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Original Article

Effectiveness of a comprehensive module in improving serving skills and lob shots during badminton training

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Abstract:
Background: The quality of badminton skill achievement among secondary school students in physical education classes can be improved using a training module. Improving badminton skills in physical education classes is important to fulfil students' needs and learning objectives. This study was conducted to evaluate the effectiveness of a comprehensive module for badminton training using the Student Teams Achievement Divisions (STAD) cooperative learning instructional model to improve the badminton skills of secondary school students in Malaysia after six weeks of intervention. **Materials and Methods:** A total of 68 students from secondary school were selected through intact sampling for a quasi-experimental study, which included an experimental group (which used the developed module for badminton training based on the STAD cooperative learning model) and a control group (which used the traditional teaching approach implemented in physical education classes). In this study, the badminton high serve, backhand short serve, and lob shot tests were used to evaluate student performances in achieving badminton skills. **Results:** Pre-test results showed that both groups were equivalent before the intervention. Meanwhile, post-test results showed that the use of the badminton skill-training module for 6 weeks improved badminton skills as evidenced by higher mean scores in the high serve, backhand short serve, and lob shot tests compared to those of the control group. In addition, the post-test difference between the experimental and control groups reached 18.36% for the high serve skill, 21.59% for the backhand short serve skill, and 19.37% for the lob shot skill. **Conclusion:** This badminton skill-training module improves badminton skill learning, creates a more conducive learning environment compared to traditional teaching, and improves secondary school students' achievements in physical education classes to meet learning objectives. Therefore, this badminton skill-training module should be used more widely throughout secondary schools in Malaysia to overcome issues in badminton skill achievement and to help students attain optimal performance during badminton training sessions.
Keywords: **Badminton, Achievement, Serving Skills, Lob Shots, Learning Environment, Module**

Introduction

Education is an important aspect of life that is given considerable attention in Malaysia. The education development responsibility has been entrusted to the Malaysian Ministry of Education (MOE) to carry out continuous efforts for improving the country's education system. The development of the educational system for secondary school students began to receive attention through the introduction of the Secondary School Integrated Curriculum in 1988 until its end in 2021. In 2017, the MOE introduced the Secondary School Standard Curriculum to replace the Secondary School Integrated Curriculum to provide secondary school students with a more comprehensive education (MOE, 2016a). Starting in 2021, the Secondary School Standard Curriculum was fully implemented in secondary schools to provide equal educational opportunities to all students and to bridge the educational gap as a proactive initiative for achieving the Malaysia Education Blueprint, which is being implemented from 2013 until 2025 (MOE, 2013). Bridging the educational gap between students in secondary schools through high-quality and up-to-date education will allow development of the National Education Philosophy. Thus, physical education has been set as a compulsory subject in secondary schools in the Secondary School Standard Curriculum to develop students holistically, i.e., intellectually, spirituality, emotionally, and physically (MOE, 2016a).

In Malaysia, the skill domain is the main pillar of the Physical Education Curriculum and Assessment Standard document. It must be mastered by all students regardless of their ability level for sport skills (MOE, 2017; 2018; 2021). The mastery of the skill domain in physical education promotes and helps students maintain an active lifestyle through sports participation by achieving learning outcomes (i.e., psychomotor, cognitive, and affective) in the main domains of physical education (Casey & Goodyear, 2015; Bores-García, et al., 2021; Fernandez-Rio, et al., 2017; Fernández-Espínola, et al., 2020). The achievement of psychomotor and cognitive learning outcomes in the field of physical education skills is important to allow students to master and improve skill competency through training sessions in physical education classes (Dyson, Colby & Barratt, 2016; Gorucu,

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2016; Nopembri et al., 2019; Altinkok, 2017). Through physical education, students need to efficiently master sports skills to maintain good health; being involved in sports and recreational activities will allow them to improve health-related physical fitness and maintain an active lifestyle (Darnis & Lafont, 2015; O'Leary, et al., 2015; Seymour & Garrison, 2017). In addition to maintaining a healthy lifestyle, the mastery of physical education skills improves individual skill competence for participation in competitive games and improvement in performance in the sports he/she engages in (Colvin, Markos & Walker, 2016; Seymour & Garrison, 2017; Wuest & Bucher, 2015). Therefore, physical education teachers in Malaysia play an important role in improving skill learning to allow students to engage in sports throughout their lives and contribute to improving the quality of sports in the country (Kilue & Muhamad 2017; Karim, 2019). Therefore, physical education teachers should always strive to increase their knowledge by updating current teaching and facilitation methods to improve student learning of skills and student performance of sports using those skills. Thus, training modules are an important tool, which allows physical education teachers to improve skills of students during teaching and learning activities. Next, the implementation of effective teaching and learning in physical education using a training module can positively impact students' skill development needs to allow them to participate in sports and games (MOE,2018; 2021; Kilue & Muhamad 2017; Wee, 2016).

