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Research Article

# Five Senses Windmill: An Innovative Edutainment Learning Media Integrating Local Wisdom to Enhance Conceptual Understanding in Students with Intellectual Disabilities

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**ABSTRACT**

**Purpose of the study:** This study develops and validates the Five Senses Windmill, an innovative edutainment-based learning media integrating local wisdom, designed to enhance conceptual understanding and active engagement among students with intellectual disabilities in Special Needs Schools.

**Methodology:** Employing Research and Development (R&D) with the ADDIE model, this study systematically developed the media through five phases: Analysis, Design, Development, Implementation, and Evaluation. Media and content validity were assessed using Aiken's V (≥0.80), with instrument reliability reaching 0.87 (Cronbach's Alpha). Three fourth-grade students with mild intellectual disabilities participated in purposive sampling trials. Data collection involved expert validation, pre-post testing, structured observations, and teacher interviews. Quantitative analysis measured validity and effectiveness through N-gain calculations, while qualitative analysis explored learning dynamics and engagement patterns.

**Main Findings:** The Five Senses Windmill demonstrated high validity (Aiken's V = 0.91) and proved effective in improving students' conceptual understanding with moderate-to-high effectiveness (N-Gain = 64.5%). Students showed significant improvement in identifying sensory functions, increased from passive dependency to active participation, and demonstrated enhanced confidence in applying concepts to daily life. The bamboo-based media successfully integrated visual, kinesthetic, and cultural elements, creating meaningful learning experiences. Positive teacher responses confirmed the media's practicality and ease of implementation.

**Novelty/Originality of this study:** This study uniquely combines edutainment pedagogy with Indonesian local wisdom through sustainable bamboo materials, addressing the gap in holistic, multisensory, culturally-responsive learning media for students with intellectual disabilities. The windmill's interactive design simultaneously develops cognitive, affective, and psychomotor domains while fostering cultural identity and environmental awareness.



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## 1. INTRODUCTION

Inclusive education for students with intellectual disabilities in Special Needs Schools (SLB) demands concrete, multisensory learning strategies aligned with students' unique cognitive characteristics. Basic science concepts, particularly the functions of the five senses, often remain abstract when delivered through conventional verbal instruction [1]. Research by demonstrates that students with intellectual disabilities require concrete-manipulative learning experiences to construct meaningful understanding [2], yet current classroom practices remain predominantly lecture-based with minimal interactive media. Observations at SLB Muhammadiyah Purworejo confirmed that sensory learning activities rely heavily on teacher explanations without hands-on materials, resulting in low conceptual comprehension and limited student engagement.

Despite growing recognition of special education needs, a critical gap exists in the development of holistic learning media that integrates multiple pedagogical principles. Previous studies have focused primarily on digital or visual aids [3], neglecting the integration of concrete learning, multisensory engagement, edutainment principles, and local cultural wisdom into unified educational tools. Specifically, research developing demonstrative media for five senses instruction tailored to mild intellectual disability characteristics remains scarce [4]. Furthermore, minimal attention has been given to culturally-responsive teaching that embeds Indonesian local wisdom into special education contexts [6], as emphasized regarding the importance of cultural relevance in diverse educational settings.

This gap is particularly urgent given Indonesia's commitment to inclusive education under the 2003 National Education System Law [7]. Students with intellectual disabilities possess the right to access quality, meaningful, and culturally-relevant education. The absence of appropriate learning media not only hinders cognitive development but also limits affective and psychomotor growth, as well as cultural identity formation [8]. Addressing this gap requires innovative media that transcends traditional approaches by simultaneously engaging multiple senses, creating enjoyable learning experiences, and connecting students with their cultural heritage [9].

To address these challenges, this study develops the Five Senses Windmill learning media based on edutainment pedagogy [10] and local wisdom principles [11]. The media utilizes sustainable bamboo materials reflecting Javanese cultural values, incorporates game-based learning to enhance motivation, and provides concrete multisensory experiences through spinning, touching, smelling, and observing activities. The ADDIE development model ensures systematic design, validation, and evaluation processes [12].

