EDUMATSAINS
JURNAL PENDIDIKAN MATEMATIKA DAN SAINS
E-ISSN:2527-7235
Volume 10, Issue. 3, January 2026, pp 1-17
http://ejournal.uki.ac.id/index.php/edumatsains

# The Validity and Practicality of the Dunia Geometri Application as an Interactive Mathematics Learning Medium for Students

**Muhammad Zazid Solakhudin[1], Nabila Nur Tasnima[2*], Naufalia Adani[3], Choirul Anwar[4], Enika Wulandari[5], Wulan Izzatul Himmah[6]**

[1,2,3,5,6] Program Studi Tadris Matematika, Fakultas Tarbiyah dan Ilmu Keguruan, UIN Salatiga, Salatiga, Indonesia

[4] Program Studi Pendidikan Guru Madrasah Ibtidaiyah, Fakultas Tarbiyah dan Ilmu Keguruan, UIN Salatiga, Salatiga, Indonesia.

e-mail: *nabilanurtasnima09@gmail.com

Article Info

Article history:
Received: Juni 25th, 2025
Revised: November 5th, 2025
Accepted: November 17th, 2025
Available online: January 31st, 2026

https://doi.org/10.33541/edumatsains.v10i3.7095

Abstract

This study aims to develop and evaluate the validity and practicality of a mathematics learning application called *Dunia Geometri* as an interactive learning medium for junior high school students. The research background is rooted in students' low understanding and motivation in learning three-dimensional geometry, which is further exacerbated by the limited availability of innovative and interactive learning media. To address this issue, the *Dunia Geometri* application was designed to integrate 3D visualizations, instructional videos, and tiered evaluation features that support student engagement and conceptual understanding. The research employed a Research and Development (R&D) approach using the ADDIE model, limited to the stages of Analysis, Design, and Development. Data were collected using validation sheets completed by media and material experts, as well as practicality questionnaires administered to teachers and students. The results of expert validation indicated a high validity score (87.69%), categorized as very valid. Similarly, the practicality test showed high ratings from teachers (85.71%) and students (79.33%), demonstrating that the application is easy to use and effectively supports classroom learning activities. The implementation of interactive technology in the *Dunia Geometri* application has been shown to enhance students' motivation and understanding of geometric concepts. These findings confirm that the application exhibits a high level of validity and practicality, making it an effective learning medium for teaching geometry at the junior high school level. Future development is recommended to incorporate gamification and augmented reality features to further enhance engagement and improve long-term learning outcomes.

**Keywords**: Dunia Geometri Application, Validity, Practicality, Interactive Media, Research and Development (R&D)

## 1. Introduction

Mathematics education in Indonesia, particularly in the area of three-dimensional geometry, still faces significant challenges (Hafirizka et al., 2022). Data from the 2022 Programme for International Student Assessment (PISA) indicate that Indonesian students' mathematical proficiency remains well below the international average, showing a notable decline compared to previous cycles (Adiputri, 2023). According to PISA 2022, only 18% of Indonesian students reached at least Level 2 proficiency in mathematics significantly lower than the OECD average of 69%. At Level 2, students are expected to recognize situations requiring simple problem-solving strategies, extract relevant information from various representations (such as tables, charts, or 2D representations of 3D objects), and demonstrate a basic understanding of functional relationships and spatial reasoning (OECD, 2022). These data clearly illustrate that many Indonesian students are still struggling with fundamental mathematical literacy, particularly in the domain of space and shape.

Weak understanding of solid geometry concepts is one of the main factors contributing to low mathematics achievement, especially in solving problems that demand spatial visualization and interpretation of diagrams or maps (Hawes et al., 2022; Sururi & Khotimah, 2023). This limited spatial reasoning ability not only affects problem-solving skills but also reduces students' motivation to learn and their capacity to apply mathematical concepts in real-life contexts (Amjad et al., 2023).

To address these problems, the use of interactive learning media is highly essential (Waspodo, 2022). Interactive learning tools can provide students with a more engaging learning experience while deepening their conceptual understanding (Fitriana et al., 2024). In the context of geometry learning, interactive media that enable realistic 3D visualizations have been found effective in helping students overcome spatial difficulties by directly supporting the development of spatial abilities, including mental rotation, spatial visualization, and spatial reasoning (Rohendi et al., 2025). These abilities are crucial for comprehending and manipulating geometric structures in both academic and everyday problem contexts.

Alongside pedagogical needs, advances in information and communication technology (ICT) have significantly transformed educational practices. The integration of smartphone-based learning applications with 3D visualization capabilities is becoming increasingly relevant to students' learning needs (Alenezi et al., 2023; Godsk & Moller, 2025). Such technology not only enhances interactivity but can also integrate supportive features such as educational videos, animations, and automatic assessments, enriching students' learning experiences and fostering motivation, critical thinking, and creativity (Rahman et al., 2024).

