

A NEEDS ANALYSIS OF PROJECT-BASED INTERACTIVE MULTIMEDIA FOR ENHANCING SPATIAL ABILITY IN ELEMENTARY SCHOOL STUDENTS

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Abstract

This study aims to analyze the needs for interactive multimedia based on Project-Based Learning (PjBL) in elementary schools. It was conducted in ten schools in Mojowarno sub-district, Jombang Cistrict, involving 227 fifth-grade students and 10 teachers. Data were collected using questionnaires consisting of 10 items for students and teachers, rated on a 5-point Likert scale. This research is motivated by the fact that students' spatial abilities remain low, as reflected in the 2024 ANBK geometry scores, which were the lowest at 50.14. It underscores the need for effective learning media in mathematics instruction. The results of the questionnaire show the majority of students require digital learning media to facilitate understanding of lesson material (98.67%) and prefer media that integrate images, videos, animations, and games (86.34%). Both students and teachers expressed a need for interactive multimedia based on PjBL to support mathematics learning. The results of the questionnaire show that all teachers agreed on the importance of media that help students visualize abstract concepts (40% strongly agreed; 60% agreed) and media that are easy to use anytime and anywhere (60% strongly agreed; 40% agreed). These findings highlight the importance of developing interactive multimedia based on PjBL to enhance fifth-grade students' spatial abilities and improve learning outcomes in mathematics.

Keywords: *Spatial abilities; interactive multimedia; Project Based Learning*

Abstrak

Tujuan dari penelitian ini adalah untuk menganalisis kebutuhan multimedia interaktif berbasis PjBL di sekolah dasar. Penelitian ini dilakukan di 10 sekolah dasar yang terletak di Kecamatan Mojowarno Kabupaten Jombang. Subjek dalam penelitian ini adalah 227 murid dan 10 guru kelas V sekolah dasar. Data dalam penelitian ini diperoleh dengan menggunakan kuesioner terkait kebutuhan dari multimedia interaktif berbasis PjBL yang masing-masing berjumlah 10 pernyataan untuk murid dan guru dengan skala 1-5. Penelitian ini dilatar belakangi oleh kemampuan spasial murid kelas V masih rendah, hal tersebut terlihat dari hasil ANBK 2024 pada domain geometri memiliki hasil yang paling rendah diantara yang lain yakni sebesar 50,14. Sehingga dalam kegiatan belajar matematika dibutuhkan pemilihan media pembelajaran yang tepat. Berdasarkan hasil analisis kebutuhan, murid menyatakan bahwa mereka membutuhkan multimedia interaktif berbasis PjBL. Hasil kuesioner menunjukkan sebanyak 98,67% murid membutuhkan media agar lebih mudah memahami materi pelajaran, dan sebanyak 86,34% murid menyukai media pembelajaran yang dapat menggabungkan gambar, video, animasi, dan games. Hal serupa juga ditunjukkan pada hasil analisis kebutuhan guru, yang menyatakan bahwa mereka membutuhkan multimedia interaktif berbasis PjBL untuk pembelajaran matematika. Hasil kuesioner menunjukkan sebanyak 40% sangat setuju dan 60% setuju bahwa guru membutuhkan media yang dapat membantu murid untuk memvisualisasikan konsep yang abstrak dan sebanyak 60% sangat setuju dan 40% setuju bahwa guru membutuhkan media pembelajaran yang mudah digunakan dimana saja dan kapan saja. Hasil penelitian ini menunjukkan bahwa perlu untuk mengembangkan multimedia interaktif berbasis PjBL.

Kata kunci: Kemampuan Spasial; multimedia interaktif; project Based Learning.

INTRODUCTION

21st-century learning requires both teachers and students to stay aware of developments in Information and Communication Technology (ICT), which is inseparable from educational transformation. (Sinclair et al., 2016) stated that technological advances

have altered human interaction, including the methods of teaching and delivering learning materials. Similarly, (NCTM, 2019) highlighted six key principles for effective learning, namely equity, curriculum, teaching, technology, learning, and assessment, emphasizing the importance of digital-based instruction.

With the rapid development of digital technology, elementary school students increasingly use technology to learn under teacher guidance (Cruz et al., 2023). (Zulaiha et al., 2025) further emphasized that the push for educational transformation through technology motivates educators to design more creative and innovative learning strategies. Among these, interactive multimedia has proven to be one of the most effective tools for implementing digital-based learning.

