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# Development of Smart Apps Creator Media with IDEAL Approach to Improve Mathematics Problem Solving Ability in Elementary School

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**Abstract:** Students' less-than-optimal ability to solve math problems is crucial in today's education. This research aims to develop Smart Apps Creator media with the IDEAL approach to improve students' ability to solve math problems. The method used is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The research subjects in the small-scale trial were 15 fourth-grade students of SDN Karangayu 03, while the large-scale trial was 27 fourth-grade students of SDN Karangayu 01. The initial data collection in this study involved documentation, interviews, questionnaires, and observations. The research instruments used include pretest and post-test to measure the effectiveness of the media, as well as expert validation to assess the feasibility of the developed media. The paired sample t-test analysis in the small group showed a t-count value of -19.587, smaller than the t-table value of 2.145, while in the large group, the t-count value obtained was -33.771, smaller than the t-table value of 2.056. This result shows a significant difference between both groups' pre-test and post-test results. The use of smart apps creator learning media with the IDEAL approach proved to be very effective in improving students' problem solving abilities. This is evidenced by an increase in pretest and post-test scores, with an N-gain test value in the small group of 0.69, which is included in the medium category, while in the large group, it is 0.83, which is included in the high category. Developing smart apps creator learning media with an IDEAL approach is valid, practical, and effective in improving students' mathematical problem-solving abilities.

**Keywords:** learning media, smart apps creator, problem-solving, IDEAL.

## ▪ INTRODUCTION

Today's rapidly changing world makes 21st-century competencies and the need for high-quality education even more critical. Technology renewal in education can fulfill the need to develop learners' competencies in the 21st century (Niño et al., 2024). In the current era of global development, several competencies are essential, such as communication, collaboration, critical thinking, problem-solving, creativity, and character education (Drake & Reid, 2020). Problem-solving abilities are one of the most needed abilities in the 21st century (Wadtan et al., 2024). Problem-solving is considered crucial because it can help individuals analyze situations, think critically, and find practical solutions (Choudhar et al., 2022). Many students have difficulty solving problems, especially in mathematics learning, which is often caused by cognitive deficits, concept understanding, motivation, learning environment, and language (Agostini et al., 2022; Viesel-Nordmeyer et al., 2023).

Education not only focuses on academic knowledge but also developing abilities relevant to the needs of the 21st century to support students in adapting to change (Islam et al., 2022). Teachers have a vital role in the success of education. Continuous teacher training is needed to increase their innovation and creativity in designing effective learning so students can understand the concepts deeply (Valdivia & Palomino, 2023). By introducing appropriate training, teachers can develop the necessary ability to

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overcome challenges in modern education (Kwaah et al., 2022). Introducing technology to teachers is crucial to ensure that teachers can use varied and effective learning media (North et al., 2024).

Learning media has a significant function in supporting the achievement of learning objectives. Teachers can use learning media to deliver material and increase student interest in the learning process, making it more interactive and engaging (Sukavatee & Khlaisang, 2023). In realizing these goals, multimedia is an ideal representation of effective learning media. Multimedia is an attractive combination of various media elements, including text, visual, audio, video, and animation, integrated into a computer program to facilitate interactive communication with learners (Çeken & Taşkın, 2022). By combining these elements, multimedia offers variety in the delivery of information and has the potential to accommodate students' various learning styles, thus strengthening its appeal and effectiveness as an interactive and engaging learning tool.

Mathematics is a core subject that must be taught at various levels of education. Learning media is crucial in helping students understand mathematical concepts because many students often consider mathematics challenging (Cruz Neri et al., 2021; Ndagijimana et al., 2024). One of the factors that cause students to experience difficulties in learning mathematics is influenced by low problem-solving abilities. Students' low mathematical problem-solving abilities are often related to problems in understanding and applying basic mathematical concepts in real situations. Students face various challenges in learning mathematics, namely difficulties in calculating, understanding basic operations, and using mathematical concepts in problem-solving (Filiz & Güneş, 2023). Therefore, the quality of learning teachers facilitate significantly impacts students' ability to solve mathematical problems. In this case, there are several approaches to solving math problems, including IDEAL. IDEAL problem-solving indicators according to Bransford & Stein (1993: 20-38) in Buzduga & Rodrigues, (2022) , there are five steps, namely 1) Identify the Problem; 2) Define the Goals; 3) Explore Possible Strategies; 4) Act on the Strategies; 5) Look Back and Learn. Learners must have high problem-solving ability in mathematics, as this is the standard for all competencies at all levels of educational units (Santos-Trigo, 2024; Szabo et al., 2020).

Data from TIMSS (Trends In International Mathematics and Science Study) in 2015, which involved 53 countries, ranked Indonesia 49th with a math score of 397 points. Based on the TIMSS 2015 survey results, Indonesia has a percentage of mathematical problem-solving abilities that is still below international standards; this is reinforced by the reality in schools (Sari & Ekayanti, 2022). In response to the TIMSS 2015 results, which show that Indonesian students' mathematical problem-solving abilities are still lagging, various intervention efforts are crucial, including initiatives that focus on developing teacher competencies to create more interesting and practical learning.

Previous research has also identified problems related to students' problem-solving ability. Research conducted by A. Lagria & C. Pañares, (2023) found that students' ability to solve mathematical problems is strongly influenced by conceptual understanding, proficiency in mathematical abilities, and positive emotional attitudes toward mathematics. These findings imply that the development of mathematical problem-solving ability depends not only on the mastery of procedures but also on a solid foundation of understanding and the formation of affective attitudes that support students'

engagement and perseverance in facing mathematical challenges. Another study by Svraka et al., (2024) stated that cognitive abilities, emotional responses to mathematics, and learning environment conditions influence students' unsatisfactory mathematical problem-solving abilities. Thus, this study indicates that improving mathematical problem-solving requires attention not only to intellectual aspects but also to managing students' emotions and creating a conducive learning environment.

