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# Development of T-Solve Interactive Learning Media with Polya Approach on Pythagorean Theorem

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**Abstract**
Mathematics learning in schools is often dominated by conventional methods, resulting in passive student participation and low conceptual understanding, especially in topics such as the Pythagorean Theorem. This study aims to develop and evaluate the effectiveness of "T-SOLVE," an interactive learning media based on Polya's problem-solving approach, in enhancing students' understanding of the Pythagorean Theorem. The research employed a Research and Development (R&D) method using the ADDIE model. The sample consisted of eighth-grade students at SMP Negeri 2 Sumowono. Data were collected through expert validation sheets, student response questionnaires, and tests to measure learning outcomes. The results indicate that the T-SOLVE media is valid, practical, and effective in improving students' conceptual understanding and engagement. The media's integration of problem-solving steps supports students in learning independently and applying concepts to real-life situations. The implication of this research is that T-SOLVE can be used as an alternative learning resource that promotes interactive, student centered learning, which addresses the initial problem of passive learning and low motivation. Furthermore, it contributes to improving mathematical problem solving skills and serves as a relevant tool for 21st century learning.

**Keywords**
interactive media; polya approach; pythagorean theorem; self learning; t-solve

## INTRODUCTION

Mathematics is a universal discipline that plays an essential role in human life. It helps solve various problems that arise in daily activities. Therefore, mathematics learning should be designed in such a way that it encourages active student involvement in the learning process, enabling them to build understanding and concepts independently (Rizko et al., 2023; Cely et al., 2023; Bonar et al., 2021). As an effort to strengthen the

implementation of education, teachers can take advantage of the advancements in science and technology (S&T) that are continually evolving today. One way to do this is by integrating innovative learning media, which not only covers the entire subject matter but also instills character values in students (Rini et al., 2023; Astriyani, 2022; Yonatan et al., 2024). This approach is taken to ensure that the educational process aligns with the advancement of civilization and serves as a relevant and effective learning resource for students.

Media in learning serves as a tool to visualize concepts, helping convey messages from educators to students, and achieving learning objectives optimally (Baharuddin et al., 2020; Budiman, 2016). Media also acts as an intermediary that delivers information to the recipient (Wulandari et al., 2023; Rahayu et al., 2021). The proper use of media can assist teachers in presenting material more effectively, stimulating student engagement, and creating an engaging learning environment (Siregar & Ananda, 2023; Samala et al., 2024). Therefore, media should be designed systematically and tailored to the material, ensuring that information is received well and easily remembered by students (Prayoga et al., 2022; Budiman et al., 2022). Teachers need to have the skills to choose the appropriate media to ensure that learning objectives are achieved effectively.

Learning in schools is still dominated by conventional lecturing methods, with teachers as the center of activity and students as passive (Suheni et al., 2025). The lack of learning media results in low student understanding (Saadah et al., 2022). At SMP Negeri 2 Sumowono, observations show that the absence of media leads to passive learning and decreased student motivation. The use of media can facilitate student understanding, as seen in primary education, where students better grasp material through hands-on practice. Therefore, interactive learning media that are engaging and effective, such as educational games, are needed. These games can enhance student interest and active participation in learning (Rastal et al., 2022). One relevant innovation is the development of the "T-SOLVE" media, an educational game-based tool that supports conceptual understanding through the Polya problem-solving approach, helping students build understanding independently.

Interactive learning offers many benefits for both teachers and students, creating a more engaging learning environment, improving time efficiency, and enhancing the quality of teaching. It allows students to access materials anytime, anywhere, making it

suitable for flexible learning needs. One such innovation is the interactive learning media "T-SOLVE," developed using Articulate Storyline 3. This audio-visual media is designed to present content interactively, making it engaging and easy for students to understand. Articulate Storyline 3 integrates various elements like slides, animations, videos, and animated characters into a unified learning tool, making it an effective medium for presentations and communication (Akhlilia et al., 2024).The media developed using Articulate Storyline 3 is attractive, entertaining, and easy to use, enabling students to access and use it directly in their learning (Winta & Ariani, 2024).

