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The Influence of Badminton Game Education Using Pop Up Books On The Level Of Student Knowledge At SDN Wotanggare 1

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ABSTRACT

Physical education plays a crucial role in supporting students' holistic development, encompassing physical, cognitive, social, and psychological aspects. However, the implementation of physical education in elementary schools often faces challenges, particularly the limited use of innovative instructional media that can effectively enhance students' understanding of sports materials. Therefore, engaging and interactive learning media are needed to improve students' motivation and knowledge acquisition. One such medium is the pop-up book, which provides three-dimensional visual elements that can stimulate students' interest and facilitate better comprehension. This study aimed to examine the effect of badminton game education using pop-up book media on the knowledge level of students at SDN Wotanggare 1. The research employed a quantitative approach with a pre-experimental one-group pretest–posttest design. The participants consisted of 36 fifth- and sixth-grade students. Data were collected using a structured questionnaire administered before and after the intervention and analyzed using the Wilcoxon Signed Rank Test at a significance level of 0.05. The results showed that before the intervention, 20 students (55.6%) had a moderate level of knowledge and 16 students (44.4%) had a good level. After the intervention, students with good knowledge increased significantly to 33 students (91.7%), while only 3 students (8.3%) remained in the moderate category. Statistical analysis indicated a significant difference between pretest and posttest results ($p = 0.000 < 0.05$). In conclusion, badminton education using pop-up book media is effective in improving students' knowledge and can be considered an innovative instructional strategy in elementary physical education.

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INTRODUCTION

Education is a systematic and continuous process aimed at developing individuals' potential through the enhancement of knowledge, skills, and attitudes to produce high-quality human resources. In the Indonesian educational context, learning is not merely focused on cognitive development but also emphasizes affective and psychomotor domains to achieve holistic student development. This multidimensional approach is

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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essential to prepare students to adapt to rapid scientific and technological advancements while fostering critical, creative, and innovative thinking skills (Mahfud et al., 2020; Taufan, 2018; Suryadi et al., 2021; Hidayat & Pratiwi, 2019). One of the key components of this educational system is physical education, which plays a strategic role in promoting students' physical fitness, mental health, social interaction, and character development. Physical education is not limited to physical activity but also includes the development of motor skills, sportsmanship, discipline, and cognitive understanding of sports concepts (Kirk, 2017; Bailey et al., 2019; Casey & Goodyear, 2018; Hastie et al., 2020). However, in practice, physical education learning in elementary schools often prioritizes motor skill execution while neglecting the cognitive aspect, particularly students' knowledge of sports theory and rules (Dyson et al., 2016; Lund & Tannehill, 2018). Badminton, as one of the most popular sports in Indonesia, is widely taught in elementary schools due to its accessibility and benefits in improving coordination, agility, and teamwork. Despite its popularity, students' knowledge of basic badminton concepts, techniques, and rules remains relatively low. Previous studies have shown that elementary school students' understanding of badminton is categorized as moderate to low, indicating a gap in effective knowledge transfer during learning processes (Silki & Ardhika, 2020; Pratama et al., 2021; Nugroho et al., 2022).

Interestingly, students' interest in badminton tends to be high. Research by Bayu et al. (2022) reported that students' interest in badminton reached 73.06%, categorized as high. This discrepancy between high interest and low knowledge highlights a critical issue in physical education learning: the inability of current teaching methods to effectively transform student enthusiasm into meaningful understanding. Additionally, the increasing exposure to digital technology has reduced students' engagement with traditional learning resources such as books, further impacting their knowledge acquisition (Rahmawati et al., 2020; Setiawan & Kurniawan, 2021). Recent developments in educational research emphasize the importance of innovative and interactive learning media to enhance student engagement and knowledge retention. Constructivist learning theory suggests that students learn more effectively when they actively interact with learning materials rather than passively receiving information (Piaget, 2013; Vygotsky, 2018; Mayer, 2020). In this context, visual and interactive media have been proven to significantly improve learning outcomes, particularly among elementary school students (Arsyad, 2019; Moreno & Mayer, 2018).