Interactive multimedia is user-friendly and visually appealing, making it superior to conventional learning media. (K. A. H. Pujawan, 2018) emphasized that its use enhances student engagement, while (Tamami & Dwiningsih, 2020) noted that interactive multimedia provides a more meaningful learning experience due to its attractiveness and interactivity.

However, field observations indicate that teachers have not yet optimally utilized technology in learning. At SD N Mojoduwur 2, the availability of digital-based media is insufficient to meet the demands of 21st-century education, and the variety of media used during instruction remains limited. Beyond selecting suitable media, students require a learning process tailored to the characteristics of fifth-grade learners. Therefore, choosing an appropriate learning model is essential to support effective learning, with Project-Based Learning (PjBL) identified as a particularly suitable approach.

Project-Based Learning (PjBL) presents challenges that require students to collaborate in groups to solve problems, fostering curiosity and initiative in problem-solving (Omelianenko & Artyukhova, 2024). As a student-centered model, PjBL engages learners in real-life projects, requiring them to apply knowledge collaboratively to practical situations. Consequently, interactive multimedia based on PjBL can help students connect learning with everyday life through technology. (Yustina et al., 2020) emphasized that developing PjBL-based interactive multimedia is important to create meaningful and effective learning that meets the needs of the curriculum, students, and teachers.

In mathematics, geometry is a key topic requiring spatial abilities. The 2024 ANBK results at SD N Mojoduwur 2 showed that geometry had the lowest score among the four

tested domains (Number, Algebra, Geometry, and Data and Uncertainty), with a score of 50.14. This indicates that students continue to face difficulties in solving geometry problems, particularly those involving spatial reasoning, such as solid shapes.

Spatial abilities are important for solving geometry problems (I. G. N. Pujawan et al., 2020; Wahyuni et al., 2024) and have a significant impact on students' geometry performance (Tessema, 2018). They are also crucial for understanding and retaining mathematical contexts, particularly in geometry (Rohmah & Indriati, 2021).

Previous research on developing PjBL-based interactive multimedia has been conducted, but it has primarily focused on improving general learning outcomes, as seen in studies by (Marpelin et al., 2023; I. P. A. Pratama et al., 2022; Toya et al., 2025). In contrast, this study will focus specifically on students' spatial ability. Spatial ability is a crucial competency for understanding abstract concepts in geometry. Furthermore, research on spatial ability has been more dominantly implemented at the secondary (Pambudi et al., 2022) and tertiary education levels (Sukestiyarno et al., 2023), while its implementation in elementary schools, particularly in grade 5, remains scarce. Therefore, this study aims to conduct a needs analysis for developing PjBL-based interactive multimedia specifically designed to enhance the spatial skills of fifth-grade elementary school.

The novelty of this study lies in integrating interactive multimedia with Project-Based Learning (PjBL) to enhance students' spatial abilities. The urgency of this study is underscored by the growing demand for spatial skills in education, driven by technological advancements and the increasing complexity of global challenges.

Referring to preliminary findings, which revealed low spatial abilities among students and insufficient learning media to address this issue, this study tries to analyze the needs for interactive multimedia based on PjBL as a tool to improve elementary school students' spatial abilities.

METHODS

This study employed a quantitative approach using a survey method. It was conducted in ten elementary schools in the Mojowarno Sub-district, Jombang District, from August to October 2025. It involved 227 fifth-grade students and 10 fifth-grade teachers as participants.

The researcher used questionnaires to assess the need for interactive multimedia based on Project-Based Learning (PjBL) to enhance students' spatial abilities. The questionnaire

consisted of 10 items for both students and teachers, rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Before being used, the instrument was tested for validity and reliability, the validity test confirmed that the instrument is valid for use. Subsequently, the reliability test measured using Cronbach's alpha coefficient, produced a value of 0.880 indicating a very high category.

Data were analyzed using descriptive statistics to provide an overview of the requirements for interactive multimedia based on PjBL in supporting the development of spatial abilities among fifth-grade students. This analysis focused on identifying the specific needs and preferences of both students and teachers to inform the design of effective learning media.

RESULTS AND DISCUSSION

The use of technology not only supports the delivery of knowledge and learning materials but also promotes the development of students' spatial abilities. The results of the student needs analysis are presented in Figure 1 below.