In response to these challenges and opportunities, this study focuses on developing a technology-based mathematics learning application called *Dunia Geometri*. This application is designed to assist students in understanding spatial geometry through interactive 3D models that can be freely manipulated according to user needs (Hwang et al., 2023).

The *Dunia Geometri* application includes structured learning materials, educational videos, and tiered assessments to support the gradual development of students' conceptual understanding (Bekker, 2022). By using this application, students are expected to visualize and comprehend complex geometric concepts more effectively and practically (Nadzeri et al., 2022).

The main objective of developing the *Dunia Geometri* application is to provide an engaging and effective learning medium for solid geometry, a topic that has traditionally been considered difficult by students. The application aims to innovate conventional teaching methods by employing technology-based learning that enhances understanding, motivation, and the ability to apply geometric concepts in real-world situations (Astuti et al., 2024; Nurhidayah et al., 2025). Furthermore, the application features automatic evaluation and detailed problem-solving explanations, enabling students to understand mathematical reasoning processes step by step (Ramalia et al., 2024).

The hypothesis of this study is that the *Dunia Geometri* application possesses a high level of validity and practicality and can effectively support the mathematics learning process in spatial geometry. To ensure its quality, the study focuses on testing the validity and practicality of the developed product through expert validation and student trials. Validation covers both content and media aspects, ensuring that the final product is appropriate and ready for implementation in mathematics classrooms (Shidqi et al., 2023). The student trials aim to gather feedback on usability, engagement, and effectiveness in improving understanding of spatial geometry.

Through the development and evaluation of the *Dunia Geometri* application, this research is expected to contribute to the improvement of mathematics education in Indonesia by providing an effective 3D mobile learning medium that directly supports the enhancement of students' spatial abilities and geometric understanding.

In summary, the contribution of this study lies in offering an empirically validated and practical digital learning innovation that addresses Indonesian students' weaknesses in spatial geometry thus supporting national efforts to elevate mathematical proficiency as indicated by the PISA 2022 findings.

## 2. Methods

The research method used in developing the *Dunia Geometri* learning media is classified as Research and Development (R&D), focusing on testing the validity and practicality of the product. This study employed the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) as a framework for developing application-based educational media on spatial geometry (Branch & Varank, 2009)

However, the study was limited to the Development stage of the ADDIE model, which included testing the validity and practicality of the *Dunia Geometri* application as part of the formative evaluation process. The Implementation and Evaluation stages were not conducted due to time constraints and the research focus, which emphasized formative evaluation to ensure the media's readiness before broader classroom application. This limitation was intentional, as the primary goal of the research was to produce a valid and practical prototype, not to test large-scale effectiveness. Future studies are expected to extend to the Implementation and Evaluation stages to measure the application's impact on learning outcomes. The research procedures followed the steps illustrated in Figure 1.

**Figure 1**
***Steps of the R&D Method Used***


The research subjects consisted of several parties involved in the media evaluation. The validators involved were subject matter experts and learning media experts, each of whom were experienced mathematics education lecturers at UIN Salatiga. In addition, the practicality of the media was tested by mathematics teachers of grade IX at SMP N 4 Salatiga.

The technique used in selecting participants in this study was purposive sampling, a type of non-probability sampling technique conducted based on specific considerations or criteria relevant to the research objectives (Sugiyono, 2022). This technique was chosen because not all individuals in the population possess the characteristics required for the study; therefore, participants were intentionally selected to obtain data that are more accurate and representative of the research focus.

In this study, the participants consisted of ten ninth-grade students and one mathematics teacher from the same school. The students were selected purposively based on their average level of mathematical achievement, representing a typical group in terms of geometric understanding. This selection aimed to ensure that the media trial results would reflect actual classroom conditions.

Meanwhile, the teacher was selected based on experience in teaching geometry and a solid understanding of the curriculum and the use of educational technology in the school. These criteria were considered essential because the teacher served both as a validator and as a potential user during the implementation of the developed learning media. Thus, the purposive selection of participants was expected to provide relevant and in-depth information regarding the validity and practicality of the technology-based learning media being tested, namely the *Dunia Geometri* application.

The instruments in this study were designed to measure the validity and practicality of the *Dunia Geometri* application. They were developed based on relevant aspects and indicators to ensure the content, visual design, and functionality of the media met educational standards.

The validation instrument consisted of a validation sheet containing several aspects and indicators related to content quality, design feasibility, and media functionality. Each aspect was rated using a four-point Likert scale (1 = not valid, 4 = very valid) to evaluate the appropriateness, clarity, and relevance of the developed product to the learning objectives.

The validation process involved three experts: one expert in mathematics education, one in instructional design, and one in educational technology. Each expert independently assessed the *Dunia Geometri* application using the provided indicators. The feedback and quantitative scores from the validation sheets were analyzed to determine the level of validity, and revisions were made according to the experts' comments to improve the content accuracy, visual layout, and interactivity before proceeding to the practicality testing stage.

