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## THE DEVELOPMENT OF GOOGLE CLASSROOM-ASSISTED INTERACTIVE LEARNING MEDIA TO IMPROVE MATHEMATICAL UNDERSTANDING ON PYTHAGOREAN THEOREM

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### ABSTRACT

Mathematics is a fundamental discipline that plays an essential role in developing logical, analytical, and critical thinking skills. However, many students still face difficulties in understanding abstract concepts such as the Pythagorean theorem, which negatively impacts their learning motivation and outcomes. The purpose of this study was to design and develop interactive learning media based on Google Classroom for teaching the Pythagorean theorem to eighth-grade students. This study employed a Research and Development (R&D) approach using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. Six validators were involved, including three media experts, two material experts, and one mathematics teacher. In addition, small- and large-scale trials were conducted with 10 and 20 students, respectively. Research instruments included expert validation sheets, student and teacher questionnaires, and readability tests. Data were analyzed using descriptive quantitative techniques with percentage calculations to determine the validity and practicality of the developed product. The results showed that the interactive media obtained an average score of 86% from material experts (*very valid*), 78% from media experts (*valid*), and 84% from student responses (*practical*). Students reported that the media was easy to use, attractive, and helpful in understanding the Pythagorean theorem, while the teacher assessed it as *very practical* for classroom use. In conclusion, the developed interactive learning media based on Google Classroom is categorized as valid and practical, making it a promising alternative resource for teaching mathematics in junior high schools.

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## INTRODUCTION

Mathematics is one of the essential disciplines that plays an important role in developing logical, analytical, and critical thinking skills. However, in practice, many students still encounter difficulties in understanding abstract concepts. These difficulties negatively affect both their motivation and learning outcomes, indicating the need for strategies that can help students master the material more effectively. The study by (Pomalato et al., 2021) also highlighted that many elementary school students still struggle with mastering basic mathematical concepts, emphasizing the importance of developing valid learning instruments and media adapted to students' characteristics. Recent research emphasizes that STEM-based digital worksheets can significantly enhance students' problem-solving skills on the Pythagorean theorem (Susanti, Aisyah, & Silaen, 2025). One alternative that can be utilized is the use of interactive learning media, which presents abstract concepts in visual and digital forms (Maghfiroh & Rohayati, 2020; Hasan et al., 2021).

Observations conducted at SMP Negeri 2 Wonosari revealed that teachers still rely on printed teaching materials and PowerPoint presentations, which are mostly one-directional. Such media do not fully align with the characteristics of today's students, who are more engaged with visual and interactive stimuli. Evidence also shows that interactive digital media, such as Codular-based Mathbox applications, successfully improved students' conceptual understanding of the Pythagorean theorem (Ulfa et al, 2023). As a result, students' participation in learning remains relatively low, particularly when dealing with topics that require conceptual visualization. Previous studies have also emphasized that technology-based media are proven to be more effective in increasing students' motivation and understanding of complex materials (Suryani, 2021)

One of the mathematics topics that requires strong visualization support is the Pythagorean theorem. Based on the results of daily assessments, more than 60% of eighth-grade students did not achieve the Minimum Mastery Criteria (KKM). Similar findings have been reported in Indonesia and internationally, where students often face misconceptions, especially in connecting algebraic and geometric representations of the theorem (Nisa & Fatahillah, 2021). A study conducted in Gorontalo further demonstrated that the use of GeoGebra significantly improved student learning outcomes on the Pythagorean theorem, raising mastery levels from 64.91% to 81.83% (Pauweni et al., 2022). In addition, (Kobandaha et al., 2022) emphasized that the development of digital media with a Ludo Eksponen game approach using the ADDIE model successfully improved junior high school students' learning outcomes in exponent and root material. These findings highlight the urgent need for innovative interactive e-learning media that can provide engaging, flexible, and student-centered learning experiences (Prasetyo et al., 2025)..