The interactive learning application I created allows students to learn independently. It combines entertainment and education, providing a fun experience while enhancing conceptual understanding. Articulate Storyline 3 is ideal for this media because it actively engages students in the learning process. The application offers an interactive menu where students can explore learning materials and take tests or quizzes for evaluation.

To enhance learning appeal and accelerate students' understanding of concepts, an engaging teaching strategy is essential. One way to improve the effectiveness of this learning media is by incorporating elements that allow students to learn independently and enjoyably. A very effective approach is integrating Polya's problem-solving strategy, which helps students not only understand theories but also apply them in real life. By following Polya's steps understanding the problem, planning the solution, executing the plan, and evaluating the result students can easily connect learned concepts to real-world situations. Interactive learning media in the form of applications is highly suitable for use in middle school math education (Muhajir et al., 2025). This application combines education with an engaging approach, making it a fun and effective tool for helping students understand and master math concepts. Using this app, students can learn independently and actively, deepening their understanding in an enjoyable and easy-to-grasp manner.

Previous studies have shown that interactive application-based media is effective and suitable for learning processes (Nur'aini & Nurul Arfinanti, 2024). This is evident from increased student engagement in learning. Interactive media can also enhance students' learning outcomes (Hasna et al., 2023). Other research indicates that interactive media development boosts students' interest and motivation (Jannah et al., 2023). These studies suggest that application-based interactive learning media is effective and beneficial for

education. However, previous research has not examined "T-SOLVE" interactive media for the Pythagorean Theorem concept using Polya's problem-solving strategy. Therefore, this study focuses on evaluating the "T-SOLVE" media to determine its validity and effectiveness in improving students' understanding of the Pythagorean Theorem through Polya's problem-solving steps.

The implication of this research is that the validated and effective "T-SOLVE" media can be used as an alternative learning resource in mathematics classrooms, especially for geometry topics. It provides a fun, interactive, and student-centered learning experience that supports independent learning and enhances conceptual understanding, which may ultimately contribute to improving students' problem-solving skills and learning outcomes.

## METHOD

This research is a development study. The application-based learning media developed in this study follows the modified Borg and Gall development model by Soenarto (2003), which includes: analysis of the product to be developed, preparation of the initial product, and product testing. The product testing process includes validation by experts, revisions based on feedback, and small-scale trials followed by product revisions. Expert validation consists of media validation and content validation conducted with the help of three validators: two mathematics education lecturers and a mathematics subject teacher.

The development product of this media is evaluated based on the validation results to determine the feasibility of the "T-SOLVE" interactive learning media before it is used in the learning process. The validation was conducted by three validators, including content experts and media experts, who assessed the media based on aspects of content feasibility, visual presentation, and alignment with the Polya problem-solving strategy. The validation assessment was carried out using a validation sheet that was systematically designed according to relevant indicators. The data collection instrument used in the validation process was developed based on these indicators and is presented in Table 1.

**Table 1.** Data Collection Instruments

| Aspek Measuret | Instrument | Observed Data | Respondent |
|---|---|---|---|
| Validity of Interactive Learning Media "T-SOLVE" | Validation sheet | Validity of content, visual appearance, and suitability to Polya's strategy | Media experts, material experts, and concept experts |

## RESULT AND DISCUSSION

### Development results

### Analysis of the products developed

The analysis of the developed product consists of concept analysis, design, and material collection. In the concept analysis stage, a study is conducted on the aspects required for the planning of the learning tools. At this stage, it was decided that the material to be used is the Pythagorean Theorem.

In the design analysis stage, the researcher designs the appearance of the web to be developed. At this stage, the researcher begins to plan the main elements of the website, such as the main menu, theme, animations, layout, and other aspects. In the material collection stage, the necessary materials for the product creation are gathered. At this stage, the researcher compiles the content to be used in the learning media being developed. This includes creating a learning video about the Pythagorean Theorem, developing animations, creating an online quiz, and developing a game in an application format that can be installed on Android smartphones.