Validation scores were analyzed by calculating the average score for each aspect. The media was considered valid if the mean score exceeded 3.00, indicating a high level of validity. Expert content validation focused on content aspects with six evaluation indicators, while media validation covered structural consistency, appeal, and functionality, consisting of eight indicators with a total of 13 evaluation items.

To evaluate practicality, a response questionnaire consisting of seven items was used for both teachers and students. The questionnaire aimed to gather data on ease of use, clarity of instructions, and the media's effectiveness in supporting geometry learning. The assessment used a five-point Likert scale, as presented in the table below.

**Table 1**
***Likert scale categories***

| Symbol | Category | Value |
|---|---|---|
| SB | Very good | 5 |
| B | Good | 4 |
| CB | Fairly good | 3 |
| KB | Less good | 2 |
| TB | Not good | 1 |

Data were collected through the completion of validation sheets and face-to-face response questionnaires. Validators filled out the validation forms prepared by the researchers, while teachers and students completed practicality questionnaires after using the application. The data collected were analyzed using a Likert scale, which quantifies respondents' attitudes and perceptions toward the learning media (Joshi & Joshi, 2021).

The validation data obtained from subject matter experts, media experts, and instructional design experts were analyzed using the following formula:

$$HR = \frac{\sum SP}{\sum SM} \times 100\%$$

Description:
HR = Rating Results
$\sum SP$ = Total score obtained
$\sum SM$ = Maximum total score

Data were analyzed using descriptive statistics, interpreted based on the validity level categories presented in Table 2.

**Table 2**
***Validity Level Catagory***

| Simbol | Kategori | Persentase (%) |
|---|---|---|
| SV | Highly Valid | 81-100 |
| V | Valid | 61-80 |
| CV | Fairly Valid | 41-60 |
| KV | Less Valid | 21-40 |
| TV | Not Valid | 0-20 |

The interpretation of the validation results and practicality scores was carried out using specific categorical criteria. Based on the experts' validation results, the *Dunia Geometri* learning application was categorized as valid to highly valid, according to the scores obtained from the validation sheets.

In terms of practicality, the scores obtained from the teacher and student response questionnaires indicated a highly practical category, meaning that the learning media was easy to use and effectively supported independent learning processes. These categories serve as indicators that the developed learning media is feasible for use in mathematics learning, particularly in spatial geometry materials for ninth-grade students.

To analyze the responses from teachers and students, the researchers employed descriptive statistical techniques, including the calculation of mean scores and percentage distributions for each evaluation indicator. The mean values were then interpreted based on predetermined score ranges to determine the level of practicality, categorized as *very practical, practical, less practical,* or *impractical.*

This analytical approach provided a clear quantitative representation of users' perceptions toward the *Dunia Geometri* application. Further descriptive statistical analyses, such as calculating average percentages and presenting score distributions across each aspect, were also utilized to strengthen the findings.

The criteria used to assess the practicality level of the application are presented in Table 3.

**Table 3**
***Practicality level categories***

| Symbol | Category | Percentage (%) |
|---|---|---|
| SV | Very practical | 81-100 |
| V | Practical | 61-80 |
| CV | Fairly practical | 41-60 |
| KV | Not very practical | 21-40 |
| TV | Not practical | 0-20 |

## 3. Result and Discussion

This study aims to develop an interactive learning media based on an application called Dunia Geometri, which is specifically designed to improve the understanding of spatial concepts among ninth-grade students. The development process of this learning media follows the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model, although this study was only conducted up to the Development stage.

Analysis Stage

The analysis stage was conducted through a preliminary study involving teachers and ninth-grade students at SMP N 4 Salatiga. The results of the teacher needs survey showed that spatial geometry learning was still dominated by the use of conventional media such as blackboards and books, and there was a lack of media that supported three-dimensional visualization. Teachers emphasized the need for learning media that can visualize three-dimensional objects in a realistic and interactive manner. On the other hand, the results of the survey from 10 students indicated that most students struggled to understand three-dimensional geometry material and were less motivated in mathematics learning. Students also expressed the need for engaging and easily accessible learning media through digital devices.

The results of this study are consistent with the findings of (Putri et al., 2022), who identified the limitations of conventional approaches to learning 3D geometry, where traditional approaches relying on 2D media have been shown to hinder the transfer of knowledge, both from the perspective of students who experience conceptual difficulties and educators who are constrained in presenting adequate visual representations. This differs from the research by (Moma et al., 2023), which emphasizes the development of generative learning instruments to enhance higher-order mathematical thinking skills without explicitly exploring the need for digital visualization technology. Therefore, the analysis conducted at SMP Negeri 4 Salatiga indicates an urgent need for innovative digital learning media that not only function as a support for conceptual understanding but also play a role in enhancing students' learning motivation through the implementation of more interactive and contextual approaches. In line with the research conducted by (Himmah, 2018), multimedia-assisted mathematics learning is effective in terms of students' mathematics learning outcomes in 3D spatial geometry lessons.

