Effectiveness of integrated learning, problem-based learning, and direct learning models on HOTS in badminton

Eficacia de los modelos de aprendizaje integrado, aprendizaje basado en problemas y aprendizaje directo sobre HOTS en bádminton

Authors

Sefri Hardiansyah [1]
Nurlan Kusmaedi [2]
Amung Ma'mun [3]
Herman Subarjah [4]
Syahriadi [5]
Deddy Rahmat Saputra [6]

[1] Universitas Negeri Padang (Indonesia)
[2,3,4] Universitas Pendidikan Indonesia (Indonesia)
[5] Universitas Riau (Indonesia)
[6] Universitas Muhammadiyah Muaro Bungo (Indonesia)

Corresponding author:
Nurlan Kusmaedi
nurlankusmaedi@upi.edu

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Abstract

Introduction: Higher-Order Thinking Skills (HOTS) are needed by students in higher education as a provision for them to enter the world of work, therefore it is important for every student to master HOTS well, including physical education students at Universitas Negeri Padang.
Objective: The purpose of this study was to examine the effectiveness of integrated learning models, problem-based and direct instruction on students' HOTS development.
Methodology: This study used pretest-posttest control group design. The sampling technique used was purposive sampling so that 62 students were obtained. This study used HOTS instrument consisting of 15 questions. Data analysis was conducted using paired sample t test and ANOVA test.
Results: The results of the paired sample t test analysis of pre-test and post-test data showed that the three learning models had a p-value <0.05 (hypothesis accepted) and based on the ANOVA test (testing the effectiveness of the learning model) obtained a p-value> 0.05 (hypothesis rejected).
Discussion: Although the integrated learning model and problem-based learning explicitly guide students to analyze and solve problems, a well-planned direct instruction model can also develop students' HOTS as well as integrated and problem-based learning models.
Conclusions: Integrated learning, problem-based learning and direct instruction models provide significant improvements to students' HOTS, but the improvements of the three models are not significantly different.

Keywords

Badminton; direct instruction; higher-order thinking skills; integrated learning, problem-based learning.

Resumen

Introducción: Las Habilidades de Pensamiento de Orden Superior (HOTS, por sus siglas en inglés) son necesarias para los estudiantes de educación superior como provisión para entrar en el mundo laboral, por lo tanto es importante que cada estudiante domine bien las HOTS, incluyendo los estudiantes de educación física de la Universitas Negeri Padang.
Objetivo: El propósito de este estudio era examinar la eficacia de los modelos de aprendizaje integrado, basado en problemas y la instrucción directa en el desarrollo de HOTS de los estudiantes.
Methodology: Este estudio utilizó un diseño de grupo de control pretest-postest. La técnica de muestreo utilizada fue el muestreo intencional, de modo que se obtuvieron 62 estudiantes. Este estudio utilizó el instrumento HOTS que consta de 15 preguntas. El análisis de los datos se llevó a cabo mediante la prueba t de muestras pareadas y la prueba ANOVA.
Resultados: Los resultados del análisis de la prueba t de muestras pareadas de los datos del pretest y el postest mostraron que los tres modelos de aprendizaje tenían un valor p <0,05 (hipótesis aceptada) y en base a la prueba ANOVA (prueba de la eficacia del modelo de aprendizaje) se obtuvo un valor p> 0,05 (hipótesis rechazada).
Discusión: Aunque el modelo de aprendizaje integrado y el aprendizaje basado en problemas guían explícitamente a los estudiantes a analizar y resolver problemas, un modelo de instrucción directa bien planificado también puede desarrollar los HOTS de los estudiantes tan bien como los modelos de aprendizaje integrado y basado en problemas.
Conclusiones: Los modelos de aprendizaje integrado, aprendizaje basado en problemas e instrucción directa proporcionan mejoras significativas en los HOTS de los estudiantes, pero las mejoras de los tres modelos no son significativamente diferentes.

Palabras clave

Bádminton; instrucción directa; habilidades de pensamiento de orden superior; aprendizaje integrado, aprendizaje basado en problemas.

