

Analysis of the Needs of Geometry Student Worksheets Based on Augmented Reality Integrated with Ethnomathematics in Elementary Schools

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Article	Abstract
<p>Keywords: <i>Student worksheet;</i> <i>Geometry learning;</i> <i>Augmented reality;</i> <i>Ethnomathematics; Needs analysis; Elementary school.</i></p> <p>Article History Received: Nov 12, 2025 Reviewed: Des 11, 2025 Accepted: Jan 11, 2026 Published: Feb 03, 2026</p>	<p><i>This study aims to analyze the learning needs for developing student worksheets integrated with local cultural context to support geometry learning in Grade V elementary school. The research employed a qualitative descriptive approach as part of the needs analysis stage in a research and development framework. The study was conducted at UPT SD Inpres Kampus IKIP, involving one Grade V teacher as the key informant and fifteen Grade V students as respondents. Data were collected through classroom observation, structured interviews, and student questionnaires. Data analysis was carried out using qualitative techniques including data reduction, data display, and conclusion verification, supported by descriptive percentage analysis of questionnaire results. The findings revealed that students experienced high difficulties in visualizing three-dimensional objects independently (82%) and perceived the current learning media as less engaging (75%). Students also showed very high interest in learning through digital technology (95%) and high interest in integrating geometry learning with local cultural contexts (88%). These results indicate an urgent need for innovative, interactive, and contextual learning materials to enhance students' spatial understanding and engagement in geometry learning.</i></p>



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INTRODUCTION

Education plays a crucial role in producing human resources that are adaptive to the advancement of science and technology. Mathematics at the elementary school level occupies a fundamental position to train students' logical, analytical, and systematic reasoning. Mastery of mathematics is not limited to memorizing numbers or formulas, but building a structured frame of mind to solve various problems in real life (Dewi et al., 2022). The measurement of learning outcomes is the main indicator to test the level of students' understanding of the material that has been delivered in class. The reality on the ground indicates that the achievement of these goals still faces serious challenges, especially when students are faced with material that demands a high level of spatial imagination.

Geometry demands strong visual and spatial skills due to the abstract nature of the object. Students at the elementary school level, especially grade V, often experience cognitive barriers in connecting the representation of a two-dimensional flat building with the shape of a three-dimensional room in real situations (Alinda et al., 2025). This difficulty arises because geometry materials require spatial thinking skills that are not yet fully developed, so they are often considered difficult and scary materials for students (Nasir et al., 2025). This complexity leads to a low understanding of basic concepts, so they often find it difficult to identify the properties of spatial construction, measure volume, and solve spatial problems.

These problems are increasing due to the dominance of conventional approaches and the lack of use of interactive learning media in the classroom. The knowledge transfer process often relies only on printed textbooks and monotonous lecture methods, thus failing to stimulate the active involvement of today's generation of digital learners (Harini et al., 2026). The use of creative learning media is actually very necessary to make abstract material more real and easy to understand (Pertiwi & Gunawan, 2025). Learning that does not facilitate direct visual experiences makes students passive, bored quickly, and have difficulty building their own knowledge independently. Dynamic teaching device innovation is absolutely necessary to dismantle the freezing of the teaching and learning process.

Utilization of technology *Augmented Reality* (AR) comes as an innovative breakthrough for visualizing abstract geometric objects into three-dimensional simulations that can be observed interactively. The integration of AR technology with ethnomathematical approaches provides significant added value, because the concept of mathematics is packaged using a meaningful local cultural context for students. Associating mathematical concepts with elements of local culture has been proven to be able to provide relevant context so that it is easier for students to remember the material (Pertiwi & Gunawan, 2025). The combination of the sophistication of AR visual representation and the cultural proximity of ethnomathematics is able to improve spatial visualization skills, deepen conceptual understanding, and foster appreciation for cultural heritage (Ms et al., 2025).

