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Developing an Ethnoscience-Based Snakes and Ladders Board Game to Enhance Gross Motor Skills and Independence in Children with Speech Impairments

Agrielsa Alphasati Sinaga[1], Yunita Miftahul Jannah[1], Christina Ester Manthalina Hutabarat[1*]

[1]Department of Elementary School Teacher Education, Faculty of Education, Parahyangan Catholic University, Bandung, Indonesia.

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Corresponding Author:
Christina Ester Manthalina Hutabarat
christinaester@unpar.ac.id

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Abstract: This study aims to develop an ethnoscience-based snakes and ladders board game as a learning medium to improve integrated gross motor skills and independence of students with speech impairments at the junior high school (SMP) level in inclusive education settings. The study employed a Research and Development (R&D) approach using the ADDIE model, which consists of the stages of analysis, design, development, implementation, and evaluation. Gross motor skills were defined as coordinated movement abilities involving balance, body control, and dynamic coordination relevant to adolescents with speech impairments, while independence was defined as the ability of self-regulation, decision-making, task completion, and responsibility in learning activities. The research subjects were 15 seventh-grade students with speech impairments at SLB Negeri 1 Bantul, Yogyakarta. Data were collected through observation sheets, expert validation questionnaires, and assessment instruments for gross motor skills and independence. The validation results indicated that the developed media were highly feasible, with average scores of 91% from material experts and 89% from media experts. Limited trials demonstrated improvements in gross motor skills (mean scores increased from 64.3 to 80.7) and independence (from 66.1 to 83.5), with N-gain values in the moderate to high category. Ethnoscience elements were integrated through local cultural contexts such as traditional games, batik motifs, and Yogyakarta cultural symbols embedded in science learning challenges. These findings indicate that the ethnoscience-based snakes and ladders board game is effective as an alternative learning medium for students with speech impairments at the junior high school level.

Keywords: Board game; Children speech impaired; Ethnoscience; Gross motor skills; Independence; Snake stairs

Introduction

Education is one of the efforts made to increase the quality of human resources. Education can be obtained through educational institutions, both formal, informal, and non-formal. Schools are one of the examples of formal institutions. Schools play a very important role; schools are not only a place for learning, but also a place to give people life skills that will help society in the future. Schools teach children to socialize. This is not only important for normal children but also useful for children with special needs who have difficulties and shortcomings when interacting with other people (Pratiwi & Laksmiwati, 2016).

In this era of globalization, students reduce their sense of nationalism because they know more about foreign cultures in the modern world and understand less about local culture and the wisdom of Indonesian society (Nuralita, 2020). As an archipelagic country with thousands of tribes, languages, and traditions,

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Indonesian culture is very rich. However, many local cultures are starting to fade amidst rapid modernization, driven primarily by technological advances and globalization (Lawe et al., 2025).

This finding is supported by research conducted by Widyaningrum (2018) in elementary schools in Surakarta, which emphasized the importance of integrating local knowledge into science learning to improve students' understanding. According to Suastra (2017), ethnoscience-based learning can develop students' scientific work and critical thinking skills.

Every child, including children with special needs, has the right to education. Every Indonesian citizen, including children with special needs, has the same right to education. Education that does not discriminate against children with disabilities is known as inclusive education (Aishah et al., 2024). Since 2002, an inclusive education system has been implemented in Indonesia and is realized through the establishment of inclusive schools. These schools aim to eliminate educational discrimination against children with special needs. Inclusive education eliminates segregation between children with special needs and their peers (Widiyawati et al., 2022). The implementation of an inclusive education system provides equal opportunities for children with disabilities to learn alongside children without special needs in regular schools (Barsihanor & Rosyida, 2019; Rahmatika et al., 2020).

Children with special needs are those who have certain conditions that require special attention and handling in the teaching and learning process (Fakhiratunnisa et al., 2022). They can include children with physical, cognitive, emotional, and social disabilities.