Introduction

Development globalization in the 21st century has affected the whole world, requiring educators to produce graduates who are creative, innovative, and can solve problems or what is often called higher-order thinking skills (HOTS)(Wu et al., 2024; Taningrum et al., 2024). HOTS is the highest level of cognitive ability based on Bloom's taxonomy which consists of analyzing, evaluating, and creating (Krathwohl, 2002; Prahani et al., 2020). By mastering HOTS, students can make decisions, find solutions, collaborate, and maintain the knowledge they have over a relatively long time, and help them connect the material learned today with previous material (Phuseengoen & Singhchainara, 2022; Wijnen et al., 2021; Klegeris et al., 2013) and since the last few years, HOTS has become a curriculum standard in various countries (Liu et al., 2024; Massey et al., 2024) such as the curriculum in Singapore which demand students to develop problem-solving and critical thinking skills (Tan et al., 2017; Kesici et al., 2021). Then the curriculum standards in the United States require students to be able to solve problems, critical thinking and gather relevant information (Coffey & Alberts, 2013). Likewise, curriculum standards in the UK make creativity an integral part of their national education (Cooper, 2018). Meanwhile, in Malaysia, the Ministry of Education has established a policy to promote HOTS at all levels of Malaysian education (Chun & Abdullah, 2019). Similar to other countries, in Indonesia the objectives of Indonesian national education include developing the potential of students to be able to think critically and creatively. Various efforts have also been organized by the Indonesian government to improve students' HOTS including providing workshops and HOTS-based training programs to teachers (Edwar et al., 2023). This is strong evidence that HOTS has been considered important and has become a concern for education in Indonesia.

However, in the midst of the Indonesian government's high attention to HOTS, several studies report that student HOTS in Indonesia is still low (Suhirman et al. 2020; Suwarma & Apriyani, 2022). Findings from the most recent Program for International Student Assessment (PISA) evaluation also support this conclusion, placing Indonesia in the bottom 12 (69th) out of 81 countries worldwide (OECD, 2023) in the assessment of education quality, including students' higher order thinking skills. If this continues, the quality of Indonesia's education will fall further behind the rest of the world. In addition, in the short term this will also have a direct impact on students' low ability to generate new ideas and integrate their knowledge into new contexts (Ichsan et al., 2019). Therefore, it is necessary to take anticipatory steps so that students' HOTS in Indonesia can develop optimally.

In an effort to increase HOTS, physical education study programs must play an active role in this step even though it is dominated by sports activities and physical activities, but physical education is seen as having a strategic position in improving cognitive abilities including student HOTS. As stated by Umar et al. (2023) that thinking skills are closely related to psychomotor abilities. According to Perlman & Webster, (2011), Physical education is responsible for improving students' movement abilities and thinking abilities. Physical activity and sports activities are considered to be a means of improving students' abilities to solve problems, think critically, and make decisions (Sozen, 2012). The same thing is also shown by the results of a study conducted by Charles et al. (2020) which proves that physical activity can improve reasoning skills. In addition, physical activity can also benefit cognitive abilities and increase blood flow to the brain (Gligoroska & Manchevska, 2012) and according to Ratey & Loehr, (2011) regular and systematic physical activity can help maintain cognitive function. These findings highlight the importance of promoting physical activity across the lifespan for optimal cognitive development and brain health (S. da Silva & Arida, 2015). Various exercise modalities, including cardiovascular exercise and resistance training, have shown positive benefits on cognitive abilities (Gutiérrez-Capote et al., 2024; Srinivas et al., 2021). Through planned physical activity contained in physical education, it can accommodate the development of three important domains, namely cognitive, affective, and psychomotor (Donnelly et al., 2016; Coe et al., 2006). Therefore, physical education must be designed to develop students' HOTS (Hardiansyah, 2024). One of these efforts is through badminton learning. Badminton learning can be a medium for increasing HOTS for students because many activities in badminton learning involve complicated things that will require students to analyze, solve problems, and think critically. However, the success of increasing HOTS in badminton learning cannot be separated from the learning model used by lecturers. As stated by Purnomo et al., (2024) to improve the quality of learning/education, an effective learning method or model is needed, and Sánchez-Cabrero et al., (2021) state that effective learning will produce meaningful learning experiences for students.