In the secondary school Physical Education Curriculum and Assessment Standard document, there are two major domains that students need to master to meet the requirements in each school session term. The curriculum content includes a 75% skill domain and 25% fitness domain (MOE, 2018; 2021). Therefore, the focus for students is to acquire sports skills in secondary school (MOE, 2015; 2016; 2017). In the Curriculum and Assessment Standard document, badminton skills are one of the skills in the skill domain that need to be mastered by secondary school students. Thus, high serve, backhand short serve, and lob shot are important badminton skills that students must master to meet the requirements described in the Physical Education Standard Curriculum (MOE, 2015; 2018; 2021); therefore, through learning sessions in a physical education class, secondary school students can learn complex badminton skills. Previously, the Malaysian MOE developed a badminton training module for badminton coaching and co-curriculum implementation of badminton sports in secondary schools (MOE, 2010; 2011). However, the previously developed badminton training modules were not suitable for physical education teachers to improve the quality of teaching and learning of badminton skills during physical education classes. This situation has resulted in the frequent use of traditional teaching approaches by secondary school physical education teachers when teaching secondary school students sports skills because the teachers felt comfortable using the traditional approach during badminton skill teaching and learning sessions (Nguang, Ali & Hutkemri, 2020; Wee, 2016). Thus, the achievement of badminton skills in physical education class is negatively affected because the traditional approach is less effective at improving secondary school students' abilities for mastering badminton skills (Nguang et al., 2020). Therefore, students have experienced difficulties mastering badminton serve and lob skills (Nguang et al., 2020; Tiong & Chin, 2019). This has occurred because the traditional teaching approach does not provide opportunities for students to work together and help each other during teaching and learning activities because students who are faster at successfully mastering sports skills will marginalize other students who are less capable or slow at mastering these skills (Aggerholm et al., 2018; Chatoupis, 2018; Schulze & Von Huth, 2023). Thus, the teaching and learning sessions cannot be used efficiently by all students with different ability levels during physical education classes; this negatively affects the ability of students to master badminton skills.

Therefore, there is a need to develop an effective badminton skill-training module to meet the needs of students with different abilities in secondary schools to improve their badminton skills using the STAD cooperative learning instructional model (Metzler & Colquitt, 2021); using this approach, discussion, feedback, and guidance can be provided to weaker students in small groups. Discussion, feedback, and guidance provided in small groups during learning sessions can more efficiently improve the achievement of badminton skills by each student (Bofill-Herrero et al., 2022; Hammouri, AY & Al-Dababseh, 2016; Schulze & Huth, 2023). Thus, it is rational to develop a new module for badminton skill training using the STAD cooperative learning instructional model for badminton skill learning to meet the needs of students in secondary schools in Malaysia. The application of this training module during the physical education class will improve the quality of teaching and learning, and the problems of badminton skill achievement can be overcome and the students' badminton skill levels can be improved. In addition, the use of the badminton skill-training module constructed based on the STAD cooperative learning model (Metzler & Colquitt, 2021) with the application of the Fitts and Posner Learning Theory (Magill & Anderson, 2016) and the Social Interdependence Theory (Johnson & Johnson, 1989) has been proven to be useful for students in skill learning because this approach creates a positive learning environment owing to positive interdependence among students to improve their physical performance.

The application of the Fitts and Posner Learning Theory together with the Social Interdependence Theory in the badminton skill-training module can increase skill learning by enhancing students' initiative to help and provide feedback to other classmates in small groups to increase their abilities and develop proper badminton skills. Through effective communication during learning sessions, information about badminton skills is received clearly through opinions, suggestions, and feedback from small-group members, which increases badminton skill learning and results in better game performance. Thus, students' badminton skill learning improves during learning sessions in physical education classes because more feedback is provided to students

on the skills learned while engaging in group learning activities. Using the badminton skill-training module in combination with the Fitts and Posner Learning Theory and the Social Interdependence Theory, students can effectively master badminton skills by forming deep memory of the movements required for badminton skills learned during the sessions. Thus, the badminton skill-training module is suitable for learning complex badminton skills. Therefore, this study was conducted to investigate the effectiveness of the badminton skill-training module and the traditional teaching approach in the learning of badminton skills among secondary school students.