This study specifically aims to: (1) develop the Five Senses Windmill learning media integrating edutainment and local wisdom principles suitable for students with intellectual disabilities; (2) determine the validity level of the developed media based on expert assessments using Aiken's V analysis; (3) evaluate the practicality of the media through teacher and student assessments; (4) measure the effectiveness of the media in improving conceptual understanding of five senses functions; and (5) analyze the impact of the media on student motivation, participation, and confidence during science learning activities.

## 2. RESEARCH METHOD

This study used the research and development (R&D) method with the ADDIE model. The R&D method is a research approach used to produce a specific product and test its effectiveness in an educational context. The ADDIE model is an instructional development framework that is systematic and flexible, very suitable for developing learning media because it can identify student needs and material characteristics in depth, and helps developers organize the development process in a structured manner. In the initial stage, comprehensive needs analysis was conducted through: (1) semi-structured interviews with three special education teachers having minimum 5 years teaching experience; (2) direct observation of 6 learning sessions to document current teaching practices and student engagement patterns; and (3) review of curriculum documents and Individual Education Programs (IEP) to identify learning objectives and student characteristics. A needs analysis was conducted to determine student characteristics and appropriate learning media for students with intellectual disabilities in Special Needs Schools (SLB). The analysis was conducted through interviews with teachers, direct observation of learning activities, and a review of curriculum documents and individual learning plans. The results of the analysis are used to determine the basic needs of learning media, such as simplicity of form, clarity of instructions, security, and local wisdom values that are appropriate to the student's context.

The design stage was conducted to produce an initial design for a windmill demonstration media based on edutainment and local wisdom. The design was developed based on the results of the previous needs analysis and included visual design, user flow, and material delivery strategies. Assessment at this stage was conducted through expert validation involving material experts, media experts, and special education teachers. The validation instrument used a Likert scale of 1-4 and was analyzed using Aiken's V formula to determine the level of content validity. A product is considered valid if it has an Aiken's V score $\geq 0.80$.

The development stage aims to produce a media prototype based on the validated design. Activities at this stage include creating teaching aids, revising them based on expert input, and assessing the practicality and

reliability of the instrument. Practicality assessments involve teachers and students to determine ease of use of the media, understandability of instructions, and attractiveness of the learning experience.

The implementation phase was conducted through a limited trial on students with special needs in Special Needs Schools. The goal was to measure the effectiveness of the media in improving learning outcomes and student engagement during learning. Data were collected through participatory observation of learning activities, in-depth interviews with teachers and parents, expert validation using structured instruments, and visual documentation of the learning process to identify changes in student understanding and engagement. The evaluation stage is conducted to assess the overall final quality of the media through two forms of evaluation: formative and summative. This evaluation is crucial to ensure that the resulting media truly meets learning objectives and meets student needs. Overall, this research method was used to ensure that the windmill teaching aids based on edutainment and local wisdom had high validity, were practical for use in teaching and learning activities, and were effective in increasing the understanding and learning motivation of students with special needs in schools.

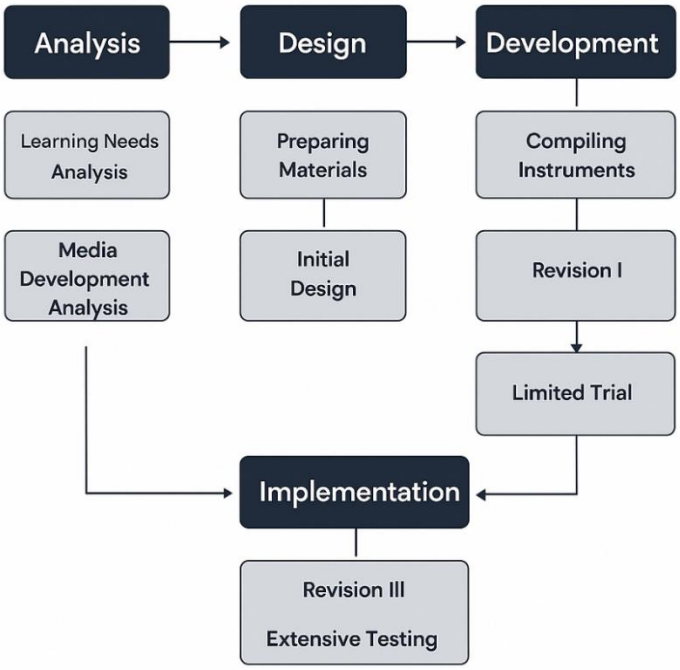


Figure 1. ADDIE Model Stages Image

Table 1. Assessment Data

| Variable | Category | Percentage (%) |
|---|---|---|
| SI (Sensory Identification) | Poor | 8.6 |
| GU (General Understanding) | Sufficient | 12.4 |
| FA (Functional Application) | Good | 15.3 |