Efforts to improve the quality of learning should consider adopting and developing media that can attract students' attention, facilitate a deeper understanding of concepts, and encourage active involvement in learning activities. The application of interactive multimedia in learning has a great opportunity to increase the effectiveness of learning implementation (Tuma, 2021). In a study conducted by Mahuda et al. (2021), the development and implementation of Android-based learning tools designed using brilliant app creators improved the quality of mathematics learning while empowering students' ability to solve mathematical problems. This finding indicates that technology, especially interactive applications easily accessible through mobile devices, has great potential to transform mathematics learning practices and improve student learning outcomes. This is reinforced by the research of Khotimah et al., (2023) that the utilization of brilliant app creators in the context of classroom learning can significantly increase students' engagement with the subject matter and positively impact improving their academic achievement. These findings imply that integrating easy-to-use app development tools can create more engaging and meaningful student learning experiences

The IDEAL strategy can effectively improve students' mathematical problem-solving abilities (Puma et al., 2020). These findings indicate that a structured approach such as the IDEAL strategy can provide a clear and systematic framework for students facing mathematical challenges, thus facilitating the development of better problem-solving abilities. Research conducted by Kurniasih, (2021) explains that combining the IDEAL model with the "Beko" learning media effectively improves student achievement in mathematics, especially in learning the circumference and area of a circle. This finding implies that the synergy between structured learning strategies and concrete and attractive media can be a powerful approach to improving students' concept understanding and learning outcomes in mathematics.

Previous research has explored the effectiveness of smart app creators and IDEAL strategies separately in mathematics learning; no research explicitly integrates brilliant app creators with the IDEAL approach in flat area measurement material to improve students' mathematical problem-solving abilities. This combination is essential because the brilliant app creator offers flexibility and interactivity in presenting materials and problem-solving exercises visually and engagingly. At the same time, the IDEAL approach provides a systematic cognitive framework to guide students through the problem-solving process. The unique contribution expected from this research is to produce learning media that not only presents area measurement material innovatively through brilliant app creators but also embeds the steps of the IDEAL strategy in its design and activities so that it has the potential to have a more significant impact on the development of students' problem-solving ability than the use of smart apps creator or IDEAL strategy separately.

Based on the background and gap analysis above, the problem of this study is: "How is the validity, practicality, and effectiveness of Smart Apps Creator-based learning media

with the IDEAL approach in improving the mathematical problem-solving ability of grade IV students on flat area measurement material?"

## ▪ METHOD

### Participants

This research was conducted in three elementary schools in Karangayu, namely SDN Karangayu 01, 02, and 03. The selection of these three schools was based on considerations of researcher accessibility and variations in student characteristics and learning environments between different schools. The main subjects in this study were classroom teachers in the three schools. The research instrument trial involved all students in grades IVA and IVB of SDN Karangayu 02, with a total of 48 students. In addition, a small-scale trial was conducted on 15 fourth-grade students from SDN Karangayu 03. Sampling for the small-scale trial used a purposive sampling technique based on students' ability levels. The grouping of student ability levels (high, medium, low) was based on analyzing report card scores in mathematics and recommendations from class teachers. Several students were purposively selected from each ability group to represent the variation of ability in responding to the instrument. The large-scale trial involved 27 fourth-grade students of SDN Karangayu 01. The selection of fourth grade at SDN Karangayu 01 using convenience sampling was based on the ease of access of researchers and the availability of collaboration time with the class teacher.

The team of experts who served as validators in this study consisted of media, material, and language experts. These three expert validators are Semarang State University lecturers with expertise in their respective fields. The media expert has an educational background and experience developing interactive learning media. The material expert is a mathematics education lecturer specializing in elementary school mathematics curriculum and assessment. The linguist involved has a linguistic and educational background and is experienced in editing academic materials. The object of this research is the math problem-solving ability of grade IV students.

### Research Design and Procedures

This research is a development research or Research and Development (R&D) type. The Research and Development method is a research approach that aims to produce products while testing their effectiveness (Sugiyono, 2021). The model used in this research is ADDIE. The period for this study was from March 6, 2024 - February 7, 2025.

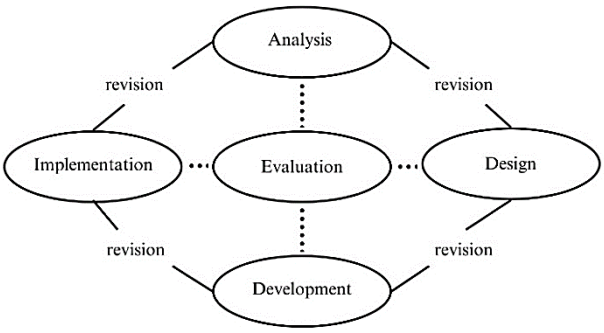


**Figure 1.** Steps of the ADDIE model

Based on Figure 1, the ADDIE model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The first stage is analysis; this stage is done by analyzing the results of identifying needs, student characteristics, and learning materials. Based on teacher interviews and student needs questionnaires, focusing on applying of technology-based learning media is essential to improve learning quality. Furthermore, the analysis also highlights students' learning difficulties in certain materials in mathematics, especially in measuring the area of flat buildings. Then, the model or strategy that teachers often use in learning mathematics. In addition, the initial analysis also mapped students' ability to solve math problems as the primary focus of the research. Based on the students' questionnaires, the ideal learning media is interactive, visually appealing, easy to use, and presents contextual and relevant material to everyday life.