Materials and Methods

Participants

The subjects of this study included 68 students from a secondary school in Sarawak, Malaysia. The subjects were 13-year-old students who have recently entered secondary school from primary school. There were 35 secondary school students in the experimental group and 33 secondary school students in the control group; the students were selected through intact sampling for participation in this quasi-experimental study (Chua, 2014; 2016). A total of 35 secondary school students from the experimental group participated in the badminton skill-training module, while 33 students participated in the traditional teaching method of badminton skill learning in the physical education class. All students involved in this study were informed about the test implementation procedures and asked to complete consent forms that gave written permission to participate in this study. This study was approved by the Malaysian MOE, the Sarawak State Education Department, and the school principal to be conducted in a secondary school in Sarawak, Malaysia. Prior to the implementation of the study, the subjects had to declare their health and injury history before being allowed to participate in this study. All secondary school students involved in this quasi-experimental study were healthy and recommended not to engage in any extracurricular activities involving badminton during the study. They were also asked to cooperate during the implementation of tests and intervention programmes.

Procedures

Before implementation of the intervention, each subject took three badminton skill tests, i.e., the badminton high serve, backhand short serve, and lob shot tests modified from Yong (1993). These tests are suitable for evaluating performance achievement of badminton skills for secondary school students. The instruments for the high serve, backhand short serve, and lob shot skills have shown high content validity with a validity coefficient value of 0.94 for the high serve, backhand short serve, and lob shot tests in badminton. The content validity for the instruments was verified by three experts in the field of physical education consisting of a professor (Ph.D.), senior lecturer (Ph.D.), and lecturer from the Malaysian Institute of Higher Education. High reliability of test instruments for the badminton high serve (0.96), backhand short serve (0.88), and lob shot (0.95) tests was also obtained in a pilot study conducted on secondary school students in Sarawak, Malaysia. In the intervention programme, all secondary school students in both groups participated in learning sessions for 6 weeks. The learning session duration is based on the available timetable determined by the school. This intervention programme was conducted once a week for 60 min according to the time allocated for the physical education lesson in the secondary school. A pre-test was conducted on the subjects before the start of the intervention programme. During the first and second weeks, all subjects participated in badminton high serve skill learning sessions, followed by backhand short serve skill learning sessions during the third and fourth weeks. Next, the subject participated in the badminton lob shot skill learning sessions during the fifth and sixth weeks. Finally, all study subjects performed a post-test after completing the intervention programme.

Six-week Intervention Programme with Badminton Skill-Training Module Implementation for Improving Badminton Skills

During the badminton learning sessions using the badminton skill-training module, the learning activities began with a dynamic warm-up, goal setting, and showing of video clips of badminton skills, followed by teacher's explanations and demonstration of badminton skills, small group activities on badminton skills, practical tests of badminton skills, modified mini games, assessments, and reflections, and the sessions ended with cool-down activities. The teaching aids used to conduct teaching and learning sessions in the badminton skill-training module included video clips about badminton skills, a laptop, an LCD TV, audio systems, shuttlecocks, badminton rackets, badminton nets, hula hoops, score forms, baskets labelled with scores, marker pens, a whiteboard, and a game box for modified mini games. The implementation of traditional teaching learning activities in the control group was more focused on explanations and demonstrations by the teachers as the main approach of teaching badminton skills after dynamic warm-up activities, followed by drills together with follow-through exercises to implement badminton skills according to the instructions given by the physical education teachers. After the badminton skill drill, the traditional badminton skill learning session continued with modified mini games and ended with cool-down activities. The teaching aids required for these traditional learning sessions were shuttlecocks, badminton rackets, badminton nets, and game boxes.

Statistical Analysis

The Statistical Package for Social Science (SPSS version 22.0, IBM, New York, USA) was used to analyze the data. Descriptive analysis with the mean value and standard deviation was used to evaluate the achievements of all study subjects in pre- and post-tests. Then, a one-way MANOVA test was performed to

examine whether there was a significant difference between the groups. Prior to the one-way MANOVA analysis, skewness and kurtosis normality tests were conducted on the experimental and control group data obtained during pre- and post-tests to ensure that the data were normally distributed. The significant level was set at $p < 0.05$.