Design Stage

Based on the results of the needs analysis, the *Dunia Geometri* application was designed by considering the learning objectives, user characteristics, and instructional materials aligned with the mathematics curriculum. The application integrates simple navigation, engaging visual design, and interactive features such as 3D visualization, instructional videos, practice exercises, tiered evaluations, and automatic feedback, all aimed at fostering active learning and conceptual understanding. The application's usage flow is illustrated through a flowchart, ensuring a systematic development process. The spatial geometry content includes cubes, rectangular prisms, pyramids, prisms, cylinders, cones, and spheres.

The development of these features is grounded in relevant pedagogical and cognitive learning theories, particularly the Constructivist Learning Theory and Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2009). Constructivist theory emphasizes that learners actively construct knowledge through exploration and interaction with their environment. Therefore, the inclusion of interactive components and tiered evaluations in the application encourages students to engage in self-directed exploration, discovery, and reflection, leading to a deeper conceptual understanding of geometric concepts.

Meanwhile, according to Mayer's Cognitive Theory of Multimedia Learning (2009), learning becomes more effective when verbal and visual information are presented simultaneously in ways that support dual-channel processing and reduce cognitive overload. Thus, the 3D visualization and animated instructional features in the *Dunia Geometri* application are designed to strengthen students' spatial reasoning and mental rotation abilities, enabling them to visualize abstract three-dimensional shapes more concretely.

Through this pedagogical foundation, every feature of the *Dunia Geometri* application is intentionally designed to enhance conceptual understanding, spatial ability, and learner autonomy in learning three-dimensional geometry.

**Figure 2**

***Designing the Dunia Geometri application***

Development Stage

During the development stage, the Dunia Geometri application was designed and developed using software, namely Unity 2020 as the main platform, CorelDraw 2022 for graphic design, and Visual Studio Code 2022 for coding. The application was created for Android devices with a minimum version of 5.0 (Lollipop) and is equipped with various learning features such as interactive 3D visualization of spatial structures, learning videos, practice questions and graded evaluations, as well as detailed question discussions. The Dunia Geometri application was created so that students can manipulate geometric objects visually and interactively, thereby improving their conceptual understanding and motivation to learn.

The results of this development are in line with the research conducted by (Irmayanti et al., 2022), who developed a digital technology-based geometry learning application, specifically augmented reality, using Unity, Blender, and Vuforia software. Although it does not specifically mention CorelDraw or Visual Studio Code, the basic principles of development are similar, namely the use of 3D spatial objects to help students understand concepts of shape, volume, and surface area in a more concrete and interactive way. Meanwhile, the research by (Nursakinah et al., 2023) shows similarities in the Unity-based development approach in the FunLABS application, although in the context of chemistry learning. The DDD-E model they used emphasizes the importance of the design and evaluation stages in ensuring the effectiveness of digital media on learning motivation. Thus, the development of the Dunia Geometri application can be considered aligned with previous research trends that highlight the potential of interactive digital technology in enhancing student engagement and understanding, despite variations in the context of the material and development tools used.

**Figure 3**
***Dunia Geometri application design display***


Validity of the Dunia Geometri Application

The aspects assessed by subject matter experts include the suitability of the content and the use of language in the application. There are two main aspects with six indicators outlined in thirteen statements. The evaluation was conducted directly (face-to-face), and the results indicate that the Dunia Geometri application meets high validity criteria in terms of content and language. Therefore, this application is considered suitable as a mathematics learning medium, particularly for spatial geometry content.

The validation by learning media experts assesses the display structure, visual appeal, and navigation consistency within the application. The indicators consist of eight items divided into three aspects, totaling thirteen statements. The evaluation results show that this learning media meets the highly valid category in terms of visual display, interface design, and ease of navigation.

Before the Dunia Geometri application is tested on ninth-grade students on spatial geometry material, the validation results will first be used as evaluation material for the application's feasibility. This aims to ensure that the application meets the required standards before being implemented in the testing phase with students. Below are the validation calculation results conducted by subject matter experts and learning media experts.

**Table 4**
***Validation results***

| Expert | Rating Results (HR) (%) | Category |
|---|---|---|
| Material | 86,15 | Highly valid |
| Learning Media | 89,23 | Highly valid |
| Average | 87,69 | Highly valid |

Based on the validation results shown in Table 4, it can be seen that the development of the device validated by two experts, namely the subject matter expert and the learning media expert, shows a very high level of validity. The subject matter expert gave a rating of 86.15%, while the learning media expert gave a rating of 89.23%. Both values fall into the “highly valid” category, indicating that both the content and the educational media aspects have met the established standards of quality in the development of educational instruments or tools. On average, the overall rating reached 87.69%, which also falls into the “highly valid” category. This data reinforces the argument that the tested Dunia Geometri application has met the criteria for content validity, both in terms of material substance and media design, making it suitable for use in future learning processes.

