



Development of an Ethnomathematics-Based Snakes and Ladders Game Media Integrating Banten Cultural Context for Teaching Number Operations in Elementary School

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Abstract: This study aims to develop Snakes and Ladders game media for the concept of number operations by integrating the cultural context of Banten. This research employs a development method using the ADDIE model—analysis, design, development, implementation, and evaluation. The study uses a purposive sampling technique involving 20 sixth-grade students at an elementary school in Serang, Banten, selected based on considerations such as school facilities and curriculum implementation. Data were collected through number-operation tests and student reflection journals. The data were analyzed qualitatively using thematic analysis to identify themes emerging from patterns of meaning. The results show that the ethnomathematics-based Snakes and Ladders game media can enhance students' self-efficacy and subsequently improve their understanding of number operation concepts. Furthermore, students reported increased motivation and enthusiasm during the learning process due to the engaging and enjoyable nature of the media. This study contributes to mathematics education by offering a more meaningful and enjoyable learning experience, while also reducing students' anxiety toward mathematics. The findings further indicate that integrating cultural elements from Banten into mathematics learning can improve students' learning outcomes.

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Introduction

Mathematics is essential to teach to students at all levels of education; in fact, mathematics is a universal subject taught in schools around the world (Witherspoon & Causey, 2024). Mathematics is crucial in various aspects of life and industry (Masjudin et al., 2024), promoting a variety of student skills and thinking abilities (Unlu et al., 2017), including fostering 21st-century skills (Whitney-Smith et al., 2022; Szabo et al., 2020). According to Andrei (2024), mathematics is very important for developing students' logical thinking and creativity.

Mathematics has become a subject that poses significant challenges for students (Tambychika et al., 2010) and is considered difficult to understand (Laurens et al., 2018). Mathematics teaching is primarily oriented towards mastering lower-level cognitive processes, only requiring students to work individually and in silence. It does not stimulate them to develop a deeper understanding of mathematical concepts (Silver et al., 2009).



Students' difficulties are also caused by mathematics being taught using abstract and formal concepts. In fact, mathematical knowledge enables students to gain a greater understanding of the abstract world and solve problems relevant to their daily lives (Devlin, 2018; Gainsburg, 2008). This means that mathematics needs to be taught contextually, linking abstract mathematical concepts with concepts in everyday life.

According to Magas (2025), to help reduce students' concerning performance in Mathematics, teachers need to design various methods and strategies to overcome the challenges students face in dealing with mathematics. Learning designs that support student learning activities allow students to engage in the learning process. According to Pokhrel (2018), activity-based mathematics learning can develop various skills such as collaboration, leadership, communication, presentation abilities, and creativity. This means that learning mathematics through engaging activities promotes both mastery of the subject and comprehensive student development.

One of the most important mathematics subjects for elementary school children is numbers. Numbers are a fundamental basis of basic mathematics education, requiring systematic development from basic concepts to more complex mathematical understanding. According to Gronmo (2018), numbers and algebra are an essential part of mathematics. The importance of numbers is not merely a matter of calculation. Instead, numbers have a deeper aspect, namely, mathematical imagination and beauty (Merkley & Ansari, 2016). According to Verschaffel et al. (2007), numbers become an important subject to learn because they are related to students' real-life experiences, serve as a foundation for understanding other subjects, and are among the first topics taught in formal schooling. In the curriculum, this usually includes number topics ranging from natural numbers to integers and fractions. This requires a careful pedagogical approach because it involves abstract concepts (Febrianti & Purwaningrum, 2021). Effective development of number understanding can be achieved through mathematical tasks connected to students' surrounding experiences (contextual), emphasising aspects that are important in the elementary school mathematics curriculum (Rahmawati et al., 2023).