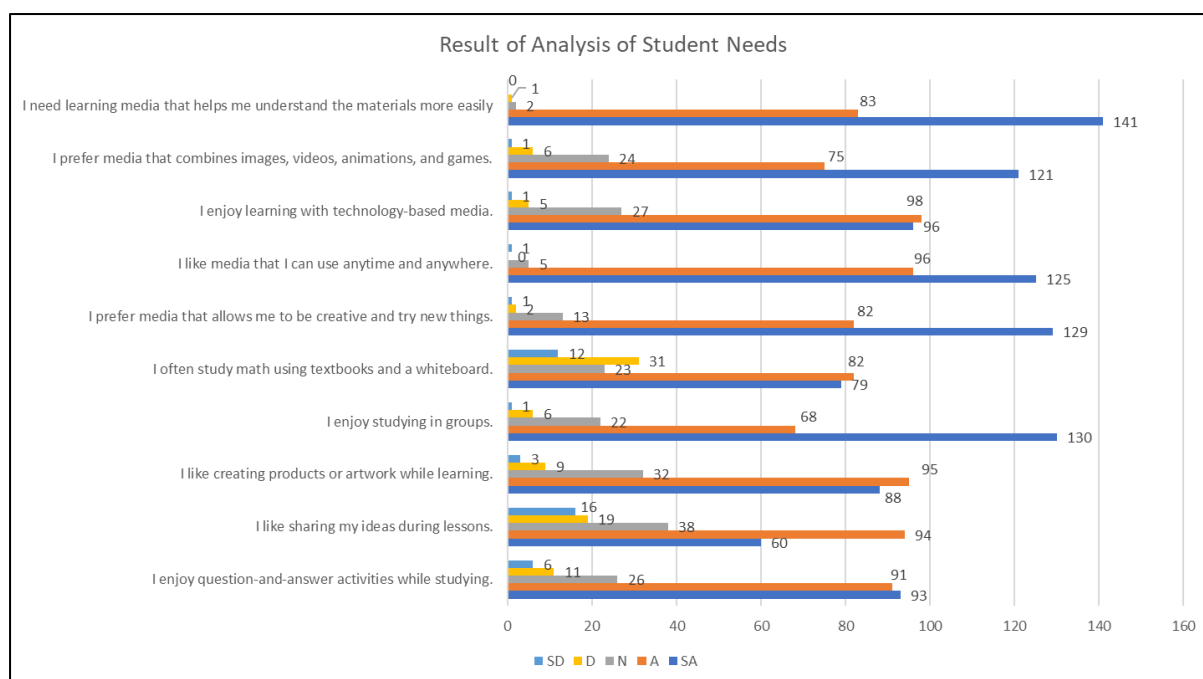


Figure 1. Results of Analysis of Student Needs

Figure 1 presents the analysis of student needs for interactive multimedia based on Project-Based Learning (PjBL) to enhance spatial skills. The results indicate that the majority of students require digital learning media to facilitate understanding of lesson material

(98.67%) and prefer media that integrate images, videos, animations, and games (86.34%). Most students favor technology-based learning media (85.46%) that can be accessed anytime and anywhere (97.35%) and encourage creativity and experimentation (92.95%).

Observations also showed that 70.92% of students frequently use textbooks and whiteboards during mathematics lessons, while 87.22% prefer studying in groups, and 80.61% enjoy creating artwork or products during learning. Additionally, 67.84% of students are willing to express opinions, and 81.05% favor active question-and-answer sessions. These findings suggest that students need digital-based learning media that support collaborative, creative, and interactive activities, aligning closely with the principles of PjBL-based interactive multimedia.

Learning with interactive multimedia offers several advantages. (Rachmadtullah et al., 2018) reported that it facilitates more effective interaction between students and teachers compared to traditional methods, while (Komalasari & Saripudin, 2017) highlighted its ability to engage students in active participation during learning.

Interactive multimedia also serves as a vital link between teachers and students and has been shown to enhance spatial thinking skills. (Park et al., 2016) noted that spatial learning requires students to visualize the effects of changes in an object's position or shape. Similarly, (Heo & Toomey, 2020) found that interactive multimedia can support students with low spatial ability by presenting relationships between visual components more clearly and in detail. This is further strengthened by (D. A. Pratama et al., 2023) that interactive multimedia is more effective in improving students' spatial thinking skills compared to conventional approaches.