The second stage is design; this stage focuses on designing the product to be developed. The product development process includes creating a storyboard using Microsoft Word to visualize the navigation flow and layout, designing the visual appearance of the media with Canva, and editing the apperception and question videos using Capcut. The storyboard is a visual guide that details the movement between pages, the placement of visual elements and text, and how users interact with the media. While design in Canva focuses on visual aesthetics, color selection, typography, and attractive graphic elements that match the characteristics of elementary school students.

The third stage is development; at this stage, the learning media products designed in the previous stage begin to be realized and functioned. After the storyboard design and initial display design are evaluated by expert validators, a one-time iteration or revision process is carried out based on the input provided. Feedback from the validators was carefully integrated into the final product. Specifically, based on the material expert's assessment, the revisions made included the need for visualization of numbers when looking for flat shape formulas, the addition of relevant example problems after each slide of flat shape formulas, giving sequential numbers to each example problem to make it more straightforward, adjusting images and problems to be more in line with reality, and changing the names and objects in the questions to make them more varied. Input from linguists was implemented by including a clear source in the opening video, improving capitalization according to Indonesian language rules, and fixing punctuation. This development process aims to produce learning media that is engaging and interactive, materially accurate, and uses good and correct language.

The next stage is implementation, which is testing the media in class for 3 JP each meeting. The teacher acts as an observer and facilitator from behind the scenes. Students worked in groups using the media application to encourage collaboration and discussion. The use of mobile phones was regulated by being collected before the lesson, distributed when the learning started and collected again after the quiz was completed. Classroom learning followed the steps of the PBL (Problem-Based Learning) model, where students faced contextual problems, collaborated to find solutions, conducted investigations, presented results, and evaluated the learning process.

The final stage is an evaluation to measure the effectiveness of the media. The pre-test and post-test each lasted 50 minutes. The pre-test was conducted before implementation, and the post-test after the entire implementation series was completed (after the second meeting). The test was closely monitored by two supervisors, one at the front and one at the back of the class.

**Instruments**

This research uses various data collection instruments to understand the phenomenon under study comprehensively. The data collection used in this study was as follows: (1) In-depth interviews were conducted with each class teacher from the three schools, using semi-structured interview guidelines that focused on mathematics learning in grade IV; (2) Observation was conducted to directly observe the mathematics learning process in grade IV at SDN Karangayu. The aspects observed were the use of media, learning methods or models used, student characteristics, and student's ability to solve math problems. (3) The expert validation instrument in this study was an expert validation questionnaire, which aims to measure the level of validity of the learning media developed before implementation. The validation process involves material experts, linguists, and media experts; (4) Media practicality instruments in the form of teacher and student response questionnaires to smart apps creator media with the IDEAL approach; (5) To assess the effectiveness of the learning media developed, pre-test and post-test instruments are used.

The following is an explanation of the aspects assessed by expert validation. Aspects assessed by material experts include two main things. First, the material feasibility aspect, which includes a description that the material in the developed learning media is easy to understand, can improve students' mathematical problem-solving ability, broaden students' insights about area measurement, and provide a deep understanding of area measurement. Second, the suitability aspect of the material, which includes a description that the learning media developed is by the applicable learning outcomes, relevant to existing learning materials, aligned with predetermined learning objectives, able to present questions that are relevant to learning outcomes, contain videos that are by the material and learning outcomes, present IDEAL problem-solving stages that are relevant to the material and learning outcomes, and present a summary of learning material that is by learning outcomes.

The aspects assessed by linguists include three main things. First, aspects of sentence effectiveness, with a description that the sentences used can convey the intended information precisely, do not cause double meaning and are arranged at each stage of IDEAL problem-solving. Second is the aspect of language rules, with descriptions that include grammatical accuracy, correct use of conjunctions, punctuation accuracy, suitability of using letters and writing words with PUEBI, and correct use of verbs, adjectives, and adverbs. Third, the communicative aspect includes descriptions that include ease of understanding of the information conveyed, the use of short, concise, and clear sentences, and the selection of sentences that are by the student's level of understanding.

The aspects assessed by media experts include four main things. The first aspect is the usefulness of learning media, with a description of the suitability of the learning media developed with the expected media functions, its ability to turn on communication in learning, its potential to improve students' mathematical problem-solving ability, and its ability to improve students' understanding of area measurement material. The second aspect is the feasibility of learning media, with a description of the suitability of the image size, font size, and color combination on the appearance of the learning media developed, the readability of the writing in it, and the suitability of the animation used. The third aspect is the presentation of learning media, with a description of the ease of use of the learning media developed, the conciseness of the learning media design in the learning

flow, the suitability of learning media to increase students' passion for learning, its ability to increase student interest and motivation, its potential in improving the quality of learning, the ease of use of navigation, and the accuracy of navigation functions in the learning media developed. The fourth aspect is the suitability of learning media, with a description of the suitability of learning media to the needs of students, not excessive use of images and text in learning media, the suitability of decorations on the media display to the needs, the harmony of sound with the material presented, the accuracy of image placement in learning media, the suitability of background selection in learning media, and the accuracy of using language that is easy to understand in the learning media developed.

On the other hand, the teacher response questionnaire consists of five aspects, namely: presentation (two questions), learning media function (five questions), material suitability (five questions), IDEAL problem solving (five questions), and language and sentences (three questions). The student response questionnaire measured four main aspects: the functionality of the learning media (through three questions), the quality of the language and sentences used (through three questions), the suitability of the material to learning needs (through four questions), and the ability of the media to support problem-solving based on IDEAL steps (through five questions).