In line with the research conducted by (Baihaki et al., 2022) in the development of Adobe Animate- based media for spatial geometry, the validity was 80.12%, and the practicality level was 4.19. The same was confirmed by (Putra & Rahmawati, 2022), who stated that geometry learning requires interactive and attractive displays so that students can build strong visual representations. The results of the development of interactive mathematics learning media show that the media is valid with scores of 3.64 and 3.36, respectively, is considered practical with a score of 3.83, and is highly effective as demonstrated by the level of mastery of the material, which reached 90%. A similar finding was reported by (Wulandari et al., 2024), who showed that all participants (100%) understood the training material, and some of them were able to create mathematics questions based on the local environment using the MathCityMap application. These findings indicate that the use of such media is effective in supporting participants' understanding of the learning process. Thus, the high validity achieved by the Dunia Geometri application strengthens the argument that learning media developed based on needs analysis and instructional design principles will be more easily accepted by users.

Practicality Test of Learning Media

After validation, the practicality of the Dunia Geometri application was tested through limited implementation at SMP N 4 Salatiga, involving one mathematics teacher and ten ninth-grade students as test subjects. The practicality test was conducted by distributing questionnaires to teachers and students after they used the application in the learning process. The summary data on

the level of practicality based on the assessments of teachers and students is presented in the table below:

**Table 5**
***Practicality summary results***

| Respondents | Rating Results (HR) (%) | Category |
|---|---|---|
| Math teachers | 85,71 | Very practical |
| Ninth grade students | 79,33 | Practical |

Based on the data in Table 5, it was found that the Dunia Geometri application developed was considered quite practical for use in learning. The assessment was carried out by two groups of respondents, namely mathematics teachers and ninth-grade students. Mathematics teachers gave a practicality rating of 85.71%, which falls into the "very practical" category. This data indicates that the application is easy to use, relevant to learning needs, and does not pose significant obstacles in its implementation. Meanwhile, ninth-grade students gave a rating of 79.33%, which falls into the "practical" category. Although slightly lower than the teachers' assessment, the results still indicate that the tool can be used functionally by students and supports their learning process. Both practicality test results indicate that the Dunia Geometri application has a good level of practicality from the perspective of direct users, both educators and students, making it suitable for further implementation in mathematics learning at the junior high school level.

In addition to the quantitative data, qualitative responses were also collected from both teachers and students to gain a deeper understanding of the practicality of the *Dunia Geometri* application. The mathematics teacher reported that the application "is easy to integrate into existing lesson plans and helps students visualize three-dimensional objects that are often difficult to explain using static images." Students similarly expressed positive experiences, stating that the 3D visualization and automatic problem discussion features made learning more engaging and helped them understand how shapes like pyramids and cones are formed. One student commented, *"I finally understand how a cone looks from different sides and how its volume is calculated."* These qualitative findings support the quantitative results, indicating that the *Dunia Geometri* application is both user-friendly and effective in assisting the learning process.

Research by (Simarmata et al., 2024) on Adobe Flash-based geometric transformation media shows that practicality is greatly influenced by the ease of user interaction and the compatibility of the media with the devices used. Students' responses to the learning media showed a total score of 89.86%, indicating that the developed mathematics learning media is suitable for use and receives positive responses from students. In line with the research by (Majid et al., 2021) who developed.

Calcu Card media based on augmented reality. The research shows that the average validator rating for the Calcu Card application is 3.25 and the average student response through the questionnaire is 3.19. Although the technology is more advanced, practicality remains the main factor in the success of media in learning. Thus, the Dunia Geometri application in terms of practicality shows that media development does not have to use the most advanced technology, but rather ensure alignment between design, function, and user needs.

The Impact of Applications on Student Motivation and Understanding

The results of the study indicate that the interactive features in Dunia Geometri, particularly 3D visualization and automatic problem discussion, can increase student motivation to learn. Most students find it easier to understand the concepts of volume, nets, and spatial shapes because the media provides a real representation of geometric objects. This aligns with constructivist learning principles, where students build knowledge through direct experience and active exploration. The research findings have a strong correlation with the study by (Alim et al., 2020), who developed an interactive multimedia-assisted geometry learning model for elementary school students. Although it does not explicitly mention 3D visualization or automatic problem-solving features, the study emphasizes the importance of interactivity in learning media and its alignment with the constructivist approach. The developed model was proven to be valid, practical, and effective in enhancing students' geometric reasoning through active learning experiences.

