

# Development of Mathematics Learning Media Based on Smart Apps Creator Integrated with GeoGebra

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**ABSTRACT** This study aimed to develop Smart Apps Creator (SAC)-based mathematics learning media assisted by GeoGebra for teaching lines and angles to Grade VII students at SMP Negeri 4 Tondano and to assess its validity, practicality, and effectiveness. The study employed a research and development (R&D) approach using the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation). Product validity was evaluated by five media experts and four subject matter experts, resulting in scores of 96.7% for the media and 95% for the content, both of which were categorized as highly valid. A limited trial involved nine students representing high, medium, and low ability levels, while the implementation stage involved 26 students from Class VII A. The research instruments included expert validation rubrics, a 14-item student response questionnaire, interview guidelines, and a 10-item learning outcome test. The practicality score obtained from the student response questionnaire was 91.87%, indicating that the media was highly practical. Effectiveness was determined by the percentage of students who achieved the minimum mastery criterion ( $KKTP \geq 75$ ) on the learning outcome test. A total of 88.5% of the students met this criterion, indicating that the media was highly effective. Therefore, the SAC-based mathematics learning media assisted by GeoGebra was considered valid, practical, and effective for use in junior high school mathematics instruction.

**Keywords:** learning media, Smart Apps Creator (SAC), GeoGebra, lines and angles, ADDIE

## INTRODUCTION

Mathematics education at the junior high school level plays an important role in fostering students' logical, analytical, and systematic thinking (Agustinsa et al., 2021). In Grade VII, lines and angles constitute a fundamental topic for understanding geometry (Asnawati & Caswita, 2018). Ideally, instruction should not merely emphasize formula memorization but should promote conceptual understanding through visual, contextual, and interactive approaches (Hartono et al., 2021). Consistent with this goal, the Independent Curriculum encourages teachers to implement student-centered learning,

use digital technology, and integrate media suited to the characteristics of 21st-century learners (Mardiana & Emmiyati, 2024).

However, mathematics instruction in many schools remains dominated by conventional methods using whiteboards and textbooks (Saodah et al., 2024; Siti Kholisah et al., 2024). Such media do not always provide interactive and engaging learning experiences (Pulungan & Rakhmawati, 2022). The limited availability of learning media designed to support students' digital learning preferences may contribute to low engagement and motivation. Similarly, Sulistyaningsih et al. (2022) emphasized that the effectiveness of e-learning in mathematics depends strongly on interactive media that are designed according to students' needs. Therefore, media aligned with the characteristics of 21st-century learners can support conceptual understanding, strengthen thinking skills, and create more meaningful and enjoyable learning experiences (Prasetya et al., 2025).

These challenges were also observed at SMP Negeri 4 Tondano, where mathematics instruction remained dominated by teacher explanations and textbooks, with occasional use of YouTube videos. Students tended to participate passively by taking notes and completing exercises without fully understanding the underlying concepts. Some students also experienced difficulty solving contextual and applied problems. This condition was reflected in the academic performance of Grade VII students during the previous academic year. Data provided by the subject teacher indicated an average mathematics score of 72.76, below the Learning Objective Achievement Criteria (KKTP) threshold of 75.

The gap between the expected and observed conditions highlights the need for innovative technology-based learning media (Oroh et al., 2025). Digital learning media have been shown to improve mathematics learning outcomes significantly (Subiyati et al., 2026). Smart Apps Creator (SAC) provides a flexible interactive platform that enables teachers to create Android applications without programming skills and to incorporate visual, audio, and interactive features for presenting lines and angles in an engaging manner (Hidayah et al., 2023; Mahuda et al., 2021). Meanwhile, GeoGebra is widely recognized as a dynamic mathematics application that integrates geometry, algebra, graphs, and calculus, thereby helping students visualize abstract concepts more concretely (Hohenwarter & Jones, 2007). Recent studies have also confirmed its effectiveness in visualizing mathematical concepts (Kunrade et al., 2023).

Despite these findings, previous research has generally focused either on SAC-based media for other topics, such as solid geometry (Oroh et al., 2025), or on GeoGebra as a stand-alone visualization tool (Hohenwarter & Jones, 2007; Kunrade et al., 2023). Limited attention has been given to integrating SAC and GeoGebra to address students' specific conceptual difficulties with lines and angles, including identifying angle relationships, understanding the properties of parallel lines, and applying angle theorems

to contextual problems. This integration combines SAC's interactive features with GeoGebra's dynamic visualization, providing a medium that is both engaging and supportive of conceptual understanding.