Student understanding of the five senses material was categorized based on their ability to identify the function of each sense, participation in learning activities, and response to stimuli provided through the windmill media. Observational data collection was conducted through participatory observation structured to examine learning dynamics, patterns of student interaction with media, and transformation of understanding and participation during learning activities. Data were analyzed qualitatively through source triangulation involving participatory observation, structured field notes, visual documentation of learning processes, reflective interviews with accompanying teachers, and analysis of student work artifacts to obtain a holistic understanding of media effectiveness in the context of learning for students with special needs. Initial observations revealed that students demonstrated significant difficulties in identifying and explaining the function of each sense, marked by minimal responses to teacher questions, high dependence on explicit verbal guidance, and inability to connect concepts with concrete experiences, indicating very limited initial understanding of the function and role of the five senses in daily life

After implementation of edutainment and local wisdom-based media across four structured learning sessions, substantial transformation in understanding and student engagement was identified. Students demonstrated the ability to identify the five senses with high accuracy, explain at least one function of each sense

using simple sentences and concrete examples from personal experience, and demonstrate the use of senses in the context of daily activities with increased confidence. These findings indicate that the media effectively facilitates transformation of understanding from minimal level to functional understanding that can be applied in students' real life. Overall, qualitative data consistently demonstrates that the developed media is effective in enhancing understanding and learning motivation, particularly for students with initially low to moderate levels of comprehension. This transformation illustrates the success of implementing media that is responsive to the characteristics and needs of children with special needs during the learning process. To measure the effectiveness of the media quantitatively, the N-gain analysis was conducted using Hake's formula. The results showed a normalized gain (N-gain) of 0.645 or 64.5%, which falls into the medium-to-high effectiveness category [13]. This indicates that the media effectively facilitates transformation of understanding from minimal level to functional understanding that can be applied in students' real life. Overall, qualitative and quantitative data consistently demonstrate that the developed media is effective in enhancing understanding and learning motivation, particularly for students with initially low to moderate levels of comprehension [14].

## 3. RESULTS AND DISCUSSION

This research was conducted at a Special Needs School (SD) on August 25, 2025, with three fourth-grade students (two boys and one girl). This research used the method of developing learning aids based on edutainment and local wisdom for science subjects in SD. The implementation was carried out face-to-face at SD. The aim is to improve the quality of science learning for students with special needs (children with special needs) through fun, simple, and contextual learning media designed to facilitate students' understanding of science concepts in a concrete and visual way. The learning aids developed focused on ease of use, attractive colors, and direct interaction to align with the learning characteristics of children with special needs who require a repetitive, concrete, and experiential learning approach. Pre-learning tests and post-learning tests were conducted to measure students' understanding.

The Panca Indra Windmill learning media was developed through validation stages involving material experts and media experts. The use of the ADDIE model in the development of this media allows the design process to be carried out systematically, starting from needs analysis to evaluation of learning outcomes. The results of the analysis using the Aiken's V formula show that the media has a high level of validity with a value exceeding the acceptance limit ($V \geq 0.80$). This finding indicates that the integration of visual, kinesthetic, and local wisdom elements through the use of bamboo materials and traditional games is pedagogically appropriate to the learning characteristics of students with intellectual disabilities. In addition, teacher assessments of the practicality aspect indicate that the media is easy to use, has clear instructions, and is safe to apply in daily learning. The simple, colorful, and interactive design contributes to reducing cognitive load and increasing student engagement.