Similarly, research by (Tambunan et al., 2021) shows the effectiveness of interactive media based on Adobe Flash CS6 in improving students' spatial abilities, although it does not directly address learning motivation or constructivist principles. Research by (Lukman et al., 2023) on the gamification of mathematics teaching media shows that 91% of the validity indicators for the GEMAS game content developed have been met and classified as highly valid criteria, making it suitable for use in classroom learning. The integration of game features and visual challenges can foster learning interest and significantly improve conceptual understanding. Thus, the results of this study reinforce the understanding that the integration of visual technology and interactive features in geometry learning is effective. Although the Dunia Geometri application has not fully adopted gamification, the existing interactive features have contributed similarly.

The theoretical implication of this study is the reinforcement of the concept that the validity and practicality of media are key factors in the effectiveness of technology-based learning. The research findings contribute to the literature on the development of interactive media in mathematics education, particularly in geometry. In line with the study by (Muliana et al., 2023), this research confirms the effectiveness of web-based interactive learning media in geometry transformation material through high validity, good operational practicality, and positive user responses. The research by (Putri et al., 2022) also presents quantitative data supporting the research, with a validity rate of 86.57% and practicality of 89.53%, both falling into the very high category. Thus, the claim that validity and practicality are not merely technical requirements in media development but important theoretical aspects that directly contribute to the effectiveness and sustainability of interactive media use in mathematics learning is supported.

Practically, teachers and educational institutions can adopt the Dunia Geometri application as a flexible learning aid. The Dunia Geometri application can be used in face-to-face learning, blended learning, or fully online learning. This is highly relevant to the current educational landscape, which demands high flexibility. For further development, it is recommended to add gamification or Augmented Reality (AR) features to enhance student engagement. From a pedagogical perspective, gamification can increase students' intrinsic motivation and sustain attention through reward mechanisms, challenges, and feedback loops, as suggested by self-determination theory (Safitri & Khotimah, 2023). Meanwhile, AR features can provide authentic and immersive learning experiences by allowing students to interact directly with virtual geometric objects in real-world contexts, which supports constructivist and experiential learning principles.

Although the Dunia Geometri application has not yet implemented AR, previous studies have shown that AR-based interactive media can effectively improve students' spatial reasoning and motivation in geometry learning. For instance, (Jazila & Achmad, 2024) demonstrated that AR

integration in solid geometry lessons enhanced students' spatial visualization and engagement, highlighting the pedagogical potential of visual-interactive technology for future media development. Additionally, future research could include studies to measure the app's impact on long-term academic performance and its influence on students' critical and creative thinking skills.

## 4. Conclusion

This study concludes that the Dunia Geometri application is a highly valid and practical interactive learning medium for use in teaching mathematics on spatial figures at the junior high school level. The high validity (87.69%) obtained from experts indicates that the content, visual presentation, and navigation of the application meet the standards for developing effective educational media. The practicality assessed by teachers (85.71%) and students (79.33%) also shows that the application is easy to use and relevant to classroom learning needs. The implementation of 3D visualization features and automatic evaluation in the application has proven to significantly enhance students' learning motivation and understanding of geometric concepts. This study contributes to the development of education technology based on applications with a deep visual approach and responsiveness to contemporary learning needs. The practical implications of this study are that teachers can utilize similar applications as teaching aids in technology-based learning contexts. For further research, it is recommended to develop additional features such as gamification and augmented reality to enhance student interactivity and engagement, as well as evaluate the long-term impact on learning outcomes and critical thinking skills.

## 5. References


Adiputri, R. D. (2023). *PISA 2022 dan Refleksi Pendidikan Indonesia*. Kompas.Id.

Alenezi, M., Wardat, S., & Akour, M. (2023). The need of integrating digital education in higher education: Challenges and opportunities. *Sustainability*, *15*(6), 4782. https://doi.org/10.3390/su15064782

Alim, J. A., Fauzan, A., Arwana, I. M., & Musdi, E. (2020). Model of geometry realistic learning development with interactive multimedia assistance in elementary school. *Journal of Physics: Conference Series*, *1471*(1), 12053. https://doi.org/10.1088/1742-6596/1471/1/012053

Amjad, A. I., Habib, M., Tabbasam, U., Alvi, G. F., Taseer, N. A., & Noreen, I. (2023). The Impact of Brain-Based Learning on Students' Intrinsic Motivation to Learn and Perform in Mathematics: A Neuroscientific Study in School Psychology. *International Electronic Journal of Elementary Education*, *16*(1), 111–122. https://doi.org/10.26822/iejee.2023.318

Astuti, N. D., Hapsan, A., Herianto, Mutmainna, Warsyidah, A. A., Riskawati, Mahmud, N., Febriana, B. W., & Toron, V. B. (2024). *PRINSIP-PRINSIP PENGUKURAN DAN EVALUASI PENDIDIKAN: Disertai dengan contoh kasus*. CV. Ruang Tentor. https://books.google.co.id/books?id=8esFEQAAQBAJ