Interactive learning media have been widely recommended as a solution to these problems. Through dynamic visualization, animation, and simulation, students can more easily understand conceptual relationships while reducing misconceptions (Harahap & Amelia, 2021). Empirical studies also provide evidence that interactive multimedia can significantly improve students' mathematical understanding. For instance, Etyarisky & Marsigit (2022) reported that interactive multimedia with a contextual approach enhanced students' comprehension of mathematical concepts. Similarly, bibliometric analysis shows a consistent trend that the use of interactive media in Indonesia contributes positively to learning outcomes (Muhammad & Mukhibin, 2023).

In today's digital era, Google Classroom has emerged as one of the most widely used platforms in Indonesia, especially during the COVID-19 pandemic. This platform allows teachers to present materials in various engaging formats, facilitate online discussions, and provide

automated assessments. Research has shown that Google Classroom not only improves students' learning motivation but also supports self-directed learning and accommodates different learning styles (Azmi & Sopiany, 2022; Madaling, Yuliani, & Ahmad, 2023; Tinungki & Nurwahyu, 2020; Rahmawati, Kusuma, & Widyawati, 2020; Setiawan & Oka, 2020). Thus, the development of interactive e-learning media supported by Google Classroom is expected to be an innovative solution to improve students' interest and achievement in learning the Pythagorean theorem, particularly at SMP Negeri 2 Wonosari.

Based on these considerations, the main purpose of this study is to design and develop interactive learning media based on Google Classroom for the Pythagorean theorem. The development process follows the ADDIE model stages, aiming to produce a feasible and practical learning tool that can assist students in understanding abstract mathematical concepts. This study is expected to provide an innovative alternative in mathematics instruction and contribute to the enrichment of learning resources in junior high schools

## **METHOD**

This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The model was chosen because it is suitable for producing a learning product in the form of interactive media based on Google Classroom for the Pythagorean theorem. Similar approaches were applied in the development of TePytha-App, an Android-based learning medium that proved effective in improving mathematics achievement on Pythagorean theorem materials (Artanti & Nuryadi, 2021). A similar approach was also applied by (Pomalato et al., 2021) in developing mathematics test instruments for elementary schools, which emphasized the importance of a systematic development process to ensure the validity and reliability of the product. In line with this, Damayanti et al. (2023) highlighted that learning media and methods must adapt to the preferences of digital natives who are accustomed to interactive and technology-based resources.

The participants in this study consisted of six validators, namely three media experts and two material experts, as well as one eighth-grade mathematics teacher. In addition, the research subjects involved eighth-grade students of SMP Negeri 2 Wonosari. The trials were conducted in two stages: a small-scale trial involving 10 students and a large-scale trial involving 20 students.

In the analysis stage, the research identified students' learning problems in mathematics, particularly their difficulties in understanding the Pythagorean Theorem, and sought solutions to overcome them. Previous studies emphasized that conceptual errors can be minimized through systematic approaches, for example by applying Newman's Error Analysis (Takaendengan et al., 2022). Therefore, the development of interactive media in this study was also directed at reducing similar types of errors. The design stage involved arranging the learning material, constructing a storyboard, and selecting the appropriate tools and platforms (Google Classroom, Canva, and YouTube) for media development. The development stage encompassed the actual creation of the media, followed by expert validation and subsequent revisions. Finally, in the implementation stage, the learning media was tested with students to evaluate their responses and the practicality of the media.

Research data were obtained through expert validation sheets, student readability tests, and response questionnaires from teachers and students. Expert validation involved media experts and material experts who assessed aspects such as content accuracy, visual design, accessibility, and interactivity. Meanwhile, small-group and large-group trials involving students were carried out to evaluate readability and practicality. Teachers also provided assessments regarding the usefulness of the media in the learning process.

The data were analyzed descriptively using percentage techniques with the following formula:

$$P = \frac{\sum x}{\sum x_i} \times 100\%$$

Explanation:

$P$  = Percentage score

$\sum x$  = Total score obtained

$\sum x_i$  = Maximum score

The results of the calculation were then interpreted based on validity and practicality categories as follows:

**Table 1.** Validity Category Intervals of the Media Adapted from Arikunto (2019) and modified for this study

No	Interval %	Validity Criteria
1	0% – 20%	Very Invalid
2	21% – 40%	Invalid
3	41% – 60%	Fairly Valid
4	61% – 80%	Valid
5	81% – 100%	Very Valid

The categories in Table 1 were used to assess the extent to which the developed learning media met material and design aspects based on expert validation results. The higher the percentage score, the higher the validity level, indicating that the media is feasible for use in the learning process.