Results

Normality Test and Overall Descriptive Statistics of Students from the Experimental and Control Groups

According to Table 1, the pre-test mean score for the high serve skill for the experimental group (M = 23.43 ± 8.10) was slightly lower compared to that for the control group (M = 23.84 ± 6.62). Similarly, for the backhand short serve skill pre-test, the experimental group (M = 28.67 ± 8.56) showed a slightly lower score compared to the control group (M = 29.09 ± 6.42). In terms of the lob shot skill pre-test, the control group had a slightly higher score (M = 23.78 ± 7.40) compared to the experimental group (M = 22.76 ± 8.87). The post-test mean score for the high serve skill for the experimental group (M = 44.00 ± 11.11) was higher compared to that for the control group (M = 36.57 ± 8.48). In terms of the post-test mean for the backhand short serve skill, the experimental group (M = 54.95 ± 8.80) had a higher score compared to the control group (M = 47.27 ± 8.06). Similarly, for the lob shot skill, the experimental group (M = 47.05 ± 9.56) had a better post-test score compared to the control group (M = 38.79 ± 8.81). The normality skewness and kurtosis tests were conducted on the pre-test data of badminton high serve, backhand short serve, and lob shot skills obtained from the experimental and control groups. The results of the normality skewness and kurtosis tests showed that the data were normally distributed because the skewness and kurtosis values for normally distributed data were in the range of −3.00 to +3.00 (Byrne, 2010), as shown in Table 1.

The skewness and kurtosis results in Table 1 show that the values of skewness and kurtosis for the experimental group were normally distributed in the high serve skill pre-test, i.e., skewness was 1.22, while kurtosis was 1.55. In the backhand short serve skill pre-test, the skewness was 1.17, and kurtosis was 1.89. Meanwhile, skewness and kurtosis for the lob shot skill were 1.53 and 1.99, respectively. For the control group, the skewness and kurtosis values were also normally distributed in the high serve skill pre-test, where skewness was 0.54, and kurtosis was −0.20. For the backhand short serve skill, skewness was 0.89, and kurtosis was 0.78 in the pre-test. Moreover, skewness and kurtosis for the lob shot skills of the control group were 1.74 and 2.84, respectively.

Table 1. Test of Normality and Overall Descriptive Statistics of Students from the Experimental and Control Groups

Badminton Skills	Overall Achievements of the Students	Experimental Group (*n = 35*)		Control Group (*n = 33*)	
		Pre-test	Post-test	Pre-test	Post-test
High Serve Skill	Mean	23.43	44.00	23.84	36.57
	Standard Deviation	8.10	11.11	6.62	8.48
	Skewness	1.22	1.28	0.54	0.50
	Kurtosis	1.55	1.36	−0.20	0.46
Backhand Short Serve Skill	Mean	28.67	54.95	29.09	47.27
	Standard Deviation	8.56	8.80	6.42	8.06
	Skewness	1.17	0.62	0.89	0.04
	Kurtosis	1.89	−0.11	0.78	0.50
Lob Shot Skill	Mean	22.76	47.05	23.78	38.79
	Standard Deviation	8.87	9.56	7.40	8.81
	Skewness	1.53	1.20	1.74	0.09
	Kurtosis	1.99	1.08	2.84	−1.28

The results of the normality skewness and kurtosis tests showed that the post-test data were also normally distributed because the skewness and kurtosis values were in the range of −3.00 to +3.00 (Byrne, 2010). According to the skewness and kurtosis shown in Table 1, the skewness and kurtosis values for the experimental group in the post-test high serve (1.28, 1.36), backhand short serve (0.62, −0.11), and lob shot (1.20, 1.08) skills were normally distributed. Meanwhile, the skewness and kurtosis values for the control group were also normally distributed in the post-test high serve (0.50, 0.46), backhand short serve (0.04, 0.50), and lob shot (0.09, −1.28) skills.

Differences between Pre-tests in Badminton Skills

When the pre-test data from the experimental and control groups were identified as normally distributed and met the criteria of normality, the variant equity was identified from the variance–covariance homogeneity matrix using Box's M test. The significant value for Box's test of covariance matrices for the pre-test was 0.650, as shown in Table 2.

Table 2. Box's M Differences in Pre-test Badminton Skills between the Groups

Box's M	*F* value	*df*1	*df2*	Sig.
4.419	0.700	6	31252.42	0.650

Table 2 shows that there was no significant variance–covariance difference between the badminton high serve, backhand short serve, and lob shot skills for the experimental and control groups with a F = 0.700 and $p = 0.650$ because $p > 0.01$ (Pallant, 2013). Thus, the variance–covariance of the pre-test badminton high serve, backhand short serve, and lob shot skills are the dependent variables and are homogenous across the experimental and control groups, which are the independent variables. Therefore, the condition of covariance equality in Box's M was also successfully met.

