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Development of a Motor Coordination Training Model Based on Critical Thinking Fun Games to Improve Basic Cricket Batting Techniques for Elementary School Students

Reffie Camelisa [1], Bafirman [1], Syahrastani [1], Anton Komaini [1], Syahrial Bakhtiar [1] and Eri Barlian [1]

1 Faculty of Sport Sciences, Universitas Negeri Padang, Indonesia

* Correspondence: syahrial@fik.unp.ac.id

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Abstract: A motor coordination training model based on fun critical thinking games to improve basic cricket batting techniques for primary school students. The method used in this research is a re-search and development method, with the development model being the ADDIE development model. The subjects of this research were children aged 9 to 12 years, in the learning phase of training, totaling 30 individuals. The data collection instruments included expert validation questionnaires, documentation, and cricket batting tests. The data analysis techniques used were independent sample t-tests and Aiken evaluator scores. The results of this research are: 1) The motor coordination training model based on fun critical thinking games to improve basic bat-ting technique was demonstrated with a calculated t of -8.468 and a p-value of 0.000 < 0.05; 2) The motor coordination training model based on fun critical thinking games is practical for use to improve basic batting skills in children aged 9 to 12, as shown by the average of each test falling within the practical category; 3) The motor coordination training model based on fun critical thinking games is effective in improving basic batting skills in children aged 9 to 12, demon-strated by the pretest-posttest data of the motor coordination training model based on fun criti-cal thinking games to improve basic batting technique having a p-value of 0.000 < 0.05; 4) The motor coordination training model based on fun critical thinking games is better compared to not applying any treatment. This is demonstrated by the fact that the average N-Gain value of the experimental class is higher than the N-Gain of the control class, with N-Gain Experiment 14.43% > N-Gain Control 10.39%.

Keywords: Motor Coordination Training Model, Fun Critical Thinking Games, Batting

1. Introduction

Sport plays a very strategic role in sustainable human development [1]. Through sports activities, a person not only gains physical conditioning but also develops psychological, social, and moral aspects that support the formation of a positive character, such as discipline, responsibility, cooperation, and sportsmanship [2], [3], [4]. In the context of formal education, sport becomes an integral part of physical education with the aim of developing the physical, mental, and social potential of children in a balanced way [5], [6]. In elementary school, sports play a fundamental role as an initial stage in the development of basic motor skills (Fundamental Movement Skills), which will serve as a foundation for more specific sports skills in the future [7]. The age of elementary school is included in the early age category in athlete training, which is the most potential period to develop children's motor and coordination skills [8], [9], [10]. This period is known as the golden age, which is the period of optimal development of the nervous system and the child's motor functions, during which movement learning can be carried out very effectively [11], [12], [13], [14], [15], [16]. At this stage, the child's brain and neuromuscular system show a high level of plasticity, so various

movement stimuli provided through exercise can strengthen neural connections and enrich the child's repertoire of movements. Therefore, sports development in early childhood should be aimed at strengthening motor coordination, and not solely at performance or achieving accomplishments.

Motor coordination is the ability to organize and integrate various movements of the body in a harmonious way in order to perform a physical activity efficiently, accurately, and in a controlled manner [17], [18], [19], [20]. From a physiological perspective, coordination involves the cooperation between the central nervous system, sensory organs, and the muscular system to produce a motor response that meets the demands of the situation. According to motor development theory, movement coordination becomes one of the main indicators of a child's neuromotor maturity. This skill encompasses several important aspects such as balance, agility, reaction, movement rhythm, and accuracy. In primary school age, motor coordination should be trained systematically, as it is the main foundation for mastering sports technical skills, includes sports that require coordination between the eyes, hands, and body [21]. Good coordination allows children to perform movements that are more efficient, economical, and adaptable to changes in the play environment. On the contrary, weakness in coordination can cause technical errors, decreased performance, and a higher risk of injuries. Therefore, in training young athletes, coordination training should not be ignored, but rather should be a central part of the training program, especially in the initial stage of introducing basic sports techniques. Motor coordination not only supports the development of physical abilities but also plays an important role in stimulating children's critical thinking. When engaging in activities that require coordination, children learn to observe the situation, make quick decisions, and adjust their movements according to the conditions they face. Thus, motor coordination training becomes an integrated learning space where motor and cognitive aspects mutually reinforce each other. Critical thinking is the ability to analyze information, evaluate situations, and make decisions in a logical and rational manner. In the context of sports learning, critical thinking arises when children face dynamic game situations and must determine the best strategy to achieve the goal [22]. This skill trains children to think reflectively, creatively, and problem-solve, so that they are not only physically active but also develop high-level thinking skills that support the lifelong learning process. In the context of sports training for young children, the training approach should consider the child's physical, cognitive, and emotional developmental characteristics. Children in the primary school stage have a high motivation to move and play; they learn more effectively through direct experiences and fun activities.

