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AVK game model based on technology and local wisdom to improve physical fitness of children aged 6-12 years

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ABSTRACT

This study aims to develop and evaluate AVK (Audio, Visual, Kinesthetic) Game Models based on Technology and Local Wisdom to improve the physical fitness of children aged 6-12 years. The research was carried out for one year using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. The analysisstage involved identifying learning needs, dominant learning styles, and the physical fitness conditions of children through observations, interviews, and surveys involving 100 student participants. The design and development stage resulted in four interactive games that integrate physical movement, audio-visual media, and elements of South Sumatra local culture, namely Musi Fort, Palace Jump Rope, Sriwijaya Hide and Seek, and Belida Fish Catch. The design and development stage produced four interactive games that combine physical movement, audio-visual media, and elements of local South Sumatra culture: Musi Fort, Palace Jump Rope Jump, Sriwijaya Hide and Seek, and Belida Fish Catch. The implementation of the model was carried out on 60 students (consisted of 30 males and 30 females), with pretest and posttest measurements of physical fitness using TKSI instruments, as well as observation of student involvement and response. The evaluation stage was conducted after implementation by comparing pre-test and post-test results, supported by observations and questionnaires on students' and teachers' responses, with the evaluation results serving as the basis for drawing conclusions regarding the effectiveness and feasibility of the model in elementary school Physical Education learning. The results of the statistical analysis using a paired-sample t-test showed a significant difference between the pre-test and post-test scores ($p < 0.05$). The results showed significant improvements in various aspects of physical fitness, namely flexibility (10%), muscle endurance (8%), coordination (10%), agility (8%), and cardiopulmonary endurance (9%). In addition, 91% of students showed a positive response to this learning model, and teachers considered this media to be effective and support the integration of local wisdom values. In conclusion, the AVK Game Model based on Technology and Local Wisdom has been proven to be effective in improving physical fitness, motivating students' active participation, and strengthening appreciation for local culture. This model deserves to be used as an innovative alternative in Physical Education learning in elementary schools, which brings together technology, multiple intelligences, and local wisdom values in a fun and contextual way.

Key words: Local wisdom; physical fitness; avk game model; educational technology; children aged 6–12 years

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INTRODUCTION

An important age in the process of growth and development, both physical, motor, social, and emotional, is at the age of 6-12 years. At this age, children are experiencing a very rapid growth and development process, and are even

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said to be the initial foundation for children's development that has a range and determines at the next stage (Hijriati, 2021). In this phase, children are very active and have high curiosity, so they need the right stimulation to support their growth and development. One aspect that should not be ignored is physical fitness, because it is directly related to their health, endurance, and readiness to carry out daily activities, including learning activities.

High levels of physical fitness in children are generally associated with better body composition, lower risk of cardiovascular disease, better physical fitness, and better development of motor skills, which are important determinants of overall health (Au et al., 2025; Komura et al., 2025; Stavnsbo et al., 2020). In addition, physical fitness also influences, improving cognitive function, reducing the risk of anxiety and depression, and improving sleep quality (Garst et al., 2020). The WHO recommends that school-age children and adolescents (5-17 years old) engage in moderate to vigorous aerobic physical activity for an average of 60 minutes each day, accompanied by strengthening exercise at least three times a week for health benefits (Nascimento et al., 2025). Regular physical activity is also widely considered to be one of the most effective ways to avoid obesity (Li et al., 2025). However, the reality on the ground shows that the physical fitness condition of Indonesian children is still relatively low.

Based on data from the 2023 Sports Development Index (IPO) released by the Ministry of Youth and Sports, only around 6.79% of children aged 10-15 years have physical fitness in the good category, while the majority are in the poor category (Handayani, 2019). This low level of fitness is influenced by changes in the lifestyle of children who spend more time in front of the screen (screen time), lack of physical activity, and the lack of interesting and contextual physical learning models. This problem is greatly influenced by the environment both at home and at school. In schools, there are physical education learning and sports extracurricular activities to modernize it. Each child has different learning styles that affect his or her interest in learning, such as auditory, visual, and kinesthetic (AVK). However, the approach in physical education still does not consider the variety of learning styles, so learning tends to be monotonous and less effective. Considering the characteristics of elementary school students who still have the nature of children and prefer play-based activities, learning should be designed to be more engaging and enjoyable (Handayani et al., 2025). The physical education learning model in schools includes various play activities that are creatively and engagingly designed to stimulate the development of children's movement skills (Pratiwi et al., 2024). On the other hand, the use of technology and the strengthening of local wisdom values are two very relevant approaches to attract children's interest while enriching children's learning experiences. Based on these problems, it is necessary to develop a game model

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that integrates the AVK approach, utilizes technology, and raises elements of local wisdom. This model is expected to be able to increase children's participation in physical activities in a fun, effective, and meaningful way that can reduce children's dependence on screens. This is in line with (Lanos & Letari, 2019), which states that students will be more enthusiastic if interactive multimedia is available in the learning process.