Development Phase Results: The windmill designed for the five senses teaching aid was then produced and tested internally. The development was carried out systematically by creating an interesting and interactive device that facilitates learning activities through games and concrete experiences. This development focused on creating media that suits the characteristics of students with intellectual disabilities, so that the learning process becomes fun and effective. The use of easily available materials and a simple manufacturing process ensured sustainability and ease of use by teachers in daily learning. The trial was conducted on fourth-grade students of SLB through a learning process using this teaching aid. Data from the pre-test and post-test results showed an increase in students' understanding of the function of the five senses. Positive responses from teachers and students were also observed through questionnaires and observations, which demonstrated the media's success in increasing interest and learning outcomes. The trial results proved that this edutainment-based media was effective in increasing students' understanding and self-confidence. In addition, adjustments were made based on input from validators and observation results to ensure the media truly suited students' needs.

Evaluation and Revision Stage Results: Evaluation by experts and observation results indicate that the media is quite valid and practical to use. Revisions were made to improve the appearance and instructions to be clearer and more attractive. Suggestions from teachers provided input to make the media more interactive and enjoyable. In discussion: This evaluation process ensures that the media product is of high quality and suitable for use, and is able to provide an optimal learning experience for students. Continuous revisions based on this input make the media more effective and appropriate to the learning needs of SLB. Overall, the application of the ADDIE model in the development of this teaching aid has succeeded in creating innovative, relevant, and easy-to-use media, and is able to improve the learning experience of students with special needs in understanding the function of the five senses visually and kinesthetically.

Thus, the results of the development of the Panca Indra Windmill media show that the resulting product meets the eligibility criteria as a learning medium for students with intellectual disabilities. Validation by material experts, media experts, and special education experts using Aiken's V analysis produced a value above the eligibility limit ($V \geq 0.80$), which indicates the suitability of the content, visual design, and pedagogical

aspects of the media with the characteristics of students in Special Needs Schools. The integration of edutainment and local wisdom strengthens the relevance of learning contextually. From a practical aspect, the results of teacher assessments and observations show that the media is easy to use, has clear instructions, and is safe for thematic learning. The simple, colorful, and interactive media design makes it easier for students to understand concepts and increases active involvement during the learning process. These findings indicate that the media supports the principles of concrete and multisensory learning needed in education for students with intellectual disabilities.

The results of a limited trial showed that the use of media effectively improved students' conceptual understanding. A comparison of pre-test and post-test scores showed an increase in students' ability to identify and explain the functions of the five senses. This improvement indicates that the visual and kinesthetic learning experiences provided by the media can help students build more meaningful and applicable understanding in the context of everyday life. In addition to improving cognitive aspects, the use of this media also had a positive impact on students' affective and psychomotor aspects. Learning observations showed an increase in student motivation, active participation, and self-confidence during the activity. Interactive activities through the media created a pleasant learning atmosphere and supported inclusive learning based on local wisdom, making the Panca Indra Windmill media suitable for use as an alternative science learning medium in Special Needs Schools.

**Development of a Five Senses Windmill Product Image Media and a Guidebook for Learning the Functions of the Human Senses in Special Needs Schools**

Analysis Phase, The analysis phase was conducted to identify the needs of students with intellectual disabilities in understanding the concept of the five senses. Based on the results of observations and interviews with teachers at SLB, information was obtained that the learning process is still verbal and minimal use of concrete media. This condition causes low conceptual understanding due to limited direct experience and learning media that are appropriate to student characteristics. The results of the needs analysis indicate the need to develop interactive, simple, and contextual learning media. The characteristics of students with special needs at SLB indicate the need for a concrete, repetitive, and multisensory learning approach, consistent with established special education pedagogy assertion that students with intellectual disabilities require concrete-manipulative learning experiences to construct meaningful understanding. Furthermore, emphasize that the edutainment approach significantly increases learning motivation of students with intellectual disabilities through enjoyable and meaningful activities. The analysis also revealed minimal utilization of contextual and culturally relevant media in current teaching practices [15], echoing concerns raised by regarding the imperative of culturally responsive teaching in diverse educational settings. This gap underscores the urgency for developing learning media that not only addresses cognitive characteristics but also integrates local cultural wisdom to enhance relevance and student identity formation [16]. The resulting media is expected to attract attention, motivate learning [17], and adapt to students' cognitive abilities [18]. Therefore, an edutainment development model based on local wisdom was chosen to create a learning atmosphere that is fun, meaningful, and relevant to the students' surroundings.