Therefore, the training model based on fun critical thinking games becomes the most suitable approach for training young athletes. The movement coordination training model based on fun critical thinking games is a form of training that combines game elements in the design of physical and technical skills, with the aim of allowing children to train without pressure and maintain motivation. Through play, children can simultaneously develop motor, cognitive, and social skills. In addition, this approach promotes fun, reduces boredom, and increases children's active participation in the training process. This model can be modified into a circuit game, so that children not only practice physically, but also learn strategy, timing, and specific sports skills in a fun way. This training approach is also in line with the principle of Long-Term Athlete Development (LTAD), especially in the Train to Train stage, where children are guided to improve basic movement skills, coordination strength, and technical abilities through systematic, progressive, and fun-based activities. Therefore, game-based training not only prepares children to become potential athletes in the future but also makes the training process a positive learning experience. Cricket began to be known and introduced in Indonesian primary schools as part of sports diversification within physical education. Cricket has game characteristics that require concentration, quick reaction, and high coordination between vision and hand movements. One of the main basic techniques in the sport of cricket is batting, that is, the

ability to hit the ball accurately with the bat. Batting technique requires complex coordination between visually observing the direction and speed of the ball, body position, balance, and the timing of hand movements. For primary school children, mastering this technique is often a challenge because their coordination skills are still developing. Therefore, training in batting technique needs to be supported by a practice model that stimulates movement coordination in a comprehensive and enjoyable way.

The development of a motor coordination training model based on circuit games is expected to become an innovative solution in teaching the basic cricket batting technique in primary education. This model is designed to jointly integrate the elements of play, motor coordination, and mastery of basic technique. Through this approach, children not only practice basic motor skills but also learn to control body movements, improve reaction speed, and develop confidence in game situations. In addition, the development of this training model is also relevant to the principles of long-term athlete development (LTAD), as it prioritizes fun, movement variety, and coordination development in the early stages of training. Therefore, it is expected that this training model can be a real contribution to improving the effectiveness of cricket learning in primary school, while also supporting the sustainable development of the quality of young athletes.

2. Materials and methods

The research uses a research and development method with the purpose of developing a motor coordination training model based on fun critical thinking games. This research and development method is used with the aim of developing a product in the form of a learning model and evaluating the effectiveness of this learning model. The type of research that will be conducted is the Research and Development method, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation (ADDIE). The research uses a research and development method with the purpose of developing a motor coordination training model based on fun critical thinking games. This research aims to develop a motor coordination training model based on fun critical thinking games. In addition, this research aims to produce a training model that is effective and fun, based on enjoyable critical thinking games and presented in the form of a game draft.

The population of this research is divided into two parts, namely the small group population and the large group population, where the subjects of this research are students from the UNP Development Laboratory Elementary School, conducted in June - July 2025 for the small group, and SDN 15 Anduring, conducted in August - September 2025 for the large group. This research will be carried out in the field at SDN 15 Anduring and at the UNP Development Laboratory Elementary School. Based on population data, the researcher determines the sample for this study using the Purposive Sampling technique, taking 11 years of age as the criterion. This technique determines the sample based on the researcher's consideration of which samples are most suitable, useful, and considered representative of a population. In the initial phase, the researchers will carry out a needs analysis through a preliminary study by making direct observations in the field. The data obtained at this stage will serve as the basis for developing the design or plan of the program to be implemented. Subsequently, in the implementation phase, the research will use a quasi-experimental method with a single-group pretest-posttest design to measure the effectiveness of the designed program. The final phase consists of an evaluation conducted in two ways: formative evaluation, carried out during the process to make improvements, and summative evaluation, conducted after the activities have concluded to assess the results and overall success of the program.

