Al-Jabar: Jurnal Pendidikan Matematika
Volume 14, Number 2, 2023, Pages 527 – 544
http://ejournal.radenintan.ac.id/index.php/al-jabar/index

Design of google site-based learning media for circle material to support critical thinking skills

Nurul Istiqomarie[1], Hapizah[1*], Budi Mulyono[1]
[1] Universitas Sriwijaya, Indonesia
✉ hapizah@fkip.unsri.ac.id*

Article Information
Submitted July 16, 2023
Revised September 14, 2023
Accepted November 05, 2023

Keywords
Google site; Circle materials; ADDIE; Critical thinking.

Abstract

Background: Critical thinking ability is one of the 21st-century skills that are essential to solve problems related to contextual issues in everyday life. The rapid development of technology in the 21st century can be utilized by educators to innovate in response to learning needs, especially in the field of mathematics, which is often associated with everyday life.

Aim: The purpose of this study is to design a valid and practical Google Site-based learning media for circle material in eighth grade that supports students' critical thinking skills.

Method: This research employs a design and research (R&D) methodology with the ADDIE research procedure, consisting of the stages of analysis, design, development, implementation, and evaluation. The study was conducted in one of the junior high schools in Palembang city. Data collection techniques used were interviews, questionnaires, and tests, while data analysis techniques were quantitative and descriptive qualitative.

Result: This study produced a Google Site-based learning media to support students' critical thinking abilities for circle material, which is valid, practical, and can enhance students' critical thinking skills based on the aspects of critical thinking stages according to Facione.

Conclusion: The designed learning media can be an alternative for teaching circle material for junior high school teachers..

INTRODUCTION

The 21st century is recognized for its globalization, fundamentally altering various aspects, particularly in the swift advancements in technology (Afdhal, 2015; Arnyana, 2019; Hidayatillah et al., 2022). These technological advancements have impacted numerous sectors, including education, which has innovated by leveraging rapid technological progress tailored to learning needs, for instance, through the implementation of media (Istikomah et al., 2020). In this era, individuals are required to exhibit excellence across all life domains, including the emergence of high-quality human resources produced by entities aiming to advance specific sectors (Wijaya et al., 2016). One of the global community skills that must be mastered is critical thinking for personal and professional growth, which can be fostered through learning that applies the principles of critical thinking processes (Ansori et al., 2022; Sudiansyah et al., 2023).

Critical thinking is a key principle for solving everyday life problems (Ansori et al., 2022), encompassing explanation, evidence, and analysis (Facione, 2020). Iskandar (2017) revealed that, in fact, critical thinking abilities can serve as an indicator of an individual's resilience or competitiveness in contests to excel, as it enhances the competitive spirit of the individual, in line with the findings of several researchers who argue that critical thinking

How to cite: Istiqomarie, N., Hapizah, & Mulyono, B. (2023). Design of google site-based learning media for circle material to support critical thinking skills. *Al-Jabar: Pendidikan Matematika*, *14*(2), 527-544.
E-ISSN: 2540-7562
Published by: Mathematics Education Department, UIN Raden Intan Lampung

skills are recognized as essential for success in learning, working, and living (Cahyono, 2017). Enhancing learners' critical thinking skills (CTS) can aid them in discovering solutions to real-world problems they encounter, facilitated by educators through the selection of appropriate media (Stephenson & Sadler McKnight, 2016). Meanwhile, benchmarks for critical thinking indicators may include explanations from analyzing a statement, as well as developing foundational skills through observation, and selecting strategies and tactics in conceptualizing solutions to problems (Ennis, 2011). Ennis's perspective aligns with Facione's (2020) view on critical thinking, which emphasizes the relationship with skeptical yet not cynical reasoning, open-mindedness and consistency, and the ability to analyze and evaluate. Facione briefly mentions that there are five stages of critical thinking, abbreviated as IDEAS, derived from the human phenomenon of curiosity, broad-mindedness, reliance on common sense, open-mindedness, flexibility, fairness in judgment, honesty, willingness to reconsider, structured thinking in complex matters, and diligence in seeking relevant information. This phenomenon emerges from facing problems without accompanied stimuli and steps for resolution in a relatively short period. From this phenomenon, Facione identifies these five stages as Identify, Determine, Enumerate, Assess, and Scrutinize, known collectively as IDEAS.