### Developing the initial product

The development of the initial product began with the creation of the domain name to be used, followed by the development of the media according to the plan that had been prepared. Then, materials related to the Pythagorean Theorem, including videos, Android games (.apk), and online quizzes, were integrated into the media. The result of this development is as follows. The name of the developed application is T-Solve. The selection of this name is based on its uniqueness, making it easy for students to remember. The first page accessed when opening the T-Solve application is the main page. This main page displays an introductory video about the developed application, as well as introduces the problems and basic concepts of the Pythagorean Theorem. The front page can be seen in Figure 1.


**Figure 1.** Introduction Page

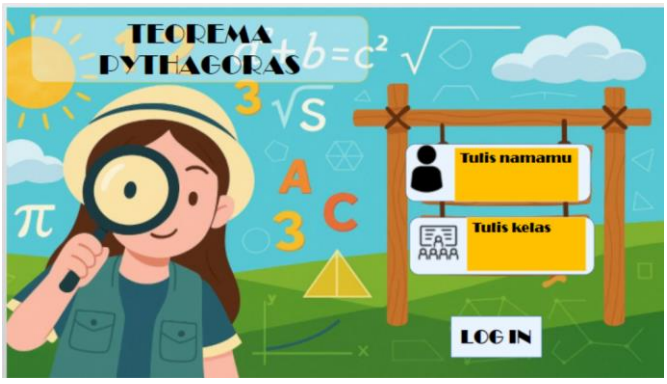


**Figure 2.** Login Page

The second page of the T-Solve application is the login page, where students are asked to enter their name and class before they can access the application. After successfully logging in, students can access the main menu page. The main menu page contains options such as learning objectives, learning goals, materials, examples, quizzes, information, developers, references, and exercises that can be explored by the students. The main menu page can be seen in Figure 3.


**Figure 3.** Main Menu Page

The main menu page contains options for materials that students can study. These materials include learning videos and slides. Below are some examples of the displays of these materials.

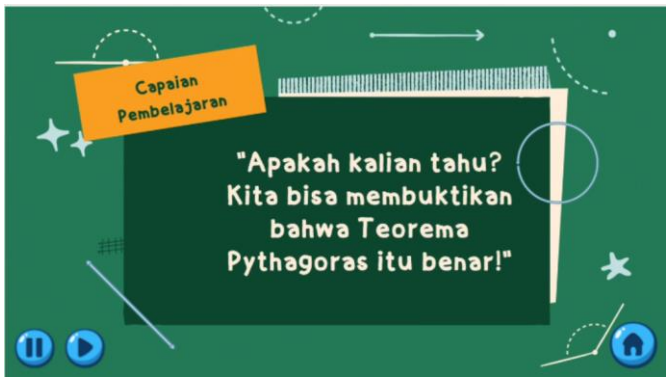


**Figure 4.** Learning Achievement Video

In Figure 4, it can be seen that the provided material starts with a video on the initial learning objectives (LO) related to real-life contexts. This video introduces students to the concept of the Pythagorean theorem with easy-to-understand examples from everyday life. At the end of the material, there is a conclusion video summarizing the learning objectives, reinforcing the students' understanding.


**Figure 5.** Display of Instruction Information

In Figure 5, there is a display of information providing instructions on the functions of the buttons used in the developed media, allowing students to use it independently.

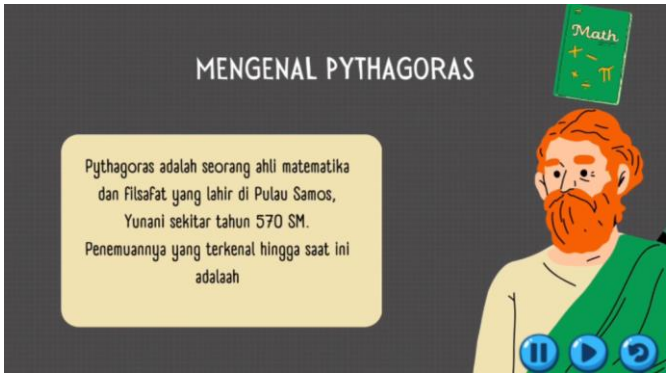


**Figure 6.** View of Pythagoras History Material

The display of the Pythagoras History material begins with a video that introduces students to the figure of Pythagoras and his life journey. The video explains how Pythagoras developed his mathematical theories, including the Pythagorean Theorem, and his role in the history of mathematics. This is followed by a summary of the importance of Pythagoras' contributions to science.

