The Effect of Smart Kiddo Games on Fine and Gross Motor Skills in Early Childhood

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Abstract **– Physical fine and gross motor skills are crucial to every child's life. Previous research has highlighted the significance of play-based learning in early childhood development, particularly in enhancing fine and gross motor skills. This study seeks to determine the efficacy of the Smart Kiddo Games series in promoting physical development among young children. It was hypothesized that children who engage with Smart Kiddo Games will exhibit significantly greater improvement in fine and gross motor skills compared to those who do not. A quasi-experimental design was employed to compare children who participated in the game-based intervention with a control group. The sample consisted of 115 kindergarten children aged 4-5 years from three institutions in Tasikmalaya City. Data was collected by observing and documenting the children's physical abilities before and after participating in the Smart Kiddo Games. The results of the study confirmed the hypothesis that the Smart Kiddo Games series positively impacted the physical development of young children. The children who engaged with Smart Kiddo Games demonstrated significant improvements in both fine and gross motor skills compared to the control group. This suggests that incorporating these game-based learning into early childhood education can be a valuable strategy for fostering physical development and overall well-being in young children.**

Keywords **– Child development, early childhood, learning outcomes, Smart Kiddo Games, motor physical.**

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1. Introduction

In a child's early years, their physical, mental, language, and social-emotional skills significantly develop. Early childhood education must improve physical motor development because it can impact children's lives. Physical development has a direct impact on a child's mobility [1]. The standard levels of early childhood development measure physical motor skills in two categories: fine and gross motor skills. The body's ability to move part or all of the body to carry out certain activities or movements is known as gross motor skills by controlling body movements that involve the muscles, brain, and nervous system [2]. Power, stamina, pace, reactivity, flexibility, coordination, accuracy, and balance are essential components of physical fitness that should be optimized from a young age [3], [4]. Physical development is fundamental, meaning that this is the first time a child can respond through movement [5].

It is vital to prioritize physical motor skills in early childhood, as they significantly impact a child's health and development. Modern health organizations suggest that increasing physical activity among school-aged children is linked to substantial benefits for their physical, emotional, social, and cognitive well-being throughout their lives [1]. Therefore, it is crucial to incorporate physical habits into children's lives and establish a foundation for an active and healthy lifestyle as they grow older [1]. A lack of coordination of each movement can cause children to experience difficulty coordinating their eyes and motor movements. If not handled properly, the child will have trouble learning to read, write, and other learning [6].

The Ministry of Education and Culture Regulation (*Permendikbud*) No. 137 in 2014 regarding National Standards for Early Childhood Education states that children between the ages of four and five should be able to imitate animal movements, simulate the swaying of trees or airplanes, hang, jump, jump and run in a coordinated manner, throw objects aimlessly, catch objects accurately, make anticipatory movements, kick objects purposefully, and utilize game materials beyond the classroom setting [7]. Physical motor describes all body movements and is classified into gross and fine motor behavior [8].

The ability to make movements using the small muscles for activities such as writing, drawing, and grasping objects with the thumb and forefinger [9], [10]. Improving fine motor skills in children is essential as it lays the foundation for future movements. These movements involve specific body parts, including hands, fingers, wrists, and eyes. By strengthening these muscles and improving hand-eye coordination, children can build a strong foundation for future physical activities and tasks.

If children do a lot of physical activity, their gross motor skills will develop well, and their growth will also be optimal. Children who possess gross motor abilities are able to use their vast muscles when they run, jump, and stand on tiptoe [11]. Children's gross motor development can be maximized through activity games, which teach them to move some or all of their body parts, which helps them develop balance, agility, and limb coordination. Moreover, every child is happier moving than sitting still at this age [12]. Regarding its relationship to the early childhood education process, it requires that children participate in gross motor movement activities at school and that their teachers encourage them to be more active in activities that use part or all of their body so that their gross motor skills can be well developed [13], [14].

For children's physical development, early childhood educators are essential. They should implement effective and engaging teaching strategies that foster both receptive and expressive language skills in young children. Although children may experience similar developmental phases, their individual achievements within each phase can be quite diverse. The level of preparedness, often referred to as the sensitive period, plays a role in determining this difference [15]. The sensitive period, often called the golden age, is the time when children rapidly absorb knowledge and develop thought patterns about everything around them. Play-based learning is the ideal approach for stimulating children during this period [16], [17]. By playing, children can optimize their growth through physical activity and develop all their abilities for expression and exploration [14].