The topic of circles falls within the domain of geometry, where its applications are frequently encountered in daily life scenarios, necessitating the use of steps and formulas related to circles. Its application requires critical thinking processes to discover solutions to existing problems, especially in relation to the objectives that students should achieve according to the basic competencies (BCs) on the subject of circles. Students are expected to be able to translate, interpret, and conclude concepts effectively, so they can apply these to solve problems ranging from simple to complex (Andriyani & Buliali, 2021). Observations by researchers indicate that the teaching of circle material in eighth-grade middle school has not involved the critical thinking process as it should, according to Facione's stages of thinking. By providing stimuli through animations and presenting questions that incorporate the IDEAS critical thinking stages, students are encouraged to be skeptical and solve problems within a relatively short period. This observation is supported by research from Lestari et al., (2019), which found that many students struggle with high-level problems related to circle material, as seen from test results where more than 50% of students did not meet the minimum threshold.

The integration of critical thinking education into the curriculum has become a focal point in Indonesian educational circles (Cholily et al., 2023). However, research findings indicate that students' critical thinking abilities have not developed as expected, with students facing difficulties in solving problems by following steps such as analyzing the problem and other stages (Fikri et al., 2017; Raudhah et al., 2019). The challenges educators face in focusing on critical thinking abilities during instruction are significant, yet they underline the need for innovative teaching methods that can support the development of students' critical thinking skills in mathematics education. This view is shared by researchers such as Arnellis et al., (2023) and Raudhah et al., (2019).

Previous studies have highlighted the significance of leveraging technology in education to foster critical thinking and mathematical creativity among learners (Riwayati et al., 2020; Yasinta et al., 2020). Furthermore, the adoption of platforms such as Google Sites

has been demonstrated to be both practical and effective in delivering educational content, enhancing student comprehension, and boosting their motivation to learn (Japrizal & Irfan, 2021; Jubaidah & Zulkarnain, 2020; Maskar et al., 2021; Nuryati et al., 2022; Waseso et al., 2022; Yuniar et al., 2021). However, despite documented effectiveness of Google Sites and other technologies in mathematical education, there remains a gap in the literature regarding how digital learning media can be specifically designed to support critical thinking stages as outlined by Facione in the mathematical context.

Most prior research has concentrated on the general facilitation of learning through technology, without focusing on the critical thinking aspect as proposed framework by Facione's (2020). This study aims to bridge that gap by creating learning media that not only utilizes technology like Google Sites but also specifically supports the development of learners' critical thinking abilities. This will be achieved by developing and integrating animations designed to initiate and facilitate critical thinking stages. Therefore, this research contributes to the existing literature by introducing new technological applications in mathematical learning and offering a novel approach in designing educational materials focused on enhancing critical thinking skills.

METHODS

Design:

The method employed in this study is research and development, commonly referred to as R&D, as introduced by Dick and Carey, alongside the utilization of the ADDIE development model. This model encompasses five procedural stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). These stages are illustrated in Figure 1 below.