At the elementary school age, children are at the stage of concrete operational thinking. They can think rationally and systematically, but are still bound to things they can see, touch, or physically experience in the real world. This means that the use of concrete media will make it easier for students to understand various concepts in mathematics. According to Widodo & Wahyudin (2018), learning media can help students form an understanding of abstract mathematical concepts. The use of learning media can make it easier for teachers to teach concepts to students. Learning media must be able to attract students' attention so that they become more motivated and active in the learning process. Learning media can help students understand abstract concepts, thereby improving their learning outcomes (Maharani & Dewi, 2015). In fact, integer number operations are still considered difficult for students, including reading, understanding, transformation, process skills, and concluding (Zainudin et al., 2022). Therefore, this needs to be addressed appropriately. Using board game media, such as Snakes and Ladders, is engaging for students because they can learn while playing. Games can help improve appropriate behavior in the classroom (Jamshid et al., 2016), thereby impacting the learning process.

One of the learning media that can be used must be appropriate to the real context, including being close to the students. The use of culture in mathematics learning becomes an important part to enhance students' understanding. Ethnomathematics is the study of how certain cultural groups understand, express, and use mathematical concepts in the context of their lives. According to Greer & Mukhopadhyay (2015), ethnomathematics was initially



defined by D'Ambrosio as the mathematics used by a specific cultural group. This concept rejects the assumption that mathematics is culturally neutral and questions the Eurocentric (Europe-centred) perspective on how mathematics develops. This approach acknowledges that mathematics is not a static and universal science, but can be found in various forms and applications within local cultures Simbolon (2024). Ethnomathematics is the latest pedagogical trend in education, offering a more inclusive, new, and greatly expanded definition of the mathematical-scientific contributions of a particular group. According to Rosa & Orey (2015), ethnomathematics is a pedagogical action. This means that mathematics is no longer seen as a separate discipline, but rather as a product of human culture that is alive and dynamic, which ultimately makes students more motivated, happy, and creative in learning. In the study by Wulandari et al. (2023), several important aspects of how teachers can use ethnomathematics were highlighted, including 1) using everyday life examples and local culture, 2) aligning the curriculum with local wisdom, 3) involving the community and utilizing cultural resources, 4) integrating traditional tools and methods, and 5) creating an engaging learning environment. Through ethnomathematics, students can learn mathematics contextually through various cultural activities that are already familiar in their daily lives (Rosa & Orey, 2011). In addition, ethnomathematics is considered very important for developing positive student character that represents the cultural values of the nation while also enhancing students' cognitive aspects in mathematics (Arisetyawan et al., 2014).

One culture that can be implemented is the Banten culture. Banten is known for having a vibrant and engaging culture (food, dance, arts, musical instruments, or other traditions). The cultural context of Banten is an important part that can be integrated into learning, especially in mathematics, and this will impact students' understanding of mathematical concepts. This is supported by previous research, such as Urohmah et al (2025), which shows that integrating Banten culture enhances students' understanding of mathematical concepts. Amelia et al. (2025) also explain that integrating Banten culture affects students' numeracy.

This study aims to develop a Snakes and Ladders game based on ethnomathematics for teaching number operations in elementary school. The snakes and ladders game is very familiar and often played by children; however, this game is intended to improve the understanding of mathematical concepts in number operations and introduce the cultures of Banten (food, dance, art, musical instruments, or other traditions). Some relevant studies include Fauzi et al. (2023), who researched the integration of culture in Indonesia (hopscotch game) in the didactic design of fraction concepts in elementary schools. Supriadi (2019) studied the design of Sundanese ethnomathematics didactic learning for elementary school students. These two studies confirm that the integration of culture in mathematics learning has a positive impact on students' understanding of mathematical concepts. This study focuses on the integration of Banten culture into the Snakes and Ladders game as an alternative in the creation of learning media for number operations for elementary school students. This research contributes to the development of effective learning media for teaching mathematics. It can enhance the understanding of mathematical concepts, particularly in the topic of number operations for elementary school students.