The process of developing pretest-posttest questions in this study followed systematic steps, which included identification of learning objectives and indicators, preparation of question grids, writing question items, reviewing questions, revising questions, testing questions, analyzing question items, selecting and compiling questions into pretest and post-test instruments, and finalizing instruments. To test the quality of the instrument, validity, reliability, difficulty, and differentiation tests were conducted using SPSS statistical software. The validity test was conducted to ensure that the questions developed measured students' mathematical problem-solving ability related to the area of flat buildings. The results of the validity test of 30 multiple-choice questions can be seen in Table 1.

**Table 1.** The results of the validity test of the test questions

| Categories | Question Item Number |
|---|---|
| Valid | 2.4.7.8.9.10.11.12.14.15.16.17.18.19.20.21.22.23.24.25.26.27.29 |
| Invalid | 1.3.5.6.13.28.30 |

Based on Table 1, the validity test results on the trial questions show that 23 questions are categorized as valid, while seven other questions are invalid. The reliability test is carried out to measure how consistent the instrument is in providing similar results. Reliability analysis using SPSS with the Alpha Cronbach method aims to see the extent to which the items in the instrument are related and measure the same construct consistently. The reliability test results obtained a value of 0.754, which means that this instrument meets the criteria for good reliability.

Indicators of mathematical problem-solving ability are measured from 23 questions with valid categories. The first indicator, namely, students can calculate the area of a square, rectangle, parallelogram, and trapezoid in problem-solving, which consists of 10 questions. An example of a problem in this indicator is when a picture is presented, then a question is given, "Mr. Anton has a square tile with a side length of 15 cm. What is the area of the tile?". Second, students can calculate the area of a square, rectangle,

parallelogram, and trapezoid in story problems and analyze the available information, which consists of 9 problems. An example of a problem on this indicator is "Grandpa has a parallelogram-shaped field that will be used to grow grass. The length of the side of the base of the field is 18 meters, and the height is 12 meters. How much land area will grandfather plant grass?". Third, students can solve contextual problems related to square, rectangle, parallelogram, and trapezoid flat shapes of 4 problems. An example of a problem in this indicator is presented with a picture, then given the question, "A rectangular land with a length of 25 meters and a width of 15 meters, the land will be planted with grass except in the middle, which is a square with a side length of 10 meters. How much area will be planted with grass?".

**Data Analyses**

The data analysis techniques used in this research include validity, practicality, and effectiveness tests. The validity test aims to see the feasibility of a product used in research. Users fill in the media practicability instrument to see the user's response to the smart app creator media with the IDEAL approach. The instrument assessment uses a Likert scale, which is then converted into a percentage for interpretation. The interpretation criteria used are the percentage of 0% - 20% is categorized as very inappropriate, 21% - 40% is categorized as inappropriate, 41% - 60% is categorized as quite feasible, 61% - 80% is categorized as feasible, and 81% - 100% is categorized as very feasible. Instrument data management is assessed using a Likert scale score, namely very feasible (4), feasible (3), inappropriate (2), and very inappropriate (1) (Sugiyono, 2021).

The effectiveness of the media was obtained from the results of the Pretest and Post-test, which consisted of 23 questions on mathematical problem-solving ability. The effectiveness of learning media is seen from the Normality Test, Paired Sample T-test, and N-gain Test using SPSS.

## ▪ RESULT AND DISSCUSSION

Developing Smart Apps Creator learning media based on the IDEAL approach to improve mathematical problem-solving abilities has gone through the ADDIE model development procedure. The achievements at each level of development will be explained below:

**Analyses**

The analysis stage in this research includes teacher interviews, distributing questionnaires on student and teacher needs, and observing the mathematics learning process. This analysis aims to identify the most suitable media for students. The problems revealed are teacher-centered learning, lack of innovative media, and lack of problem-based exercises, which impact students' conceptual understanding and analytical ability. The needs analysis results show that students need interactive and engaging learning media such as intelligent app creator, which is equipped with materials, sample problems with IDEAL (Identify, Define, Explore, Act, and Look Back) problem-solving steps, problem videos, and problem exercises. Using innovative learning media, especially technology-supported, positively influences students' understanding of mathematical concepts and problem-solving ability (Carstens et al., 2021).

**Design**

The design stage is carried out by designing the product to provide a comprehensive description of the contents of the learning media to be developed. The steps include making storyboards, compiling materials, and designing media displays.

The storyboarding stage is in Microsoft Word to develop a learning media framework. The display design stage was carried out using the Canva application. The first step is to create a blank white sheet about the size (16:9). The next step is to choose interesting elements according to the material used in the media. Researchers used the Canva application to select the elements used. The Canva application can be a tool for graphic design that makes it easier for users in the design process (Dündar & Dönmez, 2023). The preparation of expert validation sheets and response questionnaires in this study was systematically designed. This design process uses a comprehensive grid, referring to the relevant theoretical basis.

**Development**

The development stage is done by turning the product design into reality. Visual display of IDEAL Broad Zone learning media made using Smart Apps Creator 3 software with the IDEAL approach to improve mathematical problem-solving ability and suggestions for improvement from experts.

In this learning media, there is an initial display of the media displaying the UNNES logo, Kemdikbudristek, Merdeka Curriculum, the name of the media, namely the IDEAL broad zone, menu buttons, and developer identity buttons. This media is also equipped with audio that can provide direction and explanation to users. After pressing the menu button, the material topic page, which contains square and rectangular material, will be presented at the first meeting, while the second meeting will be about parallelograms and trapezoids. Users can press the button according to the topic of material to be studied, which will display the main menu of the media consisting of learning outcomes, material, video problems, practice questions, and bibliography. Before the sample problems are presented, this learning media discusses measuring the area of flat shapes, such as square and rectangular planes. It also explains how to find the area formula of the two flat shapes so that students can better understand the material being taught.