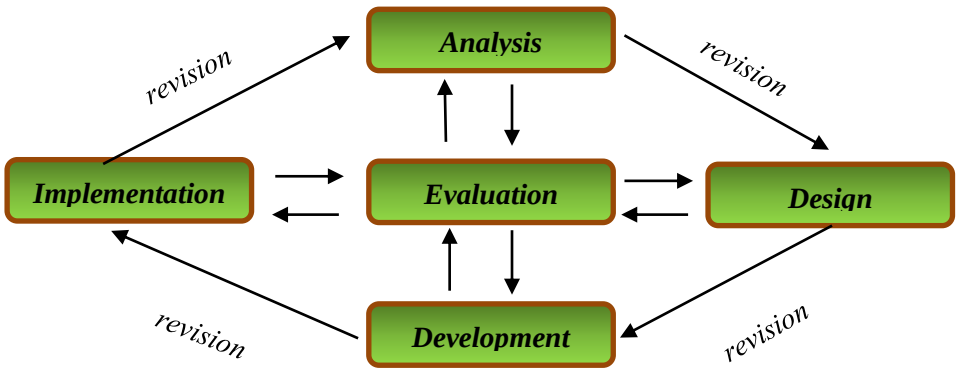


Figure 1. ADDIE Development Procedure

Participants:

The subjects of this study were eighth-grade students at SMP Negeri 24 Palembang, comprising 15 males and 16 females, selected following discussions with the mathematics teacher of the class. The study engaged a subject teacher as a model instructor who taught using a Google Sites-based learning medium designed by the researchers.

***Instruments & Data Analysis*:**

Data collection techniques in this study included interviews, surveys, and written tests. Interviews were conducted to gather preliminary data on challenges and obstacles faced by teachers and students, as well as to support data for each validation phase through to evaluating the effectiveness of the media based on student responses during the analysis stage. Surveys, utilizing a Likert scale from 1 to 5, served as a tool for media validation regarding its construction and content. Media validators, comprising two professionals skilled in Mathematics and technology fields—one being a university lecturer and the other a teacher from a Mathematics Teacher Working Group (MGMP)—validated the construct and content. The surveys were also employed to assess the practicality of the media during the development and implementation phases, analyzed using the formula provided by Andriyani & Buliali (2021).

$$R = \frac{\Sigma v_i}{n}$$

Information:
R = Average of assessment results from validators
V_i = Score from validator's research results-*i*
n = Lots of data

The average results obtained will be categorized according to Table 2 below (Sari & Surya, 2021).

Table 2. Category Validity and Practicality of Learning Media

Average	Category Validity	Category Practicality	Information
$x > 4{,}21$	Very valid	Very practical	No need for revision
$3{,}41 < x \leq 4{,}20$	Valid	Practical	No need for revision
$2{,}61 < x \leq 3{,}40$	Fairly valid	Quite practical	Needs a little revision
$1{,}81 < x \leq 2{,}60$	Invalid	Not practical	Needs lots of revisions
$x \leq 1{,}80$	Very Invalid	Very impractical	Total revision

Meanwhile, the tests conducted during the evaluation phase serve as testing instruments designed to ascertain the potential effect of the learning media in supporting students' critical thinking abilities as they solve problems. These are then descriptively analyzed based on modified critical thinking ability indicators from Munawwarah et al., (2020) as illustrated in Table 3 below.

Table 3. Critical Thinking Indicators

Aspect	Indicator
Identify (I)	Ability to pinpoint the main idea of the encountered problem
	Effectively communicate the main idea of the problem in their own words, whether orally, in writing, through drawings, or diagrams
Define (D)	Capability to articulate what is known and what is being asked in the problem and to inform what is unused or unnecessary for solving the problem
Enumerate (E)	Ability to list potential strategies for solving the problem
	To discover a sensible and appropriate strategy for problem resolution
Assess (A)	Competence in analyzing strategy options to select a solving procedure
	To predict the best answer based on the problem-solving procedure
Scrutinize (S)	Skill in thoroughly reviewing the solving procedure to ensure the best answer is obtained
	drawing valid conclusions that the obtained answer is indeed the best solution.

Table 3 outlines the aspects of critical thinking according to Facione (2020) and the indicators for each aspect to determine the students' critical thinking abilities.

RESULTS AND DISCUSSION

This research focuses on the design of a learning media using Google Sites, which incorporates a series of steps to stimulate students' critical thinking abilities as outlined by Facione (2020) in "Critical Thinking: What It Is and What It Counts," including the IDEAS framework: Identify, Define, Enumerate, Assess, and Self-Regulation. The ultimate goal of this media design is to support the development of students' critical thinking skills.

