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Development of Adaptive Physical Education Learning Model Through Visual Media for Deaf Students

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Abstract
This research aims to develop an adaptive physical education learning model by utilizing visual media intended for deaf students. Students with hearing impairments often experience limitations in understanding verbal instructions that are generally used by teachers in the physical education learning process. Through visual media in the form of pictures, animations, and demonstration videos, it is hoped that students can understand movements, rules, and learning strategies more optimally. The research method used is Research and Development (R&D) with the Borg & Gall development model consisting of ten stages, but this research is limited to a limited trial stage. The subjects of the study were deaf students in special schools (SLB) with a total of 15 students. The results of the study show that visual media provides an increase in understanding of movement instruction, learning motivation, and student participation in physical education activities. Thus, visual media-based learning models can be used as an alternative to innovation in adaptive physical education learning for deaf students.

Keywords: *Adaptive Physical Education, Visual Media, Deaf Students, Learning Models*

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INTRODUCTION

Physical education is an integral part of the school curriculum which has a strategic role in developing motor skills, physical fitness, social skills, and positive attitudes towards physical activity. Targeted physical activity not only fosters physical health, but also trains cooperation, sportsmanship, and self-discipline. However, challenges arise when physical education learning is given to students with special needs, one of which is deaf students. Students with hearing impairments face limitations in understanding oral instruction which is generally the main communication medium in physical education learning. This condition causes them to have difficulty following the teacher's directions, imitating movements, and actively participating in activities. Recent research confirms that deaf students have a tendency to rely more on visual modalities in obtaining information than auditory (Azzahra et al., 2025). Therefore, the development of visual-based learning media is an urgent need in the implementation of adaptive physical education. The use of visual media, whether in the form

of images, illustrations, animations, or instructional videos, has been proven to be able to improve the understanding of movement and motivation of deaf students. Studies conducted by (Fadlih & Tola, 2023) showed that the use of digital-based visual media in physical education learning can clarify the process and increase the participation of deaf students. Similar results were found in this study.(Pratama & Mulyani, 2024), where audio-visual based teaching materials are effective in helping deaf students master locomotor and non-locomotor movement skills.

Beyond practical aspects, the visual approach also has a strong theoretical basis. The Deaf Gain concept emphasizes that visual communication developed by the deaf community is not simply a means of compensating for hearing loss, but rather a form of excellence that can enrich the learning experience of all children. (Gale & Martin, 2024). This reinforces the view that visual media in learning is not only beneficial for students with hearing impairments but can also improve learning effectiveness in general.

Therefore, research into developing a visual media-based adaptive physical education learning model for deaf students is crucial. This innovation not only provides a pedagogical solution to improve students' understanding of movement instructions and active participation, but also supports the principles of inclusive education, which guarantees equal access to education for all students.

METHOD

This research uses a research and development (R&D) approach. (Sugiyono, 2017) with the Borg & Gall model that has been modified to suit field needs. According to(Jariono et al., 2025), The R&D approach is relevant for developing learning media for children with special needs because it allows for an iterative process through limited trials and continuous revision. In line with (Zhong et al., 2025), The integration of visual technology in physical education requires a systematic design that accommodates the needs of students with disabilities.

This design was chosen because the research aimed not only to test hypotheses but also to produce a learning product in the form of adaptive visual media for physical education for deaf students. The R&D model implemented involved several stages: preliminary study and needs analysis, learning model design planning, initial product development (visual media prototype), limited trials, product revision, field trials, final product refinement, and dissemination of research results.

These stages were adapted to the conditions of the deaf students who were the subjects of the research so that the developed product was truly relevant to the learning needs of the school.

The research subjects were deaf students at a Special Needs Middle School (SMPLB) who were taking Physical Education. The initial trial included 10 students, while the field trial expanded to 25 students. Subjects were selected using purposive sampling, based on their special needs (deafness) and active involvement in Physical Education (PJOK) learning. This purposive sampling method is commonly used in special education research. (Bertills & Björk, 2024) because it ensures that participants align with the research objectives.