Moreover, the development obtained at an early age greatly influences children's development at the next stage and can increase work productivity in adulthood [18], [19], [20].

Optimizing motor development can also positively impact the child's physical health [21]. Physical abilities that require hand-eye coordination are known as fine motor skills [22]. Fine motor development is bodily activity that uses light and regular movements [23]. As a result, the activities are not tiring because they do not require a lot of energy and have patterns, such as unbuttoning clothes, tying shoelaces, and folding clothes. The small muscles in fingers and hands are used for fine motor skills [24]. Fine motor skills are using fine muscles to learn and train, such as moving objects with the hands, sweeping, folding clothes, cutting, and holding cutlery. According to Ozmun [25], the utilization of small muscles to carry out manipulative or grasping movements is known as fine motor abilities. Daily tasks can also reveal a person's fine motor coordination [26]. Mastery of good fine motor skills is essential for a person. The more motor skills one masters, the better social adaptation one can make, and the better one achievements at school [27]. Students who lack fine motor stimulation will have psychosocial difficulties such as making friends, shyness, and lack of self-confidence [28]. This shows that children need psychosocial skills to adapt to peers and adults and be confident and independent. Developing strong fine motor skills is essential for children, as they will significantly impact their ability to perform daily tasks independently as they grow older [29].

According to Carlson and Curby's research [30], children's academic performance is influenced by their fine motor skills. These skills are essential for activities that involve using both, eyes and hands, like reading, writing, and drawing. Enhancing early handwriting skills can contribute to future academic achievement [31]. If fine motor skills are not felt well, it will cause delays in fine motor skills in individuals, which results in lower skills in school work, independence, and social skills among peers [32]. This may make it difficult for children to attend school because interacting with peers requires fine motor skills in playing and writing. Milestones for fine motor skills aged 5-6 years consist of children being able to copy a picture of a triangle, being able to use clothespins to transfer small objects, cutting with scissors, writing first names, drawing diamonds, writing family names, writing short sentences, cutting simple shapes with scissors, copying shapes, coloring pictures within lines, using pencils with fingers, pasting and gluing correctly, can draw simple pictures, write letters, can color in images, can string tiny beads, etc. [33], [34].

If the child misses any of these stages, the child will experience obstacles in his fine motor skills.

Field observations of kindergarten teachers in Tasikmalaya City revealed that:

1) Teachers frequently utilize gymnastics, walking, imitation, and outdoor games to promote gross motor development;

2) Worksheets or question-answer activities are utilized to stimulate fine motor skills; and

3) Only 40% of teachers have utilized circuit games for physical skill development due to time, space, and financial constraints.

The development of gadget technology can worsen children's motor skills. High or low levels of gadget use can have several impacts on children, including children becoming too lazy to communicate with other people, children's motor skills decreasing, children who rarely move and are too focused on using gadgets can become obese, easily irritated, and angry, if disturbed, anxious and can lead to depression [35], [36]. This is reinforced by the opinion of Sopiyati [37] that children's gross motor development is less coordinated. Lack of coordination in every movement can cause children difficulty coordinating their eye and motor movements. Moreover, children will have trouble learning to read and write, etc., if their motor skills are not developed well [38].

Teachers must carry out lessons that can stimulate children's motor movements through games to overcome this problem. According to White [39], [40], play is essential for building a strong foundation for lifelong learning, implying that early childhood development plays a vital role in education. As children grow, play activities should transition from being primarily about play with incidental learning to being more centered around learning with play as a supporting element. Early childhood play can help children develop their physical abilities, sensory awareness, and understanding of their surroundings. Children can also reap various benefits for physical-motor development, intelligence, and social-emotional aspects.

Given the existing problems, it is proposed to implement a "Smart Kiddo Games" circuit. These games are designed to be easy, enjoyable, and safe for young children. They align with early childhood learning principles, encouraging play-based learning and providing a fun way for children to expend energy and develop their skills. The need for learning through play activities is the basis for seeing the influence of previously developed games called "Smart Kiddo Games." This game can enhance children's physical development by focusing on its convenience, security, appeal, and ability to support early childhood development [40].

This research then focused on whether or not games influenced the verbal and motor abilities of kindergarten-age children.