Research Method

This study uses developmental research. According to McKenney and Reeves (2012), development research is characterized by an iterative (repetitive) approach and is centered on problem-solving. Some of its features are systematic, validity, effectiveness, and practicality. The goal of developmental research is to create knowledge based on data obtained



systematically from practice (Richey & Klein, 2005). One of the methods included in development research is ADDIE. According to Aldoobie (2015), the ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation.

Some activities carried out according to the ADDIE stages are: 1) Analysis: analyzing the needs of students and teachers, identifying relevant materials, and exploring local cultural elements to be integrated, 2) Design: designing a prototype of a snakes and ladders game media (game board, dice, question cards, and game rules), 3) Development: validating the media by experts (mathematics experts, instructional media experts, and local culture experts) as well as teachers and making revisions, 4) Implementation: conducting trials in one elementary school involving 20 students and two teachers and collecting input and feedback from the students, and 5) Evaluation: measuring the effectiveness of the media on understanding mathematical concepts. This is measured by looking at student engagement in the learning process.

This study involved 20 sixth-grade students from an elementary school in Serang-Banten. The research participants were selected using purposive sampling, which requires the researcher to select the most suitable sample members based on their understanding of the population and what the research is intended to achieve in the research. The selected students are one class consisting of 20 students, considering that the class has the same facilities and curriculum system as classes in other schools. In the research process, two teachers were involved, namely one teacher responsible for teaching and one teacher responsible for assisting the children's learning process (while playing snakes and ladders).

The data collection techniques in this study are: 1) number operation tests given to students while playing, and 2) reflection journals as supporting evidence provided after students play the board game. The data analysis used in this study employed qualitative steps, namely data reduction, data presentation, and concluding (Miles et al., 2014). The findings obtained are evaluated by peers and experts in the field of mathematics. In addition, the findings serve as a basis for in-depth analysis by linking the results with relevant theories or previous research.

Result and Discussion

Result

The development of the ethnomathematics-based board game is based on a crucial need to bridge the gap between number learning material, which is often considered abstract by students, and a more contextual, engaging, and enjoyable learning environment. At the analysis stage, it begins with analysing the need for the importance of media in the process of learning mathematics. To address this need, an initiative focused on designing a modified Snakes and Ladders game. The snakes and ladders game will not only function as an educational and interactive training tool that makes number operations (addition, subtraction, multiplication, division) more engaging and contextual for students, but it will also explicitly integrate Banten culture. This cultural integration, for example, can be manifested through food, dance, arts, musical instruments, or other traditions found in Banten. At the development stage, the identified needs serve as the basis for developing the Snakes and Ladders game. The Snakes and Ladders game board and the developed game rules can be seen in Figure 2.



Figure 1. Snakes and Ladders game board and rules

Based on Figure 1, the Snakes and Ladders game board consists of 100 squares, 10 x 10. Several illustrated squares contain question or challenge cards presented to the students. These challenges relate to number problems integrated with the cultural context of Banten. Examples of the question cards can be seen in Figure 2.



Figure 2. Question Cards on Number Operations

Based on image 2, the question card is given when students land on a picture square. The rule is that if the student can solve the question, they will remain in that spot, but if they cannot solve the question, they must move back three spaces. At the development stage, the media that had been created were then validated by experts. The validation of the learning media was carried out through a comprehensive evaluation by a number of experts, consisting of content experts (mathematics), learning media experts, and local culture experts, followed by input from practising teachers. Based on feedback and assessment results, the media was then revised according to the suggestions received.

At the implementation stage, the learning media that had been developed were tested on a limited basis at one Elementary School in Serang-Banten, involving 20 students. Students show a high level of enthusiasm and enjoyment for the learning media, particularly due to its integration of game elements. In addition, students are very familiar with the snakes and ladders game format used. Nevertheless, findings indicate that some students still experience difficulties in completing the practice questions provided. These findings will serve as a basis for improvements in the next product revision stage.