Figure 2 shows an example problem and its solution using the IDEAL problem-solving steps: Problem Identification. Students must understand the explanation or information in the parallelogram area measurement problem at this stage. Students must identify that the problem is to calculate the area of a parallelogram. Students must understand what information is given, such as the base and height of the plane.


**Figure 2.** IDEAL steps (identify the problem)

Figure 3 shows the solution using the IDEAL problem-solving steps: Define the Goals. Students need to determine the goal of solving this problem: correctly calculate the area of the parallelogram shape of the land.

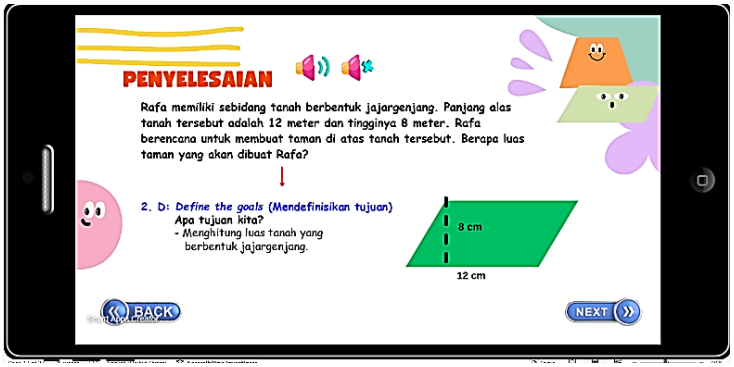


**Figure 3.** IDEAL steps (define the goals)

Figure 4 displays the solution using the IDEAL problem-solving step: Explore Possible Strategies. At this stage, students must determine the strategies or solutions that can be applied to solve the defined problem.

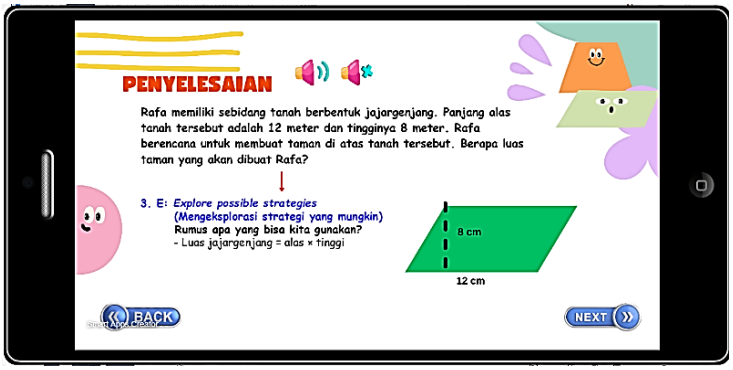


**Figure 4.** IDEAL steps (explore possible strategies)

Figure 5 displays the solution using the IDEAL problem-solving step of Act on the Strategies. The next step is to apply the strategy using the base and height information that was previously known.

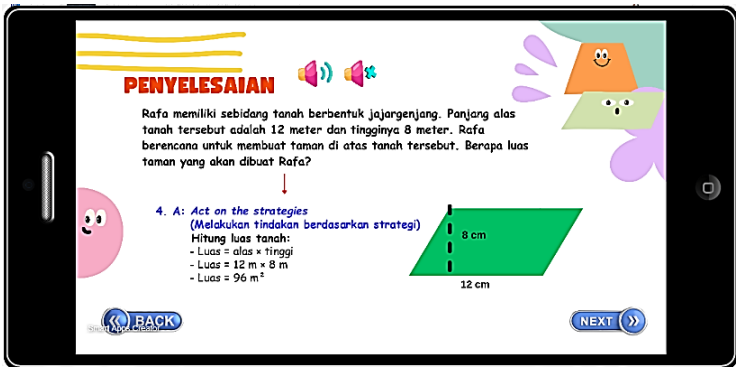


**Figure 5.** IDEAL steps (act on the strategies)

Figure 6 displays the solution using the IDEAL problem-solving steps of Look Back and Learn. The last step is to reflect on the steps done and learn from the process. Through this reflection, students can strengthen their understanding of the material learned and their ability to apply problem-solving steps.


**Figure 6.** IDEAL steps (look back and learn)

Users can find instructions for working on practice questions in the question menu. Pressing the "next" button at the bottom right corner will take the user to the question page, as shown in Figure 7. The user's score will be updated automatically at the top right corner, and the "back" button is available at the bottom left corner. After answering the question and pressing the "next" button again, the final score will be displayed, with the option to repeat the exercise or return to the main page.


**Figure 7.** Problem exercise display

Smart apps creator learning media with an IDEAL approach can be accessed using a cellphone by downloading and installing the APK file via the link https://bit.ly/APKZONALUASIDEAL. The next step is validation by validators, namely UNNES lecturers. Some parts of the media need to be improved. Based on the validation results, several aspects of the media need to be improved before being tested. The material expert gave revision notes, namely: (1) the need for visualization of numbers when finding the formula for flat shapes; (2) the addition of sample problems after presenting the formula; (3) the addition of numbers in each example; (4) the suitability of pictures and problems with real contexts; (5) the use of names and objects that are more varied. Then, linguists provided revision notes: (1) include the source in the apperception video

section; (2) improve the use of capital letters and punctuation. Based on the validation of media experts, this learning media product is declared suitable for testing without requiring further improvement. Based on the results of expert validation, the material feasibility value is 90.9% with a very feasible category, the media feasibility value is 92.7% with a very feasible category, and the language feasibility value is 95% with a very feasible category. Thus, the average overall feasibility value is 92.8%, with a very feasible classification. Thus, the average overall feasibility value is 92.8%, with a very feasible classification. This learning media is very feasible to use in learning activities. This is also by the research of Handayuni & Zainil, (2023), who developed mathematics learning media on multiplication and division of decimal numbers using smart apps creator software with very feasible media validity criteria based on the assessment of material experts, linguists, and media experts. Products revised according to expert suggestions are tested on 15 fourth-grade students at SDN Karangayu 03. The selection of students is based on the student's ability level criteria. Furthermore, teachers and students completed a questionnaire to provide feedback on the smart app creator learning media integrated with the IDEAL approach.