One innovative medium that has gained attention is the Pop-Up Book. A Pop-Up Book is a three-dimensional interactive book that integrates visual elements with movable components, creating an engaging and immersive learning experience. Studies have demonstrated that Pop-Up Books can increase students' motivation, attention, and comprehension due to their ability to present abstract concepts in a concrete and visually appealing manner (Kurniawati, 2016; Wulandari et al., 2020; Sari et al., 2021). In physical education, the integration of instructional media is increasingly recognized as a critical factor in improving learning effectiveness. Research shows that the use of visual aids, multimedia, and interactive tools can enhance students' understanding of sports

techniques and rules (Casey et al., 2017; Goodyear et al., 2019; López-Belmonte et al., 2020). However, most existing studies focus on digital-based media, while limited attention has been given to non-digital interactive media such as Pop-Up Books, especially in the context of badminton education at the elementary level. Furthermore, previous research indicates that combining cognitive and psychomotor learning approaches leads to better overall learning outcomes in physical education (Metzler, 2017; Rink, 2018; SHAPE America, 2019). Therefore, integrating innovative media that support both domains is essential for achieving optimal learning effectiveness.

Despite the growing body of literature on innovative learning media, several critical gaps remain. First, most studies in physical education focus primarily on improving motor skills and physical performance, with limited emphasis on cognitive outcomes such as knowledge of sports concepts and rules (Hastie et al., 2020; Casey & MacPhail, 2018). This imbalance results in students who are physically active but lack a comprehensive understanding of the sport. Second, while digital learning media have been widely explored, their implementation in elementary schools often faces challenges such as limited infrastructure, unequal access to technology, and excessive gadget use that may negatively impact students' learning behavior (Selwyn, 2016; Livingstone, 2019). This situation highlights the need for alternative learning media that are effective, accessible, and less dependent on digital technology. Third, research on the application of Pop-Up Books in physical education, particularly in teaching badminton, is still scarce. Existing studies on Pop-Up Books mainly focus on subjects such as science and language learning, leaving a gap in their application within sports education contexts (Sari et al., 2021; Wulandari et al., 2020). Finally, there is a lack of empirical studies that specifically examine the influence of Pop-Up Book-based learning on students' knowledge levels in badminton at the elementary school level. This gap is particularly relevant given the observed discrepancy between students' high interest in badminton and their relatively low knowledge. Based on the identified problems and research gaps, this study aims to examine the influence of badminton game education using Pop-Up Books on the level of student knowledge at SDN Wotanggare 1. Specifically, this research seeks to: (1) analyze students' baseline knowledge of badminton, (2) implement Pop-Up Book-based learning in physical education, and (3) evaluate its effectiveness in improving students' knowledge.

The novelty of this study lies in several aspects. First, it integrates cognitive learning outcomes into physical education by focusing on students' knowledge of badminton, which is often overlooked in traditional teaching practices. Second, this research introduces Pop-Up Books as an innovative, non-digital interactive learning medium in sports education, offering an alternative solution to challenges associated with digital learning. Third, this study bridges the gap between students' high interest in badminton and their limited knowledge by providing an engaging and interactive learning approach. Furthermore, this research contributes to the development of more creative and student-centered teaching methods in physical education, particularly at the elementary school level. The findings are expected to provide practical implications for teachers in designing effective learning strategies that combine visual, interactive, and experiential elements.

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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In conclusion, physical education plays a crucial role in developing students' physical, cognitive, and social competencies. However, the current learning practices often fail to optimize students' knowledge of sports, particularly in badminton, despite their high level of interest. The integration of innovative learning media such as Pop-Up Books offers a promising solution to address this issue by enhancing student engagement and understanding. Therefore, this study is essential to provide empirical evidence on the effectiveness of Pop-Up Book-based learning in improving elementary school students' knowledge of badminton and to support the advancement of more innovative and effective physical education practices.