These findings are grounded in real classroom conditions, where physical education instruction remains predominantly dominated by conventional teaching methods with limited integration of technology and contextual cultural elements. To date, the implementation of the Auditory–Visual–Kinesthetic (AVK) approach in elementary school physical education has been partial and unstructured, generally emphasizing movement demonstrations without the systematic use of multimedia and interactive learning activities. In this study, local wisdom is defined as region-specific traditional games, movement patterns, and cultural values, particularly those originating from the city of Palembang, which are closely related to students' daily lives and learning environments. By integrating these elements of local wisdom into multimedia-based AVK learning, this study provides a strong empirical foundation for future researchers to develop innovative and context-sensitive physical education learning models that enhance instructional quality and student engagement.

The search for previous relevant research studies that are in accordance with the research to be studied begins with traditional games affecting physical fitness (Manullang et al., 2022), physical activity of children and adolescents which is decreasing from year to year (Aguilar-Farias et al., 2024), physical education/sports learning has developed a technological system as an educational innovation (Lanos et al., 2023), then the impact of small games on physical fitness (Xu et al., 2024), the impact of obstacle and fortress games on the level of physical fitness of students (Handayani et al., 2024), and the Development of Locomotor Basic Movement Learning Through Traditional Games at the Elementary School Level (Nita et al., 2025). From previous studies that have been carried out, it continues to transform into research on physical fitness. Physical fitness is a very important foundation to be able to do good activities, especially for children. This is to support optimal growth and development, both physically and psychologically. For this reason, it is necessary to develop that can contain multiple intelligences (children's intelligence according to their interests) based on technology to adapt to the lifestyle in the current era. The game model to be developed must also collaborate between technology and local wisdom owned by Indonesia to strengthen the harmonious harmony of life with the environment, nature, and culture.

The novelty of this research is the development of games that can attract students according to their interests. The games are designed using technology

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that adapts to the times which has changed the lifestyle of today's children who are more interested in screens but still maintain local wisdom cultures to uphold the characteristics owned by the Indonesian state. The technology developed is in the form of a game media that collaborates a smart mat with a digital screen that combines games including audio, visual and kinesthetics.

METHOD

This one-year study involved elementary school students aged 6-12 years from three public elementary schools in Palembang, Indonesia, with participants consisting of boys and girls in balanced proportions. The research process included the development and validation of a technology-based Auditory–Visual–Kinesthetic (AVK) game model integrated with local wisdom to improve students' physical fitness. Model validation was conducted by a panel of experts comprising physical education lecturers, learning media specialists, and elementary school physical education teachers, all of whom had professional experience in curriculum development and instructional design. The implementation and evaluation of the model were carried out in real classroom settings with the direct involvement of students and teachers from the participating schools using ADDIE theory which consists of Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009), to be more clearly seen in the image below:

1. Needs analysis

The initial stage is in the form of observation and interviews with teachers, students, and parents to find out learning needs. This activity includes literature studies on physical fitness, AVK (Auditory, Visual, Kinesthetic) models, educational technology, and traditional games. At this stage, the identification of students' dominant learning styles Auditory, Visual, Kinesthetic is also carried out.

2. Design

This stage focuses on designing the game structure, including the name of the game, duration, rules, and tools used. In addition, supporting technology such as simple applications, videos, or QR codes is also designed, as well as the selection of elements of local wisdom (for example, ethical values, mutual cooperation, traditional games such as fortifications). At this stage, a design of learning media and physical fitness measurement instruments was also made.

3. Product development

This stage, the initial version of the Auditory, Visual, Kinesthetic game model was developed and subsequently validated by three experts, consisting of a learning expert, a learning media expert, and a subject matter expert in physical education. After receiving input, product revisions were carried out and trials were limited to 10-15 students to see the initial feasibility of the model.

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4. Implementation (Implementation/Field Trial)

The revised game model was piloted in schools involving 30-50 students aged 6-12 years. Pretest and posttest measurements of physical fitness (running, jumping, push-ups, etc.) were carried out as well as observation of student involvement and response during the activity.