Likewise, the results of Levene's test (Table 3) show that the three dependent variables consisting of the badminton high serve, backhand short serve, and lob shot skills have equal variance, i.e., the significance value for each variable is greater than 0.05 ($p > 0.05$). The pre-test significant value for the high serve skill is 0.634 ($F = 0.228$, $p > 0.05$), and the values are 0.207 for the backhand short serve skill ($F = 1.624$, $p > 0.05$) and 0.359 for the lob shot skill ($F = 0.852$, $p > 0.05$). Thus, the conditions to perform the one-way MANOVA test were met because the value from Box's M test is greater than 0.01 ($p > 0.01$), and the value from Levene's test is greater than 0.05 ($p > 0.05$) and showed variant equity between the groups in Levene's test (Chua, 2014a; Pallant, 2013).

Table 3. Levene's Test for the Pre-test Badminton Skill Difference between the Groups

Badminton Skill	*F value*	*df1*	*df2*	Sig.
High Serve	0.228	1	66	0.634
Backhand Short Serve	1.624	1	66	0.207
Lob Shot	0.852	1	66	0.359

Next, the one-way MANOVA test results were analyzed to identify whether there was difference in badminton high serve, backhand short serve, and lob shot skill among the students in the experimental and control groups in the pre-test. The results of the MANOVA test are shown below:

Table 4. Wilks' Lambda Differences in the Pre-test Badminton Skills between the Groups

Effect	Wilks' Lambda Value	*F value*	DK between the groups	DK in the both groups	Sig	η^2
Group	0.996	0.093	3.00	64.00	0.964	0.004

Table 4 shows that there was no significant difference in the pre-test badminton high serve, backhand short serve, and lob shot skills between the experimental and control groups, as determined by the one-way MANOVA test; Wilks' Lambda = 0.996, $F(3,64) = 0.093$, $p = 0.964$ ($p > 0.05$). The partial eta squared (η^2) was a small value of 0.004 (Pallant, 2013; Cohen, 1988). Thus, the one-way MANOVA analysis showed that the differences in the mean pre-test badminton skill achievement scores for both groups were not significant. The pre-test results show that the experimental and control groups were equivalent in terms of badminton skill achievement before implementation of the intervention programme.

Differences in the Post-test Badminton Skills between the Groups

After the normality criterion was met, the variance equity for the post-test badminton skills for the groups was identified through the variance–covariance homogeneity matrix using Box's M test. The value of Box's M test of covariance matrices for the post-test was 0.528 (Table 5).

Table 5. Box's M Differences between the Groups for Post-test Badminton Skills

Box's M	*F value*	*df1*	*df2*	Sig.
5.388	0.854	6	31252.42	0.528

Box's M results (Table 5) show that there was no significant variance–covariance difference in the badminton high serve, backhand short serve, and lob shot skills between the experimental and control groups ($F = 0.854$ and $p = 0.528$) because the significance value was greater than 0.01 ($p > 0.01$) (Pallant, 2013). Thus, the variance–covariance of badminton skills are the dependent variables and are homogenous across the experimental and control groups, which are the independent variables. Thus, the requirement of variance–covariance equity in Box's M was successfully fulfilled.

Likewise, the results of Levene's test (Table 6) show that the three dependent variables (i.e., badminton high serve, backhand short serve, and lob shot) have variance equity, i.e., the significance value for each variable is greater than 0.05 ($p > 0.05$). The significance value for the post-test high serve skill was 0.375 ($F = 0.799$, $p > 0.05$), and they were 0.368 for the backhand short serve skill ($F = 0.820$, $p > 0.05$) and 0.596 for the badminton lob shot skill ($F = 0.283$, $p > 0.05$). Thus, the conditions for performing the one-way MANOVA test were met in the post-test (Chua, 2014a).

Table 6. Levene's Test for the Post-test Badminton Skill Difference between the Groups

Badminton Skills	*F value*	*df1*	*df2*	Sig.
High Serve	0.799	1	66	0.375
Backhand Short Serve	0.820	1	66	0.368
Lob Shot	0.283	1	66	0.596

Next, the one-way MANOVA analysis was performed to identify whether there were differences in the post-test badminton high serve, backhand short serve, and lob shot skills among the students from the experimental and control groups (Table 7).

Table 7. Wilks' Lambda Differences in the Post-test Badminton Skills between the Groups

Effect	Wilks' Lambda Value	*F value*	DK between the groups	DK in the both groups	Sig	η^2
Group	0.795	5.485	3.00	64.00	0.02	0.205

Table 7 shows that there were significant differences in the post-test badminton skills between the experimental group (which used the badminton skill-training module) and the control group (which used the traditional teaching approach) based on the one-way MANOVA test; Wilks' Lambda = 0.795, F (3,64) = 5.485, $p = 0.02$ ($p < 0.05$). The partial eta squared (η^2) also shows a large effect between the groups with a value of 0.205, whereas the group of students who used the badminton skill-training module showed greater improvement compared to the group of students who participated in traditional teaching to learn badminton skills.