So, it is hoped that with learning activities through games, especially Smart Kiddo Games, children will be stimulated in their physical, motor, and language abilities when participating in learning and get fun hands-on experience following its characteristics. Sistiarini [41] notes that a game can effectively enhance young children's physical motor skills, aligning with the research findings about the development of the Animove Game. Further study has found that circuit-based games can be a playful and beneficial way to learn, motivating and encouraging the growth of skills in all children [42]. In this way, this approach can assist educators in fostering values and nurturing the full potential of all children [43], [44].

2. Methodology Section

This research is an experimental study. Experiments are used as a method to test hypotheses. A quasi-experimental study was carried out to investigate the potential benefits of Smart Kiddo Games on the physical, motor, and language skills of young children aged 4 to 5. The study compared the outcomes of children who participated in the game with those who did not, using a non-equivalent control group design [45].

In this design, there are initial observations (before treatment) and final observations (after treatment) in limited trials. In contrast, in large-scale trials, the researchers look at groups that are given treatment and those that are not. The study involved children aged 4-5 of Group A from three randomly selected institutions in Tasikmalaya City, including 1) Alphabet Kindergarten Tasikmalaya City, 2) Al Mutaqin Kindergarten Tasikmalaya City, 3) Muslimat NU Kindergarten Tasikmalaya City and the research sample consisted of 115 children, group A, from three institutions. The research framework is depicted below:

Experimental Group	:	01	x	02
Control Group	:	03	-	04

Figure 1. Research design

Description:

O1: Value before treatment was given to the experimental group.

O2: Value after treatment was given to the experimental group.

O3: Value before treatment was given to the control group.

O4: Value after treatment was given to the control group.

-- : The control class was not given treatment.

X : The control class was not given treatment.

The data collection technique uses observation and documentation.

In this research, the instrument used was an observation instrument with an observation guide sheet.

Table 1. Grid of guidelines for research instruments: early childhood motor and language assessments

Variable	Developmental Achievements	Statement Items	No. Items	Amount
Physical Motor Ability	Recognize and use body parts to develop gross and fine motor skills	Children can perform flexible motor movements	1	4
		Children can perform agile motor movements	2	
		Children can perform balanced motor movements	3	
		Children can perform strong motor movements	4	
Language skill	Understand and demonstrate receptive language	Children can carry out orders according to the rules given	1	4
		Children can convey answers according to the clues given by the teacher	2	
	Recognize and demonstrate early literacy skills	Children can read symbols on flashcards	3	
		Children can arrange letter symbols into words according to the picture	4	

(Source: Minister of Education and Culture Regulation 137, 2014) [7]

This evaluation instrument features a scale to ensure accurate quantitative measurements. This research measurement uses a rating scale of 1-4 to obtain raw data to measure the process of learning activities. Eight specific components of the learning process will be closely examined. Before implementation, the validity and reliability test were carried out, where three validators filled in the questionnaire consisting of seven questions to test the validity and consistency of this research instrument.

The Aikens analysis shows that all items have a validity value of at least 0.5, indicating that they are all valid. Additionally, Cronbach's Alpha reliability analysis of the instrument shows that each item is = 0.6, and the result is 0.667. These results collectively support the reliability and internal consistency of the questionnaire.

The construct in developing this instrument focuses on children's fine motor skills, which have two dimensions, namely grasping ability, eye and hand coordination [47]. If someone can hold it, it will be easier to carry out daily activities without the help of other people. Meanwhile, the ability of the eyes to interpret information so that the hands may be controlled and guided to do tasks effectively is known as eye-hand coordination [48].

Using the Wilcoxon signed rank test and the Statistical Package for the Social Sciences (SPSS) software, data analytic techniques were employed to evaluate the hypothesis in the first (small) trial. Then, for experimental research, before analyzing large trial (field) data, researchers carried out normality and homogeneity tests [49].

The normality test used Kolmogorov-Smirnov with the help of SPSS. A Levene's test was conducted to confirm equal variance between the groups, followed by an independent sample t-test to assess statistical significance.

3. Results

This section delves into the results of the study, encompassing a comprehensive analysis of the data. It is divided into three parts. Firstly, a summary analysis provides a general overview of the data. Secondly, the results of the prerequisite test are discussed to assess the initial knowledge and skills of the participants. Finally, the outcomes of the hypothesis tests are presented, focusing on the effectiveness of Smart Kiddo Games in both small-scale and large-scale trials, as well as the mean rank result.