5. Evaluation

The final stage involved the analysis of students' physical fitness data collected using standardized physical fitness test instruments, complemented by observation sheets and questionnaires administered to teachers and students to evaluate the practicality and effectiveness of the AVK game model. Quantitative data were analyzed using descriptive and inferential statistical tests to determine changes in physical fitness outcomes, while qualitative feedback from teachers and students was analyzed descriptively to support model refinement. Based on these results, the product was revised and finalized in the form of comprehensive model documentation, including instructional modules, learning videos, and simple digital applications, which can be utilized as technology- and local wisdom-based learning media for physical fitness.

After going through the stages of developing the AVK game model based on technology and local wisdom above, it is hoped that a learning model will be created that is innovative, interesting, and relevant to the characteristics of elementary school students. This model not only emphasizes improving physical fitness, but also fosters local wisdom values such as cooperation, sportsmanship, and responsibility. Through the integration of simple technology, students can learn interactively according to their respective learning styles (auditory, visual, and kinesthetic). Thus, the result of this development is expected to be an alternative to the Physical Education learning model that is effective, fun, and sustainable in supporting the formation of character and physical fitness of students.

FINDINGS AND DISCUSSIONS

Findings

The results of the development of a learning model entitled AVK Game Model based on Technology and Local Wisdom in an Effort to Improve the Physical Fitness of Children Aged 6-12 Years were developed in the form of an interactive video containing a 3D animation video with music audio derived from the local wisdom culture of South Sumatra and kinesthetic activities carried out by children when watching the video. After going through a series of research stages that were carried out systematically based on the ADDIE development model, a number of important findings were obtained related to the development and implementation of the AVK Game Model based on Technology and Local Wisdom. These findings depart from the urgency of the low level of physical

fitness of Indonesian children as reported by the Ministry of Youth and Sports through the Sports Development Index (IPO) in 2023, where more than 77% of children are in the underperforming category. Therefore, the results of this study are presented to provide a real picture of the process of needs analysis, design, development, implementation, and evaluation of AVK (Audio, Visual and Kinesthetical) game models, as well as show its effectiveness in improving the physical fitness of children aged 6-12 years. The stages of this research are:

1. Needs analysis

The initial stage of the study began with a needs analysis conducted in elementary schools in Palembang City. This analysis aimed to identify the physical fitness conditions of children aged 6-12 years through observations of physical education learning activities and structured interviews with Physical Education teachers. The results indicated that 77.12% of students were classified as having low physical fitness. Students tended to spend more of their leisure time using digital devices than engaging in physical activities, demonstrated a high interest in technology-based learning media, and remained enthusiastic about traditional games. In addition, Physical Education teachers expressed a need for innovative game models that integrate technology with local wisdom. To strengthen these findings, a survey involving 100 students was also conducted to examine their patterns of leisure-time use.

Table 1. Survey results of 100 children aged 6-12 years

No	Activity type	Number of children (n)	Percentage (%)
1	Playing gadgets (hp/tablet/online games)	70	70%
2	Playing physical on the field	30	30%
	Total	100	100%

The results of a survey of 100 children aged 6-12 years showed that 70% of children prefer to play gadgets in their free time, while only 30% of children are still active in physical games in the field. These findings reinforce the phenomenon that modern lifestyle changes have shifted children's play patterns, from physical activity that supports physical fitness to screen-based passive activity. The researcher also conducted a survey on children's interest in learning media, and obtained the following results:

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turnitin Page 10 of 18 - Integrity Submission Submission ID trn:oid:::1:3501362764

Table 2. Data on children's interest in learning media

No	Types of media that children like	Number of children (out of 100 respondents)	Percentage (%)
1	Technology-based/digital media (apps, animated videos, interactive games)	80 children	80%
2	Conventional media (books, whiteboards, simple props)	20 children	20%
	Total	100 children	100%

The results of a survey of 100 children aged 6–12 years showed that 80% preferred technology-based media such as digital applications and interactive games, while 20% chose conventional media. Despite this, about 65% of children remain enthusiastic about traditional games when they are attractively packaged. These findings show that learning that integrates technology with traditional games is more in line with children's interests and characteristics in today's digital era.

