



D'arisun AR: Integrating Sundanese Ethnomathematics and Augmented Reality to Enhance Elementary Students' Understanding of Number Patterns

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Abstract. Mathematics learning in elementary schools often faces challenges related to low conceptual understanding, limited critical thinking skills, and the lack of innovative digital media integrated with local culture. This preliminary study aims to analyze the need for developing D'arisun AR (Deret Aritmatika dan Sunda), an Augmented Reality-based learning media grounded in Sundanese ethnomathematics to support third-grade students' understanding of arithmetic sequences. A descriptive mixed-method design was employed. Data were collected from three public elementary schools in Tapos District, Depok City, through documentation of mathematics assessment scores ($N = 90$ students) and semi-structured interviews with three teachers and nine students. The findings showed that the average mathematics scores were 70, 66, and 68, all below the Minimum Mastery Criterion (75). Interviews revealed that students experienced difficulties in identifying numerical patterns and solving contextual mathematical problems. Teachers rarely used interactive technology-based media, and local cultural elements had not been integrated into mathematics instruction. Meanwhile, students showed strong interest in mobile learning applications and culturally contextual learning activities. The findings indicate the need for an ethnomathematics-based Augmented Reality learning media that can visualize arithmetic sequence patterns through Sundanese cultural representations, such as Mega Mendung batik motifs and traditional games. Therefore, this study recommends the development of D'arisun AR using the 4-D development model to support meaningful, contextual, and culturally responsive mathematics learning.

Keywords: Arithmetic Sequences; Augmented Reality; Elementary Mathematics Learning; Ethnomathematics; Sundanese Culture.

1. INTRODUCTION

Mathematics plays an important role in developing logical, analytical, and systematic thinking skills from an early age (Fidayanti et al., 2020). In elementary education, one of the fundamental mathematical concepts introduced to students is arithmetic sequences and number patterns. Understanding numerical patterns helps students develop reasoning skills, recognize relationships between numbers, and solve contextual mathematical problems (Ginting, 2026). However, for third-grade elementary students, arithmetic sequences are often considered abstract because students are required to identify regularities and predict patterns that cannot always be directly observed. At this stage, children aged 8–9 years are in Piaget's concrete operational stage, meaning that they learn more effectively through visual, interactive, and contextual experiences connected to their daily lives (Amanda et al., 2025). Therefore, mathematics learning should be designed to bridge abstract concepts with concrete representations.

In practice, mathematics learning in elementary schools still faces several challenges. Many students perceive mathematics as difficult, monotonous, and unrelated to their real-life experiences, resulting in low conceptual understanding and limited engagement during learning activities (Widodo et al., 2023). Similar conditions were identified in several public elementary schools in Tapos District, Depok City. A preliminary study conducted at SDN Sukatani 1, SDN Sukatani 2, and SDN Sukatani 5 revealed that the average mid-semester mathematics scores remained below the Minimum Mastery Criterion (KKM) of 75. Interviews with teachers indicated that students experienced difficulties in identifying numerical patterns and solving contextual mathematical problems. Teachers also reported limited use of interactive technology-based learning media, while mathematics instruction was still dominated by textbooks and whiteboard explanations.

The difficulties experienced by students indicate the need for learning media capable of visualizing mathematical patterns more concretely and interactively. One technology with strong potential in mathematics education is Augmented Reality (AR). AR technology enables virtual objects and animations to be integrated into real-world environments, allowing students to observe mathematical concepts dynamically and visually (Arifin, 2020). In the context of arithmetic sequence learning, AR can help students understand pattern progression, number relationships, and sequence regularities through interactive visualization. The use of AR is also considered relevant to the characteristics of elementary students who tend to be more motivated by digital and game-based learning experiences.

In addition to technology integration, contextualizing mathematics learning through local culture is also important. Ethnomathematics emphasizes the relationship between mathematics and cultural practices existing within society (Siregar, 2024). Sundanese culture contains various forms of numerical and visual patterns that can be connected to arithmetic sequence concepts, such as repetitive motifs in *Mega Mendung* batik patterns and counting patterns found in traditional games like *congklak*. Integrating these cultural elements into mathematics learning not only supports conceptual understanding but also encourages students to appreciate and preserve local cultural values (Hasanah et al., 2022).