Based on this research gap, the present study aimed to develop and evaluate Smart Apps Creator (SAC)-based mathematics learning media assisted by GeoGebra for teaching lines and angles in Grade VII. The evaluation focused on three aspects: validity, based on expert judgments of content and media design; practicality, based on student responses; and effectiveness, based on student mastery according to the KKTP threshold of at least 75. Thus, the study examined the feasibility of integrating SAC and GeoGebra to support mathematics learning at the junior high school level.

## RESEARCH METHOD

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This study employed a research and development approach to produce interactive Smart Apps Creator (SAC)-based mathematics learning media assisted by GeoGebra for teaching lines and angles to Grade VII junior high school students. The development process followed the ADDIE model described by Dick (1996), which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

### Analysis

The analysis stage identified the existing conditions of mathematics instruction and the problems encountered in the learning process. The needs analysis examined the needs of students and teachers, the media currently used, and the scope of the lines and angles material for Grade VII students. This analysis determined the depth and breadth of the material and guided the preparation of learning content based on the curriculum and the actual needs of students and teachers.

### Design

During the design stage, the researcher developed a framework for the learning media and prepared the research instruments to support systematic evaluation. The expert validation forms each comprised 18 statements for media experts and subject matter experts. Media experts assessed visual appearance, typography, audio, language, and ease of use, whereas subject matter experts assessed content and language; all assessments used a 5-point Likert scale. The student response questionnaire contained 14 statements addressing appeal, ease of use, clarity of instructions, and usefulness, also measured using a 5-point Likert scale. A semi-structured interview guide with five core questions was designed to elicit students' impressions, motivation, and suggestions and was reviewed by experts for relevance. The learning outcome test consisted of 10 multiple-choice questions aligned with the curriculum for the "Lines and Angles" topic. These instruments and the initial media design, including the main menu, instructions,

objectives, content, quiz, mini-games, and creator profile, were developed based on the needs identified during the analysis stage.

### Development

During the development stage, the lines and angles learning media was created as a student application using Smart Apps Creator (SAC) and GeoGebra in accordance with the initial design. Experts then assessed the validity of the developed media. After expert validation, a small-group trial was conducted, followed by interviews to obtain students' responses after using the application. The trial results informed product improvements, which were subsequently discussed with the experts for further validation. This stage served as a preliminary trial before classroom implementation.

### Implementation

At the implementation stage, the revised learning media was considered ready for classroom use following consultation with the experts. The researcher then conducted a field test during mathematics instruction to assess the practicality of the developed lines and angles media for Grade VII students. Practicality was evaluated using questionnaires completed by the students.

### Evaluation

The evaluation stage involved data collection through assessment rubrics, interviews, questionnaires, and a learning outcome test. The expert assessment rubrics were used to evaluate the validity of the lines and angles learning media before implementation. Interviews obtained direct suggestions and responses from the research participants. The questionnaires, administered directly or through Google Forms according to students' circumstances, measured the practicality of the media. The learning outcome test, administered at the end of instruction, assessed students' understanding of the material and the effectiveness of the media. Evaluation was also conducted throughout the ADDIE stages.

The study was conducted at SMP Negeri 4 Tondano during the 2025/2026 academic year and focused on Grade VII lines and angles material. The development process involved several groups of participants and validators. Nine experts served as validators: five media experts with expertise in instructional technology and four subject matter experts with backgrounds in mathematics education. They were selected purposively based on their academic expertise and professional experience and assessed the validity of the media using expert validation sheets.

A limited trial involved nine students representing high, medium, and low ability levels, who were selected purposively to capture diverse responses. The students used the application and participated in interviews to provide qualitative feedback. The implementation stage subsequently involved 26 Grade VII students who used the developed

media during classroom learning activities. Their responses were collected through questionnaires, and their learning outcomes were measured using a test.

All feedback, comments, and input from validators and students were analyzed using qualitative descriptive methods, whereas questionnaire data and test results were processed with descriptive statistical techniques to provide a structured evaluation of validity, practicality, and effectiveness (Sugiyono, 2019).