At the evaluation stage, it was shown that the learning media used have successfully achieved important cognitive and affective objectives, namely fostering high motivation and enthusiasm among students, particularly in dealing with number operations that are often considered difficult. Students also greatly enjoy the learning process, which is a strong indicator of the success of the Snakes and Ladders learning media design based on ethnomathematics in the psychological aspect, creating an enjoyable learning experience and reducing math anxiety. This can be seen from the students' reflection journals, as shown in Figure 3.



Figure 3. Student Reflection Journal

Based on Figure 3, students are very enthusiastic and enjoy the learning process using the Snakes and Ladders game media. Enthusiasm is a valuable initial asset and indicates that the snakes and ladders media used has excellent potential to address common problems in mathematics education, namely student boredom and alienation from learning material. The enjoyment of playing and the challenges presented while playing also impact increased self-efficacy, and ultimately, students are able to solve various problems related to numerical operations.

Discussion

Mathematics has become a very abstract subject, while the cognitive condition of elementary school students is still at the concrete stage. According to Fauzi et al. (2021), the development of thinking in elementary school students is still at the concrete operational stage and not yet at the formal stage, so a realistic context will help students understand mathematical concepts. Learning media in the form of the snake game by integrating the cultural context of Banten is an essential part of teaching mathematics, particularly for the material on number operations. According to Kemendikbud (2016), elementary school students' knowledge needs to be built using the context of the community and the students' environment. This is one part of contextual learning. According to Yanti (2025), the concept of contextual mathematics refers to a learning approach that connects mathematics material with real-life contexts experienced by students. It aims to help students better understand mathematical concepts through experiences and situations that are relevant to their daily lives. Students can learn number operations using cultural contexts that are close to their own lives. According to Widjaja (2013), contextual problems can engage and motivate students in learning mathematics. However, this requires teachers to establish a clear connection between real-world contexts and mathematical concepts to support meaningful learning development. According to Akinoğlu & Tandoğan (2007), the relationship between real-life (contextual) experiences and learning has a positive effect on capturing students' attention in the learning process. Specifically, Lange (1996) explains that real-world contexts are very important as a starting point in learning mathematics. The process of developing mathematical concepts and ideas must begin with tangible elements, and ultimately, it is necessary to reflect solutions to real-world problems. In fact, the selection of contextual material is based on the fact that



students already have cognitive schemas from their experiences. According to Sanghvi (2020), cognitive schemas are concepts or frameworks that organize and interpret information and play a central role in assimilation and accommodation.

The real-life context presented in the Snakes and Ladders game is the Banten culture, which is close to the students' lives. This is a form of integrating culture into the math learning concept, also known as ethnomathematics. According to Umbara et al. (2021), ethnomathematics allows students to communicate mathematical ideas that they discover, which are built through social phenomena. The integration of Banten culture in math learning through the snakes and ladders game can be seen from the mathematical problems and cultural contexts presented on the question cards (challenges). According to Supriadi et al. (2019), in ethnomathematics teaching materials, there should be three essential elements: 1) mathematical problems relevant to culture, 2) cultural values, and 3) contextual problems with mathematical solutions. The use of cultural elements in math lessons has a positive impact on students' understanding. According to Nugraha (2020), an ethnomathematics approach based on Sundanese culture effectively improves students' mathematical understanding. The use of ethnomathematics in teaching mathematical concepts provides significant benefits in enhancing student engagement. By connecting mathematical concepts with local culture and traditions, students feel more connected and motivated to actively participate in the learning process (Yanti et al., 2025). According to Latief & Talib (2021), by linking mathematical concepts with cultural practices, arts, or familiar everyday local activities, students can more easily visualise and understand concepts that were previously considered abstract, and this is effective in improving the mathematical abilities and understanding of elementary school students.