3. Results

Expert assessment

The expert evaluation of the motor coordination training model based on fun critical thinking games to improve basic batting technique was conducted by experts in the field in June 2025. The evaluation was carried out by experts using a questionnaire. The measurement scale used was the Likert scale with a range of 1 to 4. The results of the material evaluation on the motor coordination training model based on fun critical thinking games to improve basic batting technique can be presented in Table 1 as follows:

Table 1. Data from the Expert Evaluation Results

Description	Percentage	Category
Linguist expert	92,50%	Valid
Materials expert	91,25%	
Media expert	91,25%	
Teacher 1	93,75%	
Teacher 2	91,25%	

Effectiveness Test

At this stage, the effectiveness test is conducted to determine the effectiveness of the movement coordination training model based on fun critical thinking games to improve basic batting techniques in cricket. The design used in this study is the 'Control Group Design with Pretest and Posttest Only.' In this design, the researcher administers a pretest before the research begins to obtain the students' initial values. The posttest is applied at the end of the research and will be analyzed to draw conclusions.

Results of the Descriptive Analysis

The results of the descriptive analysis of the pretest and posttest data on the basic batting skills of the students of SDN 15 Anduring can be presented in Table 2 as follows.

Table 2. Descriptive Data Results of the Pretest and Posttest in the Experimental Class of SDN 15 Anduring

Data		Max	Mín	Deviation	Average
Batting Test	Pretest	40	16	7,02	28,93
	Postest	44	32	3,35	37,13

According to the results of the previous analysis, it is shown that the data on the skill in basic batting techniques in the sport of cricket were obtained from pre- and post-tests of each basic batting technique in cricket. The statistical results obtained show that in the cricket batting test, the maximum pretest score was 40 and the posttest score was 44, the minimum pretest score was 16 and the posttest score was 32, the standard deviation was 7.02 for the pretest and 3.35 for the posttest, and the average score was 28.93 for the pretest and 37.13 for the posttest.

Normality Test

The normality test is conducted to determine whether the variables used in the research have a normal distribution or not. The calculation of the normality test in this study was carried out using the SPSS version 21 application with the Kolmogorov-Smirnov formula. The results presented below are the normality results in this study. For greater clarity, it can be shown in the following Table 3.

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		30
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	3.29749842
Most Extreme Differences	Absolute	.129
	Positive	.082
	Negative	-.129
Test Statistic		.129
Asymp. Sig. (2-tailed)		.200[c]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		

Table 3. Kolmogorov-Smirnov Normality Test Results in the Experimental Class

According to the results of the normality test using Kolmogórov-Smirnov mentioned above, it can be observed that the data on the ability in basic batting techniques in the sport of cricket of the students at SDN 15 Anduring is at 0.200. Based on the decision-making criteria in the normality test using Kolmogórov-Smirnov, it is explained that if the significance value > 0.05, then the residuals are normally distributed, otherwise not. Therefore, it can be said that the data of each variable in this study is normally distributed, as evidenced by a significance value of 0.200 > 0.05.

Homogeneity Test

The homogeneity test is conducted to check the similarity of the samples, that is, whether the variance of the samples taken from the population is uniform or not. The homogeneity test was carried out using SPSS version 22 with Levene's test. The results of the homogeneity test with SPSS version 22 can be seen in Table 4 below.

Table 4. Results of the Homogeneity Test with Levene's Test in the Experimental Class.

Test of Homogeneity of Variances			
Levene Statistic	**df1**	**df2**	**Sig.**
1.847	1	58	.179

According to the results of the homogeneity test using SPSS version 22 with Levene's test, it is observed that the data on the skill in the basic batting technique in cricket of the students of SDN 15 Anduring is 0.179. According to the decision-making criteria for the homogeneity test using Levene's test, if the significance value > 0.05, then the residuals are distributed homogeneously; otherwise, they are not. Therefore, it can be stated that the data of each variable in this study are homogeneous, as evidenced by a significance value of 0.179 > 0.05.

Paired Sample Test

Hypothesis test analysis using the paired sample t-test (df = n-1). The analysis is used to determine the effectiveness of the motor coordination training model based on fun critical thinking games to improve basic batting technique in the sport of cricket. The research conclusion is considered significant if the calculated t-value > t-table and the p-value < 0.05. The results of the paired sample test analysis are presented in the following Table 5.