Previous studies have shown that ethnomathematics-based digital learning can improve students' engagement and conceptual understanding. Ismail et al. (2025) found that interactive digital modules integrated with batik motifs significantly improved students' understanding of geometry concepts. Similarly, Tiara (2024) reported that ethnomathematics-based mobile learning contributed positively to students' mathematical understanding. However, studies integrating Augmented Reality and Sundanese ethnomathematics specifically for arithmetic

sequence learning in elementary schools remain limited. Most previous research focused on geometry topics or general mathematics learning without emphasizing pattern visualization and local cultural integration simultaneously.

Therefore, this preliminary study aims to analyze the need for developing *D'arisun AR (Deret Aritmatika dan Sunda)*, an Augmented Reality-based learning media grounded in Sundanese ethnomathematics to support third-grade elementary students' understanding of arithmetic sequences. Specifically, this study seeks to identify: (1) the current condition of students' mathematics learning outcomes related to arithmetic sequence concepts in Tapos District, Depok City, and (2) teachers' and students' perceptions and needs regarding interactive, culturally contextualized, and technology-based mathematics learning media.

2. METHODOLOGY

This study employed a preliminary research design focusing on needs analysis to identify problems and learning needs related to arithmetic sequence learning in elementary schools. A descriptive mixed-method approach was used to obtain both quantitative and qualitative data (Creswell & Creswell, 2018). The study was conducted in three public elementary schools in Tapos District, Depok City, namely SDN Sukatani 1, SDN Sukatani 2, and SDN Sukatani 5.

The quantitative data were collected through documentation of students' mid-semester mathematics assessment scores for the even semester of the 2025/2026 academic year. The participants consisted of all third-grade students from the three schools, totaling 90 students, with 30 students from each school. The collected scores were analyzed descriptively by comparing the average results from each school with the Minimum Mastery Criterion (*Kriteria Ketuntasan Minimal / KKM*) set at 75.

To support the quantitative findings, qualitative data were gathered through semi-structured interviews with three third-grade homeroom teachers and nine students. Each school contributed one teacher and three students as interview participants. The interviews aimed to explore students' difficulties in understanding arithmetic sequences and numerical patterns, the types of learning media commonly used during mathematics lessons, the integration of local cultural elements in classroom learning, and teachers' and students' responses toward the proposed use of Augmented Reality-based ethnomathematics learning media.

The qualitative data were analyzed using the interactive analysis model proposed by Miles et al. (2014), which includes data reduction, data display, and conclusion drawing. Meanwhile, the quantitative and qualitative findings were interpreted together to identify the main learning needs and challenges faced by students and teachers. Before the data collection process was conducted, permission was obtained from the schools, and all participants were informed about the purpose of the study. Consent from teachers and parents of participating students was also obtained to ensure ethical research procedures.

3. RESULT AND DISCUSSION

Quantitative Findings: Mathematics Learning Outcomes

Table 1 presents the average mid-semester mathematics scores of third-grade students from the three participating schools.

Table 1. Average Mid-Semester Mathematics Scores (Even Semester 2025/2026)

School	Average Score	Minimum Mastery Criterion (KKM)
SDN Sukatani 1	70	75
SDN Sukatani 2	66	75
SDN Sukatani 5	68	75

Source: Mathematics teacher documentation

Based on Table 1, the average mathematics scores in all three schools were still below the Minimum Mastery Criterion (KKM) of 75. SDN Sukatani 1 obtained the highest average score (70), while SDN Sukatani 2 showed the lowest result (66). These findings indicate that students' understanding of mathematical concepts, particularly numerical patterns and arithmetic sequences, remains relatively low.

Based on the documentation analysis and teacher explanations, many students experienced difficulties in identifying number regularities, continuing numerical patterns, and solving contextual problems related to arithmetic sequences. Most students tended to focus only on performing calculations without fully understanding the relationships between numbers within a sequence. This condition supports the findings of Amaliyah et al. (2023), who stated that limited conceptual understanding in elementary mathematics can affect students' ability to solve more complex mathematical problems.