The research took place at a special needs school in North Sumatra, which provides basic physical education facilities, albeit with limited learning media.

The instruments used in this study included: a learning activity observation sheet to assess student engagement during physical education (PJOK) learning using visual media; a student and teacher response questionnaire to measure perceptions of the clarity, attractiveness, and usefulness of visual media; and a simple motor skills test, such as movement coordination, accuracy, and response speed.

These instruments were validated through expert judgment by adaptive physical education lecturers and special needs (SLB) teachers before being used in the field.

Research data was collected through several stages: initial observations to identify visual media needs; limited trials, where the initial product was used in lessons with 10 students; interviews and questionnaires with teachers and students to obtain feedback; and field trials with a larger number of subjects, accompanied by documentation of student activities.

Quantitative data was obtained through motor skills test scores, while qualitative data was obtained through observation notes and interviews.

Quantitative data were analyzed using descriptive statistics (mean, standard deviation, percentage) to see the improvement in students' skills. This technique was used because it is effective in describing the trend of improving student performance. (Nugroho & Chandrawulan, 2022). Meanwhile, qualitative data was analyzed using data reduction, data display, and conclusion drawing techniques.

The results of the quantitative and qualitative analyses were then combined to obtain a comprehensive picture of the effectiveness of adaptive visual media in physical education (PJOK) learning for deaf students.

RESULTS AND DISCUSSION

Result

The research results were obtained through three main instruments: a motor skills test, student and teacher perception questionnaires, and observations of students' active participation in physical education. Data collected from the field trial showed significant improvements after the implementation of adaptive visual media.

First, the motor skills test results showed an average increase of more than 20% across all indicators, as listed in

Table 1. Changes in the average motor skill scores of deaf students before and after the implementation of adaptive visual media

Motor Skills Indicator	Pre-Intervention Mean Score	Post-intervention Mean Score	Improvement
Hand and Foot Coordination	65,3	78,4	+20,1%
Movement Response Speed	58,7	72,1	+22,9%
Movement Accuracy (Precision)	62,4	76,0	+21,8%
Agility	60,5	73,3	+21,2%
Total Motor Score	247,0	299,8	+21,4%

Description: The motor test instrument included several simple basic movement tasks (touching signs, following movement patterns, etc.). Improvement was calculated as (Post – Pre) / Pre × 100%.

Before the intervention, students still showed difficulty following verbal movement instructions. However, after the visual media was implemented, students found it easier to understand movement patterns, resulting in consistent improvements in coordination, accuracy, and agility.

Second, responses from students and teachers, as presented in

Table 2. Student and Teacher Perception Scores on Clarity, Interestingness, and Usefulness of Visual Media

Aspect	Average Score (Students)	Average Score (Teacher)	Interpretation
Clarity of Visual Instructions	4,2 (Skala 1-5)	4,4	Sangat Baik
Appeal of Visual Media	4,0	4,1	Baik Hingga Sangat Baik
Usefulness for Understanding Movement	4,3	4,5	Sangat Baik
Suitability to Student Characteristics	4,1	4,3	Baik
Overall Average	4,15	4,33	Baik ke Sangat Baik

Description: The questionnaire uses a Likert scale of 1 (very poor) to 5 (very good); Student and teacher perceptions are used for triangulation in the analysis of the effectiveness of visual media. showed an average score ranging from "good" to "very good." This indicates that visual media is considered capable of supporting the learning process, both in terms of instruction clarity, appeal, and suitability to the needs of deaf students.

Third, in terms of active participation, the results on

Table 3. Frequency Distribution of Students' Active Participation in Physical Activities after Using Visual Media

Class/Group	Number of Students	Engagement (Present & Active)	60-79% Engagement	< 60% Engagement
Group A	5	4 People	1 Person	0 People
Group B	5	3 People	2 People	0 People
Group C	5	5 People	0 People	0 People
Total	15	12 People	3 People	0 People

Description: Active involvement is measured based on attendance and involvement in each learning session (instruction, movement practice); The use of visual media appears to increase the number of active students by ≥ 80%.

showed that almost all students achieved an engagement level of ≥80%. This indicates that visual media not only serves as a tool for delivering material but also as a motivational factor that encourages more intensive engagement in physical education.