Speech impairment is an abnormality in the pronunciation (articulation) of language sounds that makes it difficult to communicate orally in the environment (Mof et al., 2023). This can be caused by malfunctioning speech organs, for example the oral cavity, vocal cords, and tongue. Children with speech impairment have limitations in speaking that cause difficulty in verbal communication; they can only communicate with sign language, gestures, attitudes, and facial expressions (Prabowo et al., 2021). In addition, people with speech impairments also experience difficulty moving when following music (motor). As a result, they cannot maximize their abilities. Body movements are called motor movements. There are two types of motor skills: gross motor skills and fine motor skills. Gross motor skills are body movements that use large muscles, like kicking, running, jumping, and walking, while fine motor skills are body movements that use small muscles. The motor response is how someone learns to move the parts of his or her body correctly. Developing children's motor skills is very important so that children can develop well. Learning media such as audiovisual media can help children's motor development (Endrawan et al., 2020).

Independence is the capital of every human being. No one wants their independent life to be disturbed because they have a physical limitation called disability. Every human being never wants to have a physical disability, but disabilities can appear without realization, either when we experience an accident, when we are born, or when we grow. This abnormal body condition causes problems for those who experience it because it causes a decrease in motor and sensory abilities. There are several types of disabilities. Blindness causes eye defects, speech impairment causes hearing and speech defects, mental impairment causes mental disabilities, and physical impairment causes physical defects. There are also people who have two disabilities at once, known as multiple disabilities. People with disabilities are classified into three levels: Mild, Moderate, and Severe. In the educational context, people with disabilities are referred to as “children with special needs” (Pioh et al., 2017).

Independence is very important in everyone’s life, including people with disabilities. Independence is the ability of someone to feel, think, and decide something in accordance with his or her own beliefs without being influenced by others. Independence is a life capital for humans, but because of the mental and physical limitations they naturally have, people with disabilities experience disturbances in independence. Not only do people with disabilities never expect such a condition, but disabilities can also be experienced from birth, during growth, or as a consequence of accidents. In Indonesia, the limitation has many terms; the term person with disability is the most common and longest used. Disability is defined as someone who experiences a lack or impairment of physical or mental conditions that should be normal.

Independence is an enabling attitude that allows someone to act freely, do something by his or her own will, fulfill personal needs without help from others, think and act creatively, show full initiative, influence the environment, have self-confidence, and gain satisfaction from his or her efforts (Saleh et al., 2020).

The meaning of learning will be significantly impacted by the teacher's ability to select and organize an effective and efficient learning technique. The manner a teacher presents the material has a significant impact on students' learning independence and thought processes, which should boost their motivation and proficiency. The tactics employed must be in line with the instructional materials in addition to taking into

account the social circumstances of the students (Rikizaputra et al., 2021).

By using game-based learning media, students can more easily obtain information and are more motivated to learn (Haloho et al., 2023). Another study shows that the use of game-based media can increase positive learning responses and enthusiasm, and student learning outcomes can be improved (Jamalludin et al., 2023). Therefore, to increase the effectiveness of media, teachers must be able to combine games so that learning becomes interesting and fun (Rustianti & Asih, 2025).

Instructional media are used to reach equality and can be accessed anywhere by students (Nanjundaswamy et al., 2021). Teachers must be proficient in choosing the learning media that will be used to support learning activities customized to students' conditions. Learning media are not only used to communicate material, but also can increase involvement and interest in learning, open connections, and improve teaching methods. Learning media can also be used to increase activities in class and improve learning effectiveness (Wulandari et al., 2023).

The results of observations conducted with the class teacher at SLBN 1 Bantul show that there is still a problem in science learning due to the lack of utilization of learning media. This problem can be overcome by developing active, creative, innovative, and fun learning media. According to Mustika et al. (2020) the aim is to develop learning media that can be used to communicate or solve problems. The snakes and ladders board game is used as a learning medium in this study. This jumbo snakes and ladders game uses a large board where students play directly as pawns in the game. This game can be played by a minimum of five players. The game board consists of 10 rows and 10 columns divided into boxes, each given numbers 1 to 100; inside there are snakes, ladders, bombs, and icons typical of Yogyakarta culture.