METHODS

This study employed a quantitative research approach using a pre-experimental design with a one-group pre-test and post-test format to examine the influence of badminton game education using Pop-Up Book media on students' knowledge levels. Quantitative research is widely recognized for its ability to measure relationships between variables through numerical data and statistical analysis, allowing for objective evaluation of intervention effects (Creswell & Creswell, 2018; Sugiyono, 2019). The pre-experimental design, particularly the one-group pre-test and post-test model, is commonly used in educational research to assess changes within a single group before and after treatment when control groups are not feasible (Fraenkel et al., 2019; Nursalam, 2020).

The research design can be illustrated as O_1–X–O_2, where O_1 represents the pre-test, X denotes the intervention using Pop-Up Book-based badminton education, and O_2 represents the post-test. This design enables researchers to identify the magnitude of change in students' knowledge attributable to the intervention (Ary et al., 2018; Cohen et al., 2018). Although this design has limitations in controlling external variables, it remains appropriate for exploratory studies aimed at determining initial effectiveness in real educational settings (Setyosari, 2016).

The population of this study consisted of all fifth- and sixth-grade students at SDN Wotanggare 1, totaling 36 students. Due to the relatively small population size, the entire population was used as the research sample, resulting in a total sample size of 36 participants. The sampling technique applied was purposive sampling, which involves selecting participants based on specific inclusion criteria relevant to the research objectives (Etikan & Bala, 2017). The inclusion criteria included students who were officially registered in the class attendance list and who provided informed consent to participate in the study. Meanwhile, exclusion criteria included students who were absent during any stage of the research process (pre-test, intervention, or post-test) or those who did not consent to participate. This approach ensures that the sample is representative and capable of providing valid data for analysis (Palinkas et al., 2015).

The independent variable in this study was badminton education delivered through Pop-Up Book learning media. The Pop-Up Book was designed as an interactive instructional tool containing three-dimensional visual elements and movable components

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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that illustrate fundamental badminton concepts, including rules, basic techniques, and game strategies. Interactive learning media such as Pop-Up Books have been shown to enhance students' engagement, motivation, and comprehension by presenting information in a visually stimulating and concrete manner (Sari et al., 2021; Wulandari et al., 2020; Mayer, 2020). The dependent variable was the level of students' knowledge regarding badminton, which reflects their cognitive understanding of the material.

Data collection was conducted using a structured knowledge test administered in two stages: pre-test and post-test. The pre-test was given prior to the intervention to assess students' baseline knowledge of badminton, while the post-test was administered after the implementation of the Pop-Up Book-based learning to measure changes in knowledge levels. The test instrument consisted of multiple-choice questions developed based on the learning indicators of badminton education and validated through expert judgment to ensure content validity (Taherdoost, 2016). Reliability testing was also conducted to ensure the consistency of the instrument, following standard procedures in educational measurement (Taber, 2018).

The intervention was carried out during physical education learning sessions, where students were introduced to badminton concepts through the use of Pop-Up Books. The learning process emphasized active student participation, visual exploration, and interactive discussion, aligning with constructivist learning principles that promote meaningful knowledge construction (Vygotsky, 2018; Piaget, 2013).

Data analysis was performed using descriptive and inferential statistics. Descriptive analysis included mean, standard deviation, minimum, and maximum scores to provide an overview of students' knowledge levels. Inferential analysis was conducted using a paired sample t-test to determine whether there was a statistically significant difference between pre-test and post-test scores, with a significance level set at $\alpha = 0.05$ (Field, 2018; Pallant, 2020). This analysis allows for the evaluation of the effectiveness of the Pop-Up Book intervention in improving students' knowledge of badminton.

RESULTS AND DISCUSSION

Result

This study aimed to determine the effect of badminton game education using Pop-Up Book media on the level of students' knowledge at SDN Wotanggare 1. The research applied a pre-experimental design with a one-group pre-test and post-test approach. Since the data were not normally distributed based on the normality test, inferential analysis was conducted using the Wilcoxon Signed Rank Test to evaluate the significance of differences between pre-test and post-test scores.

Characteristics of Respondents

Table 1.
Distribution of Respondents Based on Grade Level

Grade Level	Frequency (n)	Percentage (%)
Grade V	20	55.6%
Grade VI	16	44.4%
Total	**36**	**100%**

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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Table 1 shows that the majority of respondents were fifth-grade students, accounting for 20 students (55.6%), while sixth-grade students consisted of 16 students (44.4%). This indicates that the sample was relatively balanced, although slightly dominated by Grade V students.