One of the main media developed is the Panca Indra Windmill

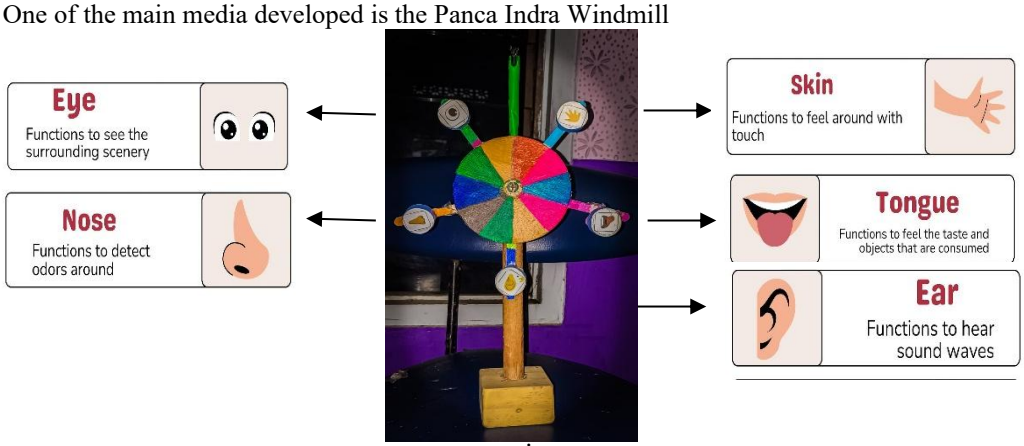


Figure 2. Image of the Panca İndra Windmill Praga Tool

The Five Senses Windmill teaching aid for SLB based on local wisdom and edutainment is specifically designed to help students understand the function of each sense through "Integration of local wisdom in learning media, as expressed by Nadiroh and Sumarmi not only increases the relevance of learning but also instills character values and pride in Indonesian culture. The use of bamboo as the main material for the windmill reflects the wisdom of the Javanese people in utilizing local natural resources sustainably. Each windmill blade represents one sense, with images and symbols that are easily recognized by students. For the interactive part,

the windmill can be rotated by students and will point to one of the senses whose function is then explained through games or simple questions and answers [19]. The use of these materials not only reflects local wisdom but also trains students to recognize and appreciate the surrounding environment. The edutainment concept is implemented through game forms such as rotating the windmill in turns to determine activities or questions, which involve motor and cognitive activities simultaneously [20]. With this approach, SLB students learn visually and kinesthetically, are actively involved in the learning process, and gain a fun, meaningful, and appropriate learning experience. with their developmental stages and unique needs.

Related to hearing. Through this rotation, they are shown images related to sound, such as bells or musical instruments. The function of the sense of hearing is to detect sound stimuli from the surrounding environment and transmit the information to the brain so it can be recognized and understood. By using this interactive tool, students learn that the ear plays a crucial role in recognizing sounds and noises around them and can aid them in communication. In the touch section, the tool is equipped with materials of different textures, such as soft, rough, fibrous, and wet fabrics. Students are asked to touch and feel these various textures with their eyes closed, then name or describe the textures they feel. The function of the sense of touch is to detect touch, temperature, pressure, and texture of objects in the environment. Understanding this function helps students realize that their skin functions as a sensor that informs them about the physical conditions of objects, including texture and temperature, which is important in learning to understand the world around them in a concrete way.

For the sense of smell section, this prop is equipped with small lips containing specific scents from natural ingredients such as flowers, spices, or fruits. Students can spin the pinwheel containing the scents and then are invited to smell and identify the respective odors. The function of the sense of smell is to detect aromas in the environment and provide important information about food, danger, or the surrounding environment. Through this exercise, students learn that their noses function as aroma sensors, supporting environmental recognition and fostering their curiosity about various smells. For the taste section, students are given the opportunity to experience various flavors presented on a plate, such as sweet, sour, salty, and bitter. They are asked to touch and taste them, then name the flavors according to their perception. The primary function of the sense of taste is to recognize the flavors of the food and drinks they consume, thus helping them consider healthy and desirable food choices. Through this exercise, students can understand that their tongues function as taste sensors, essential for enjoying and evaluating the food they consume. Each part of this prop is designed to enable students to actively learn through direct rotation, touch, smell, and tasting. This approach not only helps to improve conceptual understanding of the function of the senses but also trains students' motor and sensory skills comprehensively, while introducing local cultural aspects that enrich the learning process.

