispositions can be attributed to the effective application of the IPSTA and PASA teaching strategies.

5.1. Critical Thinking Self-Confidence and Analyticity

Critical thinking self-confidence assesses an individual's faith in their rational analysis capabilities, while Analyticity evaluates the ability to scrutinize and apply evidence in problem-solving. During educational assessment activities, students are tasked with analyzing their peers' and their own swimming skills, subsequently offering and receiving feedback, which facilitates reflection and improvement on their abilities. Assignments that necessitate students to repeatedly view a swimming video and conduct skill analyses encourage deep thinking, commentary, and suggestions. Furthermore, teachers promote and motivate students to adopt analytical, evaluative, reflective, and improvement-oriented thinking habits in their daily learning. Experimental findings indicate that both PASA and IPSTA teaching strategies enhance students' critical thinking self-confidence, and analyticity.

5.2. Inquisitiveness and Truth-Seeking

Inquisitiveness gauges intellectual curiosity and the eagerness to learn, whereas Truth-seeking evaluates the inclination to pursue the most accurate knowledge in given situations. The disparities between PASA and IPSTA in cultivating critical thinking are evident. Assessment educational activities fostering Inquisitiveness and Truth-seeking include: firstly, teachers tailoring the complexity of assessment tasks to students' evaluative skills, ensuring alignment with student capabilities; secondly, providing feedback on students' peer evaluations, which not only highlights areas for improvement but also ignites students' interest in participating in educational assessment activities; and thirdly, teacher involvement in the final exam assessment of peer evaluations, prompting students to adopt an accurate grading mindset and strive for objectivity.

5.3. Systematicity and cognitive maturity

Systematicity evaluates an individual's organizational skills, focus, and diligence in research activities, while Cognitive Maturity assesses the wisdom displayed in decision-making processes. Neither PASA nor IPSTA teaching strategies markedly enhanced students' dispositions toward critical thinking in these aspects. This could be attributed to the curriculum content and educational assessment activities not prioritizing these qualities extensively. Nevertheless, the data indicate that the average scores for Groups A and B have exhibited improvements in these dimensions to varying extents (refer to Tables 4 and 5), suggesting that a more extended period may be necessary to fully manifest these changes.

6. Conclusions

The present study examined the effects of the PASA and IPSTA teaching strategies on students' critical thinking dispositions in swimming courses. Compared with traditional teaching strategies, employing PASA and IPSTA methodologies enhances critical thinking dispositions. Specifically, Experimental Group A demonstrated improvements in two dimensions (critical thinking self-confidence and analyticity). In contrast, Experimental Group B exhibited enhancements in four dimensions (critical thinking self-confidence, inquisitiveness, analyticity, and truth-seeking). However, the remaining two dimensions of the SV-CTDI did not manifest significant advancements in both experimental groups. These results suggest that integrating evaluative teaching strategies in swimming instruction can effectively enhance certain dimensions of students' critical thinking dispositions. This study established a foundational framework for the IPSTA strategy and demonstrated the reciprocal and cooperative promotion of PA, SA, and TA.

7. Limitations

This study faced several limitations, primarily due to constraints related to student population size, course duration, and participant characteristics. Firstly, the study was conducted with a relatively small cohort of 71 students, with each group comprising only 23–25 participants. This sample size might have affected the statistical power of the analysis. Specifically, a smaller sample size can lead to wider confidence intervals, meaning that the study may have been underpowered to detect significant differences between groups even if they exist [49, 50]. Future research should aim for larger sample sizes to enhance the robustness of the findings.

Secondly, the duration of the study was limited to 9 weeks, which may not have been sufficient for the development of certain critical thinking dispositions. Future research could benefit from a longer duration to allow for a more comprehensive assessment of the long-term impact of teaching strategies on critical thinking dispositions.

Thirdly, the participants were sophomore students majoring in PE at a normal university, characterized by a higher motivation towards participating in assessment educational activities. This aspect needs to be considered for the generalization of findings. The specific characteristics of the sample may limit the external validity of the study, and future research should consider recruiting participants from diverse educational backgrounds to enhance the generalizability of the results.

8. Implications

Firstly, in the field of PE teaching, attempting to use specific teaching strategies to enhance students' critical thinking dispositions is undoubtedly a courageous exploration. This exploration is of great significance. It not only verifies the feasibility of enhancing students' critical thinking dispositions during the PE process but also expands the boundaries of the critical thinking development theory.

Secondly, this study has meticulously constructed a unique evaluation system. This system does not merely compare the three assessment methods of PA, SA, and TA. Instead, it skillfully integrates the three assessment strategies into an organic operational process. In this process, the three types of assessments each exert their unique advantages and collaborate with one another, laying a solid practical foundation for enhancing students' critical thinking dispositions.

Thirdly, this experimental study has verified that the IPSTA teaching strategy is more advantageous than the PASA in enhancing students' critical thinking dispositions. This conclusion highlights the importance of teachers' instructional design and intervention in assessment teaching strategies. Teachers play a crucial role in the implementation of assessment strategies and should receive more attention. Their professional guidance and rational design are key factors in promoting the effective implementation of teaching strategies and facilitating the development of students' critical thinking.

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