According to Pallant (2013) and Cohen (1988), the small effect size is $\eta^2 = 0.01$, medium is $\eta^2 = 0.06$, and large is $\eta^2 = 0.14$. The detailed MANOVA analysis for the post-test badminton skills for both groups is shown in Table 8.

Table 9. MANOVA Analysis Differences between the Groups for the Post-test Badminton Skills

Badminton Skills	Group	N	*df*	Type III Sum of Squares	*F*	Sig.	η^2
High Serve	Experimental	35					
	Control	33	1	938.768	9.539	0.003	0.126
Backhand Short Serve	Experimental	35					
	Group	33	1	1001.743	14.045	0.000	0.175
Lob Shot	Experimental	35					
	Group	33	1	1158.793	13.679	0.000	0.172

Table 9 shows that there was a significant difference in the post-test badminton skills among students for the high serve ($F = 9.539$ and sig = 0.003, $p < 0.05$, $\eta^2 = 0.126$), backhand short serve ($F = 14.045$ and sig = 0.000, $p < 0.05$, $\eta^2 = 0.175$), and lob shot ($F = 13.679$ and sig = 0.000, $p < 0.05$, $\eta^2 = 0.172$) skills based on the comparison of groups that participated in the badminton skill-training module vs. traditional teaching. The effect size value obtained from the partial eta squared (η^2) was moderate for the high serve skill (0.126) based on the comparison between the experimental and control groups.

The effect size value from the partial eta squared (η^2) was large for the backhand short serve (0.175) and badminton lob shot (0.172) skills. Thus, the significant difference in the post-test mean achievement score for both groups shows that the use of the training module in the experimental group resulted in better learning sessions and higher mean achievements for the badminton high serve, backhand short serve, and lob shot skills during the badminton skill learning sessions.

Discussion

The pre-test badminton skills (using the badminton high serve, backhand short serve, and lob shot tests) were evaluated for all respondents before the intervention. The pre-test achievement test revealed that there was an equal skill level among the secondary school students between the two groups before the start of the programme. The achievement results from the experimental and control groups showed no significant difference with a small effect size value. These results suggest that the levels of the experimental group (using the badminton skill-training module) and control group (using traditional teaching) were equivalent before the intervention programme. After the intervention, the post-test badminton skills were evaluated to identify the effectiveness of the badminton skill-training module at improving the badminton skills of both groups. The results of the post-test, which was administered at the end of the intervention programme, confirmed that there was a significant difference in the high serve skill with a moderate effect size, while the backhand short serve and badminton lob shot skills had a large effect size. Thus, students who participated in the badminton skill-training module demonstrated higher achievement in the badminton high serve, backhand short serve, and lob shot skills compared to the students who participated in traditional teaching, which resulted in a significant difference in the achievement of badminton skills.

The obtained results showed that the secondary school students who used the badminton skill-training module mastered skills better during the learning sessions in the physical education class compared to the students in the traditional teaching group. These observations agree with those of Salimin et al. (2013), who also discovered that the use of a comprehensive assessment module improved the TOTAPS skill learning achievements of secondary school students in Malaysia who attended a physical and health education class on the subject of first aid The use of the comprehensive assessment module helped the students to accurately perform the first aid techniques according to the TOTAPS skill requirements during teaching and simulation sessions. The results of our study are also similar to those of Abdullah et al. (2013), who evaluated the effectiveness of a traditional game module on the gross motor skill learning of preschool students in Malaysia. They found that the use of their module based on traditional games is suitable for gross motor development to help preschool students master locomotor and manipulative skills. However, our study differs from the one by Abdullah et al. (2013) because their study focused on preschool students and their locomotor and manipulative skills.

Meanwhile, the results of our study also agree with those of a study on the use of a game coaching module based on teaching games for understanding netball skills in secondary school in Malaysia, which was conducted by Jani, Salimin, and Shahril (2017). Their study showed that the use of the module successfully improved the performance of netball players compared to that of the control group. The results confirmed that the use of the module for 4 weeks improved dodging and intercepting skills of netball players in secondary school (under the age of 18) during a netball game. However, this study differs from the study by Jani et al. (2017) because their study focused on netball skills, and the implementation period for their intervention programme was 4 weeks. In contrast, our study evaluated badminton skills of 13-year-old students, and the intervention period was 6 weeks. Thus, this study found that the use of badminton skill-training module is suitable for learning badminton skills in secondary school with a learning session duration of 6 weeks.