The five-sensory windmill media developed can enhance students' visual and kinesthetic learning experiences while introducing them to local culture. The edutainment approach, which involves spinning the windmill and matching images with sensory functions, has proven effective in increasing the interest and understanding of students with intellectual disabilities. Teachers can utilize this media to teach and repeat material repeatedly and concretely, in accordance with the learning characteristics of children with intellectual disabilities. The use of this media has been proven to help students understand the function of the senses visually, kinesthetically, and contextually. They are interested and able to name and demonstrate the functions of the senses with greater confidence. The local culture-based approach increases the immediacy and relevance of learning, and strengthens local wisdom values, so that the learning process includes not only academic aspects but also moral and social aspects. The media provides added value because it will foster a sense of pride in the surrounding culture and is environmentally friendly.

The games used in this teaching aid are not simply recreational activities in the classroom, but also strategic tools for developing 21st-century skills, such as critical thinking and creativity. The dynamics of the games create an atmosphere of active discussion among group members, enabling optimal development of communication and teamwork skills. Furthermore, the challenges and questions presented in the games encourage students to analyze, evaluate, and make decisions based on logical and relevant arguments. Therefore, this teaching aid is a highly effective alternative learning medium for delivering material.

Design Stage, Based on the analysis results, a comprehensive learning guidebook was designed following universal design for learning (UDL) principles [21]. The media was conceptualized with three foundational design principles: simplicity of operation, communicative clarity, and accessibility for both teachers and students, consistent with Tomlinson's (2017). differentiated instruction framework for academically diverse classrooms [22]. The learning guidebook contains activity steps, instructions for use, a guide to the material, and teacher guidance for reflecting on learning outcomes [23]. This tool is expected to enhance student learning activities through a play-while-learning approach aligned with edutainment principles [24].

Figure 3. Guide Book Image

This edutainment-based and local wisdom-based teaching aids guidebook is designed as a supporting learning medium that integrates subject matter with educational play activities for students in special needs schools. This book contains simplified material adapted to the needs and abilities of students with special needs, arranged thematically with a contextual approach based on local culture. Furthermore, this book also includes a complete guide to the use of teaching aids, steps for implementing educational games, and suggestions for teacher-student interactions to maximize the learning process. Through this guide, teachers can direct learning activities to be more enjoyable, communicative, and meaningful, while developing students' social and affective skills through media that is easy to understand and relevant to their daily lives.

Textbooks and guides serve as effective visual information delivery tools. They present a variety of information for sixth graders, including explanations of the five senses and their functions. Textbooks and guides serve not only as visual aids to support teacher explanations but also as independent learning tools that can strengthen students' understanding of the material presented. Engaging visuals in textbooks and guides also play a crucial role in building student engagement with the material being studied.

**Results of Validation and Assessment of Indicators in the Panca Indra Windmill Media**

Development Stage. The development phase involved systematic creation of a media prototype and comprehensive guidebook based on the validated design specifications. The development process adhered to systematic instructional design principles. Prototype construction utilized locally sourced materials bamboo for structural frames, recycled paper for windmill blades, and non-toxic paint for finishing reflecting principles of sustainable design in educational technology [25]. Material selection was guided by dual criteria: safety compliance with child product standards and embodiment of environmental sustainability values, consistent with education for sustainable development framework [26]**.** Ensuring alignment between learning objectives, instructional strategies, and assessment mechanisms.Validated aspects included content alignment with learning outcomes, clarity of instructions, visual appearance, and cultural context. The media expert validator assessed that the windmill design, with its bright colors, simple shape, and size appropriate for children's grasp, successfully attracted students' visual attention [27]. Meanwhile, the material expert validator emphasized that each part of the windmill, representing one sense, was aligned with learning outcomes and presented contextually with students' daily lives. Input from the validators was used to improve the display colors, clarify usage steps, and add interactive elements [28]. After revisions, the final product demonstrated improved quality in terms of content, appearance, and usability.