This ethnomathematics-based Snakes and Ladders game provides motivation and student engagement in the learning process. This engagement is based on students' enjoyment of playing, but at the same time, they are learning about number operations. According to Juhász (2021), play and enjoyment are essential elements in education that make learning activities more meaningful. In games, students experience excitement due to a physiological and natural tendency to try new things, explore, solve problems, and have fun (Burdette & Whitaker, 2005). Learning through play has a positive impact and is highly recommended. It can be beneficial as a stimulus to create an enjoyable classroom atmosphere (Clark, 2019). According to Garry et al. (2009), the world of children is filled with activities and actions, so playing provides activities with the purpose of entering the world of children. According to Frank, children learn through play for a meaningful and valuable life; children explore various things in their own ways, test them, and learn new things (Kasmaei & Asghari, 2017). Children have extra energy, and play activities are a way for children to release that energy. Play activities are not just for fun, but there is a deeper meaning behind these activities (Burriss & Tsao, 2002). Play is seen as very important for the healthy physical, cognitive, social, and emotional development of children (Nijhof et al., 2018). Akkaya (2021) has also explained this perspective on play, stating that play is a crucial and inseparable foundation during childhood. Theorists (psychologists) and researchers have demonstrated its impact on development, including on children's cognition and brain.

In playing Snakes and Ladders, students will solve problems related to number operations, which requires them to think and solve the given problems, thereby influencing their mental operations. In cognitive theory, mental processes significantly affect the quality of understanding, decision-making, and individuals' adaptation patterns to their environment. According to Börnert-Ringleb & Wilbert (2018), teaching children how to learn and think (cognitive strategies) directly enhances their ability to perform the mental operations required



at the concrete developmental stage, ultimately making them more successful in solving various types of problems, including in mathematics. When students are challenged to solve problems, their self-efficacy increases, and this becomes the students' capital to strive in complete the given problems. According to Zimmerman (2000), students' self-efficacy serves as a highly effective predictor of motivation and learning, influencing activity choices, effort, perseverance, and emotional reactions while also mediating academic achievement. Self-efficacy affects self-regulated behaviour during learning tasks, including monitoring work time, task persistence, and hypothesis evaluation, regardless of grade level or cognitive ability (Bouffard-Bouchard et al., 1991). According to Anjum (2006), self-efficacy is a significant predictor of mathematics performance.

This research reinforces previous studies by Fauzi et al. (2021), who investigated the use of Snakes and Ladders game media in number operations. The Snakes and Ladders game media serve as a key tool for students to understand mathematical concepts (number operations) fully. The use of Banten cultural context in the game of snakes and ladders is also in accordance with the principles of RME, namely the application of meaningful context, the development of models that allow the transformation from contextual mathematics to formal mathematics, the recreation of mathematical concepts by students, interaction between students and teachers, as well as the perception of mathematics as an integrated subject (Clements & Sarama, 2013).

Conclusion

The research results show that the ethnomathematics-based Snakes and Ladders game media is proven effective in enhancing students' cognitive concept understanding and also influences students' psychological aspects by increasing self-efficacy. This increase in self-efficacy becomes an important foundation that triggers better learning outcomes in mathematics. Its engaging and enjoyable nature directly reduces the mathematical anxiety often experienced by students. Ethnomathematics-based snakes and ladders games offer practical and sustainable solutions for teachers to create inclusive, humanistic, and culturally rich mathematics learning, transforming the classroom into an enjoyable space for exploration.

Recommendation

This study has several limitations, including 1) a small sample size involving only 20 students in an elementary school class during the trial of the ethnomathematics-based Snakes and Ladders game media, 2) limited data collection techniques, and 3) the ADDIE implementation stages not being fully optimised. Future research can be conducted by considering 1) a larger and more representative sample size for concluding, 2) using adequate data collection techniques (triangulation), and 3) paying detailed attention to the ADDIE stages in the research process. In the school context, teachers can do several things: 1) integrate local culture (Ethnomathematics) into the learning process, 2) use fun mathematics learning media for students, and 3) focus on how to improve students' self-efficacy in learning mathematics.

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