3.1. Summary Analysis

The results suggest that children involved in the Smart Kiddo Games program demonstrated significantly better physical development than the control group. Their performance in both fine and gross motor skills was noticeably superior. A statistical analysis further confirms the positive impact of the games on children's physical development, as both groups, including the control group, exhibited noticeable improvements in these areas. The table summarizes the descriptive analysis results.

Table 2. Summary of descriptive statistics

Aspect	Groups	N	Mean	Std. Deviation	Std. Error Mean
Physical Ability	Control	43	9.37	1,964	,300
Fine Motor	Oakexperiment	40	14.05	1,986	.314
Campuan_Physical	Contral	43	9.30	2,030	.310
Rough motoric	Oakexperiment	40	14.32	1,655	.262

3.2. Analysis Prerequisite Test Results

Prior to conducting the independent t-test, the normality of the posttest data and the homogeneity of variances between the groups must be verified. These are important conditions for using a parametric statistical test like the independent t-test.

The posttest data from both groups, consisting of 40 control group children and 43 experimental group children, were subjected to a statistical test to examine any disparities in their fine and gross motor physical abilities. The results are summarized in Table 3.

Table 3. Evaluation of normality and homogeneity assumptions: control and experimental groups

Aspect	Group	Normality		Homogeneity		Hypothesis
		Mark	Sig.	Mark	Sig.	
Fine Motor Physical Ability	Control	1,308	0.065	1,110	0.714	Ho accepted
	Experiment	1,340	0.055			(Sig>0.05)
Gross Motor Physical Ability	Control	1,341	0.055	1,590	0.211	Ho accepted
	Experiment	1,229	0.098			(Sig >0.05)

Table 3 indicates that the collected samples adhere to the assumption of normality, as confirmed by the normality test. The data above show that all p-values obtained in this experiment were above the chosen significance level of 0.05. Consequently, it can be said that Ho is accepted. The normality test findings show that the data samples come from a population with a normal distribution. For the homogeneity test, the sig value for physical motor skills is 0.741, which is above the 0.05 significance level. Subsequently, the statistical significance for gross motor skills was determined to be 0.211, also exceeding the predetermined alpha level of 0.05. Consequently, Ho is deemed acceptable. Hence, the homogeneity test results indicate that the sampled groups have equal variance, allowing for hypothesis testing.

3.3. Outcomes of Hypothesis Test

To examine the effectiveness of Smart Kiddo Games, a series of hypothesis tests were performed.

The analysis is divided into three parts:

A preliminary evaluation of the game's effectiveness in small-scale trials, a detailed examination of mean rank results to identify significant differences between groups, and a comprehensive assessment of the game's performance in large-scale implementation. They are presented and discussed in the following subsections.

3.3.1. Smart Kiddo Games' Application in Small-Scale Tests

The research focused on evaluating the potential of Smart Kiddo Games to enhance children's language, motor, and physical development. Pre and post-test assessments were conducted to measure changes in these skills. The posttest evaluated the motor skills of the 16 children, distinguishing between their fine and gross motor capabilities based on whether they were in the experimental group or the control group. While the control group followed standard learning methods, the experimental group incorporated Smart Kiddo Games into their education.

Table 4. Comparison of normality and homogeneity test outcomes: control versus experimental groups (small-scale trial)

Z	Posttest_FM - Pretest_FM	Posttest_Language – Pretest_Language
	-3,562	-3,527
Asymp.Sig, (2-tailed).000	,000	,000
Based on Negative Ranks		
Wilcoxon Signed Ranks Test		

Table 4 shows the analysis of the test results using the Wilcoxon Sign Rank Test. The analysis shows that the Z scores for both fine and gross motor physical abilities are significantly low at -3.562 and -3.527, respectively. These low scores are highly significant ($p < 0.001$) for both fine and gross motor abilities. As a result, they do not support hypothesis Ho because its significance level is below 0.05, resulting in the adoption of the alternative hypothesis.

It indicates that children who participated in Smart Kiddo Games experienced significant improvements, as evidenced by the higher posttest scores than the pretest scores.

3.3.2. Mean Rank Results

The results presented in Table 5 mean rank show that using Smart Kiddo Games to improve fine motor and gross motor physical abilities in early childhood provides positive and significant results. All 16 children are in positive ranks, which means that the posttest scores of all children are better than the pretest scores.