### Validity Analysis

The validity analysis determined the validity of the learning media based on expert evaluations. Media and subject matter experts used assessment rubrics to evaluate the product. The following formula was applied:

$$x = \frac{\Sigma(\text{score} \times \text{the number of answers})}{n \times \text{highest score}} \times 100\%$$

Where:

x = percentage of validity

n = number of rubric items

The product validity criteria are presented in Table 1.

**Table 1.** Product Validity Criteria Range

| Number | Interval                 | Criteria     |
|--------|--------------------------|--------------|
| 1.     | $85\% \leq x \leq 100\%$ | Highly Valid |
| 2.     | $70\% \leq x < 85\%$     | Valid        |
| 3.     | $55\% \leq x < 70\%$     | Quite Valid  |
| 4.     | $40\% \leq x < 55\%$     | Less Valid   |
| 5.     | $0\% \leq x < 40\%$      | Invalid      |

Source: Hobri (2010)

### Practicality Analysis

The practicality of the lines and angles learning media was analyzed using a student questionnaire. The questionnaire consisted of 14 statements rated on a Likert scale with five response categories. The following formula was used:

$$x = \frac{\Sigma y}{N \times S_{\text{maks}}} \times 100\%$$

Where:

x = percentage of practicality

$\Sigma y$  = the total score obtained from all respondents

$N$  = number of respondents

$S_{maks}$  = maximum score for each questionnaire item

The product practicality criteria are presented in Table 2.

**Table 2.** Product Practicality Criteria Range

| Number | Interval                 | Criteria         |
|--------|--------------------------|------------------|
| 1.     | $85\% \leq x \leq 100\%$ | Highly Practical |
| 2.     | $70\% \leq x < 85\%$     | Practical        |
| 3.     | $55\% \leq x < 70\%$     | Quite Practical  |
| 4.     | $40\% \leq x < 55\%$     | Less Practical   |
| 5.     | $0\% \leq x < 40\%$      | Impractical      |

Source: Hobri (2010)

### Effectiveness Analysis

The effectiveness analysis assessed students' mastery of the material after using the learning media. Effectiveness was determined from the learning outcome test by calculating the percentage of students who achieved the minimum mastery criterion, using the following formula:

$$x = \frac{n_{\text{mastery}}}{N} \times 100\%$$

where  $n_{\text{mastery}}$  is the number of students who achieved the minimum mastery criterion and  $N$  is the total number of students.

**Table 3.** Data Conversion and Effectiveness Criteria

| Number | Interval               | Criteria           |
|--------|------------------------|--------------------|
| 1.     | $80\% < x \leq 100\%$  | Highly Effective   |
| 2.     | $60\% < x \leq 80\%$   | Quite Effective    |
| 3.     | $40\% < x \leq 60\%$   | Less Effective     |
| 4.     | $20\% < x \leq 40\%$   | Ineffective        |
| 5.     | $0\% \leq x \leq 20\%$ | Highly Ineffective |

Source: Akbar (2013)

## RESULTS AND DISCUSSION

### Results of the Analysis Stage

At SMP Negeri 4 Tondano, mathematics instruction was conducted under the *Kurikulum Merdeka* (Independent Curriculum), which emphasizes a "Deep Learning" approach. This curriculum encourages teachers to design student-centered lessons and use

digital technology in the learning process, thereby creating opportunities to develop technology-based learning media that foster active student engagement and strengthen conceptual understanding.

The needs analysis revealed that students still experienced difficulty understanding mathematical concepts, as indicated by an average learning outcome score of 72.76, which was below the minimum mastery standard (KKTP) of 75. This finding indicated the need for learning media capable of presenting the material clearly and engagingly. Furthermore, because most students owned smartphones, these devices could be used to support technology-based learning. Interactive digital media were therefore expected to facilitate conceptual understanding and improve the effectiveness of mathematics instruction.

One key Grade VII topic is "Lines and Angles," which provides a foundation for understanding geometry. The material covered the relative positions of two lines, types of angles, relationships between angles, and relationships between lines and angles. Because this topic should be taught through visual, contextual, and interactive approaches rather than through formula memorization alone, Smart Apps Creator (SAC) integrated with GeoGebra was selected to make learning more practical and effective and to help students understand lines and angles more meaningfully.

### Design Stage Results

During the design stage, the researcher used mathematics textbooks aligned with the Merdeka Curriculum, particularly *Buku Interaktif Matematika untuk SMP/MTs Kelas VII* (2022), as the primary reference for determining the learning objectives. Based on this reference, an initial media framework was developed, as presented in Table 4.