Sources of Information about Badminton

Table 2.

Distribution of Respondents Based on Sources of Information

Source of Information	Frequency (n)	Percentage (%)
Media Only	2	5.6%
People Around (family, friends, teachers)	19	52.8%
Media and People Around	15	41.7%
Total	**36**	**100%**

Table 2 indicates that most students (52.8%) obtained information about badminton from people around them, such as teachers, family members, and peers. Meanwhile, 41.7% accessed information from both media and social environments, and only 5.6% relied solely on media sources. This finding highlights the strong influence of social interaction in shaping students' initial knowledge of badminton.

Knowledge Level Before the Intervention (Pre-Test)

Table 3.

Students' Knowledge Level Before Intervention

Knowledge Category	Frequency (n)	Percentage (%)
Good	16	44.4%
Moderate	20	55.6%
Poor	0	0%
Total	**36**	**100%**

The pre-test results presented in Table 3 show that the majority of students (55.6%) had a moderate level of knowledge about badminton, while 44.4% were categorized as having good knowledge. No students fell into the poor category. This suggests that although students already had some basic understanding, their knowledge had not yet reached an optimal level.

Knowledge Level After the Intervention (Post-Test)

Table 4.

Students' Knowledge Level After Intervention

Knowledge Category	Frequency (n)	Percentage (%)
Good	33	91.7%
Moderate	3	8.3%
Poor	0	0%
Total	**36**	**100%**

Table 4 demonstrates a substantial improvement in students' knowledge following the intervention. The proportion of students with good knowledge increased significantly to 91.7%, while those with moderate knowledge decreased to 8.3%. No students were categorized as having poor knowledge after the intervention. This indicates that the use of Pop-Up Book media effectively enhanced students' understanding of badminton concepts.

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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Effect of Pop-Up Book Media on Students' Knowledge

Table 5.

Comparison of Knowledge Levels Before and After Intervention

Knowledge Level	Pre-Test (n/%)	Post-Test (n/%)
Good	16 (44.4%)	33 (91.7%)
Moderate	20 (55.6%)	3 (8.3%)
Poor	0 (0%)	0 (0%)
Total	**36 (100%)**	**36 (100%)**

The comparison presented in Table 5 clearly illustrates a positive shift in students' knowledge levels. Before the intervention, the majority of students were in the moderate category (55.6%), whereas after the intervention, most students (91.7%) achieved a good level of knowledge. The number of students in the moderate category decreased drastically, indicating that the intervention successfully elevated students' understanding.

To further confirm the effectiveness of the intervention, statistical analysis was conducted using the Wilcoxon Signed Rank Test. The results showed a p-value of 0.000 ($p < 0.05$), indicating a statistically significant difference between pre-test and post-test scores. This result confirms that the improvement in students' knowledge was not due to chance but was significantly influenced by the implementation of badminton education using Pop-Up Book media.

Overall, the findings of this study demonstrate that the use of Pop-Up Book media in badminton education significantly improves students' knowledge levels. The combination of interactive visual elements and engaging content appears to facilitate better understanding and retention of learning material. The statistical results further strengthen the conclusion that Pop-Up Book-based learning is an effective instructional strategy in physical education, particularly in enhancing cognitive learning outcomes among elementary school students.

Discussion

The findings of this study provide strong empirical evidence that badminton game education using Pop-Up Book media significantly improves students' knowledge levels at SDN Wotanggare 1. The discussion is structured into three main aspects: (1) students' knowledge before the intervention, (2) students' knowledge after the intervention, and (3) the effectiveness of Pop-Up Book media in enhancing knowledge.

Students' Knowledge Before the Educational Intervention

The pre-test results revealed that 55.6% of students had a moderate level of knowledge, while 44.4% were categorized as having good knowledge, with no students in the poor category. This indicates that students already possessed basic knowledge about badminton, although their understanding was not yet optimal. These findings align with the concept that knowledge is influenced by a combination of internal and external factors, including cognitive readiness, prior experience, and environmental exposure (Kartikasari et al., 2019; Hidayat et al., 2020; Rahmawati et al., 2021).