Table 1 shows that all motor indicators experienced an average increase of over 20%. This indicates that adaptive visual media is able to facilitate the understanding of movement and performance of movement execution for deaf students in the context of physical education.

Table 2 shows that high perception scores from students and teachers indicate that visual media is considered clear, engaging, and useful. This positive perception supports the assumption that visual media facilitates movement comprehension, especially for those with hearing impairments.

Table 3 shows that the majority of students (12 out of 15) achieved active engagement of 80% or more. No students fell below 60%. These results demonstrate that the use of visual media influences student motivation and engagement in physical education.

Discussion

The results of this study confirm that visual media plays a significant role in increasing the effectiveness of physical education for deaf students. This is in line with the findings of (Zhou & Qi, 2022) which emphasizes that the use of visual-based instruments can improve the balance and coordination of children with hearing impairments. Visual media allows students to acquire information directly through their dominant channel, namely sight.

The motor skill improvements shown in Table 1 align with research. (Cai et al., 2024), which states that hearing impairments often impact motor function but can be addressed through adaptive strategies based on movement and visuals. By using pictorial, symbolic, or animated representations, students more easily understand movement sequences that were previously difficult to explain with verbal instructions alone.

The positive perceptions of students and teachers, as presented in Table 2, further strengthen this argument. (Petrie et al., 2024) Inclusive physical education requires adaptive devices that can bridge communication barriers. Teachers benefit because instructions are more easily conveyed, while students feel comfortable because information is presented in a format that suits their needs.

Furthermore, the increased active student participation (Table 3) indicates that visual media not only functions as a cognitive aid but also influences affective aspects. When instructions are clearer, students are encouraged to participate fully. This aligns with research. (Jariono et al., 2025) which concluded that adaptive physical education can directly impact the physical development and learning motivation of children with special needs.

The findings of this study also emphasize the importance of teachers' role in adapting learning methods.(Goodwin et al., 2023) emphasized that the engagement of students with hearing impairments in physical activities is highly dependent on the instructional strategies used. Visual media is a strategic solution here because it eliminates communication barriers and facilitates more participatory interactions.

From a pedagogical perspective, the successful use of visual media in this study also aligns with the visual literacy approach discussed by (Rakhmadi et al., 2024), Students with special needs understand material more easily through symbolic and visual representations. This alignment of media with student characteristics is what makes learning more effective.

However, the results of this study also indicate that the success of implementing visual media depends not only on the availability of the media itself, but also on the teacher's skill in integrating it into the learning process. (McNamara et al., 2024) stated that prospective physical education teachers need to be equipped with specific skills to utilize adaptive media to optimally achieve learning objectives.

Thus, it can be concluded that adaptive visual media not only improves movement comprehension for deaf students but also has implications for improved motor skills, active participation, and positive perceptions of physical education learning. This provides an empirical basis for the development of a visual media-based adaptive learning model that is highly feasible for wider implementation in special needs and inclusive schools.

CONCLUSION

The results of this study indicate that the development of adaptive visual media in physical education learning for deaf students has a significant impact on improving the quality of learning. The use of visual-based media has been shown to facilitate the understanding of movement instructions that were previously difficult to grasp through verbal explanations. The increase in students' average motor skills, including coordination, response speed, accuracy, and agility, is an indicator that the visual approach facilitates internalization of movement patterns. Furthermore, positive perceptions from both students and teachers confirm that visual media not only provides clarity of instructions but also increases the appeal of learning, strengthens motivation, and fosters comfort during physical activity. The high level of active student participation after the intervention indicates that visual media not only functions as a learning aid but also plays a role in triggering emotional and social engagement in physical education activities. Thus, it can be emphasized that the development of an adaptive visual media-based learning model is a relevant, applicable, and effective pedagogical strategy in supporting more inclusive physical education learning that is tailored to the needs of deaf students.

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