**Table 4.** Learning Media Framework

| Section    | Feature             | Description                                                |
|------------|---------------------|------------------------------------------------------------|
| Start Page | Background          | Opening screen of the learning media                       |
| Title Page | Title               | Displays the learning media title, <i>Lines and Angles</i> |
| Main Menu  | Start button        | Directs users to the main menu                             |
|            | Learning Objectives | Presents the learning objectives                           |
|            | Learning Materials  | Provides materials on lines and angles                     |
|            | Quiz                | Contains 10 multiple-choice questions                      |
|            | Drag-and-Drop Game  | Contains three interactive drag-and-drop questions         |
|            | Information         | Provides instructions for using the application            |
|            | Creator Profile     | Provides information about the learning media developer    |
|            | Music               | Enables users to turn background music on or off           |
|            | Exit                | Closes the application                                     |

The researcher then developed supporting components to make the learning media more engaging and interactive. The background, menu icons, images, and text were



created using Canva, while GeoGebra was used to visualize lines and angles and facilitate student understanding. Music and sound effects were obtained from pixabay.com. During this stage, the expert validation sheets, student response questionnaires, learning outcome tests, and interview guidelines were also prepared for the limited trial, enabling the media to be evaluated before classroom implementation.

### Development Stage Results

During this stage, the lines and angles learning media was developed using Smart Apps Creator (SAC) with GeoGebra-assisted visualization. The completed media was then submitted for validation.