Qualitative Findings: Teachers' and Students' Perspectives

The interview results revealed several challenges in mathematics learning. Teachers explained that students often struggled to recognize numerical patterns and interpret contextual mathematical questions. One teacher stated: "When students are asked to continue a number

pattern, many of them only guess the answer without understanding why the numbers change in a certain way.”

Teachers also reported that classroom instruction still relied heavily on textbooks, lectures, and whiteboard explanations. Interactive learning media, especially technology-based media, were rarely used during mathematics lessons. In addition, local cultural elements had not been integrated into mathematics instruction, even though students were familiar with Sundanese cultural objects and activities in their daily lives.

Interviews with students showed that most of them considered mathematics difficult because they had trouble understanding patterns and abstract concepts. Several students expressed greater interest in visual and game-based learning activities accessed through mobile phones. One student mentioned: “I like learning with games or animated pictures because it makes math easier to understand.” These findings are in line with Ranisa et al. (2024), who found that interactive multimedia and digital learning platforms can increase students’ engagement and motivation during the learning process.

Needs Analysis for D’arisun AR

The findings from both quantitative and qualitative data indicate the need for interactive mathematics learning media that are visually engaging, culturally contextualized, and accessible to elementary students. Several learning needs identified in this study include: 1) An Android-based learning application that can be used flexibly both inside and outside the classroom. 2) Learning content focused on arithmetic sequences, number patterns, and contextual problem-solving activities. 3) Integration of Sundanese ethnomathematics elements, such as *Mega Mendung* batik motifs and traditional games like *congklak*, to represent numerical patterns and sequence concepts. 4) Augmented Reality (AR) features that allow students to visualize arithmetic sequence patterns more concretely and interactively. 5) Immediate feedback and guided explanations to help students understand pattern relationships and improve their reasoning skills progressively.

Based on these findings, the development of *D’arisun AR* is considered relevant to the learning needs of third-grade elementary students. This study adopts the 4-D development model proposed by Thiagarajan et al. (1974), consisting of Define, Design, Develop, and Disseminate stages. The current study represents the Define stage, focusing on identifying learning problems, classroom conditions, and media needs before proceeding to the product design and development stages.

Discussion

The results of this study highlight the importance of connecting mathematics learning with students' real-life experiences and cultural backgrounds. Arithmetic sequences are often perceived as abstract concepts by elementary students because numerical relationships cannot always be observed directly. Therefore, visual and interactive learning experiences are needed to help students understand pattern progression more concretely.

The integration of Augmented Reality technology into mathematics learning has the potential to support this process by presenting dynamic visualizations of arithmetic sequences. Through AR features, students can interact with number patterns in a more engaging way, which is appropriate for learners in the concrete operational stage. At the same time, integrating Sundanese cultural elements into learning activities can make mathematics feel more familiar and meaningful for students.

This study also shows that ethnomathematics-based learning can support cultural preservation while improving learning engagement. Cultural representations such as repetitive batik motifs and traditional game patterns provide contextual examples that help students connect mathematical ideas with their everyday environment (Hasanah et al., 2022). However, this preliminary study was limited to three schools within one district, so the findings may not fully represent the conditions of elementary schools in other regions. Further studies involving broader participants and product implementation stages are needed to evaluate the effectiveness of *D'arisun AR* in classroom practice.

4. CONCLUSION AND RECOMMENDATION

Based on the preliminary study conducted at three public elementary schools in Tapos District, Depok City, several conclusions can be drawn:

The average mathematics learning outcomes of third-grade students were still below the Minimum Mastery Criterion (KKM), indicating that students experienced difficulties in understanding arithmetic sequences, identifying numerical patterns, and solving contextual mathematical problems.

Mathematics learning in the observed schools was still dominated by conventional teaching methods, with limited use of interactive technology-based learning media. In addition, the integration of Sundanese cultural elements into mathematics instruction had not been implemented optimally.

Both teachers and students showed positive responses toward the proposed development of an interactive mathematics learning media integrating Augmented Reality and Sundanese ethnomathematics. Students were particularly interested in visual and game-based learning experiences that could make mathematical concepts easier to understand.