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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From a theoretical perspective, knowledge acquisition is a cognitive process shaped by interaction between the individual and their environment. According to , students' moderate knowledge levels prior to the intervention may have been influenced by informal sources such as peers, teachers, and family members, which often provide fragmented or incomplete information. This is consistent with findings by Fitria (2022) and Pratama et al. (2021), who reported that elementary school students' understanding of sports concepts tends to remain at a basic level without structured instructional support.

Furthermore, the presence of 44.4% of students in the good knowledge category suggests variability in prior exposure. Students who engage in extracurricular sports activities or frequently interact with sports-related media tend to develop better conceptual understanding (Notoatmodjo, 2016; Nugroho et al., 2022; Setiawan et al., 2020). This supports the cognitive learning theory proposed by Mayer (2020), which emphasizes that prior knowledge plays a crucial role in facilitating new learning.

However, the predominance of moderate knowledge indicates a limitation in traditional physical education practices, which often emphasize psychomotor skills over cognitive understanding (Kirk, 2017; Bailey et al., 2019; Casey & Goodyear, 2018). This imbalance can hinder students' comprehensive understanding of sports, including rules, strategies, and techniques, which are essential for meaningful participation.

Students' Knowledge After the Educational Intervention

The post-test results demonstrated a significant improvement in students' knowledge levels, with 91.7% of students categorized as having good knowledge and only 8.3% remaining in the moderate category. This substantial increase highlights the effectiveness of the Pop-Up Book intervention in enhancing students' understanding of badminton concepts.

From a cognitive perspective, knowledge is acquired through sensory processes, particularly visual and auditory stimuli (Donsu, 2017; Notoatmodjo, 2014). The Pop-Up Book, as an interactive visual medium, effectively stimulates these sensory channels, thereby facilitating better information processing and retention. This finding is consistent with multimedia learning theory, which states that students learn more effectively when information is presented through both visual and verbal channels (Mayer, 2020; Moreno & Mayer, 2018). The interactive and three-dimensional features of Pop-Up Books enable students to visualize abstract concepts in a more concrete manner. Studies by Wulandari et al. (2020), Sari et al. (2021), and Nurfadillah (2021) have shown that interactive learning media can significantly increase students' engagement, motivation, and comprehension. In this study, the visual appeal and interactivity of the Pop-Up Book likely contributed to increased student attention and active participation during the learning process.

Moreover, the results support constructivist learning theory, which emphasizes that learners actively construct knowledge through interaction with learning materials (Piaget, 2013; Vygotsky, 2018; Schunk, 2020). The Pop-Up Book provides opportunities for students to explore, manipulate, and engage with the content, thereby promoting

deeper understanding. Despite the overall improvement, a small proportion of students (8.3%) remained in the moderate category. This variation can be attributed to differences in individual learning abilities, cognitive development, and motivation levels (Sari, 2019; Hurlock, 2018; Slavin, 2020). These findings highlight the importance of considering individual differences in designing instructional strategies.

The Effectiveness of Pop-Up Book Media on Students' Knowledge

The statistical analysis using the Wilcoxon Signed Rank Test revealed a p-value of 0.000 ($p < 0.05$), indicating a significant difference between pre-test and post-test scores. This confirms that the use of Pop-Up Book media had a statistically significant effect on improving students' knowledge levels.

Education, as a deliberate process, aims to transform individuals from a state of not knowing to knowing (Notoatmodjo, 2003; Ilyas et al., 2020). In this study, the educational intervention using Pop-Up Books successfully facilitated this transformation by providing structured and engaging learning experiences. The increase in students with good knowledge from 44.4% to 91.7% demonstrates the effectiveness of this approach. The success of Pop-Up Book media can be explained through several key characteristics. First, its interactive design encourages active learning, which has been shown to improve knowledge retention (Freeman et al., 2014; Prince, 2017). Second, the visual and three-dimensional elements enhance cognitive processing by reducing cognitive load and making information easier to understand (Sweller et al., 2019; Mayer, 2020). Third, the element of surprise and engagement inherent in Pop-Up Books increases students' motivation and interest in learning (Akbar, 2020; Sari et al., 2021).