Table 3. Data on children's responses to traditional games

No	Child response	Number of children (out of 100 respondents)	Percentage (%)
1	Enthusiastic / showing interest	65 children	65%
2	Lack of enthusiasm / lack of interest	35 children	35%
	Total	100 children	100%

In addition to the survey of students, the researcher also interviewed 10 elementary school Physical Education teachers. The results showed that all teachers (100%) wanted an innovative game model that integrated technology with local wisdom. This finding confirms teachers' awareness of the importance of sports learning that is relevant to the development of the times but still rooted in the nation's cultural values. These needs are also in line with efforts to increase students' interest in learning and physical fitness through an engaging and contextual approach. These findings confirm the importance of developing AVK Game Models based on technology and local wisdom as an alternative to active and fun learning to improve children's physical fitness. Good physical fitness contributes to ideal body composition, lowers the risk of disease, and supports optimal physical development and motor skills.

2. AVK game model design

The design stage, a game-based learning strategy was developed by integrating interactive audio-visual media, kinesthetic movement, and local wisdom values. The design incorporated: (a) the application of a multiple intelligences approach aligned with children's interests, (b) game content based

turnitin Page 10 of 18 - Integrity Submission Submission ID trn:oid:::1:3501362764

on fundamental physical activities such as running, jumping, throwing, balance, and coordination, (c) interactive animated media themed on local traditional games, including Musi Fort, Palace Jump Rope, Sriwijaya Hide and Seek, and Belida Fish Catch, and (d) physical fitness assessment using TKSI instruments. Expert validation was conducted after the storyboard and initial design were completed. Validation involved three experts, namely a learning expert, a learning media expert, and a physical education subject matter expert who evaluated the model using structured validation sheets covering content relevance, instructional design, media quality, and suitability of local wisdom integration. The validation results were analyzed descriptively to determine the feasibility of the design and served as the basis for revising the storyboard and refining the AVK game model prior to final production.

3. Product development

At the development stage, the storyboard design was realized into an initial product in the form of technology-based audio visual and kinesthetic (avk) game media that integrates local wisdom. This stage includes: (a) creating a 4-6 minute digital animation featuring local identities such as the ampera bridge, the musi river, rumah limas, and traditional palembang music. (b) integration of kinesthetic elements, where each animation is accompanied by physical movement instructions tailored to the flow of the game. (c) functional tests of the product were conducted on various devices and the results showed that the media could be used both offline and online. (d) development output in the form of four digital game models based on south sumatra local wisdom, namely:

1. Musi Fortress: featuring running and jumping movements against the backdrop of the Ampera Bridge.
2. Jumping the Ropes Tepak Keraton: combining elements of Tepak dance, songket motifs, and gending music.
3. Sriwijaya Hide and Seek: presents squatting, freezing, and walking interactions in the background of Sriwijaya Temple.
4. Catch Belida Fish: featuring squatting, jumping, and catching fish in the Musi River.

These four games are physical education learning media that are interactive, fun, and full of local cultural values.

4. AVK game model implementation

The implementation stage was conducted through small- and large-group trials to assess the practicality of the model, students' responses, and the initial effectiveness of the technology- and local wisdom-based avk game model. The implementation results are presented in tabular form based on the instruments used and detailed evaluation indicators.

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Table 4. Students' responses and engagement in the implementation of the avk game model

Instrument	Evaluation indicator	Small group trial (n = 15)	Large group trial (n = 60)
Observation sheet	Students' attention during learning activities	85%	92%
Observation sheet	Active participation in game activities	87%	91%
Observation sheet	Students' learning focus	86%	92%
Student questionnaire	Enjoyment of learning activities	88%	93%
Student questionnaire	Interest in technology-based learning media	90%	94%
Student questionnaire	Motivation to engage in physical activities	84%	90%

Table 5. Physical education teachers' responses to the implementation of the avk game model

Instrument	Evaluation indicator	Percentage (%)	Category
Teacher evaluation sheet	Ease of material delivery	91%	Very good
Teacher evaluation sheet	Alignment with learning objectives	89%	Good
Teacher evaluation sheet	Integration of local wisdom values	93%	Very good
Teacher evaluation sheet	Practicality of media use	88%	Good
Teacher evaluation sheet	Student engagement during learning	92%	Very good

As presented in Table 4, the implementation results indicate that students demonstrated positive responses toward the AVK game model. In the small-group trial, 87% of students were able to follow the game activities effectively, showing increased participation and motivation. In the large-group trial involving 60 students from three elementary schools in Palembang, student engagement reached 92%, reflecting high enthusiasm and improved learning focus compared to conventional instruction. Teachers' responses, as shown in Table 5, suggest that the AVK game model is practical and effective in supporting Physical Education learning. Teachers reported that the learning media facilitated material delivery, enhanced student engagement, and supported the integration of local wisdom values. However, several implementation challenges were identified, including limited availability of technological devices, restricted classroom space, and the need to adjust instructional time due to the 4-6 minute duration of each game animation.