Baihaki, B., Djamilah, S., & Lazwardi, A. (2022). Developing Interactive Learning Media Based On Adobe Animate Applications For Geometry Transformation. *Kalamatika: Jurnal Pendidikan Matematika*, *7*(2), 191–206. https://doi.org/10.22236/kalamatika.vol7no2.2022pp191-206

Bekker, B. (2022). The buildings gallery: visualizing buildings. *Journal of Mathematics and the Arts*, *16*(1–2), 11–28. https://doi.org/10.1080/17513472.2022.2063782

Branch, R. M., & Varank, İ. (2009). *Instructional design: The ADDIE approach* (Vol. 722). Springer.

Fitriana, L., Mukti, P. S., & Setiawan, R. (2024). Articulate Storyline Media-Based Discovery Learning to Improve Students' Mathematical Concept Understanding Ability of Flat-Sided 3D Space. *Mosharafa: Jurnal Pendidikan Matematika*, *13*(2), 475–488. https://doi.org/10.31980/mosharafa.v13i2.1519

Godsk, M., & Moller, K. L. (2025). Engaging students in higher education with educational technology. *Education and Information Technologies*, *30*(3), 2941–2976. https://doi.org/10.1007/s10639-024-12901-x

Hafirizka, H., Nasir, M., & Syafi'i, M. (2022). Development of Augmented Reality-Based Learning Media on Mechanical Wave Material. *Jurnal Geliga Sains: Jurnal Pendidikan Fisika*, *10*(2), 126. https://doi.org/10.31258/jgs.10.2.126-133

Hawes, Z., Gilligan-Lee, K. A., & Mix, K. S. (2022). Effects of Spatial Training on Mathematics Performance: A Meta-Analysis. *Developmental Psychology*, *58*(1), 112–137. https://doi.org/10.1037/dev0001281

Himmah, W. I. (2018). *Keefektifan Pembelajaran Berbantuan Multimedia pada Materi Bangun Ruang Sisi Lengkung terhadap Hasil Belajar Matematika Siswa SMP*. HIKMATUNA. https://scholar.google.com/scholar?cluster=18027472634373729692&hl=en&oi=scholarr

Hwang, W.-Y., Nurtantyana, R., Purba, S. W. D., & Hariyanti, U. (2023). Augmented reality with authentic GeometryGo app to help geometry learning and assessments. *IEEE Transactions on Learning Technologies*, *16*(5), 769–779. https://doi.org/10.1109/TLT.2023.3251398

Irmayanti, D., Muni, L. S. A., & Pratiwi, M. (2022). Rancang bangun aplikasi pembelajaran bangun ruang berbasis augmented reality. *Nuansa Informatika*, *16*(2), 123–134. https://doi.org/10.25134/nuansa.v16i2.6004

Jazila, V. R., & Achmad, L. (2024). Effectiveness of Bemo: an Android-Based Educational Game As a Learning Media on Molecular Shape Material. *EduMatSains : Jurnal Pendidikan, Matematika Dan Sains*, *9*(1), 144–155. https://doi.org/10.33541/edumatsains.v9i1.5995

Joshi, R. N., & Joshi, Y. C. (2021). Construction and validation of Indian consumer ethnocentrism scale: The ice-scale. *Gadjah Mada International Journal of Business*, *23*(2), 173–192.

Lukman, H., Agustiani, N., & Setiani, A. (2023). Gamification of mathematics teaching materials: its validity, practicality and effectiveness. *International Journal of Emerging Technologies in Learning (IJET)*, *18*(20), 4–22. https://doi.org/10.3991/ijet.v18i20.36189

Majid, A. F., Ichiana, N. N., Yuliany, N., Angriani, A. D., & Kusumayanti, A. (2021). Calcu card: Developing augmented reality-based learning media on the three-dimensional shapes with curves lesson for junior high school student. *Journal of Physics: Conference Series*, *1918*(4), 42124. https://doi.org/10.1088/1742-6596/1918/4/042124

Moma, L., Tamalene, H., & Rumalean, S. (2023). Pengembangan Perangkat Pembelajaran Generatif Untuk Meningkatkan Kemampuan Berpikir Matematis Tingkat Tinggi Siswa SMP. *Jurnal Pendidikan Matematika Unpatti*, *4*(1), 16–24. https://doi.org/10.30598/jpmunpatti.v4.i1.p16-24

Muliana, R., Sukmawati, R. A., & Suryaningsih, Y. (2023). Pengembangan Media Pembelajaran Interaktif Berbasis Web pada Materi Transformasi Geometri untuk Siswa SMP dengan Metode Drill and Practice. *Computing and Education Technology Journal*, *3*(1), 1–11. https://doi.org/10.20527/cetj.v3i1.8099