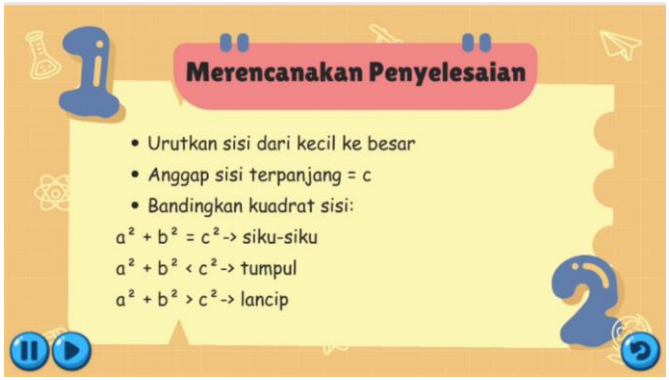


**Figure 7.** View of Pythagoras History Material

The material on types of triangles explains acute, obtuse, and right triangles. Using Polya's procedure, the first step is understanding the problem by identifying the side lengths. Then, students plan how to calculate the triangle's angles. Next, the angles are calculated to determine the triangle type: acute, obtuse, or right. The final step is checking the results to ensure their accuracy.


**Figure 8**. Quiz View

The quiz interface begins with a screen displaying a "Click Start to Begin" button. Once the button is pressed, students are directed to the quiz page containing a series of questions related to the material they have learned. After answering all the questions, students can click the "Finish" button to view their score. Additionally, they will immediately receive feedback indicating which answers were correct or incorrect for each question.

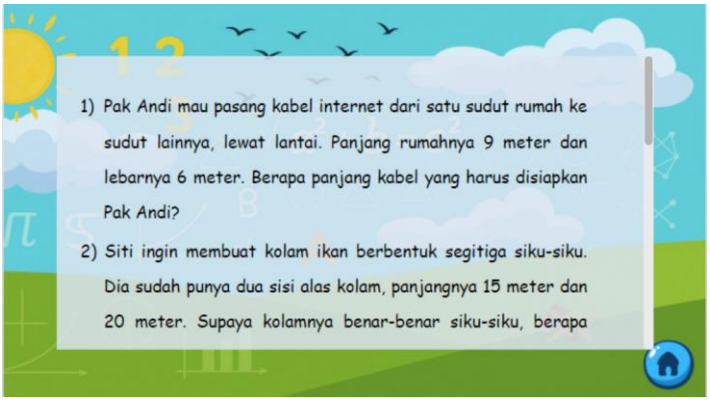


**Figure 9.** Practice Question Display

The quiz interface features a scroll panel that allows students to scroll down to view additional questions. Each question is displayed sequentially, and students can answer each one before proceeding to the next. With the scroll panel, students can easily navigate the quiz and access the full list of available questions.


**Figure 10.** Reference View

After completing the quiz and viewing their score along with feedback on correct and incorrect answers, students are directed to a final page displaying references relevant to the material studied. As shown in Figure 10, a scroll panel at the bottom allows students to scroll through and explore various references, additional learning resources, or materials to deepen their understanding.

## Product trial

After the initial product was developed, testing was carried out in two stages: expert validation and small-scale trials. Expert validation included both media validation and content validation. The assessment results from the validators regarding the media can be seen in Table 2 below.

**Table 2.** Media Validation Results

| No. | Aspect | Indicator | Average score for each aspect |
|---|---|---|---|
| 1. | Programming Eligibility | Ease of use of buttons | 4 |
| | | Clarity of instructions | 3 |
| | | Fluidity of media programs | 4 |
| | | Interactive learning media can be used and operated independently | 3 |
| 2. | Appearance Design Eligibility | Consistency of Button placement | 3 |
| | | Suitability of images or animations | 4 |
| | | Harmony of background selection | 3 |
| | | Neatness of text, image, and animation layout | 4 |
| | | Clarity of letters and texts. | 4 |
| | | Accuracy of language use | 4 |
| | | Accuracy of EYD writing | 3 |
| 3. | Interest/Concern | The attractiveness of each page's appearance | 3 |
| | | The attractiveness of the appearance of the material, questions and videos. | 3 |
| | | Interactive learning media can support the student's learning process. | 4 |
| | | Validity Score | **3,5** |