One innovative learning model widely used in 21st-century education is Project-Based Learning (PjBL). This model promotes active student engagement and fosters curiosity by encouraging collaboration on comprehensive projects (Vesikivi et al., 2020). The PjBL model has the potential to enhance students' spatial thinking skills. (Putra et al., 2021) noted that PjBL provides students with stimuli in the form of guiding questions that enable them to explore and discover spatial frameworks. Developing spatial ability early through mathematics instruction is essential, as it is closely related to understanding geometric concepts, which are fundamental for all students (Sari et al., 2022).

Furthermore, PjBL emphasizes collaborative, contextual project activities. (Putri et al., 2025) revealed that this model positions students as active learners who construct knowledge through problem-solving in real-life contexts. By engaging in projects, students are encouraged to be creative, experiment with new ideas, and develop critical spatial skills, making PjBL an effective approach for fostering spatial ability in mathematics education.

In recent years, spatial ability has been highly noticed due to its importance across various scientific fields (Kondor & Esmailnia, 2022). Low spatial ability among students often reflects the ineffectiveness of mathematics instruction, which may be influenced by the teaching methods employed (Jehlička & Rejsek, 2018). Consequently, innovative learning approaches are necessary to enhance students' understanding of mathematics. Learning media can serve as a key tool to address deficiencies in spatial ability (Arifin et al., 2020), and when selected appropriately, can optimize the learning process (Sukariasih et al., 2019).

The findings of this study indicate that students require PjBL-based interactive multimedia to enhance their spatial ability. This need is supported by previous research; for instance (Abdulah & Wangid, 2021) found that students need interactive multimedia based on drill and practice. Furthermore, a study by (Saputri & Indriayu, 2018), conducted across five elementary schools with 147 fifth grade students, recommended the development of game-based interactive multimedia to improve the quality of learning. The present study consolidates these findings by specifically highlighting the demand for a project-based approach to meet the distinct objective of fostering spatial skills.

To determine the practical needs for interactive multimedia based on PjBL to improve spatial skills, a student needs analysis questionnaire was administered and complemented by input from teachers. Teachers play a crucial role in sustaining effective classroom learning, and their perspectives are essential for aligning learning media with both curricular goals and student needs.

The questionnaire was administered online using Google Forms to ten fifth-grade elementary school teachers in Mojowarno Sub-district, Jombang District. The collected data were summarized, presented using bar charts, and analyzed as percentages. The teacher questionnaire consisted of 10 items, each rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The results of the analysis are presented in Figure 2.