Table 5. Results of the Paired Sample Test in the Experimental Class

Mean	Std. Deviation	95% Confidence Interval of the Difference		Sig. (2-tailed)
		Lower	Upper	
-7.067	.4.571	-8.773	-5.360	.000

Based on the results of the paired sample analysis in the table above, it can be explained that the pretest-posttest data of the motor coordination training model based on fun critical thinking games to improve basic batting technique obtained a calculated t of -8.468 and a p-value of 0.000 < 0.05, so the hypothesis "the motor coordination training model based on fun critical thinking games to improve basic batting technique" is accepted. After observing the results obtained in the experimental class, the comparison class in this study is also presented below, referred to as the control class or class without the application of the motor coordination training model based on fun critical thinking games, as discussed in this study.

Results of the Descriptive Analysis

The results of the descriptive analysis of the pretest and posttest data of basic batting technique skills in students of the UNP Development Laboratory Primary School can be presented in Table 6 as follows.

Table 6. Results of Descriptive Data Analysis of the Pretest and Posttest in the Control Class at the UNP Development Laboratory Elementary School

Data		*Max*	*Min*	*Stdev*	*Average*
Batting Test	*Pretest*	34	16	5.10	26.00
	Postest	46	32	3.32	41.08

Based on the results of the previous analysis, it is shown that the data on the ability in basic cricket batting techniques were obtained from the pretest and posttest values of each basic cricket batting technique. The statistical results obtained show that in the cricket batting test, the maximum pretest value was 34 and the posttest value was 46, the minimum pretest value was 16 and the posttest value was 32, the standard deviation (stdev) value was 5.10 for the pretest and 3.32 for the posttest, and the average value was 26.00 for the pretest and 41.08 for the posttest.

Normality Test

The normality test is conducted to determine whether the variables used in the research have a normal distribution or not. The calculation of the normality test in this study was carried out using the SPSS version 21 application with the Kolmogorov-Smirnov formula. The results presented below are the normality results in this study. For greater clarity, it can be shown in the following Table 7.

Table 7. Results of the Kolmogorov-Smirnov normality test in the control class

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		24
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	3.42448885
Most Extreme Differences	Absolute	.170
	Positive	.170
	Negative	-.150
Test Statistic		.170
Asymp. Sig. (2-tailed)		.072[c,d]

Based on the results of the normality test using Kolmogorov-Smirnov, it can be observed that the data on students' skills in basic batting techniques in the sport of cricket is 0.170. According to the criteria for decision-making in the normality test using Kolmogorov-Smirnov, if the significance value > 0.05, then the residual values are normally distributed; otherwise, they are not. Therefore, it can be said that the data for each variable in this study is normally distributed, which is evidenced by the significance value of 0.170 > 0.05.

Homogeneity Test

The homogeneity test is conducted to examine the similarity of the samples, that is, whether the samples taken from the population are uniform or do not vary. The homogeneity test was carried out using SPSS version 22 with Levene's test. The results of the homogeneity test with SPSS version 22 can be seen in Table 8 below.

Table 8. Results of the Homogeneity Test with Levene's Test in the Control Class

Test of Homogeneity of Variances			
Levene Statistic	**df1**	**df2**	**Sig.**
.337	1	46	.564

According to the results of the homogeneity test using SPSS version 22 with Levene's test, it can be observed that the data on students' skills in basic batting techniques in the sport of cricket is 0.564. Based on the decision criterion of the homogeneity test using Levene's test, which indicates that if the significance value is > 0.05, the residuals are distributed homogeneously, otherwise they are not. Therefore, it can be said that the data of each variable in this study are homogeneous, which is demonstrated by a significance value of 0.564 > 0.05.

Paired sample test

Hypothesis test analysis using the paired sample t-test (df = n-1). The analysis is used to determine the effectiveness of exercise without treatment in improving skills in basic batting technique. The research conclusion is considered significant if the calculated t value > t from the table and the p-value < 0.05. The results of the paired sample t-test analysis are presented in the following Table 9.

Table 9. Results of the paired sample test in the control class

Mean	**Std. Deviation**	**95% Confidence Interval of the Difference**		**Sig. (2-tailed)**
		Lower	**Upper**	
-10.250	4.580	-12.184	-8.316	.000

Based on the results of the paired sample test analysis in the table above, it can be explained that the pretest-posttest data of exercises without treatment to improve skills in basic batting techniques obtained a calculated t of -10.963 and a p-value of 0.000 < 0.05, so the hypothesis "the exercise model without treatment to improve skills in basic batting techniques is accepted." After reviewing the descriptive results of the experimental class and the control class, the next step in this research is to calculate the N-Gain value. This value is used to see the extent of the difference in improvement that occurs in the class that received the treatment (experimental class) and the class that did not receive treatment (control class). To observe this improvement, the N-Gain table for performing the basic batting technique can be seen in Table 10 below.