Based on Table 2, it can be seen that the validity score obtained is (Va) 3.5. This score indicates that the learning media can be considered valid. In the media expert validation, three revisions were made to the developed media. These revisions included the addition of example questions with images at the beginning, improvement of step-by-step instructions for students to follow, and enhancements to the appearance and flow of the quiz to make it more interactive, providing automatic feedback after students completed the questions. The changes in the media's appearance before and after the revisions can be seen in the following images.

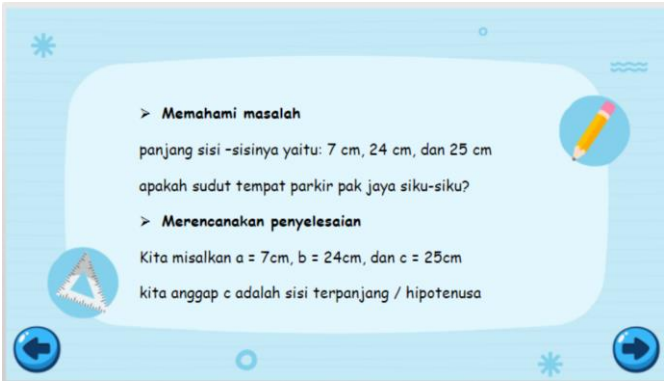


**Figure 11.** Sample Question View Before Revision


**Figure 12.** View Sample Questions After Revision


**Figure 13.** View of Instructions Before Revision


**Figure 14.** Instructions View After Revision

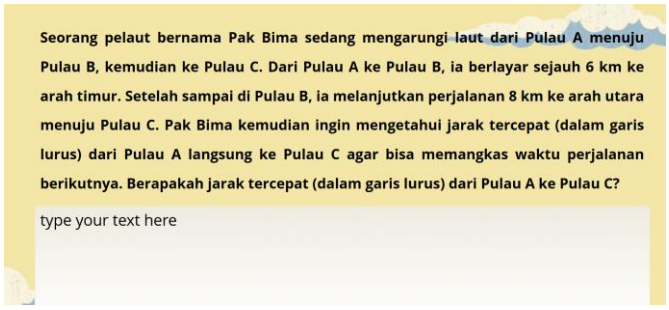


**Figure 15.** Quiz View Before Revision

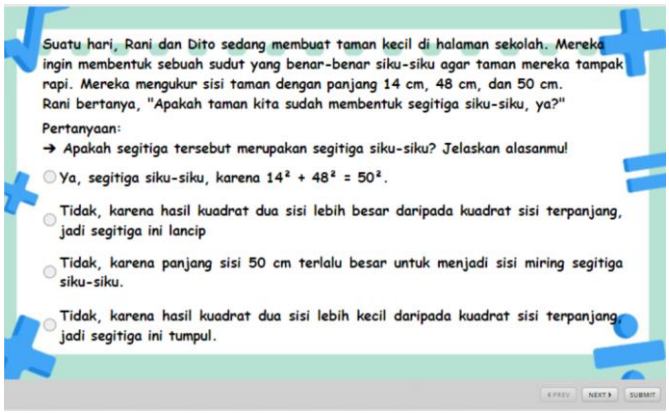


**Figure 16.** Quiz View After Revision

The results of the material expert validation can be seen in table 3 below.