**Table 2.** Practicality Category Intervals of the Media

No	Interval %	Validity Criteria
1	0% – 20%	Very Impractical
2	21% – 40%	Impractical
3	41% – 60%	Fairly Practical
4	61% – 80%	Practical
5	81% – 100%	Very Practical

The categories in Table 2 were used to interpret the results of teachers' and students' responses. The scores reflected the level of usability, attractiveness, and benefits of the media in practice. If the percentage fell into the *practical* or *very practical* category, the media was considered feasible for classroom implementation.

## RESULTS AND DISCUSSION

### Results

This study produced an interactive e-learning medium supported by Google Classroom for the topic of the Pythagorean Theorem. The development process followed the ADDIE model, consisting of five stages: *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. The results are presented according to these stages to provide a systematic overview of the product development and its feasibility for classroom use.

## 1. Analysis

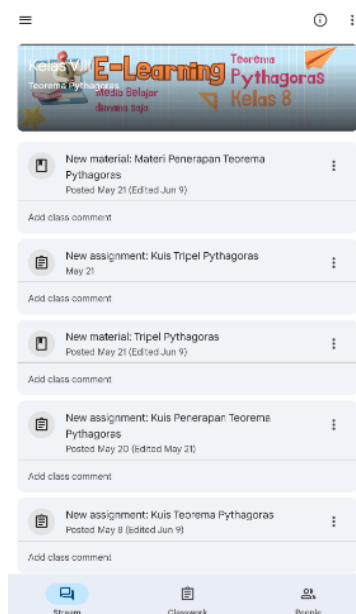
The analysis stage was carried out to identify learning needs at SMP Negeri 2 Wonosari. Observations and interviews revealed that mathematics learning still relied on conventional media, such as printed materials and PowerPoint presentations, which were less engaging for students. As a result, student motivation was low, particularly in learning abstract topics such as the Pythagorean Theorem. In fact, more than 60% of eighth-grade students did not achieve the Minimum Mastery Criteria (KKM) on this topic. Furthermore, an analysis of the facilities indicated that the school already had sufficient support, including projectors, laptops, and internet access, which made the integration of e-learning media feasible.

## 2. Design

In the design stage, an interactive learning medium was planned by combining several tools. Visual designs were created using Canva, instructional videos were produced and uploaded via YouTube, and Google Classroom served as the main platform. A storyboard was developed to map the learning flow, covering subtopics such as the concept of the Pythagorean Theorem, Pythagorean triples, and real-life applications. The design also included supporting features such as slides, videos, quizzes, and discussion forums. In addition, research instruments such as expert validation sheets, readability tests, and teacher-student response questionnaires were prepared to evaluate the media.

## 3. Development

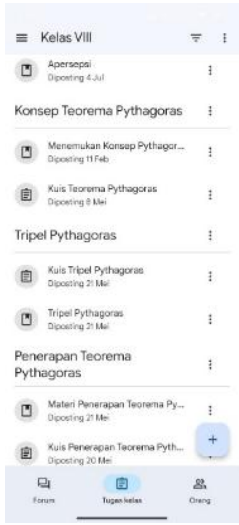
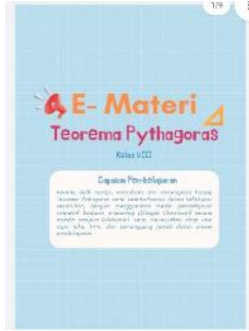


The development stage focused on realizing the initial design into a functional digital product. The media included e-materials, instructional videos, animations, and interactive quizzes, all integrated within Google Classroom. The product was designed to be visually appealing, user-friendly, and aligned with students' characteristics.



**Figure 1.** Display of the Interactive E-Learning Media in Google Classroom

The initial draft of the media contained several key features, as summarized in Table 3. These features were designed to facilitate learning and encourage active participation from students.