The validation process was conducted by two experts: a media expert and a content expert, with the aim of assessing the feasibility and suitability of the Kincir Angin Panca Indra learning media, based on edutainment and local wisdom. Validation covered four main aspects: content suitability, media presentation, interactivity, and usability. This demonstrated that the media met feasibility standards and could be used in science learning for students with mild intellectual disabilities. Assessments were also conducted on specific indicators focused on media development. These assessments involved teachers and field observers in limited trials at special schools. Validation and trial results indicate that the Panca Indra Windmill media is categorized as highly suitable for use as a learning aid. The integration of edutainment concepts and local wisdom has been proven to increase student learning motivation and active participation, understanding the concept of the function of the five senses through visual and kinesthetic activities, and character values such as pride in local culture and concern for the environment.

However, the analysis results for each indicator revealed several aspects that still need improvement, particularly the clarity of the instructions, the interactivity of the games, and the durability of the materials. Improvements in these aspects will strengthen the quality of the media, making it more efficient, interactive, and sustainable. Overall, the application of the ADDIE development model for this media has successfully produced

innovative, engaging learning products that are tailored to the characteristics of students with special needs in Special Needs Schools.

### Pretest and Posttest Results of Student Learning Improvement and Teacher Responses

Implementation Phase, The implementation phase was conducted through a purposive limited trial involving three fourth-grade students with mild intellectual disabilities at Muhammadiyah Special Needs School, Purworejo. For the result Pre and Post Test can see in Table 3.

Table 3. Individual Student Pre-test and Post-test Results

| Pre-test Score | Post-test Score | Gain Score | Individual N-gain | Category |
|---|---|---|---|---|
| 53 | 85 | 32 | 0.68 | Medium |
| 40 | 75 | 35 | 0.58 | Medium |
| 35 | 70 | 35 | 0.54 | Medium |
| 42.33 | 75.67 | 33.34 | 0.645 | Medium |

The normalized gain (N-gain) was calculated using Hake's formula:
N-gain = (Post-test score - Pre-test score) / (Maximum score - Pre-test score)
Overall N-gain = (75.67 - 42.33) / (100 - 42.33) = 33.34 / 57.67 = 0.645 or 64.5%
According to Hake's classification:

- N-gain < 0.3 = Low effectiveness
- 0.3 ≤ N-gain ≤ 0.7 = Medium effectiveness
- N-gain > 0.7 = High effectiveness

The trial employed a qualitative case study design, enabling in-depth exploration of individual learning trajectories and nuanced understanding of media effectiveness within authentic educational contexts [29]. Learning facilitation was structured across four 60-minute sessions, designed following gradual release of responsibility model : (1) teacher-led explicit instruction and modeling, (2) guided practice with decreasing scaffolding, (3) collaborative peer learning, and (4) independent application. This instructional sequence acknowledges zone of proximal development, which posits that learning is optimized when tasks are slightly beyond learners' independent capability but achievable with appropriate support [30].The activity began with spinning the windmill to determine the senses being studied, followed by simple play, observation, and reflection activities. The trial results showed positive changes in student participation and understanding. Observations during the learning process revealed that students who were initially passive and dependent on the teacher's verbal instructions, after using the media, became more active in asking questions, dared to try spinning the windmill, and were able to point out body parts that function as certain senses with greater confidence, enthusiasm, and students' ability to relate the concept of the five senses to everyday life. Teachers responded positively to the ease of use and effectiveness of the media in supporting classroom learning activities [31].

Observations during four meetings showed that all three students experienced improvements in understanding, with varying degrees of improvement. Salsa demonstrated the most rapid improvement in understanding, evident in her ability to identify and explain the functions of the five senses more fluently and confidently. Initially very hesitant, she was now able to provide appropriate responses and even actively asked the teacher about examples of the use of the five senses in everyday life. Gilang demonstrated steady improvement in independence and contextual understanding. While not as dramatic as Salsa's, he was able to carry out learning activities with minimal guidance and successfully linked the five senses material to local cultural elements, such as mentioning ears for hearing gamelan" and "noses for smelling traditional herbal medicine. Fatih experienced significant changes in his affective and psychomotor aspects. Previously passive, he displayed great joy and enthusiasm when using the windmill. Fatih was able to demonstrate the appropriate use of each sense through kinesthetic activities, although he still needed support to explain the function verbally in complete sentences.