Some countries have adopted integrated learning into their education including Lithuania, Sweden, and New Zealand (Tandzegolskienė-Bielaglovė et al., 2023; Bennett & Kaga, 2010) to provide holistic education. The integrated learning model (ILM) has a long history in education, having been used for more than 200 years (Dockterman, 2018). The priority of this model is to equip students in higher education with comprehensive skills (Coll et al., 2011). According to Freudenberg et al. (2010), ILM can combine knowledge, skills, and attitudes in the learning process. ILM can bridge the gap between theoretical knowledge and practical skills (Marar et al., 2022) so that ILM is very effectively used to help students achieve learning goals (Fazriyah et al., 2017). Therefore, the integrated learning model is assumed to be able to help Physical Education study program students improve their HOTS through badminton learning. To test this effectiveness, a comparative model is needed, namely student-centered learning through Problem-Based Learning (PBL) and teacher-centered learning, namely Direct Instruction (DI). PBL has been used for more than 30 years and has been proven to improve students' problem-solving abilities (Purnomo et al., 2024), and research results Taningrum et al. (2024) prove that PBL can stimulate students to think analytically. Meanwhile, direct instruction is a learning model that has been used in many places around the world and has the characteristics of direct explanation and demonstration from the teacher so that it can direct students' attention to important parts of the subject matter (Ziegler & Stern, 2016). This is supported by the results of Yeh, (2009) has reported that DI can improve critical thinking skills.

Many theories and research results reveal the effectiveness of Integrated learning models, Problem-Based Learning, and Direct Instruction, but no literature has been found that discusses the impact of these three models in increasing HOTS through physical education, especially badminton learning. Several previous studies related to HOTS in physical education learning have been carried out, such as recently carried out by (Hardiansyah et al., 2024) which confirms that physical education teachers who have been certified have a better attitude toward stimulating HOTS in elementary school students compared to physical education teachers who have not been certified. Next is research by Nopembri et al. (2022) which proves that the TGfU learning model can increase the HOTS of high school students in Yogyakarta, Indonesia. Then the study conducted by Waffak et al. (2022) in the same area, namely Yogyakarta, Indonesia, also proved that the implementation of the TGfU model was able to increase student HOTS in elementary schools.

In contrast to the previous studies stated above, this study was conducted to investigate the effectiveness of integrated learning model (experimental group) and problem-based learning model and direct instruction model (control group) on HOTS improvement in badminton learning in higher education. This research is important because through a good understanding of how learning models can develop HOTS, lecturers can plan and design quality learning in order to improve students' HOTS. This research can help policy makers in making more informed decisions regarding the implementation of the lecture process in higher education. In addition, this research helps prepare students to face the challenges of the future world of work through the skills of analyzing, solving problems and generating new ideas contained in HOTS.

Method

Study Design

This research uses experimentsPretest-postest control group design. The intervention used consisted of an experimental group (ILM) and a control group (PBL and DI learning models) (see Table 1). The treatment is given according to the syntax contained in each learning model. For ILM, the syntax adapts from the integrated learning model developed by Blegur et al. (2024) which consists of 1) orientation, 2) distribution, 3) experimentation, 4) analyzing, 5) problem solving, 6) presentation, while for PBL syntax consists of activities: 1) orientation to the problem, 2) organizing, 3) problem solving, 4) presentation and 5) evaluation (Hendarwati et al., 2021). Furthermore, the direct instruction syntax consists of: 1) orientation, 2) presentation, 3) guided practice, 4) feedback, and 5) self-study. This research was conducted in 15 meetings (including pretest and postest) with a schedule of three days a week. Group determination was carried out randomly.

Table 1. Research Design

Group	Pre-test	Treatment	Pos-test
Integrated Learning (ILM)	O_1	X_1	O_2
Problem-Based Learning (PBL)	O_3	X_2	O_4
Direct Instruction (DI)	O_5	X_3	O_6

O_1= ILM group pre-test
O_2= ILM group Pos-test
O_3= PBL group pre-test
O_4= PBL group pos-test
O_5= DI group pre-test
O_6= DI group pos-test
X_1= Treatment with ILM
X_2= Treatment with PBL
X_3= Treatment with DI

Samples

The sample in this study were students of the Universitas Negeri Padang (UNP) Physical Education Study Program who took Badminton courses in the even semester of the 2023-2024 academic year with a total of 62 people (male = 45 and female = 17) with an age range of 20-22 years, because students are free in choosing courses, the sample of men and women cannot be equalized, this is very dependent on the number of students who take badminton courses in that semester. Samples were selected using purposive sampling technique. Purposive sampling is often referred to as sampling based on criteria and this sampling is non-random and does not require theory (Etikan et al., 2016). So the samples involved in this research were those who were willing to take part in research activities were willing to be given treatment and had pretest and postest data. The number of samples that meet the criteria can be seen in Table 2.