Analysis

In this phase, observations and interviews were conducted by the researchers with teachers and students—each representing high, medium, and low ability levels—as subjects to gather data for analysis based on needs, student characteristics, and the learning environment, utilizing tabulation indicators. From the analysis of student needs, it was found that teachers require a medium that can assist students in independent learning and prioritize understanding learning concepts as the main element for achieving comprehensive critical thinking processes and gaining personal experience from the learning process. In analyzing student characteristics, distinctions were made into three categories: high, medium, and low abilities. It was observed that students with high abilities have a better understanding of the text content, whereas students with medium and low abilities exhibit moderate comprehension levels of the text content. Regarding the analysis of the learning environment, it was noted through observation of teaching methods that teachers have traditionally provided tasks based solely on the application of formulas, without incorporating real-life problems into circle material teaching, leading to a lack of opportunities for students to engage in critical thinking and reasoning processes.

Design

At this design stage, the process begins with outlining the media program structure, creating an initial concept, and determining the visual design. The flow of this design phase is illustrated in Figure 2 below.

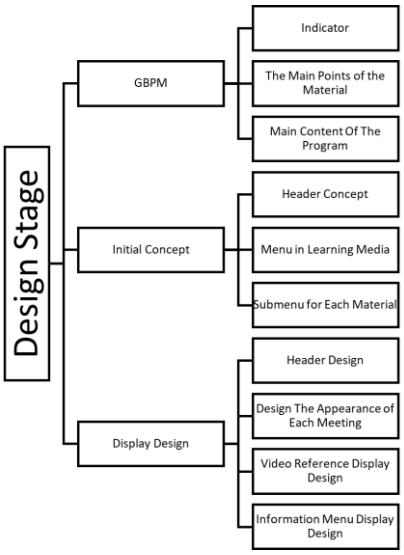
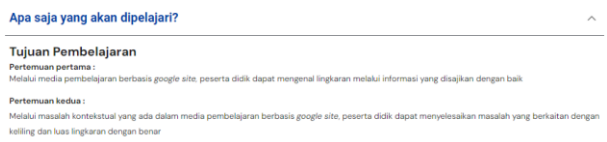


Figure 2. Flow of the Design Stage

This design phase culminates in the creation of a learning media that requires validation to be deemed effective by experts. A tabulation regarding the media produced in the design stage is detailed in Table 4 below.

Tabel 4. Tabulation of Learning Media Contents

Visual Stages	Explanation
 **Figure 3.** *Header* and Menu	The header of the learning media is titled "Learning Media for Circle Material for Eighth Grade SMP/MTs". The header features a menu with buttons including home, session 1, session 2, summary, test, and information.
 **Figure 4.** Instructions for use	On the homepage, instructions for using the learning media are provided through a link that directs users to guidelines containing symbols used in the media, as well as the sequence of steps users should follow when engaging with the media.
 **Figure 5.** Learning objectives	The researchers also articulate the learning objectives that students aim to achieve when utilizing this learning media.
 **Figure 6.** Main course	The main menu of the learning media includes three buttons: Session 1, Session 2, and Test. Each button contains media tailored to the specific Basic Competencies (KD) that students are expected to achieve.
 **Figure 7.** Submenu at Meeting 1	Clicking on the button for session 1 reveals instructions stating, "Please fill in the attendance, read the material, and complete the exercises," indicating that users must follow these steps in sequence. This session page includes three buttons as well: attendance, material, and exercises.

Visual Stages	Explanation
	The material provided consists of examples familiar to their daily lives. Before delving deeper, students are guided to first understand circles through animated examples using the (.gif) format. The circles in these examples are highlighted in red in each image.