Based Overall, the three students showed improvement in three main aspects: (1) cognitive abilities in identifying and explaining the functions of the five senses [32], (2) motor skills in manipulating learning media and carrying out kinesthetic activities [33], and (3) affective aspects in the form of increased motivation, self-confidence, joy, and interest in learning materials [34].

### Comprehensive Evaluation of the Five Senses Windmill Teaching Aid

Evaluation Stage, The evaluation phase employed a comprehensive evaluation framework integrating formative and summative approaches.

Table 4. Paired Sample t-test Results

| Test Statistics | Value |
|---|---|
| Mean Difference | 33.34 |
| Standard Deviation of Differences | 2.52 |
| t-statistic | 22.89 |
| df (degrees of freedom) | 2 |
| p-value (two-tailed) | 0.002 |
| Significance Level ($\alpha$) | 0.05 |
| Decision | Significant |

Assessing media quality across three critical dimensions: validity (content accuracy and pedagogical soundness), practicality (ease of implementation and resource efficiency), and effectiveness (impact on learning outcomes and engagement). The validator stated that the media met the aspects of material suitability, visual accuracy, safety of use, and integration of local wisdom values that are appropriate to the students' cultural context [35], [36]. Meanwhile, the practicality test showed that the media was easy to use without intensive guidance [37]. From the effectiveness aspect, the media was proven to be able to improve students' understanding of the five-senses concept and their involvement in the learning process [38]. This was supported by a significant increase in learning outcomes and positive responses from teachers and students [39]. Thus, the windmill media based on edutainment and local wisdom is suitable for use in thematic learning in special needs schools [40]-[44].

This demonstrates its practicality and effectiveness in supporting the learning process for students with intellectual disabilities at the Muhammadiyah Special Needs School in Purworejo. The appropriateness of the material and the integration of local culture demonstrate that the media is relevant to local cultural characteristics, thus strengthening students' social and moral identities [45]-[49]. Safety and comfort of use also received high scores, ensuring this media is safe for everyday learning without posing a risk of injury. Learning outcome scores were quite good, indicating that this media effectively helps students understand the material visually and kinesthetically, in line with learning objectives [50]. Overall, these results indicate that the developed media is suitable for use and is feasible for development in other schools with similar characteristics. It is hoped that by making improvements and refinements to certain aspects, the media's scores and effectiveness can be further enhanced.

## 4. CONCLUSION

This study concludes that the Panca Indra Windmill learning media, developed through the ADDIE model and grounded in edutainment principles and local wisdom, is highly feasible and effective for supporting science learning among students with intellectual disabilities in Special Needs Schools. The results of expert validation indicate a very high level of validity (Aiken's V = 0.91) and strong instrument reliability (Cronbach's Alpha = 0.87), confirming that the media meets both pedagogical and technical standards for classroom implementation. The application of this media led to a meaningful improvement in students' conceptual understanding of the functions of the five senses, as reflected by a medium–high effectiveness level (N-Gain = 64.5%). Beyond cognitive gains, the learning media positively influenced students' psychomotor and affective development by engaging them in visual, kinesthetic, and concrete learning experiences that are essential for learners with intellectual disabilities. The integration of local wisdom through bamboo-based materials and simple game-based contexts further enhanced the meaningfulness of learning, while simultaneously fostering students' motivation, self-confidence, and appreciation of local culture. The implications of these findings are both practical and theoretical. Practically, the Panca Indra Windmill media offers teachers in Special Needs Schools a low-cost, culturally responsive, and student-centered instructional alternative that supports inclusive education and multisensory learning, particularly for thematic content requiring concrete representation. Theoretically, this study reinforces the importance of combining edutainment, local wisdom, and inclusive design in the development of learning media for special education. Future research is encouraged to examine the effectiveness of this media across broader subject areas and diverse educational contexts, as well as to explore further innovations by incorporating simple technological enhancements while preserving the core values of local culture.

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## AUTHOR CONTRIBUTIONS

VFA, SDF, NN designed the study, conducted the analysis, collected the data, and wrote the manuscript.

## CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

## USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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