These findings are also consistent with research in physical education, which emphasizes the importance of integrating cognitive and psychomotor learning to achieve optimal outcomes (Metzler, 2017; Rink, 2018; SHAPE America, 2019). By incorporating Pop-Up Books, teachers can effectively address the cognitive dimension of learning, which is often overlooked in traditional physical education settings.

Additionally, the results highlight the role of learning media in enhancing educational quality. Effective learning media can bridge the gap between students' interest and understanding by presenting information in an engaging and accessible manner (Arsyad, 2019; Nurfadillah, 2021; López-Belmonte et al., 2020). In this study, the Pop-Up Book served as a powerful tool to translate students' high interest in badminton into improved knowledge.

However, it is important to acknowledge that the improvement in knowledge may also be influenced by other factors, including students' motivation, prior knowledge, and environmental support (Bandura, 2018; Slavin, 2020; Schunk, 2020). Teacher involvement and instructional quality also play a crucial role in maximizing the effectiveness of learning media (Hattie, 2017; Darling-Hammond et al., 2020).

Implications for Physical Education Learning

The findings of this study have important implications for physical education practice. First, they highlight the need to integrate innovative learning media to enhance cognitive learning outcomes. Second, they demonstrate that non-digital media such as

Nanda Putra Prayoga[1A-E*], Rohmad Apriyanto[2B-D], Mohamad Da'i[3B-D]
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Pop-Up Books can serve as effective alternatives in contexts where digital resources are limited. Third, they emphasize the importance of student-centered learning approaches that promote active engagement and interaction. Furthermore, this study supports the development of more holistic physical education programs that balance cognitive, affective, and psychomotor domains. By incorporating interactive media, teachers can create more meaningful learning experiences that not only improve skills but also deepen students' understanding of sports.

In summary, the results of this study confirm that badminton education using Pop-Up Book media significantly improves students' knowledge levels. The findings are supported by both theoretical frameworks and empirical evidence, demonstrating that interactive and visually engaging learning media can enhance knowledge acquisition. Although individual differences and external factors may influence learning outcomes, the overall effectiveness of the Pop-Up Book intervention highlights its potential as an innovative instructional strategy in physical education.

CONCLUSION

This study aimed to examine the effect of badminton game education using Pop-Up Book media on the knowledge level of students at SDN Wotanggare 1. Based on the findings, it can be concluded that the implementation of Pop-Up Book-based learning has a significant and positive impact on improving students' knowledge of badminton.

Empirically, the results showed that prior to the educational intervention, the majority of students (55.6%) were categorized as having a moderate level of knowledge, while 44.4% had a good level of knowledge, and none were classified as having poor knowledge. This indicates that although students had been exposed to badminton through various informal sources, their understanding remained incomplete and not yet optimal. However, after the intervention using Pop-Up Book media, there was a substantial improvement in knowledge levels. The proportion of students with good knowledge increased significantly to 91.7%, while those in the moderate category decreased to only 8.3%, with no students remaining in the poor category.

Furthermore, the results of the inferential statistical analysis using the Wilcoxon Signed Rank Test revealed a p-value of 0.000 ($p < 0.05$), indicating a statistically significant difference between pre-test and post-test scores. This confirms that the observed improvement in students' knowledge was not incidental but was directly influenced by the educational intervention using Pop-Up Book media.

Conceptually, these findings reinforce the importance of utilizing interactive and visually engaging learning media in physical education. The Pop-Up Book, with its three-dimensional and interactive features, facilitates better comprehension by transforming abstract concepts into concrete visual representations. This enhances students' attention, motivation, and retention of learning material.

In conclusion, badminton education using Pop-Up Book media is an effective instructional strategy for improving students' knowledge in physical education.

Therefore, educators are encouraged to integrate innovative and interactive media into teaching practices to create more meaningful and engaging learning experiences, particularly at the elementary school level.

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