**Table 3**. Results of validation of material on media

| No. | Aspect | Indicator | Average Score for Each Aspect |
|---|---|---|---|
| 1. | Subject identity. Formulation of Learning Achievements and Learning Objectives | Clarity and completeness of information regarding the identity of Interactive Learning Media. | 3 |
| | | Suitability of the content of Interactive Learning Media materials with CP and TP. | 4 |
| 2. | Polya's Problem Solving Approach | The presentation of the material meets the criteria of Polya's problem-solving approach. | 3 |
| | | There are stages of Polya's problem-solving at the beginning of learning. | 3 |
| | | | 3 |
| | | Examples of problem questions and questions contained in Interactive Learning Media meet the criteria of Polya's problem-solving approach. | 4 |
| 3. | Material | Clarity of learning topics. | 3 |
| | | The material is arranged sequentially. | 4 |
| | | The accuracy of the coverage of learning materials. | |
| | | Completeness of the material. | 4 |
| | | The suitability of the language used with the level of student thinking. | 4 |
| | | The use of language effectively and efficiently in explaining the material. | |
| 4. | Evaluation | The suitability of evaluation questions with the material taught in Interactive Learning Media. | 4 |
| 5. | Concept understanding | Clarity of material in helping students understand concepts | 3 |
| | | Example questions given are relevant and able to help students understand the concept of the Pythagorean theorem | 3 |
| | | | 3 |
| | | Evaluation questions given have covered all aspects of understanding concepts so that they are effective in measuring students' understanding of the concept of the Pythagorean theorem | |
| 6. | Learning resources | Clarity of reference | 3 |
| | | Validity Score | 3,4 |

Based on Table 3, the validity score obtained is 3.4. This indicates that the media is valid. Based on these validity test results, it can be concluded that the media can be considered valid and is ready for testing. Based on the validation and testing results, the application-based learning media on the Pythagorean theorem material is declared valid. The validity of this media is supported by the assessments from media and content experts. The validation results show a media expert score of 3.5 and a content expert score of 3.4, indicating that each evaluated aspect meets the feasibility criteria. The small-scale trial results on the developed media indicate that students provided positive feedback on every assessed aspect. Additionally, the trial also showed that the media effectively increased students' interest in learning mathematics.

The developed application-based learning media not only presents the Pythagorean theorem material in various forms but also encourages active student engagement throughout the learning process. In the T-Solve application, learning videos are provided to help students understand concepts through visual explanations and contextual problem examples. This creates a more interactive learning experience because students are not only reading the material but also listening to explanations and observing the direct application of concepts.

This application-based learning media is also equipped with problem-solving exercises in the form of interactive games integrated directly into the T-Solve application. The game is designed to make students more interested in solving problems related to the Pythagorean theorem while deepening their understanding of problem-solving. The problems presented are arranged in such a way that students gain a more meaningful and enjoyable learning experience.

In general, the advantages of the T-Solve application as an interactive learning media are as follows: (1) the user interface is designed to be simple yet attractive and easy to use for students; (2) the application provides complete and structured Pythagorean theorem material to support independent learning; (3) interactive presentation of material through videos, contextual examples, and visualizations provides a more engaging learning experience; (4) all content is presented in Indonesian, making it easy for students to understand; (5) problem exercises and quizzes in the application are arranged based on Polya's problem-solving steps; and (6) the available interactive game feature helps increase students' motivation and interest in learning mathematics in an enjoyable way.

Although it has several advantages, the T-Solve application also has some limitations: (1) the material presented is more focused on enhancing students' understanding, and does not fully address other skill aspects; (2) the bilingual language use in the application has not been fully implemented and is still limited to certain sections; and (3) the number of exercise questions is still limited, so the variation of questions for independent student practice needs to be increased.

## CONCLUSION

This study aimed to develop the interactive learning media "T-SOLVE" based on Polya's problem-solving approach to enhance students' conceptual understanding of the Pythagorean Theorem. The findings indicate that this media had a significant positive impact on students' ability to solve mathematical problems, particularly in identifying triangle types based on the Pythagorean Theorem. The media contributed to increasing students' learning motivation and conceptual comprehension through interactive and self-directed learning experiences. Compared to previous research, such as Lase & Sirega (2023) who developed learning media using Lectora Inspire, T-SOLVE has the advantage of integrating Polya's structured steps into an application built with Articulate Storyline, guiding students systematically through problem-solving stages in a more engaging and explorative format. This study is expected to serve as a foundation for further development of problem-based interactive learning media across various mathematical topics and with broader participant samples. The implication is that this kind of media can support effective independent learning and align with the educational demands of the 21st century.

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