**Implementation**

This implementation stage is carried out by applying the learning media that has been developed, namely the smart apps creator media, with the IDEAL approach in learning activities. Learning activities were carried out for 15 fourth-grade students of SDN Karangayu 03 as a small group and 27 fourth-grade students of SDN Karangayu 01 as a large group in the 2025/2026 school year.

The initial activity was to give students pretest questions before using learning media. Pretest activities are carried out by giving multiple-choice questions to students that have been prepared based on indicators of mathematical problem-solving. The next activity is using learning media, which is carried out in two meetings. Students use cell phones to access learning media. Students can listen and read material, watch video problems, read material summaries, and work on practice questions. The activity continued with giving post-test questions to students.

In the implementation of product trials at SD Negeri Karangayu 03, researchers found several problems, namely the time allocation, which should have been 3 JP, but due to school renovations, researchers could only do 2 JP at each meeting, then students in the low category needed to be guided or given more direction. Therefore, in implementing the product usage trial, researchers made sure to carry out learning with 3 JP at each meeting and guiding or giving more direction to students in the low category.

The application of smart app creator media with the IDEAL approach in learning is supported by using a problem-based learning model, according to Schmidt and Moust (2000) in Havenga et al., (2023: 4-5). The application of smart app creator media with the IDEAL approach is carried out in the core activities of the learning process. The steps of the problem-based learning model, namely: (1) students have been divided into three groups of 5 members per group. Students open the smart apps creator application/media and are directed to watch an apperception video about the area measurement using standard units. Students watch video problems on the media. (2) the teacher guides students to study the material according to the meeting; the first meeting measures the area of square and rectangular flat shapes, and the second meeting measures the area of

parallelogram and trapezoid flat shapes. After reviewing the material and sample problems in the content section, the teacher guides each group to solve the problem in the video problem by following the steps of the IDEAL problem-solving approach. The solution is then discussed together; (3) Each group is instructed to work on the LKPD that has been distributed, each group member conveys what they understand and what they do not understand from the problem; (4) each group member analyzes and organizes the results of group discussions; (5) formulates what strategies need to be used in solving problems; (6) each group member actively participates in working on LKPD; (7) each group takes turns presenting the results of their discussions and other groups provide suggestions and appreciation for the presenting group.

**Evaluation**

Student responses were assessed through a questionnaire with "yes" and "no" answer options. There were four aspects evaluated: (1) learning media function, consisting of three questions with a total of 81 answers that reached 100%; (2) language and sentences, consisting of three questions with a total of 77 answers that reached 95.23%; (3) material suitability, consisting of four questions with a total of 108 answers that reached 100%; and (4) IDEAL problem solving, consisting of five questions with a total of 135 answers that reached 100%. Based on the responses from 27 students who participated in the learning, a total of 401 "yes" answers were obtained, with an overall percentage of 99%.

The evaluation stage also involves giving a response questionnaire to the teacher, with the answer options strongly agree, agree, neutral, disagree, and strongly disagree. The evaluation results from the distribution of teacher response questionnaires showed the following: (1) presentation aspect with two questions scored 10, which reached 100%; (2) function and learning media aspect with five questions scored 25, which reached 100%; (3) material suitability aspect with five questions scored 25 which reached 100%; (4) IDEAL problem-solving aspect with five questions scored 25 which reached 100%; and (5) language and sentence aspect with three questions scored 12 which reached 80%. Based on the results of teacher responses to Smart Apps Creator media with the IDEAL approach consisting of 20 questions, a total score of 97% was obtained. These results indicate that the smart apps creator learning media with the IDEAL approach is efficient for use in the classroom. Research conducted by (Handayuni & Zainil, 2023) also shows that smart app creator learning media has a high practicality.

To test the effectiveness of this learning media, students worked on pretest questions before and post-tests after using the media. Students were given multiple-choice questions totaling 23 questions. The questions were developed based on indicators of mathematical problem-solving ability. As illustrated in Figure 8, the post-test results showed higher scores than the pretest results. Research conducted by Choirudin et al. (2025) also confirmed that the use of interactive learning media had a positive effect, with an increase in the average value of the final test by 25% compared to the initial test. The results of the average pretest and post-test scores of small groups and large groups can be seen in Figure 8.

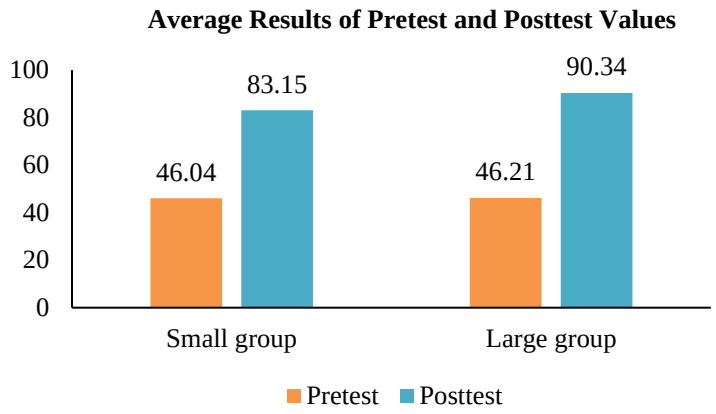


**Figure 8.** Average results of pretest and posttest values

Based on Figure 8, the results in the small group showed an average value of 46.04 in the pretest and increased to 83.15 in the post-test. In the large group, the pre-test results showed an average score of 46.21, which then increased to 90.34 in the post-test.