Table 2. Research Sample

Group	Male	Female	Total
Integrated Learning Model	14	5	19
Problem-Based Learning	17	8	25
Direct Instruction	14	4	18
Total	45	17	62

Instruments

We created a 15-question HOTS test that is pertinent to badminton content in order to gauge students' HOTS. In line with the three stages of Bloom's taxonomy—creation, evaluation, and analysis (Krathwohl, 2002): (1) Analyze (C4): the capacity to resolve issues and draw connections between the data that is provided. (2) appraise (C5): the capacity of students to evaluate and validate a notion according to specific standards. (3) create (C6): the capacity of kids to come up with original concepts and come up with imaginative answers to challenging issues (see Table 3).

Table 3. HOTS Indicator

HOTS Cognitive Domain	Indicator	Number of Items
C4: Analyze	Analytical skills: solving problems, identifying the relationship of each piece of information (Boeren & Iniguez-Berrozpe, 2022)	5
C5: Evaluate	Evaluating ability: assessing, validating a concept (Wu et al., 2024)	4
C6: Create	Creativity: generating new ideas, coming up with creative solutions to complex problems (Boeren & Iniguez-Berrozpe, 2022)	6
	Total	15

The instrument development process begins with testing the validity of the content by involving 10 validators consisting of three physical education learning experts (one professor and two doctors), three physical education measurement and evaluation experts (two professors and one doctor), three badminton experts (one professor and two doctors) and one Indonesian language expert with a professor's degree to evaluate grammar with the results of content validity 0.83-1.00 so that all items were declared valid. Furthermore, the Intraclass Correlation Coefficient test was carried out with a result of 0.825 and declared reliable. After that, the construct validity test was given to 39 students and the results obtained were 0.32-0.71 and declared constructively valid. The next stage of the reliability test through the Cronbach's Alpha test obtained a result of 0.803 so that the instrument was declared reliable. Furthermore, based on the difficulty level test on 15 questions, items were obtained in the difficult category (one item), medium category (12 items), and easy category (two items). Based on the discriminating power of the questions, questions were obtained in the sufficient category (10 items) and questions in the good category (five items) and there were no items in the poor or poor category.

Data Collection and Data Analysis

Student HOTS data is obtained from tests in the form of questions given at the beginning and end of the meeting with a total of 15 questions. The collected data was then analyzed using a paired sample t-test to test the differences (pretest and postest) for each group, while to test differences in influence or improvement in the three groups, the ANOVA test was used. Before the data is analyzed, a normality test and homogeneity test are first carried out. All data analysis processes use IBM SPSS Statistics 29 software.

Results

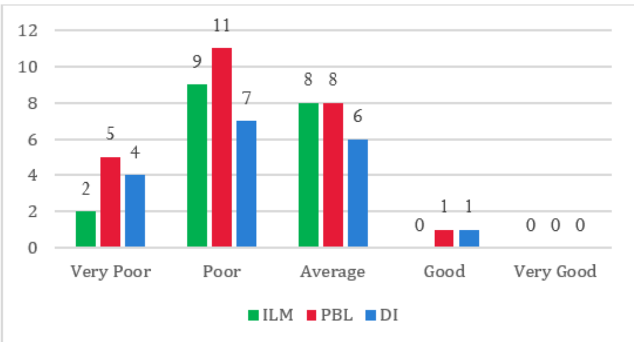
Results measurement of pre-test data on the HOTS abilities of physical education students in the ILM group obtained the lowest score of 10, the highest score of 90, a mean of 59.47, and an SD of 19.78. For the PBL group, the lowest score was 10, the highest score was 120, the mean was 53.20 and the SD was 24.66. Meanwhile, for the DI group, the lowest score was 10, the highest score was 105, the mean was 54.72 and the SD was 24.28. The distribution of HOTS pre-test abilities can be seen in Table 4. After being given treatment, we again measured the HOTS abilities of physical education students (postest) with the results for the ILM group having the lowest score of 45, the highest score of 130, the Mean of 91.84, and SD of 25.01. For the PBL group, the lowest score was 25, the highest score was 140, the mean was 75.00, SD 27.80. Meanwhile, for the DI group, the lowest score was 30, the highest score was 140, the mean was 70.00, SD was 34.17. The distribution of HOTS post-test abilities can be seen in Table 5.