The findings indicate the need to develop *D'arisun AR* as an Augmented Reality-based learning media designed to support elementary students' understanding of arithmetic sequences through contextual and culturally relevant learning experiences.

This study contributes to the development of ethnomathematics-based digital learning by emphasizing the integration of Sundanese cultural representations, such as batik motifs and traditional games, into arithmetic sequence learning. The findings also provide an initial foundation for continuing the Design, Develop, and Disseminate stages of the 4-D development model in future research.

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NOVELTY

This study offers a novel contribution by identifying the need for an Augmented Reality-based ethnomathematics learning media specifically designed for arithmetic sequence learning at the elementary school level. Unlike previous studies that mainly focused on geometry or general digital mathematics learning, this study integrates Sundanese cultural elements and interactive AR visualization to support students' understanding of numerical patterns and arithmetic sequences. The findings provide a contextual foundation for developing culturally responsive mathematics learning media that can be adapted to different local cultural settings.

REFERENCES

- Amaliyah, N., Rahmawati, F., & Suryadi, D. (2023). Rendahnya pemahaman konsep operasi hitung dasar dan implikasinya terhadap hasil belajar matematika. *Jurnal Ilmiah Pendidikan Dasar*, 10(2), 45-58.
- Amanda, L., et al. (2025). Pembelajaran matematika sebagai interaksi edukatif sistematis. *Jurnal Pendidikan dan Kebudayaan*, 15(1), 23-35.

- Arifin, A. M. (2020). Pengembangan media pembelajaran STEM dengan augmented reality untuk meningkatkan kemampuan spasial matematis siswa. *Jurnal Riset Pendidikan Matematika*, 7(1), 59-73.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
- Fidayanti, M., et al. (2020). Peran fundamental matematika dalam membentuk kemampuan berpikir logis siswa SD. *Jurnal Pendidikan Dasar*, 11(1), 55-67.
- Ginting, I. F. (2026). Upaya Meningkatkan Kemampuan Siswa dalam Membedakan Barisan Aritmetika dan Geometri Melalui Penguatan Konsep Dasar dan Latihan Soal Relevan. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, 11(04), 1-8.
- Hasanah, S., et al. (2022). Etnomatematika sebagai jembatan antara peserta didik dan kebudayaan. *Jurnal Etnopedagogi*, 5(2), 90-104.
- Ismail, M., et al. (2025). Pengembangan modul digital interaktif bermotif batik untuk meningkatkan pemahaman konsep luas bangun datar. *Jurnal Pendidikan Matematika Indonesia*, 14(1), 45-59.
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications.
- Parjono, T. (2022). Pengembangan model pembelajaran berbasis masalah menggunakan metode 4-D Thiagarajan. *Jurnal Riset Pendidikan*, 9(1), 1-15.
- Purwanti, S., Suryanti, T., & Mariana, N. (2024). Modifikasi model 4-D menjadi 3-D untuk pengembangan modul ajar terpadu. *Jurnal Pendidikan Dasar*, 13(1), 1-15.
- Ranisa, S., Sintia, R., Andhika, W., & Wahyudi, T. (2024). Penggunaan teknologi multimedia dalam meningkatkan keterlibatan peserta didik. *Jurnal Teknologi Informasi Pendidikan*, 9(1), 45-58.
- Siregar, A. R. (2024). Etnomatematika sebagai sarana penguatan budaya lokal melalui kurikulum merdeka belajar. *Prosiding Mahasaraswati Seminar Nasional Pendidikan Matematika*, 3(1), 44-57.
- Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teachers of exceptional children*. Indiana University.
- Tiara, L. (2024). Mobile learning berbasis etnomatematika untuk meningkatkan kemampuan pemahaman matematis. *Jurnal Pendidikan Matematika Digital*, 5(2), 112-128.
- Widodo, S., et al. (2023). Anggapan negatif terhadap matematika dan dampaknya terhadap pemahaman konsep dasar. *Jurnal Psikologi Pendidikan*, 11(2), 78-92.