Figure 8. Animation on Circle Example Material

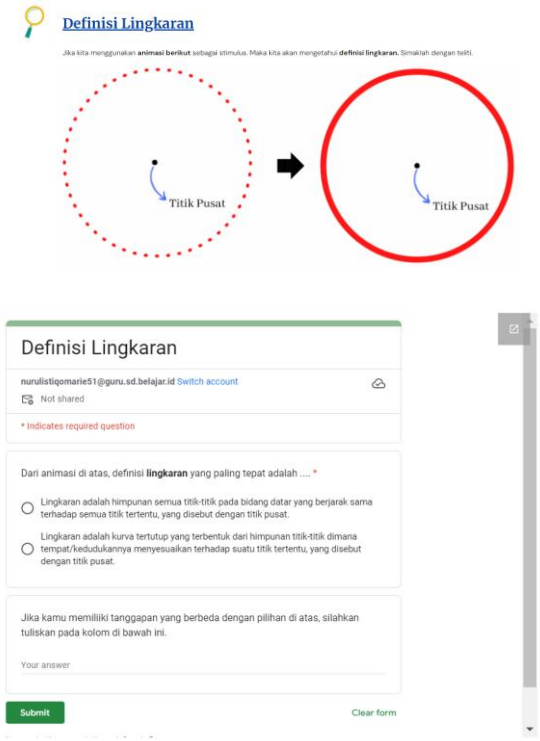
	After introducing examples of circles, students are encouraged to grasp the definition of a circle from the animations presented and then describe it in their own words.

Figure 9. Google Form on Circle Definition Material

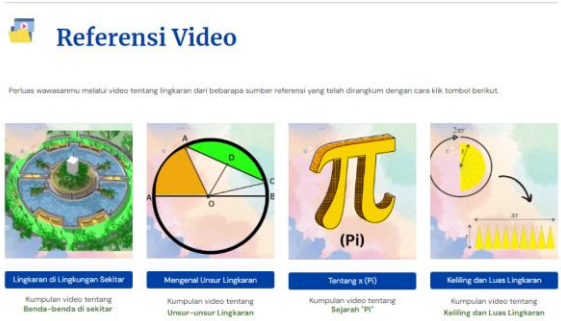
Visual Stages	Explanation
	In addition to material presentation, video references are also included to broaden users' knowledge about circle materials and their real-life applications. These videos are integrated with the YouTube platform, carefully selected by the researchers based on necessity.

Figure 10. YouTube Video Reference

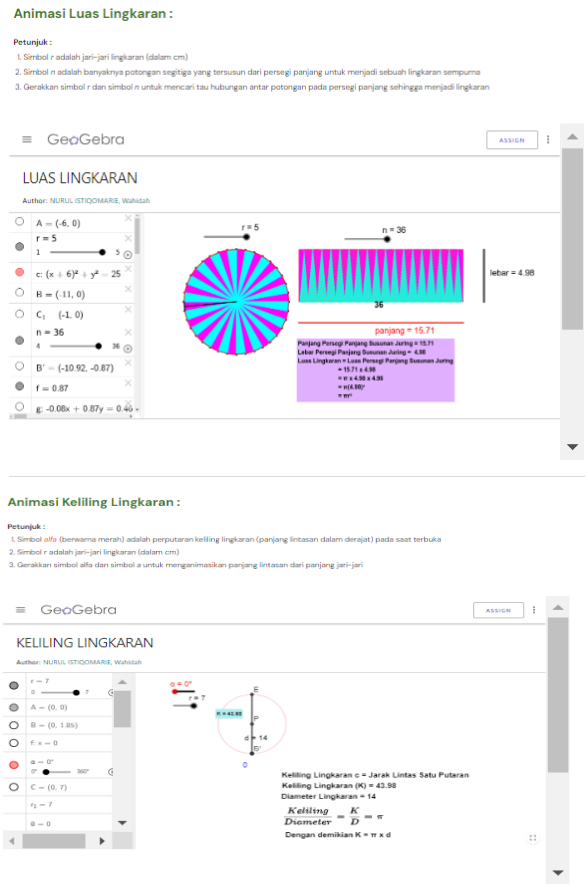
	Furthermore, other materials, such as understanding the circumference and area of circles, are presented through animations from the Geogebra platform to give students a perception of the origins of the formulas for circumference and area.