Table 4. HOTS Pre-Test Data

Interval Class	Pre-Test						Category
	ILM		PBL		DI		
	F	%	F	%	F	%	
0-30	2	10.53	5	20.00	4	22.22	Very Poor
31-60	9	47.37	11	44.00	7	38.89	Poor
61-90	8	42.11	8	32.00	6	33.33	Average
91-120	0	0.00	1	4.00	1	5.56	Good
121-150	0	0.00	0	0.00	0	0.00	Very Good
Jumlah	19	100	25	100	18	100	

The pre-test data is displayed in the form of a bar graph as shown in Figure 1.

Figure 1. HOTS Pre-Test Data



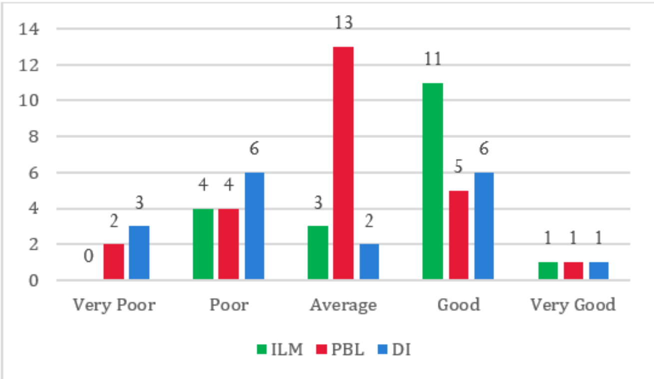
In the initial data, most of the students' HOTS for the three groups were in the poor category. For the Integrated model, there were nine students (47.37%) in the deficient category and there were no students who had HOTS in the good and excellent categories, while for the PBL model, most of the students' HOTS, namely 11 people (44%) were in the deficient category and one person had HOTS skills in the good category while there were no students who had HOTS in the excellent category, the same thing also happened in the DI group, most of the students, namely seven people (38.89%) had HOTS in the deficient category and one person in the good category and there were no students who had HOTS in the excellent category.

Table 5. HOTS Pos-Test Data

Interval Class	Post-Test						Category
	ILM		PBL		DI		
	F	%	F	%	F	%	
0-30	0	0	2	8.00	3	16.67	Very Poor
31-60	4	21.05	4	16.00	6	33.33	Poor
61-90	3	15.79	13	52.00	2	11.11	Average
91-120	11	57.89	5	20.00	6	33.33	Good
121-150	1	5.26	1	4.00	1	5.56	Very Good
Jumlah	19	100	25	100	18	100	

The post-test data is displayed in the form of a bar graph as shown in Figure 2.

Figure 2. HOTS Post-Test Data



In the post-test data, the ILM group experienced significant changes, initially most students had HOTS in the poor category and no students had HOTS in the good category, but after being given the treatment, most students (57.89%) had HOTS in the good category. Meanwhile, for the PBL model group, there were also changes, the post-test data showed that most students' HOTS were in the moderate category (52%) and one person had HOTS in the excellent category. Meanwhile, for the DI model group, most students had HOTS in the poor category and good category with a total of six people (33.33%) and there was a change for the good category which initially only one person then increased to six people. Furthermore, the pretest-posttest data were tested for normality (see Table 6).

Table 6. Shapiro-Wilk Normality Test

Group	HOTS	df	Sig.
ILM	Pre-test	19	.170
	Post-test	19	.159
PBL	Pre-test	25	.130
	Post-test	25	.578
DI	Pre-test	18	.993
	Post-test	18	.083

The results of the normality test with Shapiro-Wilk show that all data groups have a Sig value. > 0.05 so it can be concluded that the three groups of data in this study have met normality standards. The next step was to test the homogeneity of the data. The homogeneity test was conducted using the improvement data from the three groups (ILM, PBL and DI) as a prerequisite for the ANOVA test (see Table 7).

Table 7. Test of Homogeneity of Variances

	Levene Statistics	df1	df2	Sig.
Based on Mean	2.227	2	59	.117
Based on Median	2.200	2	59	.120
Based on the Median and with adjusted df	2.200	2	45.874	.122
Based on trimmed mean	2.224	2	50	.117

The results of the homogeneity of the variance test show that all data groups have a Sig value. > 0.05 so it can be concluded that the variance of all data groups has met the homogeneity test. Next, a paired sample t-test analysis was carried out to determine the differences (pretest and postest) in each group (see Table 8).