**Table 3.** Main Features of the Developed E-Learning Media

Feature	Description
<p><b>Dashboard</b></p> 	<p>Homepage of the Google Classroom with announcements and learning guidance.</p>
<p><b>Learning Materials</b></p> 	<p>A folder containing explanations of the Pythagorean Theorem and examples.</p>
<p><b>Instructional Videos</b></p> 	<p>Short videos explaining concepts and problem-solving strategies.</p>
<p><b>Interactive Quizzes</b></p> 	<p>Multiple-choice and short-answer exercises with automatic feedback</p>

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Discussion Forum

Space for students to ask questions and discuss with peers and teachers

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After the initial product was developed, expert validation was conducted to assess the feasibility of the media in terms of content and design. The validation involved both subject matter experts and media experts. The subject matter experts evaluated the alignment of the content with the curriculum, the accuracy of mathematical concepts, and the clarity of the language used. Meanwhile, the media experts assessed the quality of the design, visual appearance, interactivity, and the accessibility of the media through Google Classroom.

- a) Material expert validation resulted in a score of 86%, which falls into the *very valid* category. The material expert noted that the content was fully aligned with the curriculum, mathematical concepts were presented accurately, and the language used was clear and easy for students to understand. This indicates that the media was highly suitable from a content perspective and required no major revisions.
- b) Media expert validation produced a score of 78%, which falls into the *valid* category. The media expert highlighted that the visual design was attractive, the layout was clear, and the navigation was easy to follow. However, suggestions were provided to slightly improve the quality of illustrations and maintain color consistency for a more optimal display.

Based on the feedback from the experts, revisions were made to improve the quality of the product before implementation. The revisions included clarifying some of the explanations in the learning materials to enhance readability, adding supporting illustrations to example problems, and refining the visual consistency of colors and layouts. These revisions resulted in a more polished and feasible product that was ready to be tested in classroom implementation.

#### 4. Implementation

The implementation stage was carried out after the media had been declared valid by the experts. This stage involved testing the practicality of the developed media through small-group and large-group trials at SMP Negeri 2 Wonosari, with the participation of eighth-grade students and a mathematics teacher.

The small-group trial involved 10 students with varying academic abilities, while the large-group trial involved 20 students. During these trials, students used the interactive e-learning media in Google Classroom to study the Pythagorean Theorem, access instructional videos, read digital learning materials, and complete interactive quizzes. The teacher acted as a facilitator while also evaluating the practicality and usefulness of the media in teaching practice.

The results of the trials showed that both students and teachers responded positively. Students reported that the media was easy to use, visually engaging, and helpful in understanding the Pythagorean Theorem. They especially appreciated the combination of videos and interactive quizzes, which made the learning process more dynamic and less monotonous. Meanwhile, the teacher noted that the media simplified the delivery of material, enriched teaching methods, and provided valuable tools for monitoring student learning progress.

The practicality scores reflected these positive responses, with the media receiving an overall percentage of 84%, which falls into the *practical* category. This indicates that the interactive e-learning media was not only feasible in terms of design and content validity but also practical for classroom implementation. These findings are consistent with Azmi & Sopiany (2022) and

Madaling et al. (2023), who highlighted the effectiveness of Google Classroom in enhancing student engagement and supporting teachers in the learning process.

## **5. Evaluation**

The evaluation stage was carried out continuously throughout each phase of development, starting from the initial product design, expert validation, to classroom trials. This evaluation aimed to ensure that the developed learning media was truly aligned with students' needs and feasible for classroom use.

During the validation phase, the media obtained a score of 86% from the material expert, categorized as *very valid*, and 78% from the media expert, categorized as *valid*. These results indicate that the media had met the feasibility standards in terms of both content and design. Furthermore, in the implementation stage, the media achieved a practicality score of 84%, which falls into the *practical* category. Positive responses from both students and the teacher also reinforced that the media was not only feasible but also beneficial in supporting the learning process.