Nadzeri, M. B., Meng, C. C., Ismail, I. M., & Abu Hassan, A. H. (2022). The Development and Evaluation of Augmented Reality Learning Application in Geometry Topic. *International Journal of Academic Research in Progressive Education and Development*, *11*(1). https://doi.org/10.6007/ijarped/v11-i1/12279

Nurhidayah, A., Mawarsari, V. D., & Suprapto, R. (2025). Systematic Literature Review : Penggunaan Media Articulate Storyline Dalam Kemampuan Berpikir Geometri Siswa SMP. *Innovative: Journal Of Social Science Research*, *5*(1), 6866–6885. https://doi.org/10.31004/INNOVATIVE.V5I1.17881

Nursakinah, Y., Prima, E. C., & Agustin, R. R. (2023). The Development of FunLABS Android-Based Application Using Unity Software as Learning Media to Explore Students' Motivation on Acid, Base, and Salt Topic. *Journal of Science Learning*, *6*(2), 204–215. https://doi.org/10.17509/jsl.v6i2.50447

OECD. (2022). *PISA 2022 Results*.

Putra, A., & Rahmawati, Y. (2022). Development of Interactive Mathematics Learning Media on Geometry Material. *Brillo Journal*, *2*(1), 42–53. https://doi.org/10.56773/bj.v2i1.27

Putri, S., Abdurahman, A., Andrian, D., Angraini, L., & Effendi, L. (2022). Development of interactive multimedia based mathematics learning media macromedia flash 8. *International Journal of Trends in Mathematics Education Research*, *5*(2), 206–213. https://doi.org/10.33122/ijtmer.v5i2.133

Rahman, M. A., Ling, L. S., & Yin, O. S. (2024). Interactive Learning System for Learning Calculus. *F1000Research*, *11*, 307. https://doi.org/10.12688/f1000research.73595.2

Ramalia, T., Muchlis, E. E., Susanto, E., & Cheng, A. Y. (2024). Exploration of Students' Abilities in Solving Mathematical Literacy Problems on Geometry Material Using Polya's Steps. *International Journal of Geometry Research and Inventions in Education (Gradient)*, *1*(2), 83–93. https://doi.org/10.56855/gradient.v1i2.1269

Rohendi, D., Ramadhan, M. O., Rahim, S. S. A., & Zulnaidi, H. (2025). Enhancing student's interactivity and responses in learning geometry by using augmented reality. *Eurasia Journal of Mathematics, Science and Technology Education*, *21*(1), em2559. https://doi.org/10.29333/ejmste/15796

Safitri, A., & Khotimah, R. P. (2023). Kemampuan Literasi Matematika Peserta Didik dalam Menyelesaikan Soal PISA Konten Space and Shape Ditinjau dari Gaya Kognitif. *Jambura Journal of Mathematics Education*, *4*(1), 24–34. https://doi.org/10.34312/jmathedu.v4i1.18745

Shidqi, L., Trisniawati, T., & Rhosyida, N. (2023). The development of kobatar learning media for learning mathematics in elementary school. *Advances in Mobile Learning Educational Research*, *3*(2), 886–892. https://doi.org/10.25082/amler.2023.02.015

Simarmata, J., Solihin, M. D., Hutahaean, H. D., & Isnaini, M. (2024). Development of Geometry Transformation Learning Media by Utilizing Mobile Technology. *Jurnal Penelitian Pendidikan IPA*, *10*(SpecialIssue), 209–214. https://doi.org/10.29303/jppipa.v10iSpecialIssue.7913

Sugiyono, P. (2022). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. CV Alfabeta.

Sururi, A., & Khotimah, K. (2023). Hubungan Antara Kecerdasan Spasial Dengan Hasil Belajar Matematika Materi Bangun Ruang Kelas VIII MTs N 2 Lampung Utara. *Griya Cendikia*, *8*(1), 379–386. https://doi.org/10.47637/griyacendikia.v8i1.675

Tambunan, D. R. U., Syahputra, E., & Simanjorang, M. M. (2021). Development of Interactive Learning Media Based on Adobe Flash CS6 to Improve Spatial Abilities Students in Geometry Transformation. *Development*, *12*(8).

Waspodo, M. (2022). Requirements Analysis of Media Development Interactive Multimedia-Based Learning on Three Dimensional Geometry Materials. *International Journal on Engineering, Science and Technology*, *1*(2), 113–122. https://doi.org/10.46328/ijonest.116

Wulandari, E., Himmah, W. I., Diamudrika, E. S., & Lu'luah, Z. (2024). Pengembangan Soal Matematika Kontekstual Berbasis Local Environment Berbantuan Aplikasi MathCityMap untuk Guru Matematika SMP. *Indonesian Journal of Community Services*, *6*(1), 57. https://doi.org/10.30659/ijocs.6.1.57-65