Table 10. Results of the N-Gain Test of Batting Test Ability of the Experimental Class and the Control Class

Batting Test					
Class	**N**	**Max**	**Min**	**Average**	**Average (%)**
Experimental	30	0,23	-0,03	0,14	14%
Control	24	0,24	0,00	0,10	10%

The results shown in Table 10 above indicate the difference in descriptive outcomes obtained by the experimental class and the control class. In the experimental class, in the basic batting technique, a maximum n-gain value of 0.23 was obtained, a minimum n-gain value of -0.03, an average n-gain of 0.14, and an average n-gain percentage of 14.43%. Meanwhile, in the control class, a maximum n-gain value of 0.24 was obtained, a minimum n-gain value of 0.00, an average n-gain of 0.10, and an average n-gain percentage of 10.39%.

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4. Discussion

The research results on the development of a motor coordination training model based on fun critical thinking games show that this approach can be an effective solution for improving basic batting skills in children aged 9 to 12. The designed training model was evaluated not only in terms of content suitability, language, and media presentation by experts but also through reliability tests and direct application in small and large groups. Each stage ensures that the resulting model is truly suitable for the training needs of children in the sport of cricket. Cricket is a sport that requires the synergy between physical ability, technical accuracy, and understanding of the game situation. Although the game unfolds at a slow pace, there are moments that require a quick response, such as when the player hits the ball, catches it, or moves quickly between the two posts. Hitting technique becomes one of the most decisive aspects, as the quality of the hit greatly affects the score and the progression of the game. Therefore, mastering hitting technique from an early age should be supported through training methods that match the child's character and learning needs.

The fun critical thinking game approach that combines elements of critical reasoning offers a more lively learning experience for students. Children not only repeatedly learn striking techniques, but they also face game challenges that push them to analyze, make correct decisions, and adjust their movements according to the situation they encounter. The variety of activities provided helps improve children's coordination, agility, and timing in a more natural way. In addition to having a technical impact, exercises in game form have also been shown to increase children's emotional engagement in the training process. A pleasant training environment makes children more focused, motivated, and willing to try new strategies to hit the ball. This is very important because, at the ages of 9 to 12, children's motor development and social abilities are in a phase of rapid growth, so engaging training is more easily internalized and produces significant improvements in skills. Considering all the observation and evaluation results, the motor coordination training model based on fun critical thinking games is considered suitable to be used as an alternative in teaching the basic batting technique in cricket. This approach is able to integrate elements of technique, game understanding, and fun into a single effective training process. It is expected that physical education teachers and coaches can consistently apply this model so that children can have a more meaningful and guided learning experience. Overall, this study demonstrates that a training model that combines motor coordination and problem-based play can significantly contribute to improving batting skills in children. A creative and fun approach like this is very suitable for the character of primary school-aged children, who are active and enjoy moving, while also supporting them in developing cricket technical skills more optimally.

5. Conclusions

After analyzing the obtained data and considering some hypotheses proposed in this research, the conclusions that can be drawn from this study are as follows: 1) It was confirmed that the motor coordination training model based on critical thinking and fun games to improve basic batting technique obtained a t-value of -8.468 and a p-value of 0.000 < 0.05; 2) The practical motor coordination training model based on critical thinking and fun games can be used to improve basic batting skills in children aged 9 to 12 years, evidenced by the fact that the average score in each test falls into the practical category; 3) The motor coordination training model based on critical thinking and fun games is effective in improving basic batting skills in children aged 9 to 12 years, which is demonstrated by the pre-test and post-test data of the training model based on critical thinking and fun games showing a p-value of 0.000 < 0.05; 4) The motor coordination training model based on fun critical thinking games is not better compared to not applying any treatment. This is demonstrated by the average N-Gain value in the experimental class, which is higher than in the control class, namely N-Gain Experimental 14.43% > N-Gain Control 10.39%. The results of this study show that the approach of the motor coordination training model presented in the form of games can increase students' interest and active participation in the training process. Through motor coordination play activities, children can learn batting techniques in a more natural, fun, and pressure-free way. It has also been shown that the motor coordination training model helps in mastering movement, throwing strength, and accuracy in the direction of ball hitting. Therefore, this method is suitable as one of the alternative training strategies in training young cricket athletes, as it also improves skills.

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