### Learning Media Display



Figure 1. Start Page View



Figure 2. Main Menu View



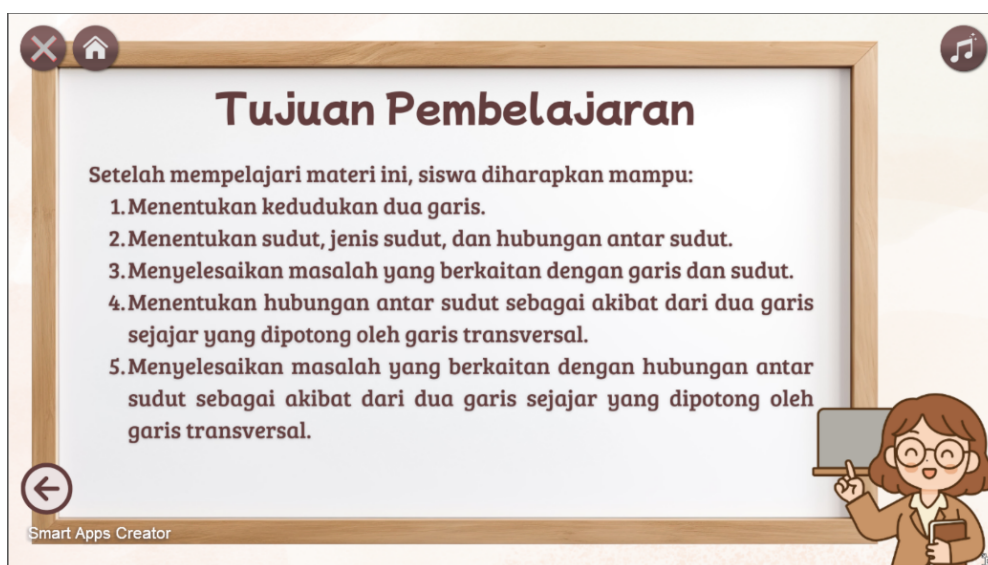


Figure 3. Learning Objectives View

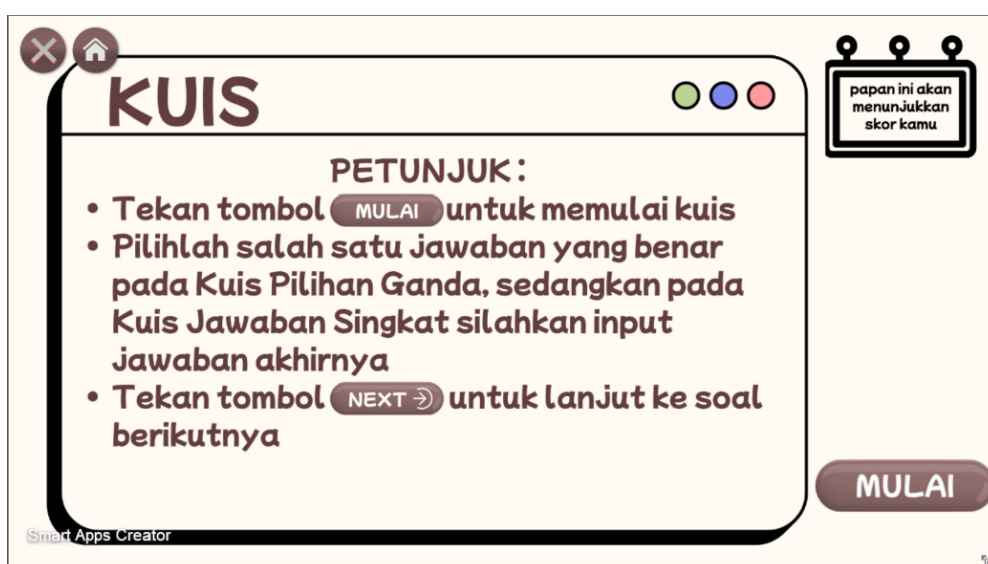


Figure 4. Quiz Menu View

### Learning Media Validation

After the learning media was developed, it was reviewed by media and subject matter experts, including lecturers and mathematics teachers, to obtain recommendations for improvement. The media experts evaluated visual appearance, typography, audio, language, and ease of use, whereas the subject matter experts evaluated content and language. Each validator completed an 18-item validation instrument using a scale from 1 to 5. The researcher subsequently revised the media according to the experts' recommendations. The media and content validation results are presented in Tables 5 and 6.

**Table 5.** Media Validation Results

| Aspect           | V1   | V2  | V3   | V4   | V5   | Percentage | Criteria     |
|------------------|------|-----|------|------|------|------------|--------------|
| Visual Display   | 96,7 | 100 | 96,7 | 90   | 100  | 96,7%      | Highly Valid |
| Use of Letters   | 100  | 100 | 90   | 100  | 100  | 98%        | Highly Valid |
| Sound            | 93,3 | 100 | 100  | 100  | 100  | 98,7%      | Highly Valid |
| Language         | 100  | 100 | 90   | 100  | 80   | 94%        | Highly Valid |
| User Convenience | 100  | 100 | 93,3 | 86,7 | 93,3 | 94,7%      | Highly Valid |
| Average          | 97,8 | 100 | 94,4 | 94,4 | 96,7 | 96,7%      | Highly Valid |

**Table 6.** Content Validation Results

| Aspect   | V1   | V2   | V3  | V4   | Percentage | Criteria     |
|----------|------|------|-----|------|------------|--------------|
| Content  | 98,6 | 98,6 | 100 | 82,8 | 95%        | Highly Valid |
| Language | 95   | 100  | 100 | 85   | 95%        | Highly Valid |
| Average  | 97,8 | 98,9 | 100 | 83,3 | 95%        | Highly Valid |

As shown in Tables 5 and 6, the learning media was categorized as highly valid based on the assessments of the media and subject matter experts. Following validation, the researcher revised the media according to the experts' recommendations. Table 7 presents the revisions made to the Smart Apps Creator (SAC)-based learning media assisted by GeoGebra.

**Table 7.** Revision of Learning Media

| Before Revision                                                                                           | After Revision                                                                       |
|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <p>1. Suggestion: Main Menu is made into a single page only and the efficiency of the button features</p> |                                                                                      |
|                        |  |

## Before Revision

## After Revision

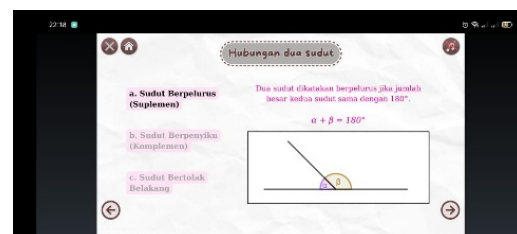
2. Suggestion: visualization of two intersecting lines still needs to be improved