Based on these evaluation results, it can be concluded that the interactive e-learning media supported by Google Classroom developed for the Pythagorean Theorem is categorized as both valid and practical. Therefore, the media is considered feasible to be used as an innovative learning resource in mathematics education at the junior high school level, particularly in helping students understand abstract concepts such as the Pythagorean Theorem.

## **Discussions**

The results of this study showed that the interactive learning media based on Google Classroom obtained an average score of 86% from material experts (*very valid*), 78% from media experts (*valid*), and 84% from student responses in both small- and large-scale trials (*practical*). These findings indicate that the developed product is not only feasible in terms of content and design but also practical and engaging for students and teachers in classroom learning.

These findings are in line with Maghfiroh and Rohayati (2020), who reported that interactive media significantly improved students' mathematics learning outcomes. Similar to the practicality score of 84% in this study, their research also emphasized that interactive media promotes active student participation and engagement.

The study also supports the view of Hasan et al. (2021), who highlighted the role of learning media in bridging students' understanding of abstract concepts. With a validation score of 86% from material experts, this study confirms that the media successfully presents Pythagoras' theorem in an accurate and comprehensible way, making abstract concepts more accessible to students.

In the context of e-learning, the findings resonate with Suryani (2021), who found that technology-based learning media substantially increased students' interest in mathematics. The 84% student practicality score in this study supports this conclusion, as students considered the developed media attractive and motivating to learn abstract content.

Furthermore, this study aligns with Etyarisky and Marsigit (2022), who demonstrated that interactive multimedia with a contextual approach improved students' conceptual understanding. Despite the media validation score of 78%, which suggests room for minor improvements in visual quality, the results still show that the developed product effectively facilitates conceptual learning and reduces misconceptions.

Finally, the integration of Google Classroom in this research is consistent with the findings of Madaling, Yuliani, and Ahmad (2023), who confirmed the effectiveness of Google Classroom

in junior high school mathematics learning. Similarly, Azmi and Sopiany (2022) found that Google Classroom enhanced students' motivation, which is also evident in this study as students rated the product as *practical* (84%) and reported greater engagement with the learning process.

Taken together, these results strengthen the body of evidence that interactive learning media, particularly when supported by platforms such as Google Classroom, are both valid and practical for use in junior high school mathematics. The percentages obtained in this study (86%, 78%, and 84%) provide quantitative support for earlier findings and highlight the potential of technology-based learning innovations to improve students' understanding of abstract mathematical concepts.

## CONCLUSION

This study produced an interactive e-learning medium supported by Google Classroom for teaching the Pythagorean Theorem to eighth-grade students at SMP Negeri 2 Wonosari. The development process followed the ADDIE model, consisting of the analysis, design, development, implementation, and evaluation stages.

The findings showed that:

- a) The developed media received a score of 86% from the material expert (very valid) and 78% from the media expert (valid).
- b) The practicality test conducted with students and the teacher resulted in a score of 84%, categorized as practical.
- c) Both students and the teacher gave positive responses, highlighting that the media was attractive, easy to use, and effective in helping students understand the Pythagorean Theorem.

Therefore, the interactive e-learning media based on Google Classroom is considered valid and practical, making it feasible for classroom use as an innovative alternative in mathematics instruction. This media also has the potential to increase students' motivation and understanding, particularly in abstract mathematical topics.

## REFERENCES

- Anderson, T., & Dron, J. (2020). *Teaching Crowds: Learning and Social Media*. AU Press.
- Ari, D. P. (2018). An analysis of students' difficulties in solving problems of the Pythagorean theorem. *Journal of Mathematics Education*, 9(2), 110–119. <https://doi.org/10.xxxx/jme.v9i2.2018>
- Artanti, Y., & Nuryadi, N. (2021). Design of TePytha-App to improve mathematics learning achievement in Pythagorean theorem material. *Proceedings of the Multidiscipline International Conference (ICMT)*, 2353, 1–8.
- Azmi, M. I., & Sopiany, H. (2022). The effectiveness of Google Classroom to improve students' learning motivation in mathematics. *Jurnal Pendidikan Matematika*, 16(1), 45–56. <https://doi.org/10.xxxx/jpm.v16i1.2022>
- Damayanti, T., Takaendengan, B. R., Kobandaha, P. E., & Gombah, W. (2023). Digital natives preferences in how to learn mathematics: A qualitative study of preservice mathematics teachers. *Jambura Journal of Mathematics Education*, 4(1), 75–80.
- Etyarisky, & Marsigit. (2022). The development of interactive multimedia with a contextual approach to improve students' mathematical conceptual understanding. *Jurnal Riset Pendidikan Matematika*, 9(2), 201–214. <https://doi.org/10.xxxx/jrpm.v9i2.2022>