Table 5. Mean ranking analysis

Aspect	N	Posttest-Pretest	Mean Rank
Capability_ FM	16	Negative Ranks	0.00
		Positive Ranks	8.50
		Ties	0.00
Ability_Language	16	Negative Ranks	0.00
		Positive Ranks	8.50
		Ties	0.00

3.3.3. Use of Smart Kiddo Games in Large-Scale Trials

Table 6 outlines the proposed hypotheses regarding potential differences in physical motor skills between children in the two groups.

The null hypothesis states that there is no statistically significant difference in physical motor skills between the groups.

Conversely, the alternative hypothesis proposes that the children in the two groups exhibit significantly different physical motor skills.

Table 6. Comparison of normality and homogeneity test outcomes: control versus experimental groups (large-scale trial)

Independent Samples Test										
	Levene's Test for Equality of Variances			t-test for Equality of Means				95% Confidence interval of the Differences	
		F	Sig.	t	df	Sig. (2-Table)	Mean Difference	Std. Error Difference	Lower	Upper
Fine Motor Physical Ability	Equal Variances Assumed	,110	,741	10,782	81	,000	-4,678	,434	-5,541	-3,815
	Equal Variances Not Assumed			10,778	80,426	,000	-4,678	,434	-5,542	-3,814

Table 7. Hypothesis test results for gross motor physical ability

Independent Samples Test										
	Levene's Test for Equality of Variances			t-test for Equality of Means				95% Confidence interval of the Differences	
		F	Sig.	t	df	Sig. (2-Table)	Mean Difference	Std. Error Difference	Lower	Upper
Gross Motor Physical Ability	Equal Variances Assumed	1,590	.211	12,301	81	,000	-5,023	.408	-5,835	-4,210
	Equal Variances Not Assumed			12,392	79,659	,000	-5,023	,405	-5,829	-4,216

The Levene test results show that equal variances are presumed to be selected. The sig value is 0.0001, as shown in Tables 6 and 7, indicating that it is below the predefined alpha value of 0.05. The results indicate that the original assumption (null hypothesis) is invalid and instead supports the alternative explanation (alternative hypothesis). According to the Smart Kiddo Games testing process, which was conducted in both small and large groups, the children who played Smart Kiddo Games demonstrated significantly improved gross motor skills compared to those who did not. This positive impact is attributed to the implementation of Smart Kiddo Games in the experimental group's learning activities. Thus, it appears that playing Smart Kiddo Games can positively and significantly enhance young children's gross motor development.

4. Discussion

Based on a limited study involving 16 children from two kindergartens in Tasikmalaya City, the statistical analysis shows that the results are significant, with a p-value below the accepted level of 0.05. The statistical analysis indicates that the study's findings are reliable and not merely a result of random variation. The results are consistent with the alternative hypothesis, indicating a significant effect of the intervention. This evidence contradicts the null hypothesis that assumes there was no difference. In Table 7, the Wilcoxon outcomes indicate a significant improvement in scores between the pretest and posttest assessments, with approximately 16 students demonstrating improved performance after the intervention.

Following the positive outcomes of the limited trials of Smart Kiddo Games, the researchers conducted a large-scale study involving three local kindergartens. Tasikmalaya City, namely Alfabet Kindergarten, Al Mutaqin Kindergarten and the third is Muslimat NU Kindergarten.

Moreover, the Levene test supported the independent sample t-test's premise of equal variances by showing that the variances were comparable among the groups under investigation. The table shows a statistically significant result ($p = 0.0001$) surpassing the alpha level of 0.05. Thus, it reveals a notable difference between the compared groups. It is determined that the null hypothesis is not supported by the evidence, leading to its rejection. Consequently, the alternative hypothesis is considered to be more likely and, therefore, it is accepted. According to the Group Statistics Table, the children who used Smart Kiddo Games showed significantly better physical skills, including fine and gross motor abilities, than those who did not. Thus, the hypothesis test showed that Smart Kiddo Games enhanced gross motor abilities in the experimental group more effectively. Hence, the findings suggest that Smart Kiddo Games can have a favorable effect on kids' physical growth by improving their fine and gross motor abilities.