Educational games are a learning method that allows students to play while learning so that they do not feel burdened by the lesson. Games that are entertaining and contain educational elements are considered learning media (Wibisono & Yulianto, 2010). The snakes and ladders game are an example of educational game media that can be used in the learning process. According to Karimah et al. (2014), the snakes and ladders game can be used as a fun learning medium for students. There is research related to creating learning media in the form of a snakes and ladders game. This research was conducted by Nugroho et al. (2013), which produced learning media in the form of a snakes and ladders game that meets excellent criteria. However, new innovations are needed to develop existing educational games. One way to do this is by using advanced technology. The lack of variety in the media distributed is not only because teachers do not optimize technological advances (Oktiana, 2014). Learning was carried out using snakes and ladders learning media, and the lesson plans received validation in the very feasible category (Budiarti & Jumadi, 2022). According to other research, learning with snakes and ladders media increases student activity and their learning outcomes (Mulasiwi, 2013). The snakes and ladders game is a board game played by two or more people, and the results of analysis show that there are significant differences in learning outcomes of students who learn using question cards and snakes and ladders with a scientific approach (Gultom et al., 2023).

The snakes and ladders game has strengths as well as weaknesses. Strengths of this learning media include: it can become a learning activity, students can play an active role directly, it supports all aspects of student development, trains problem-solving skills, can be applied inside and outside the classroom, is easy to use, has simple rules, guides and entertains students with positive and interactive methods (Putra et al., 2020b). Weaknesses include: requiring careful planning, students may become bored easily, students may lose interest, requiring long duration of play, and the game cannot develop all learning materials (Setiawati et al., 2019).

This study aims to develop learning media in the form of a snakes and ladders science board game that can be applied by students with speech impairments in learning materials. Researchers hope this learning media can encourage the learning process, improve memory training, understanding of each main topic, and practice speaking skills.

Method

This study uses a research and development (R&D) method referring to the ADDIE model, which consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. Research and development is a type of research used as stages to improve a new product or complete an existing product by seeing the feasibility and effectiveness of the product (Sugiyono, 2019). This model was chosen because it is considered systematic and flexible in developing contextual learning media appropriate to the needs of students with special needs, especially children with speech impairments.

The subjects of this study are 15 junior high school students with speech impairments at SLB Negeri 1 Bantul, Yogyakarta. The selection of subjects was done purposively by considering the characteristics of students who have verbal communication obstacles but

show basic motor skills that can be stimulated through play activities. In addition to students, this research also involves accompanying teachers and observers as respondents in filling out questionnaires to evaluate the effectiveness of the developed media.

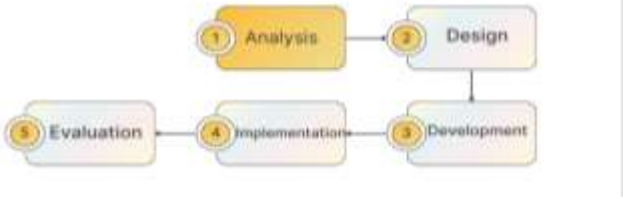

Figure 1. Research design

At the analysis stage, the learning needs of children with speech impairments in Special Schools (SLB) are identified. This includes learning the characteristics of students, overcoming communication difficulties, and obtaining media that helps students become more independent and learn gross motor skills. The first design stage, or design, includes making jumbo snakes and ladders board game media based on Yogyakarta culture and ethnicity. Batik designs on the board game and local pictures such as puppets, pedal rickshaws, and the Yogyakarta monument are representations of local culture. In addition, the learning material is arranged in the form of challenge boxes and science-related questions with learning themes such as animals, changes in the form of objects, the rotation of the earth, and the solar system.

At the development stage, the process of creating and validating media is carried out by media experts and science material experts. The validation results form the basis for conducting media revisions until it is declared worthy of use. At the implementation stage, the media is tested on children with speech impairments in learning activities at school to determine how effective it is in increasing independence and gross motor skills.

The last stage, evaluation, is carried out to evaluate the effectiveness and implementation of the media. During play, teachers and observers fill in questionnaires to collect data to evaluate children's responses, gross motor development, and aspects of independence. Pretests and posttests were also used to measure changes in children's gross motor skills and independence. To identify significant differences between the initial and final conditions, the Wilcoxon Signed-Rank statistical test was used to analyze questionnaire and test data.