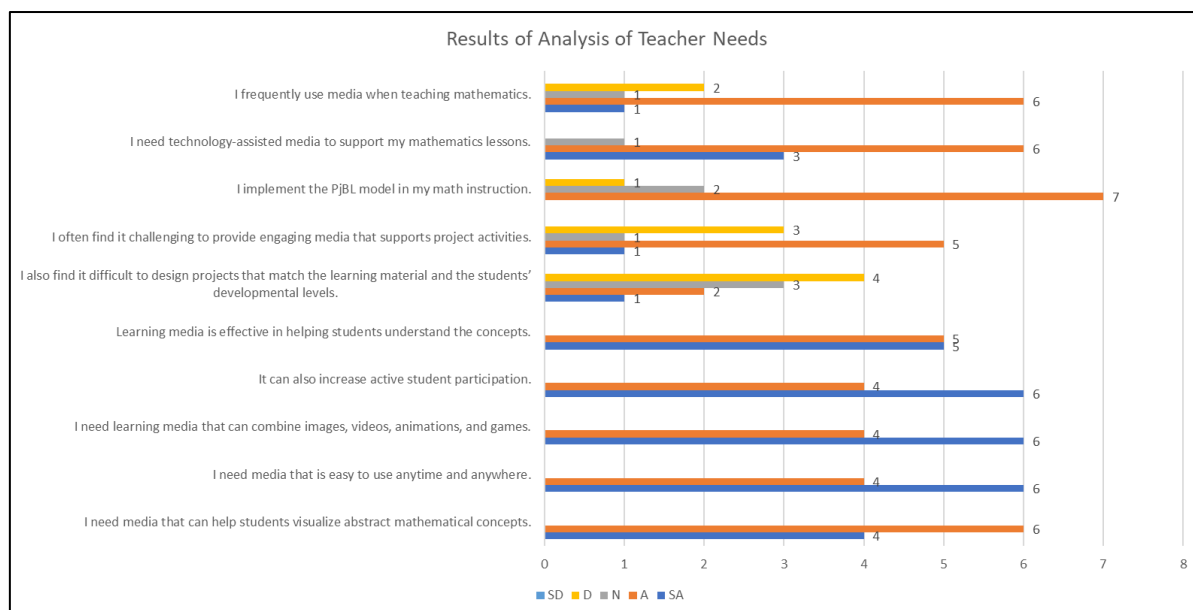


Figure 2. Results of Analysis of Student Needs

Figure 2 presents the results of the teacher needs analysis for interactive multimedia based on Project-Based Learning (PjBl) to enhance students' spatial abilities. The findings indicate that all teachers agreed on the importance of media that help students visualize abstract concepts (40% strongly agreed; 60% agreed) and media that are easy to use anytime and anywhere (60% strongly agreed; 40% agreed). Similarly, teachers emphasized the need for learning media that integrate images, videos, animations, and games (60% strongly agreed; 40% agreed) and that can increase active student participation (60% strongly agreed; 40% agreed). Half of the teachers (50% strongly agreed; 50% agreed) considered such media effective in helping students understand the material.

Regarding the challenges of implementing PjBl, some teachers expressed difficulty in designing projects appropriate to the material and student development (10% strongly agreed; 20% agreed; 30% unsure; 40% disagreed) and in providing engaging media that support project activities (10% strongly agreed; 50% agreed; 10% unsure; 30% disagreed). Most teachers reported implementing PjBl models (70% agreed; 20% unsure; 10% disagreed) and recognized the need for technology-assisted media in mathematics learning (69% strongly agreed; 30% agreed; 10% unsure). Finally, teachers indicated that students frequently use media during mathematics learning (60% strongly agreed; 10% strongly agreed; 6% agreed; 10% unsure; 20% disagreed). These results highlight the necessity of

developing interactive multimedia that supports both PjBL implementation and the improvement of students' spatial abilities.

In the current era of the Industrial Revolution 4.0, digital technology is advancing rapidly, necessitating changes in educational practices, referred to as learning in the digital transformation era (Seaman et al., 2023). Integrating technology into learning significantly enhances student engagement and understanding. One effective approach is the use of digital-based learning media, such as interactive multimedia.

Interactive multimedia supports multiple representations of information in diverse formats. (Asmi et al., 2025) found that interactive media is easier for students to comprehend compared to traditional books and printed materials. By combining images, audiovisuals, animations, text, and videos, interactive multimedia engages multiple senses in the learning process, thereby making knowledge transfer more effective (Pramusita et al., 2024).

Interactive multimedia can clarify complex and dynamic concepts, enhancing students' understanding and promoting greater engagement in learning. (Rahayu & I Gusti Ayu Tri Agustiana, 2023) and (Sukmawati et al., 2022) found that incorporating animation in interactive multimedia helps students visualize abstract mathematical concepts, thereby improving their thinking skills and deepening their comprehension of mathematics. Moreover, (Darma et al., 2024) highlighted that interactive multimedia offers several advantages, including fostering independent learning, promoting interactivity, and providing comprehensive content that supports the entire learning process. These features make interactive multimedia a highly effective tool for enhancing both understanding and engagement in mathematics education.

PjBL-based interactive multimedia features an engaging design that can increase student motivation in learning mathematics. Furthermore, the use of appropriate media helps students grasp abstract concepts in geometry. (Winarti, 2018) spatial ability stands as a determinant factor in geometric problem-solving, facilitating the mental visualization and manipulation of shapes required for solution derivation. Mastering geometry requires well-developed spatial ability. (Hidayat et al., 2022) reveal that low spatial ability can lead to misconceptions in geometry. The role of spatial ability in mathematics learning is crucial, as it allows students to detect relationships and identify transformations in geometric shapes (Sutrisno & Atira, 2020). Conversely, underdeveloped spatial ability can potentially cause

misunderstandings of geometric concepts (Syafiqah et al., 2020). Moreover, spatial ability is known to enhance student learning outcomes (Susilawati, 2020). Based on this rationale, applying PjBL-based interactive multimedia is a viable strategy for improving students' spatial ability.

CONCLUSION

Based on the results of the analysis, it can be concluded that students require digital-based learning media that integrate images, videos, animations, and games. Such media not only facilitate collaborative group activities but also encourage active participation in question-and-answer sessions and feedback. Furthermore, learning media that specifically enhance spatial skills are important. The findings indicate that digital-based interactive multimedia is the most suitable medium to meet these requirements.

Future studies need to extend the analysis of needs for digital-based interactive multimedia to other variables, learning materials, and grade levels to further optimize its implementation and effectiveness across diverse educational contexts.

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