Table 8. Results of paired sample t test analysis of each group

Group	Mean		Difference in Mean Pretest-Mean Pos-test	Sig. (2-tailed)
	Pre-test	Post-test		
Integrated Learning	59.47	91.84	32.37	.000
Problem-Based Learning	53.20	75.00	21.80	.000
Direct Instruction	54.72	70.00	15.28	.047

Testing the difference between pretest and postest means with a paired sample t-test proves that all p-values are <0.05, so it can be concluded that there is a difference between the pretest and postest mean data in each group. Next, to find out the differences in the effects of the three groups, ANOVA analysis was carried out (see Table 9).

Table 9. Test the differences between the three sample groups using the ANOVA test

Group	N-Gain Average	F	Sig.
ILM	0.36		
PBL	0.23	2.616	.082
DI	0.15		

To test the differences between the three groups, samples were taken from the N-Gain Score data and then analyzed using the ANOVA test. Based on this test, the Sig value was obtained. 0.082 > 0.05 so it can be concluded that the influence exerted by the three groups (Integrated, PBL, and DI) is not significantly different.

Discussion

The research results prove that the three learning models used in this research, namely the integrated learning model, problem-based learning, and direct instruction, have been able to improve higher-order thinking skills (HOTS) in Physical Education study program students through learning badminton. Barber, (2012) claims that integrated learning is an important learning strategy in higher education and the results of the research conducted by Fazriyah et al., (2017) have confirmed that the integrated learning model is effectively used to improve student learning outcomes. Our research findings are then supported by the results of research conducted by Almulla & Al-Rahmi, (2023) which proves that ILM can develop important 21st century skills at various levels of education. This is possible because of ILM combines various elements such as problem-based learning and collaborative strategies that can stimulate students' cognitive development (R. Silva et al., 2021; Chaiyama, 2019). In the results of other research Baranova et al. (2019) have confirmed that ILM can increase student involvement in the learning process so that it can improve student learning outcomes. Almost the same as ILM, PBL is also a student-centered learning model with the characteristics of students working collaboratively, the teacher only as a guide and problems are a trigger for learning, and students in their groups working together to solve existing problems (Zwaal, 2019; Irons & Thomas, 2014). Several studies have also confirmed the success of PBL in improving student learning outcomes, including research conducted by Argaw et al. (2016) reported that PBL can improve students' problem-solving abilities, further findings Sungur & Tekkaya, (2006) claims that the PBL model is effectively used to improve critical thinking skills. However, in certain cases, the lecture model is considered preferable compared to PBL, according to research results (Solomon, 2020). However, the results of research conducted by Luo, (2019) have confirmed that the PBL model has been able to improve the badminton performance of students in Taiwan.

Meanwhile, for the Direct Instruction model, even though it has different characteristics from ILM and PBL, DI is also an effective model to use in learning. Several studies have also reported that the DI model is effective in physical education learning as per research results in Rodriguez-Negro & Yanci, (2020) which proves that the DI model is effectively used to increase physical activity in students. According to Ziegler & Stern, (2016), DI can direct students' attention to important parts by highlighting any difficulties students experience. The findings of this study are also supported by research results by Klahr & Nigam, (2004) which prove that when comparing the direct instruction and discovery learning models on students' scientific assessment performance, both models have the same good impact. These results refute the prediction that the discovery learning model will be superior to the DI model. Next are the research findings Cohen, (2008) claims that the DI model is effective in improving learning outcomes. Many studies have been conducted to assess the effectiveness of DI, including when DI was compared with 12 other models involving almost 75,000 students in 180 locations, and the results DI proved to be better and effective in many aspects such as learning, student participation to student learning outcomes DI is better than other models (Magliaro et al., 2005).