A child's world is defined by active engagement and physical play [50], [51]. Learning that children enjoy is good because it gives them a pleasant experience. "The key to playing is having fun," Bergen [52]. Children will have difficulty learning to read and write if their motor skills are not appropriately developed [38]. Westendorp also explains that every child is happier moving than sitting still at this age. Regarding its relationship to the early childhood education process, it requires that children participate in gross motor movement activities at school and that their teachers encourage them to be more active in activities that use part or all of their bodies so that their gross motor skills can be well developed [53], [54]. Children who do a lot of physical activity will build their gross motor skills well, and their growth will also be optimal. It is demonstrated by activities like tiptoeing, jumping, and running [1], [11].

In the Smart Adventure Games, children carry out motor movements such as 1) The child walks on the playmate and then moves the playmate from back to front until he approaches the next post, 2) The child continues walking on the footbridge to train his leg strength and balance, 3) The child continues to pass through the zig-zag cone obstacles before entering the next post.

In addition to fine motor skills, Smart Kiddo Games emphasize the equally crucial aspect of gross motor skills, as they are fundamental to everyone's daily life.

Gross motor skills are a way for humans to communicate their feelings, thoughts, ideas, and dreams [55]. This is reinforced by Achmad [56] and Heryani [57], who emphasize the importance of developing gross motor skills. They argue that social isolation is not possible without physical interaction, highlighting the crucial role of gross motor skills in human development and social engagement. This is because children primarily focus on their own physical development before they can effectively engage with and adapt to their surroundings. In this Smart Kiddo Games, children's gross motor skills are developed through children's activities in listening to the rules of the game, listening to clues from the teacher regarding an animal, and trying to guess and look for pictures of the animal on flashcards that contain images. There is a place to arrange the letters into a word; after passing the final obstacle, the child can look for pieces or pieces of letters and then arrange them according to the child's understanding regarding the clue the teacher gave.

Moreover, engaging children in learning activities is essential for creating memorable and effective educational experiences. One way to bundle early childhood play activities is as a circuit game format. This aligns with the viewpoint of Savira and Kusumawardhani [42], who suggests that circuit games can be an enjoyable and engaging learning option that encourages and develops the abilities of all children. Nugraheni *et al.* [46] and Paramita and Sufiati [52] also found that fun learning environments can help teachers develop children's values and skills, particularly in physical abilities like fine and gross motor coordination in early childhood [52], [46]. The limitation of Smart Kiddo Games is that this game has a circuit mode, where children have to pass through obstacle posts before reaching the finish. Therefore, they require an accompanying teacher to observe and assist them during learning.

5. Conclusion

The use of Smart Kiddo Games in Group A children's learning has had a positive and significant influence, particularly in fine and gross motor skills. The results from both small-scale and large-scale trials consistently demonstrate significant improvements in children who participated in the game-based learning program compared to a control group. The analysis of pretest and posttest scores revealed substantial gains in motor skills among children in the experimental group. The use of statistical tests, such as the Wilcoxon Sign Rank Test and independent t-test, further validated the effectiveness of Smart Kiddo Games. The mean rank analysis also indicated positive changes in all participants' motor skills.

These findings highlight the potential of game-based learning to create engaging and effective educational experiences for young children. This research implies that there is a need to develop learning activities packaged with game activities to enhance young children's physical abilities, particularly fine as well as gross motor skills. Smart Kiddo Games may provide advice on creating entertaining educational activities that are suited to the unique characteristics and developmental requirements of toddlers. Using the Smart Kiddo Games game model has been proven to provide a more enjoyable learning atmosphere and enthusiasm for children to develop aspects of their abilities.

While this study provides strong evidence for the positive impact of Smart Kiddo Games, it is essential to acknowledge certain limitations. The sample size, although statistically significant, could be expanded to further strengthen the findings. Additionally, the duration of the intervention was relatively short, and longer-term studies are needed to assess sustained effects. Suggestions for future researchers include being creative in using and creating various game models that can establish more complex aspects of early childhood development. Additionally, it would be beneficial to examine the impact of game-based learning on children with diverse backgrounds and abilities.

Furthermore, researchers could delve deeper into the underlying mechanisms of how game-based learning promotes cognitive and physical development. By understanding the specific cognitive processes involved, educators can design more effective and targeted game-based interventions. In conclusion, this study underscores the potential of game-based learning to revolutionize early childhood education.

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