The normality test, paired sample T-test, and N-gain test were conducted to determine the effectiveness of improving mathematical problem-solving ability. Normality tests for pretest and post-test scores of small and large groups used Kolmogorov-Smirnov and Shapiro-Wilk tests with the help of the SPSS application. The Kolmogorov-Smirnov test results showed that the significance of the pretest in the small group was 0.194, and in the large group was 0.197. For post-test scores, the Kolmogorov-Smirnov test showed significance in the small group of 0.117 and the large group of 0.200. Furthermore, the Shapiro-Wilk test results showed the significance of the pretest in the small group of 0.279 and the large group of 0.101. For post-test scores, the Shapiro-Wilk test showed significance in the small group of 0.062 and the large group of 0.102. Based on the results of these two tests, the pretest and post-test data for the small and large groups are normally distributed because the significance value in each test is greater than 0.05. Furthermore, a paired sample t-test was conducted on the small and large groups. The t-test results in the small group showed a t-count value of -19.587, smaller than the t-table value of 2.14479. Meanwhile, in the large group, the t-count value obtained was -33.771, also smaller than the t-table value of 2.05553. Thus, the results of the comparative analysis between the pre-test and post-test show that this media significantly improves students' mathematical problem-solving skills. The comparison analysis between the pretest and post-test showed that this media significantly improved students' mathematical problem-solving ability.

Based on the data shown in Figure 9 shows the N-Gain score of each indicator measured in this study. Indicator 1 in the small group scored 0.42, and the large group scored 1.26. Indicator 2 in the small group scored 0.24, and the large group scored 1.09. For indicator 3, the results showed a value of 0.36 in the small group, while in the large group, the value obtained was 0.96. This difference indicates that the media implementation on a larger scale substantially improves students' mathematical problem-solving ability for the three measured indicators.

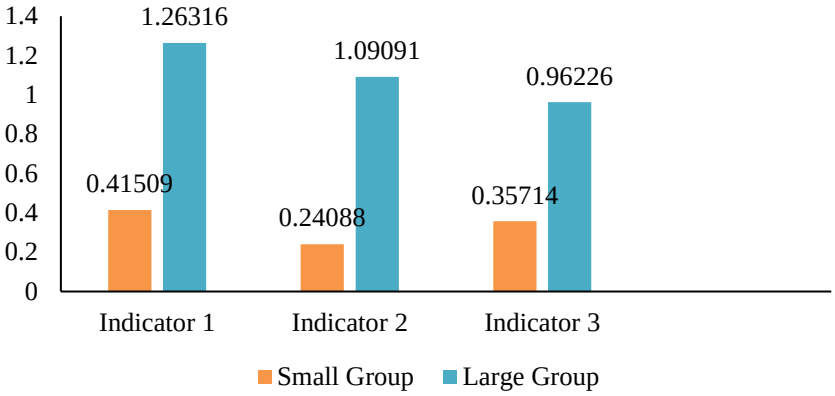


**Figure 9.** Small and large group n-gain score

The average N-Gain on the pretest and posttest scores of the small group was 0.69 and the large group was 0.8324. Based on the N-Gain effectiveness criteria, the small group value is included in the medium category, and the large group is included in the high or very effective category. This shows that using innovative learning media, especially those supported by technology, positively affects students' understanding of mathematical concepts and improves students' ability to solve mathematical problems (Carstens et al., 2021). In addition, applying the IDEAL strategy is a practical approach to improving students' problem-solving ability in mathematics (Puma et al., 2020).

The following presents examples of students' post-test answers based on the IDEAL problem-solving steps used in this study. Figure 10 illustrates that S4 successfully applied the IDEAL steps (Identify, Define, Explore, Act, and Look Back) to solve the problem clearly and accurately.

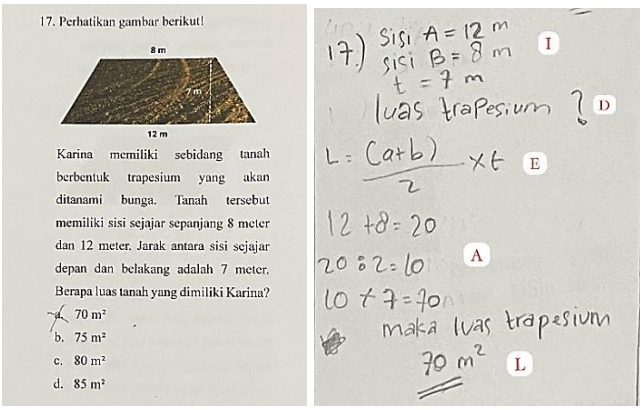


**Figure 10.** Example of student post-test answer results

Figure 11 illustrates S4's ability to select relevant problem-solving strategies for multiple-choice problems, reflecting a good understanding of the Explore Possible Strategies stage in the IDEAL problem-solving framework.