Result and Discussion

This study was conducted on children with speech impairments using a pretest and posttest design. The learning media used was in the form of a jumbo snakes and ladders board game developed specifically to adapt to the needs and characteristics of children with speech impairments. The contents of this board game include science challenge boxes and questions designed to stimulate interaction, improve gross motor skills, and foster children's independence. Through educational play activities, this research aims to create a fun, meaningful, and contextual learning experience for students with special needs.

The results of this study indicate that the ethnoscience-based snakes and ladders board game developed is highly feasible, as evidenced by validation scores of 91% from material experts and 89% from media experts. These findings suggest that the developed media meets the criteria of content appropriateness, visual design quality, and alignment with the characteristics of junior high school students with speech impairments. The use of the ADDIE model contributed to this high level of feasibility, as the model emphasizes systematic development based on learner needs and continuous evaluation (Branch, 2009).

The improvement in integrated gross motor skills, reflected by an increase in mean scores from 64.3 to 80.7, demonstrates that gross motor development remains relevant for adolescents with speech impairments. Previous studies have shown that hearing or speech impairments are often associated with vestibular dysfunction and limited movement experiences, which may result in delayed balance and coordination persisting into adolescence (Rajendran & Roy, 2011; Melo et al., 2017). In this study, gross motor skills were conceptualized as coordinated movement abilities involving dynamic balance, body control, and motor integration within learning activities. Physical movements such as walking, stepping, and changing positions on the jumbo-sized board provided structured motor stimulation, supporting the view that planned motor activities contribute to motor development across age levels (Gallahue & Ozmun, 2012).

In addition, the findings revealed a substantial improvement in students' independence, with mean scores increasing from 66.1 to 83.5. Independence in special education contexts encompasses self-regulation, decision-making, task completion, and responsibility during learning activities (Saleh et al., 2020). The rule-based gameplay, turn-taking mechanisms, and challenge completion embedded in the board game encouraged students to manage their actions independently and take responsibility for their learning decisions. This result is consistent with previous studies reporting that structured and participatory learning activities can enhance independence among students with special educational needs (Aiyuda, 2018).

The integration of ethnoscience elements through local cultural contexts, such as traditional games, batik motifs, and Yogyakarta cultural symbols, enhanced students' engagement and learning motivation. Ethnoscience-based learning enables students to connect scientific concepts with culturally familiar experiences, making learning more contextual and meaningful (Suastra, 2017). Furthermore, game-based learning has been shown to promote active engagement and conceptual understanding, particularly in inclusive education settings (Putra et al., 2020a). Overall, these findings support the conclusion that the ethnoscience-based snakes and ladders board game is an effective alternative learning medium for improving integrated gross motor skills and independence among junior high school students with speech impairments in inclusive education contexts.

This study was performed on children with speech impairments using pretest and posttest design. The learning media was used in the form of a jumbo snakes and ladders board game developed in a special way to adapt to the needs and characteristics of deaf children. The contents of this board game cover science challenge boxes and questions designed to stimulate interaction, improve gross motor skills, as well as foster independence in mute children. Through educational play activities, this research aims to create a learning experience that is fun, meaningful, and contextual for students with special needs.

The results of this study show a significant improvement in the gross motor skills of students with speech impairments after being given the intervention, $Z = -3.92$, $p < 0.001$. Similarly, students' independence increased in a significant way ($Z = -3.86$, $p < 0.001$). Thus, the implemented learning program had a positive influence on the gross motor development and independence of children with speech impairments.

Jumbo Snakes and Ladders Board Game

Figure 2. Jumbo snakes and ladders board game

Figure 3. Jumbo dice

This board game was made in a jumbo size with an ethnoscience-based design, lifting the typical cultural values of Yogyakarta. On the edge sections of the board game, there are batik motifs, while every box inside the board is decorated with images that represent Yogyakarta cultural identity, such as puppets, temples, traditional musical instruments, the Yogyakarta Monument, and pedal rickshaws. In addition, challenge boxes are marked with a bomb picture, while question boxes are given a question mark symbol (?) to make it easier for players to recognize the types of activities that must be done. The dice used are also jumbo-sized and designed with a batik-patterned background, so that the overall appearance of the game reflects a combination of educational, recreational, and local Yogyakarta wisdom.