Previous research has shown that the use of AR technology in geometry learning has a positive impact on students' understanding of concepts and learning activities. (Khasanah & Prastiwi, 2024) proving that the development of Augmented Reality-based interactive learning media that integrates ethnomathematics in elementary school building materials is declared valid and effective, and is able to increase students' motivation and understanding of the nature of building spaces. The results of the study confirm that the visualization of three-dimensional objects through AR can help students understand abstract concepts more concretely, while strengthening the relationship between learning and local culture so that learning becomes more meaningful for students. The findings show that the integration of AR and ethnomathematics has the potential to be an innovative solution to overcome students' difficulties in understanding geometry, especially spatial building materials.

The urgent need for relevant teaching materials encouraged the conduct of this research. This study aims to analyze the needs for the development of teaching materials in the form of Augmented Reality (AR)-based Student Worksheets (LKPD) that are integrated with ethnomathematics in elementary school geometry materials in grade V. Through an in-depth identification of constraints in the field and the learning preferences of students and teachers, this research is projected to provide a strong empirical foundation for the development of innovative learning tools. This study is expected to be able to make a real contribution to the literature on basic education innovation in the 21st century.

Based on the geometry learning problems found in the field and supported by the results of previous research, the hypothesis in this study is that the development of Augmented Reality (AR)-based LKPD that integrates ethnomathematics in elementary school geometry materials in grade V is needed by teachers and students and is suspected to be able to improve the understanding of the concept of building space, spatial visualization skills, and students' learning interest.

METHOD

This research applies a qualitative descriptive approach which is an integral part of the *need analysis* stage within the framework of research and development *or Research and Development* (R&D). The scope of this research focuses on mapping geometry learning problems and identifying the specifics of teaching materials needed to bridge students' spatial limitations. The main focus of the research is directed at the potential of integrating *Augmented Reality* (AR) technology and ethnomathematical approaches as innovative solutions in learning devices in elementary schools.

In this study, the focus of needs analysis is directed to several main aspects, namely students' needs for visual-interactive learning media in building materials, teachers' needs for teaching materials that are able to increase student involvement, and school needs for the use of learning technology that is relevant to the development of the 21st century. Augmented Reality (AR) is defined as a technology that projects three-dimensional virtual objects into the real world through digital devices such as smartphones, allowing students to observe the construction of spaces in a more concrete way. Meanwhile, ethnomathematics is interpreted as a mathematics learning approach that relates the concept of geometry to the local cultural context, so that learning is more meaningful and close to students' lives. Need indicators in this study include the level of difficulty students in understanding geometry material, students' interest in technology-based learning, students' responses to the use of teaching aids, and teachers' obstacles in the application of learning media in the classroom.

The research activity was carried out at SD UPT SD Inpres IKIP Campus, by involving class V teachers as key informants and all class V students as research subjects. The population in this study is all students of class V of elementary school, upt elementary school, inpres of the IKIP campus. The research sample involved as many as 15 students in class V who filled out a needs analysis questionnaire, as well as 1 teacher in class V as the main informant in the in-depth

interview. The selection of teachers as informants is based on the consideration that teachers have a central role in the learning process and directly understand the obstacles experienced by students in learning geometry.

The main materials and tools used in this research include digital questionnaire instruments, structured interview guidelines, and class activity observation sheets. The data collection technique is carried out through triangulation techniques, which combine data from direct observation to review the availability of media, in-depth interviews to explore teachers' pedagogical constraints, and the distribution of questionnaires to students to measure interest and learning difficulties objectively.

Qualitative data analysis techniques are carried out through the stages of data reduction, data presentation, and conclusion verification to produce an accurate picture of needs. In addition, the data obtained from the student questionnaire was processed using percentage descriptive analysis techniques to provide a strong quantitative foundation regarding the urgency of product development. The results of this stage will be the main basis in formulating the conceptual design of culturally integrated AR-based LKPD teaching materials that are relevant to the characteristics and real needs in the field.