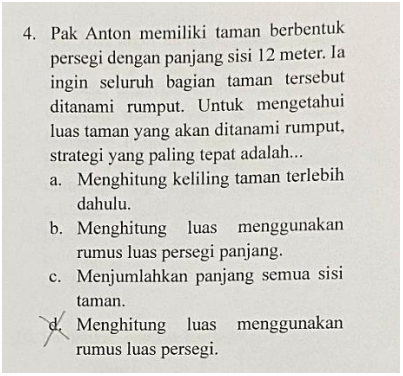
4. Pak Anton memiliki taman berbentuk persegi dengan panjang sisi 12 meter. Ia ingin seluruh bagian taman tersebut ditanami rumput. Untuk mengetahui luas taman yang akan ditanami rumput, strategi yang paling tepat adalah...
   a. Menghitung keliling taman terlebih dahulu.
   b. Menghitung luas menggunakan rumus luas persegi panjang.
   c. Menjumlahkan panjang semua sisi taman.
   d. Menghitung luas menggunakan rumus luas persegi.

**Figure 11.** Example of students' post-test answers for the explore possible strategies step

The effectiveness of smart app creator media in improving mathematical problem-solving ability refers to how its features are designed in line with the principles of cognitivism, constructivism, and cognitive load theory. The interactive nature of the app allows students to engage with the learning material actively. They do not just receive information but engage in discovery, testing, reflection, and repeating less understood parts as needed. This active interaction aligns with constructivism learning theory, where students construct their knowledge and understanding through experience and reflection on that experience (Marougkas et al., 2023). With interactivity, students do not just passively receive information but actively seek solutions and build an understanding of mathematical concepts. This app presents the IDEAL (Identify, Define, Explore, Act, Look Back) problem solving steps according to Bransford & Stein (1993:20-38) in the (Buzduga & Rodrigues, 2022). This explicit structure helps students organize their thought processes systematically. This is highly relevant to cognitivism, which emphasizes how information is processed and organized in the mind (Bakhsh et al., 2022). With a clear step guide, students' cognitive load in remembering the steps of problem-solving is reduced, so more cognitive resources can be allocated to understanding the problem and finding a solution. These steps help students go through the problem-solving process in a structured manner. Presenting problems in an animated video format has several advantages. First, it can increase student engagement and motivation. Second, visualization of the problem context and relevant information can help students identify and define stages of IDEAL. Visual representations can reduce extrinsic cognitive load, i.e., load not directly related to the learning material, which may arise from understanding complex problem descriptions in text form (Gkintoni et al., 2025). With problems that are easier to understand, students can focus more on important aspects relevant to finding solutions. Having practice problems integrated with immediate feedback is an important component of learning. When students work on problems and receive feedback, they can immediately know whether their understanding is correct or incorrect and why. Constructive feedback helps students identify misconceptions and improve their understanding. In addition, relevant and timely feedback can help students gradually build a deeper understanding of the concepts and procedures needed to solve problems (Sujatha & Vinayakan, 2022). Feedback can also direct students back to the IDEAL steps if they make mistakes in the problem-solving process.

Teachers' and students' positive responses to the Smart Apps Creator media with IDEAL approach demonstrated its practicality based on the accessibility and ease of use

of the application, clear structure in guiding problem solving through IDEAL steps, potential to increase student's engagement and motivation to learn through multimedia elements, support for personalized learning through practice and feedback features, and facilitation of independent learning. In addition, practical challenges such as different student characteristics created a less conducive classroom atmosphere at the beginning of the implementation, but this was overcome through direct instruction and explanation and constant supervision during the learning process.

The high validation scores for the Smart Apps Creator media with the IDEAL approach are likely the synergistic result of a strong initial design and an effective revision process based on expert feedback. A strong initial design is reflected in the careful planning of the integration of pedagogical principles relevant to mathematical problem solving, the selection of an app format that is interactive and engaging for students, and the organization of the app usage flow by the IDEAL steps. However, the expert validation process provided essential critical and constructive perspectives. Feedback from material experts, learning media experts, and linguists enabled the identification of potential shortcomings that could be improved upon in the initial design. The revision process that is responsive to this feedback, by making improvements and adjustments based on the experts' suggestions, ensures that the resulting media has a good concept and an effective implementation and complies with educational quality standards. Therefore, the high validation scores reflect the initial design foundation being strengthened and refined through careful evaluation and revision by the experts.

This study found an N-gain value of 0.83 in the large group, which indicates a significant increase in students' mathematical problem-solving ability after using Smart Apps Creator with the IDEAL approach. This finding is in line with a study by Mahuda et al., (2021), which reported an increase in problem-solving ability through interactive media in mathematics, albeit with a lower N-gain value of 0.6, which falls into the moderate category. Similarly, a study by (Puma et al., 2020) on applying the IDEAL model in mathematics learning showed significant improvement, with an effect size of 72.7%. The similarity lies in recognizing that a clear structure of cognitive steps such as IDEAL and visual and interactive representations facilitated by media can significantly assist students in understanding and solving mathematical problems. The higher effect found in this study may be due to the strong integration between Smart Apps Creator and the IDEAL approach, the quality of the media design and implementation, the focus on strategy development, and the characteristics of the learners and the supportive learning context.

## ▪ CONCLUSION

This smart app creator learning media with an IDEAL approach named IDEAL Broad Zone presents materials and sample problems based on IDEAL steps (Identity, Define, Explore, Act, and Look Back) in a structured manner, supported by video problems and practice problems to improve students' mathematical problem-solving ability. Assessments from material experts, media experts, and linguists show that this learning media is highly qualified to be used. Both teachers and students gave positive and enthusiastic responses to this learning media. In addition, the results of statistical tests show that the development of this media has a considerable influence on improving students' mathematical problem-solving ability, with a high level of improvement. This

learning media has proven valid, practical, and effective in improving students' mathematical problem-solving ability.

Suggestions for further research include developing content using smart app creator software that is more varied in improving students' mathematical problem-solving abilities by integrating various materials and increasing the number of more varied questions.

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