Independence

Table 1. Wilcoxon independence results

	Posttest - Pretest
Z	-3.438 [b]
Asymp. sig. (2-tailed)	.001

Based on the results of the analysis using the Wilcoxon Signed-Rank Test, a Z value of -3.438 was obtained with a significance value of Asymp. Sig. (2-tailed) = 0.001. Because the significance value is smaller than 0.05 ($p < 0.05$), it can be concluded that there is a significant difference between the pretest and posttest results of the independence of children with speech impairments after following learning using the ethnoscience-based jumbo snakes and ladders board game media. These results show that the developed learning media has a real influence on improving children's independence. This result is consistent with the findings of Aiyuda (2018), which show that improvements in daily activities and social participation of children with special needs can trigger higher independence.

Gross Motor Skills

Table 2. Wilcoxon results

	Posttest - Pretest
Z	-3.436 [b]
Asymp. sig. (2-tailed)	.001

Based on the results of the Wilcoxon Signed-Rank statistical test shown in the table, a Z value of -3.436 was obtained with a significance value (Asymp. Sig. (2-tailed)) of 0.001. Because the significance value is smaller than 0.05 ($p < 0.05$), it can be concluded that there is a significant difference between the pretest and posttest results of the gross motor skills of deaf children. This means that the use of the ethnoscience-based jumbo snakes and ladders board game media gives a significant influence on the improvement of the gross motor skills of children with speech impairments.

Motor development is an important aspect of child development involving various types of movement activities. Motor development is the development of physical movement control through the activities of the central nervous system, peripheral nerves, and coordinated muscles (Mulyani, 2018). Thus, it can be concluded that motor movements are movements controlled by the brain and supported by body organ functions such as large muscles (gross motor skills) or small muscles (fine motor skills). Games are one of the helpful alternatives to improve motor skills in children because they involve fun movement tasks.

This improvement can be explained through physical activities that appear during the game. In the jumbo snakes and ladders game, children perform movements such as jumping, walking, or stepping on each game box in accordance with the numbers obtained from throwing the dice. These activities train coordination between large muscles, body balance, and spatial orientation. In addition, the large size of the media encourages children to move more actively and interact with peers, which helps stimulate their gross motor development.

The ethnoscience-based game design with Yogyakarta cultural nuances such as batik motifs on the board, wayang illustrations, temples, and pedal rickshaws also adds contextual and emotional value. Children become more enthusiastic in participating in activities because they feel closer to familiar local cultural elements. This emotional involvement strengthens children's motivation to move actively and complete the existing challenges in the game.

Science process skills must be implemented in the science learning process, so that students can have science process skills which will make it easier to participate in learning (Zelviana et al., 2023).

Conclusion

This study produced jumbo snakes and ladders board game learning media based on Yogyakarta ethnoscience and culture. It was proven effective in increasing the gross motor skills and independence of children with speech impairments at SMP SLB Negeri 1 Bantul. The development was carried out using the ADDIE model from the analysis stage to the evaluation stage. The results of the Wilcoxon Signed-Rank Test were $Z = -3.436$; $p = 0.001$ (< 0.05), which indicates that the use of the media shows significant improvement. In addition to increasing learning activeness and independence, physical activities in the game and student participation in answering science questions about animals, shape changes, Earth rotation, and the solar system also increase learning independence. This media effectively supports inclusive learning for children with speech impairments because ethnoscience and local Yogyakarta cultural elements such as batik motifs, wayang, and pedal rickshaws make learning more contextual and enjoyable.

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Author Contributions
A.A.S. contributes in determine research ideas, search and determine partners, preparing needs analysis instruments students, conducting analysis of the results based on needs analysis instrument students, designing learning media, and preparing data collection instruments (rubrics) For measuring gross motor skills and independence); Y.M.J. contribute in do revision product based on the validator 's suggestions, conducting trials at SLBN 1 Bantul, and conducting revision product based on trial results; C.E.M.H. contributed in processing data, compiling results and discussion, drawing up conclusions. All writer has read and agree version the script that has been published.

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Writer state no there is conflict interest in publication this.

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