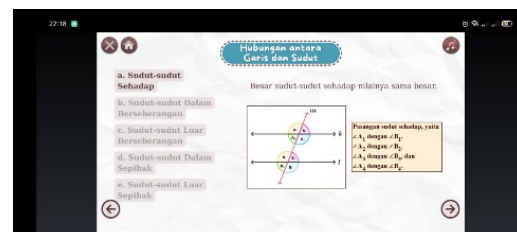
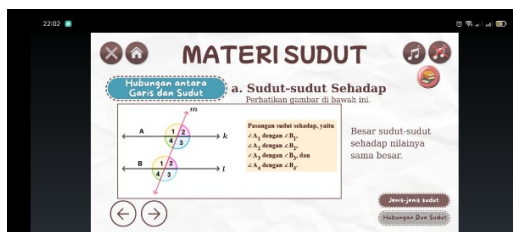
3. Suggestion: Button efficiency and display should not be too crowded



4. Suggestion: Efficiency in the use of buttons and displays should not be too crowded. In part c also add  $\alpha = \beta$ .



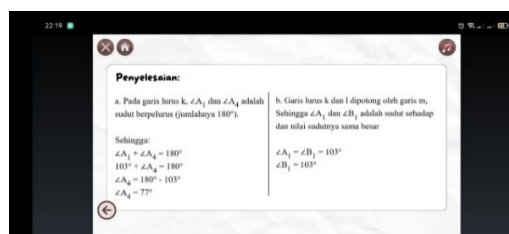
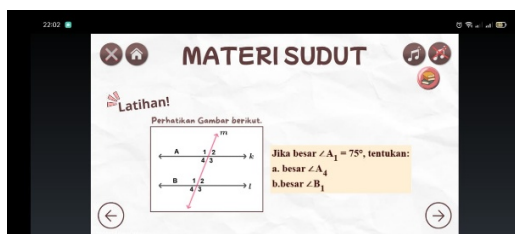
5. Suggestion: Efficient use of buttons and pay attention to the display to avoid being too crowded. Also fix the picture (naming the angle).



## Before Revision

## After Revision

6. Suggestion: Practice questions added solution/answers. Also the practice of the angle question, the angle value still needs to be improved.



For the limited trial at SMP Negeri 4 Tondano, the homeroom teacher selected nine Grade VII B students representing different ability levels. Classification into high, medium, and low ability groups was based on academic criteria, including previous mathematics scores, classroom participation, and consistency in completing assignments. Three students were selected from each category to ensure balanced representation and capture diverse learning responses. This selection enabled the developed media to be evaluated across different learner profiles.

The limited trial was conducted in one meeting lasting approximately 60 minutes. During the session, students used the Smart Apps Creator and GeoGebra-based learning media on lines and angles. The activities included exploring the main menu, studying the materials, completing quizzes and mini-games, and following the instructions provided in the application.

After completing the learning activities, the students were interviewed to obtain their responses, impressions, and suggestions regarding the media. Their comments were analyzed qualitatively to identify the strengths and weaknesses of the application, while their engagement during the trial provided practical insights for further refinement. Thus, the feedback represented the perspectives of students at different ability levels and contributed to the evaluation of the media.

**Table 8.** Students' Statements During the Interview

| STUDENT'S STATEMENT     |                                                                                                                                                                                                                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High Ability Students   | : "The impression of being happy because it can help learn, add more in-depth knowledge"<br>"I think the appearance makes me interested in learning. But there are certain parts where you can't click."                                                                                       |
| Medium Ability Students | : "It's exciting, and it can add motivation for me to learn, because the explanation is short."<br>"It's fun for the kids"<br>"Media can make students interested in learning, because it is a quiet appearance, especially since the songs are exciting, and do not interfere with learning." |
| Low-Ability Students    | : "It's very exciting and exciting."<br>"The instructions are clear and easy to understand."                                                                                                                                                                                                   |

### Implementation Stage Results

During the implementation stage, the learning media was used by 26 students in Class VII A at SMP Negeri 4 Tondano. The implementation was conducted over two meetings, each lasting approximately 60 minutes. Students used their own smartphones, and the researcher conducted the instruction directly. The learning activities began with an introduction to the application and its features, followed by exploration of the main menu, study of the lines and angles material, completion of quizzes, and participation in the drag-and-drop mini-games. At the end of the activities, the students completed questionnaires to assess the practicality of the media and provide feedback. Each student used the application individually and interacted directly with its features. The student response results are presented in Table 9.