Better mean achievement of badminton skills was obtained by students who used the badminton skill-training module because it contains sections on goal setting, teacher's explanation of activities in small groups, practice, modified mini games, assessment, and reflection. Thus, students can learn together in small groups, teach and guide peers during learning sessions, and participate in discussion and reflection (Schulze & Von Huth, 2023). This is a more systematic collaboration process during learning sessions that improves the achievement of each group member compared to the traditional teaching approach in which students only focus on the teacher's instruction to perform drills during the badminton skill learning sessions. Meanwhile, the students in the traditional teaching group had to ensure that only their own skill performance was achieved (by following all instructions given by the teacher) without focusing on their classmates' achievements (Nguang et al., 2020; Wee, 2016; Salimin et al., 2015). Therefore, the mean achievement of badminton skills by students in the traditional teaching group is lower compared to that for the group using the badminton skill-training module.

In addition, assessments and modified mini games, which were used during the badminton skill-training module, also help to identify students' weaknesses in small groups. The students in each group will know the ability level of their group members and the badminton skills that need to be mastered during the learning sessions to achieve the group's goals. Thus, help and guidance can be given to weaker members in each group to improve their performance to achieve the small-group objectives. Thus, students in the experimental group can provide opinions or feedback on every aspect of movements and actions from the assessment in the practical session and during implementation of the modified mini game to improve the badminton skills of all group members. This showed that skill achievement can be improved by having discussions on how to improve skill performances during learning sessions (Metzler, 2011; Metzler & Colquitt, 2021; Schulze & Von Huth, 2023). Therefore, students came up with ideas on what actions need to be taken and how to develop badminton skills. In addition, the badminton skill-training module increased student readiness for the badminton learning session to complete their tasks in the learning activities, assessments, and modified mini games included in the badminton skill-training module. Furthermore, the badminton skill-training module encouraged higher badminton skill

achievement in the experimental group through the application of learning theories and an instructional learning model to provide meaningful learning experiences to students. Thus, this approach can successfully help secondary school students to obtain better achievement compared to traditional teaching, and students show significant improvement in badminton skill learning when they have good readiness to be involved in learning activities (Wee, 2016).

In the badminton skill-training module, the students could participate in learning activities in small groups and were given support from small-group members and teachers when they needed guidance during the badminton skill learning sessions. The support and help from other group members and teachers during the badminton skill learning activities in small groups in combination the with the use of the training module gave the secondary school students an opportunity to be in a comfortable and conducive environment to learn badminton skills without feeling pressured, which contributed to the observed higher mean achievement compared to that for the traditional teaching approach. A conducive learning environment helped students to actively engage themselves through learning in small groups; thus, the students had an opportunity to be involved in small-group discussions and were given more time to participate in the badminton sports training activities during the group learning sessions, which helped them to improve badminton skills that needed to be mastered (Metzler, 2011; Eleanor et al., 2014, Salimin et al., 2015; Schulze & Von Huth, 2023). Good sports skill achievement can be acquired when more training time is given to students to practice skills during each learning session and when constructive feedback is obtained from the implementation of the skills performed by the students (Osman, 2017; Hammouri et al., 2016). Therefore, students were able to effectively master complex skills during the learning sessions when they were given more time during the badminton skill-training module to perform learning activities related to the particular skills, which allowed them to master each complex skill and form deep memory of the movements required for the skills that needed to be mastered (Magill & Anderson, 2016; Schmidt & Lee, 2011). In contrast, in the traditional teaching group, the students had to wait for the teachers' instructions to perform drill activities and follow teachers' instructions while engaging in learning activities. This approach offered students fewer skill learning opportunities during the sessions even though this approach saves time for the physical education teachers when teaching skills. Using the badminton skill-training module, students have more opportunities to be actively involved in various forms of badminton skill training activities that students can perform well during the physical education class. Students can be active and support each other during the learning process using the badminton skill-training module until they successfully complete all badminton skill learning activities. Thus, opportunities offered to the students to actively involve themselves in the training using the training module resulted in a meaningful badminton skill learning process that improved their skill achievement.