RESULTS AND DISCUSSION

Results

Field findings at UPT SD Inpres IKIP Campus through in-depth interviews with grade V teachers reveal the reality that students' understanding of geometry concepts is still very limited to memorizing formulas. Guru explained that the reliance on static printing media and conventional props such as cardboard nets has not been able to provide a complete visual picture, especially in the parts of the building space that are not directly visible. This condition is exacerbated by the boredom of students who tend to be passive when learning takes place without interactive media.

Questionnaire data collected from student respondents reinforces the urgency of the need to update teaching materials through digital technology. Table 1 summarizes the distribution of students' answers related to the analysis of learning tool needs.

Table 3.1 Percentage of Student Needs Analysis

Yes	Needs Analysis Indicators	Percentage	Categories
1.	Obstacles in visualizing the construction of space independently	82%	Height
2.	Learning media is currently felt to be less attractive	75%	Height
3.	Desire to learn using HP/Augmented Reality technology	95%	Very High
4.	Interest if the material is related to the local cultural context	88%	Height

Source: Results of the Survey of the Needs of Students in Class V of Elementary School UPT Elementary School Presidential Instruction IKIP Campus, 2026.

Percentage category description: 0–25% = Low,
 26–50% = Medium
 51–75% = High
 6–100% = Very High

The number of 82% in the first indicator is a strong indicator of problems in the spatial imagination of grade V students. The majority of students (95%) show very high expectations for the use of *Augmented Reality* (AR) technology as a new and more fun means of learning. The distribution of the data is visually presented in the following Figure 1 to show the contrast between the constraints and expectations of the students.

Based on these results, it can be concluded that the need for innovative learning media that is visual and interactive is relatively high. This shows that the development of *Augmented Reality* (AR)-based LKPD that is integrated with the local cultural context is relevant as a solution to help students understand the concept of building a space in a more concrete and meaningful way.

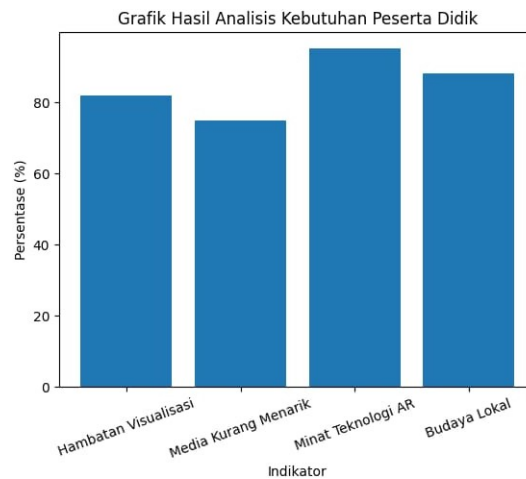


Figure 1. Graph of the Results of Student Needs Analysis

The data visualization in Figure 1 confirms that there is a great opportunity to adopt technology-based learning media in the classroom. The students' answer patterns lead to the need for teaching materials that are not only visually sophisticated, but also have emotional closeness through an ethnomathematical approach (88%).

Discussion

Cognitive barriers experienced by grade V students in representing three-dimensional objects indicates the existence of limitations use of media that is not able to facilitate their visual needs. As explained in the introduction, geometric materials demand strong visual and spatial skills due to the abstract nature of objects (Alinda et al., 2025). The finding that 82% of students experience visualization barriers proves that students' spatial thinking skills have not been optimally accommodated by static printed textbooks.

The implementation of *Augmented Reality* (AR) technology in LKPD is a very relevant solution for transforming abstract instructions into three-dimensional simulations that can be observed interactively. This dynamic visualization allows students to explore every corner of the building space in real time, thus potentially minimizing the cognitive load in understanding the concept of volume and surface area (Nasir et al., 2025). The use of AR also has the potential to answer the problem of student boredom (75%) by creating a learning experience that resembles a game, which has been proven to increase the active involvement of today's digital learners. The principle of constructivism that emphasizes the development of knowledge independently is strengthened through the integration of ethnomathematics in the design of the LKPD. In accordance with the theory of Dewi et al. (2022), the learning process will be much more meaningful if it is associated with cultural experiences that are familiar to the student's daily environment. The ethnomathematical needs data of 88% showed that students need local contexts, such as the use of architecture or cultural objects around Makassar, as a bridge to understand formal geometric formulas. The synergy between the visual sophistication of AR and the cultural proximity of ethnomathematics is a fundamental foundation for developing valid and effective teaching materials in dismantling the freezing of the learning process in elementary schools.