**Table 9.** Student Response Assessment Results

| Results of Response Assessment from 26 Students |                                                                      |
|-------------------------------------------------|----------------------------------------------------------------------|
| Total Score                                     | 1672                                                                 |
| Percentage of Practicality                      | $P = \frac{\sum y}{N \times S_{maks}} \times 100\%$<br>$P = 91,87\%$ |
| Criteria                                        | Highly Practical                                                     |

### Results of the Evaluation Stage

In the evaluation stage, the learning outcome test was administered to 26 students from Class VII A after they used the instructional media. Each student completed the 10-question quiz embedded in the application and was allowed only one attempt, ensuring that the results reflected their understanding rather than repeated practice. The maximum possible score was 100. The students achieved an average score of 85.6, and 23 of the 26 students met the mastery criterion.

The percentage of completeness is:

$$x = \frac{23}{26} \times 100\% = 88,5\%$$

The GeoGebra-assisted Smart Apps Creator (SAC)-based mathematics learning media met the effectiveness criterion, with 88.5% of students achieving mastery after using the media. Evaluation across all stages of the ADDIE model supported a systematic and well-directed development process. Expert assessments confirmed that the product was highly valid, student responses indicated that it was highly practical, and the learning outcome results demonstrated its effectiveness. Therefore, the developed media was considered feasible for classroom use. The product can be accessed at <https://bit.ly/APKGarisSudut>.

The findings that the developed media was highly valid (96.7% for media and 95% for content), highly practical (91.87%), and effective (88.5% mastery) illustrate how technology-based tools can support mathematics learning. The validity results reflect the alignment of the content and design with curriculum standards, as confirmed by expert review. Practicality was supported by SAC features, including customizable menus, interactive icons, and multimedia integration, which made the media accessible and engaging without requiring advanced programming skills. Student responses concerning enjoyment, clarity, and motivation further demonstrated its classroom usability. Effectiveness was also supported by GeoGebra's dynamic visualization, which connected abstract concepts of lines and angles with more concrete representations and thereby supported students' mastery of the material.

These findings are consistent with previous studies emphasizing the role of interactive, student-centered media in supporting motivation and understanding (Sulistyaningsih et al., 2022; Kunrade et al., 2023; Oroh et al., 2025). More specifically, the present study demonstrates the complementary strengths of SAC and GeoGebra: SAC provides accessibility and interactivity, whereas GeoGebra offers precise mathematical visualization. Together, these tools create a coherent learning environment that supports both engagement and conceptual understanding.

From a theoretical perspective, the systematic use of the ADDIE model ensured that validity, practicality, and effectiveness were evaluated throughout the development process (Akbar, 2013). The high scores across these dimensions indicate that the media not only met the established criteria but also supported student-centered learning in line with the Independent Curriculum.

Nevertheless, this study has several limitations. The trial was conducted in one school with a limited sample, over a short period, and without baseline (pretest) data, restricting claims about improvements in learning outcomes. In addition, the novelty of the technology may have influenced student responses, and the findings may not



be generalizable to other contexts. Future research should involve larger samples, multiple schools, longer implementation periods, and pretest–posttest designs to provide stronger evidence of learning gains.

Overall, the integration of SAC and GeoGebra offers a promising contribution to technology-based mathematics learning, particularly by supporting students' mastery of lines and angles through interactive design and dynamic visualization.

## CONCLUSION AND RECOMMENDATIONS

The development of GeoGebra-assisted Smart Apps Creator (SAC)-based mathematics learning media for lines and angles produced a product that was highly valid (96.7% for media and 95% for content), highly practical (91.87%), and effective, with 23 of 26 students achieving mastery (88.5%). The principal contribution of the media lies in its integration of SAC's interactive features—including menus, icons, and multimedia elements—with GeoGebra's dynamic visualization, which together support student engagement and conceptual understanding of lines and angles.

Although the findings support the feasibility of SAC–GeoGebra integration for classroom use, the study was conducted in one school with a limited sample, over a short period, and without baseline (pretest) data. The results may also have been influenced by the novelty of the technology, thereby limiting their generalizability.

Based on these results, teachers are encouraged to use SAC–GeoGebra media as a supplementary tool to enhance visualization and interactivity in geometry lessons, particularly for abstract topics such as lines and angles. Future studies should conduct larger-scale trials across multiple schools, use longer implementation periods, and employ pretest–posttest designs to strengthen evidence of learning gains and broaden the applicability of the media.

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