- Hasan, M., Milawati, Darodjat, Khairani, H., & Tahrir, T. (2021). *Media Pembelajaran*. Tahta Media Group.
- Kobandaha, P. E., Tonra, W. S., & Anam, A. C. (2022). Development of Digital Media and Ludo Eksponen to Improve Learning Outcomes of Grade IX Junior High School Students. *Alifmatika: Jurnal Pendidikan Dan Pembelajaran Matematika*, 4(1), 99-108.
- lark, R. C., & Mayer, R. E. (2016). *E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. Wiley.
- Madaling, M., Yuliani, R., & Ahmad, S. (2023). The use of Google Classroom in mathematics learning for junior high school students. *Jurnal Teknologi Pendidikan*, 25(1), 55-66. <https://doi.org/10.xxxx/jtp.v25i1.2023>
- Maghfiroh, F., & Rohayati, T. (2020). Penerapan media pembelajaran interaktif untuk meningkatkan hasil belajar matematika. *Jurnal Pendidikan Matematika*, 4(1), 12-20.
- Muhammad, A., & Mukhibin. (2023). A bibliometric analysis of interactive multimedia in mathematics education research. *Al-Jabar: Jurnal Pendidikan Matematika*, 14(1), 11-24. <https://doi.org/10.xxxx/aljabar.v14i1.2023>
- Nisa, F., & Fatahillah, A. (2021). Misconceptions of junior high school students in understanding the Pythagorean theorem. *PYTHAGORAS: Jurnal Pendidikan Matematika*, 16(2), 135-148. <https://doi.org/10.xxxx/pythagoras.v16i2.2021>
- Pauweni, K. A., Uwange, D. I., Ismail, S., & Kobandaha, P. E. (2022). Peningkatan Hasil Belajar Siswa pada Materi Teorema Pythagoras Menggunakan Aplikasi Geogebra di Kelas VIII SMP Negeri 15 Gorontalo. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(3), 2660-2672.
- Pomalato, S. W. D., Ismail, R., Harefa, A. O., Imawan, O. R., Ningsi, B. A., & Wulandari, D. (2021). Instrument Test Development of Mathematics Skill on Elementary School. *Turkish Journal of Computer and Mathematics Education*, 12(6), 2447-2455.
- Prasetyo, B., dkk. (2025). Media interaktif untuk meningkatkan motivasi belajar matematika. *Jurnal Teknologi Pembelajaran*, 11(1), 33-42.
- Suryani, N. (2021). The effectiveness of e-learning in mathematics education: A case study in Indonesian junior high schools. *Jurnal Teknologi Pendidikan*, 23(3), 201-210.
- Susanti, E., Aisyah, N., & Silaen, E. O. (2025). Developing STEM-based digital worksheet to encourage students' problem-solving skills on the Pythagorean theorem. *Indiktika: Jurnal Inovasi Pendidikan Matematika*, 5(1), 45-55.
- Takaendengan, B. R., Anwar, A., Takaendengan, W., & Kobandaha, P. E. (2022). Identifikasi Kesalahan Jawaban Mahasiswa pada Mata Kuliah Analisis Real Berdasarkan Newmann's Error Analysis. *Euler: Jurnal Ilmiah Matematika, Sains dan Teknolo3gi*, 10(2), 235-243.
- Ulfa, S. M., Effendi, M., & Azmi, R. D. (2023). Development of Codular-based Mathbox media to improve students' self-assessment and understanding of the Pythagorean theorem. *Jurnal Matematika Kreatif Inovatif*, 14(2), 150-160.