CONCLUSION

The needs analysis carried out at the UPT SD Inpres IKIP Campus emphasized that the geometry learning process in class V requires fundamental updating of teaching instruments. The high number of student visualization obstacles that reached 82% shows that conventional print media has not been able to facilitate the cognitive needs of students in understanding abstract objects of building spaces. The characteristics of digital students who have a very high interest in technology (95%) are the main potential for the development of more innovative and interactive media. Therefore, the development of Augmented Reality (AR)-based Student Worksheets (LKPD) that is integrated with ethnomathematics is considered relevant as a strategic solution to bridge these obstacles. In addition, the high need

of students for learning based on the local cultural context (88%) indicates that ethnomathematical integration can strengthen the meaningful learning of geometry. Thus, the synergy between three-dimensional visualization through AR and local cultural approaches is an important need to support more contextual and meaningful mathematics learning.

Suggestions

Teachers are expected to start exploring the use of digital devices in mathematics learning to reduce abstraction of geometry materials which have been the main obstacles for students. The adaptation of *Augmented Reality technology* needs to be prepared through strengthening digital literacy so that the transition from print to interactive media can run effectively. Schools need to provide support in the form of supporting facilities and ongoing training for educators in developing teaching materials based on local wisdom. The researcher is further advised to realize the conceptual design of this ethnomath-integrated AR-based LKPD into the form of physical and digital products that are ready to be tested. The next research focus should be directed to testing the validity, practicality, and effectiveness of the product on the measurable improvement of students' spatial abilities.

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REFERENCES

- Alinda, T., Alim, J. A., & Fendrik, M. (2025). *DEVELOPMENT OF AUGMENTED REALITY IN GEOMETRY LEARNING IN CLASS V ELEMENTARY SCHOOL. 11.*
- Dewi, K. S., Hadi, M., & Wildaniati, Y. (2022). THE DEVELOPMENT OF ETHNOMATHEMATICS-BASED GEOMETRY LKPD IS REVIEWED FROM THE ABILITY TO THINK CRITICALLY. *LINEAR: Journal of Mathematics Education*, 3(1), 28–41. <https://doi.org/10.32332/linear.v3i1.4816>
- Harini, B., Raharjo, M., & Susanto, I. A. (2026). *Training on the Creation and Use of Learning Media with AR (Augmented Reality) Technology for Elementary School Teachers in Meranjat Village, Ogan Ilir Regency.*

- Khasanah, M., & Prastiwi, S. D. (2024). *Development of Augmented Reality-Based Interactive Learning Media Integrated with Ethnomathematics in Building Spaces in Elementary Schools*.
- Ms, A. T., Suradi, & Rosidah. (2025). Systematic Literature: Integrating Augmented Reality-Based Ethnomathematics on the Understanding of the Concept of Building Space. *Mandalika Mathematics and Educations Journal*, 7(4), 1614–1629. <https://doi.org/10.29303/jm.v7i4.10497>
- Nasir, A. M., Aisyah, N., Nirfayanti, Setyawan, D., & Patta, R. (2025). The Use of GeoGebra in Geogometry Materials in Encouraging Students' Understanding. *Proximal: Journal of Mathematics Research and Mathematics Education*, 8(3), 818–826. <https://doi.org/10.30605/proximal.v8i3.6280>
- Pertiwi, B. W., & Gunawan. (2025). The Influence of Ethnomathematics-Based E-Comic Media on the Aspects of Student Self Efficacy in Geometry Materials. *Journal of Educational Publications*, 15(3), 1078–1089.