For the secondary school students, the ability to collaborate, communicate, and interact with each other in small groups encouraged them to prefer and be comfortable with the use of the badminton skill-training module compared to the traditional teaching approach, which is more focused on instructions given by the physical education teacher during training. Using the badminton skill-training module, social skill development was emphasized during the learning sessions, which allowed the students to collaborate better and enabled clear feedback on the badminton skills that the group members needed to learn. Thus, the development of social skills, which is emphasized in the badminton skill-training module, during the learning sessions also helped the students improve their badminton skills through increased understanding and improved ability to perform them (Callado, Aranda & Pastor, 2014; Casey & MacPhail, 2018; Dyson et al., 2016; Bofill-Herrero et al., 2022). Thus, effective collaboration and communication helped the students to achieve better badminton skills using the badminton skill-training module compared to students who used the traditional teaching approach. This occurs because students can play together, help teach, and give feedback to weaker members to improve badminton skills to achieve the group's goals (Casey & MacPhail, 2018; Goodyear & Casey, 2013; Schulze & Huth, 2023). Moreover, their skills were improved using the badminton skill-training module. Therefore, the use of the badminton skill-training module during the learning sessions allows to convey knowledge about badminton skills more effectively to secondary school students, and the rate of knowledge assimilation is higher than that for the traditional teaching method. Furthermore, the implemented approach improves the students' achievements because they receive knowledge through the badminton skill-training module. The results of this study agree with those reported by Zhou (2017), who showed that the use of a podcast module in learning aerobic gymnastics skills helped students to understand the movements and improve the efficiency of aerobic gymnastics skill learning during a physical education class in China. Likewise, Zhu, Shen, and Chen (2020) showed that the use of the Health First curriculum module allowed 13-year-old students to gain more knowledge about specific sports skills and resulted in better achievement of sports skills compared to secondary school students who were taught using the traditional teaching approach. Although the studies by Zhou (2017) and Zhu et al. (2020) were conducted in China and this study was conducted in Malaysia, the subjects in both studies were 13-year-old secondary school students, and the studies confirmed that the use of the training modules positively affected the achievement of sports skills.

Furthermore, the results of a study by Ahmed, Abdulmajeed, and Ali (2019) were in line with those of this study and showed that their constructed module, which was based on Karin's model, was able to develop basketball skills in college students in Iraq. Similarly, another study confirmed that the use of a need-

motivational training task module positively affected the netball skill mastery level of students in a physical education class in secondary school compared to another approach for teaching volleyball skills (Nagovitsyn et al., 2020). Although Ahmed et al. (2019) focused on basketball skills and Nagovitsyn et al. (2020) focused on volleyball skills, this study is supported by previous studies, which confirmed that the use of skill teaching and training modules is very useful for improving sports skill achievement. Thus, this study confirms that our badminton skill-training module can be applied in secondary schools in Malaysia.

This study suggests that physical education teachers should implement skill learning in physical education classes by using this badminton skill-training module. This approach provides a different learning experience for students, which allows them to better achieve badminton skills. Thus, the use of the badminton skill-training module in small groups improves student achievement of skills in physical education classes. This study encourages physical education teachers to pay attention to this training module, which is student-centered and provides a more meaningful learning experience and better understanding for students to improve their skills. The significance of this study is its implementation of an enhanced learning methodology by using a training module for physical education classes. This study can serve as a guide to schools in Malaysia.

In addition, the combination of the Fitts and Posner Learning Theory and the Social Interdependence Theory confirmed that application of the badminton skill-training module can improve secondary school students' skill learning in Malaysia in physical education classes. For those who used the badminton skill-training module in combination with the Fitts and Posner Learning Theory and the Social Interdependence Theory, they demonstrated that their mastery of badminton skills in the physical education class and improved well through learning in small groups. Thus, this new combination of learning theories can be used as a guide and applied in physical education classes in Malaysia and in other countries to help students master sports skills. This study also increases awareness of physical education teachers regarding the need to implement quality-learning sessions using this new training module with the application of learning theories to improve skill learning in physical education classes. Future studies should include more schools (e.g., regular, cluster, urban, suburban, and rural schools) because the students' understanding, school facilities, geographical factors, and students' background in different schools and settings may produce different results.

Conclusion

This badminton skill-training module can improve the abilities of secondary school students to learn badminton skills (such as the high serve, backhand short serve, and lob shot skills) during physical education classes. The results showed that 6 weeks of learning sessions using the badminton skill-training module allowed secondary school students to achieve better performance compared to students who used the traditional teaching approach. We confirmed this by controlling the involvement of all secondary school students in any training activities involving badminton games during the study implementation period. The learning sessions, which implemented the new badminton skill-training module for 6 weeks, improved the secondary school students' mastery of badminton skills by creating a conducive environment for the learning sessions during physical education classes. Therefore, this module contributes to a meaningful learning experience, meets the needs of secondary school students, and encourages physical education teachers to shift to a student-centered learning environment. The developed approach successfully contributes to the achievement of skills and is more effective than the traditional teaching approach. The combination of the Fitts and Posner Learning Theory and the Social Interdependence Theory in this badminton skill-training module also provides a meaningful and effective learning experience for secondary school students in physical education classes.

Conflicts of Interest

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The authors would like to thank Falcon Scientific Editing (https://falconediting.com) for proofreading the English language in this paper.

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