The next finding in this research is that although on average the improvement provided by the integrated model is better compared to the other two groups, statistically this difference is considered not significant. This finding is very likely to occur because each model has its advantages. ILM is learning that has a highly collaborative element, in this model the teacher does not teach but is very active as a guide (Dillenbourg, 2007). ILM can train several students at once through study groups where they solve complex problems together and this is very different from the traditional learning model where students only train one by one (Xue et al., 2023). Meanwhile, PBL has been designed to develop critical thinking skills, collaboration, problem-solving abilities, and creative thinking (Dawood et al., 2021). In implementing PBL, students are given stimulus through problem-solving, followed by independent learning, and discussions in small groups, and teachers have an important role as facilitators of student discussions (Karimi, 2011). PBL can help students construct their knowledge, find solutions in difficult situations, and develop critical thinking skills (Song et al., 2024). Meanwhile, although many parties look down on the direct instruction model, empirical evidence has shown that with careful preparation and good implementation, the direct instruction model can be a good means of communicating information (Hattie, 2008). DI is an approach that focuses on explicit instruction and high student participation (Heward & Twyman, 2021). So DI is not merely a lecture approach, the main components of DI consist of systematicity, reinforcement, and feedback. According to Richland et al. (2007), Direct instruction models that display comparisons and are accompanied by directions can help students in learning.

In the process of knowledge transfer, it cannot be forced that changes will occur, this will be closely related to several things such as student motivation, student activities outside of learning, student involvement, and learning methods. Several studies have reported that motivation is the most important factor in knowledge transfer behavior (Herghiligiu et al., 2018). Learning motivation can determine the success of student achievement in the learning process. Teachers who are able to motivate students are teachers who can teach effectively and efficiently (Wahyuri et al., 2023). Although the DI model has teacher-centered characteristics, if students have good learning motivation, DI can be optimized for HOTS improvement, so the effectiveness of DI is not much different from ILM and PBL. In addition to student motivation, according to Kim et al. (2011), the factor of work status or activities outside of learning will also affect learning outcomes, students who have a lot of work or activities outside of learning are assumed to have little time to study, so their learning outcomes are not maximized. Student activities outside of learning activities will also affect student involvement in the learning process. According to (Kahu, 2013) student involvement greatly affects learning outcomes. This is reinforced by the findings of several studies that have proven that in higher education student involvement has a positive effect on learning outcomes (Lei et al., 2018; Fisher et al., 2021; Yu et al., 2022). The absence of significant differences between the effects of the ILM, PBL and DI models on HOTS improvement could be due to student involvement in each model which is also not much different. The next factor that can influence the results of this research is the learning method used by lecturers. The right learning method makes learning more enjoyable and effective. The study results of (Magana et al., 2018) proved that undergraduate students tend to prefer learning methods that are slightly active but structured. Therefore, the ILM, PBL and DI models implemented systematically and structured in this study provide balanced effectiveness on increasing the HOTS of physical education students.

This study has several limitations such as a relatively small sample size that only involves students of the Physical Education study program at Padang State University who take Badminton lectures in the even semester of the 2023-2024 academic year, therefore the results of this study do not necessarily represent all physical education study program students or students as a whole at Padang State University or Indonesia. Then the unequal number of male and female samples resulted in the minority gender (women) not being well represented. Furthermore, the treatment given in this study was also relatively short so that it could affect the effectiveness provided by the three learning models used in this study. Finally, the researcher cannot strictly control the motivation and activities carried out by the sample outside of learning hours, so the impact provided by each model can be influenced by other elements outside of learning activities. For future researchers, the author suggests examining the effect of other relevant learning models that can improve other skills in physical education program students and involve a larger sample with equal gender and minimize external factors that can affect the impact of the implementation of learning models on learning outcomes.

Conclusions

The three models used in this research (Integrated, Problem-Based Learning, and Direct Instruction) have been able to develop HOTS for Physical Education Study Program students through Badminton learning, however, the findings of this study indicate that, in the context and sample studied, the implementation of integrated and problem-based learning models did not produce statistically significantly different HOTS improvements compared to the direct instruction learning model. Although both models (ILM and PBL) theoretically have strong potential in developing HOTS through an emphasis on analyzing, problem solving and knowledge construction by students, the results of this study prove that both models have not been able to show significant superiority in improving HOTS compared to the direct instruction model.

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Authors' and translators' details:

Sefri Hardiansyah	hardiansyah@fik.unp.ac.id	Author
Nurlan Kusmaedi	nurlankusmaedi@upi.edu	Author
Amung Ma'mung	amung@upi.edu	Author
Herman Subarjah	subarjah@upi.edu	Author
Syariadi	syahriadi@lecturer.unri.ac.id	Author
Deddy Rahmat Saputra	deddy.rahmatsaputra@gmail.com	Author
Aditya Putra	info@mafatranslator.com	Translator