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5. Evaluation of AVK Game Model

The evaluation stage aimed to assess the effectiveness of the AVK game model in improving the physical fitness of children aged 6-12 years. The evaluation consisted of formative and summative evaluations. The evaluation results are presented in tabular form based on the instruments used, physical fitness outcomes, and detailed response indicators.

Table 6. Formative evaluation results based on expert, teacher, and student feedback

Instrument	Evaluation Indicator	Result
Observation Sheet	Student motivation during learning	High
Observation Sheet	Student engagement in physical activities	High
Student Questionnaire	Interest in 3D animation media	Very high
Student Questionnaire	Interest in local culture elements	High
Teacher Evaluation Sheet	Clarity of movement instructions	Needs simplification
Teacher Evaluation Sheet	Suitability of game flow	Good

Table 7. Physical fitness improvement based on tksi test results

Physical fitness component	Average improvement (%)
Flexibility	10%
Muscle endurance	8%
Coordination	10%
Agility	8%
Cardiopulmonary endurance	9%

Table 8. Student and teacher responses to the avk game model

Instrument	Indicator	Percentage (%)	Interpretation
Student questionnaire	Enjoyment of learning activities	91%	Very positive
Student questionnaire	Willingness to reuse the avk model	91%	Very positive
Student questionnaire	Increased motivation for physical activity	89%	Positive
Teacher evaluation sheet	Effectiveness in increasing learning interest	92%	Very good
Teacher evaluation sheet	Introduction of south sumatra local wisdom	94%	Very good

As shown in Tables 6-8, the formative evaluation results indicate that students were more motivated to participate in physical activities due to the attractive 3D animations and the integration of local cultural elements. Teachers highlighted the need to simplify movement instructions to enhance clarity and

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ease of implementation. The summative evaluation, based on TKSI pretest and posttest results, demonstrated meaningful improvements across all physical fitness components, with increases ranging from 8% to 10%. Furthermore, student response data revealed that 91% of students expressed enjoyment and willingness to reuse the AVK game model, while teachers perceived the media as effective in increasing learning interest and introducing South Sumatra local wisdom within Physical Education learning.

Discussion

Based on the results of the study, the AVK Game Model based on Technology and Local Wisdom has been proven to be able to increase children's physical participation and physical fitness. This finding is in line with the opinion Krisnawati and Muslim (2016) which states that the use of interactive learning media can increase children's motor involvement in Physical Education learning. Interactive multimedia as a supporting medium in the learning process (Lestari & Lanos, 2020). The integration of audio, visual, and kinesthetic elements in this model provides a learning experience that is in accordance with the dominant learning style of students, as expressed by Gardner (2011) in the theory of multiple intelligences that learning that combines various learning styles will increase motivation and learning outcomes. In addistion, the value of local wisdom raised in games such as Musi Fort, Palace Jump Rope Jump, Sriwijaya Hide and Seek, and Belida Fish Catch function as a medium for cultural preservation as well as a means of character education. This is in line with the findings Manullang et al. (2022) that traditional games are able to form cooperation, discipline, and the spirit of children's sportsmanship.

The increase in students' physical fitness by 8-10% in various aspects (flexibility, agility, and coordination) shows that the AVK game model can be an effective learning alternative. This supports the results of a study Ramdhana and Kurniawan (2022) that found that traditional game-based activities can improve the physical fitness of elementary school students. Thus, the AVK game model based on technology and local wisdom not only acts as an innovative medium for Physical Education learning, but also as a bridge between the modernization of education and the preservation of the nation's culture.

CONCLUSION

This study concludes that the development of a technology- and local wisdom-based AVK (Audio, Visual, and Kinesthetic) game model is effective in improving the physical fitness of children aged 6-12 years. By integrating physical movement, interactive audio-visual media, and South Sumatra local cultural values, the model creates Physical Education learning that is more engaging, contextual, and enjoyable. The implementation results indicate

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improvements across multiple components of physical fitness and demonstrate positive student engagement, while Physical Education teachers perceive the model as supportive of instructional delivery and cultural value integration. For further product improvement, future development should focus on simplifying movement instructions, expanding game variations and difficulty levels, enhancing compatibility with diverse technological devices, and incorporating adaptive features to accommodate different school facilities and student characteristics. These refinements are expected to strengthen the practicality, scalability, and long-term effectiveness of the AVK game model in elementary school Physical Education learning.

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