Figure 11. Geogebra animation of circumference and area of a circle

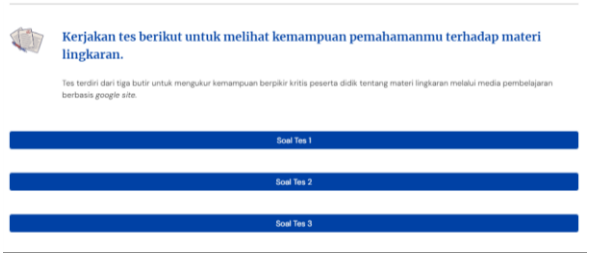
	Subsequently, there are test questions, consisting of three validated test questions provided to students to assess whether the designed learning media supports the development of students' critical thinking abilities.

Figure 12. Test Menu on Learning Media

After designing the learning media, validation and practicality tests involving experts and students were conducted during the development phase.

Development

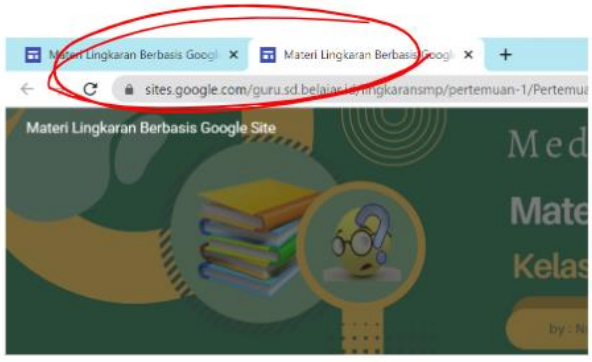
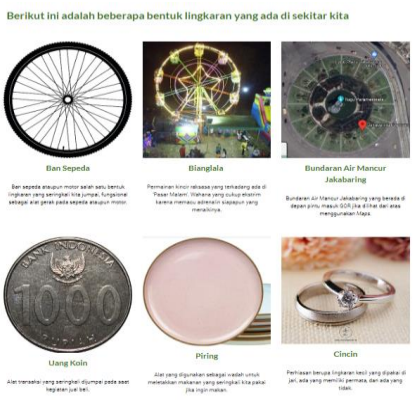
During the development stage, the process involved expert media testing for the learning media's construct and expert material testing for the content of the designed learning media. The initial step was the media expert test, which included two media experts assessing aspects such as display quality, application operation, feasibility, interface, navigation, maintainability, and compatibility. The media experts' evaluations are presented in Table 5 below.

Table 5. Media Expert Assessment of Constructs

No	Aspect	Total average for each aspect
1.	Display Quality	5
2.	Application Operation	4
3.	Implementability	4,17
4.	*Interface*	4,2
5.	*Navigation*	3,75
6.	*Maintainable*	4,83
7.	*Compatibility*	4
	Average	4,31

The media experts' evaluation fell into the "Highly Valid" category after the calculation phase, achieving an average total of 4.31, aligning with the validity categories in Table 2 and resulting in several recommendations for improvements. These were subsequently revised based on the suggestions. The improvements made are detailed in Table 6 below.

Table 6. Refinement of Learning Media Constructs

Learning media before revision	Learning media after revision
	
	

Learning media before revision	Learning media after revision
	

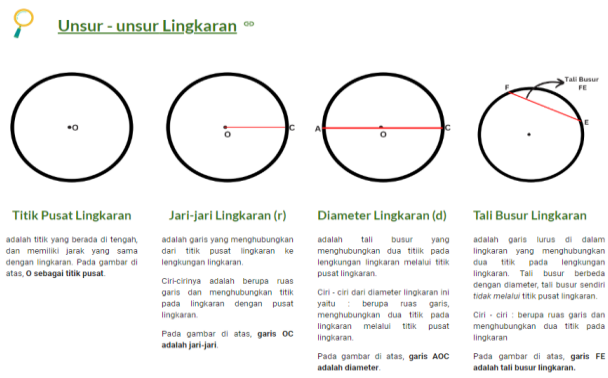
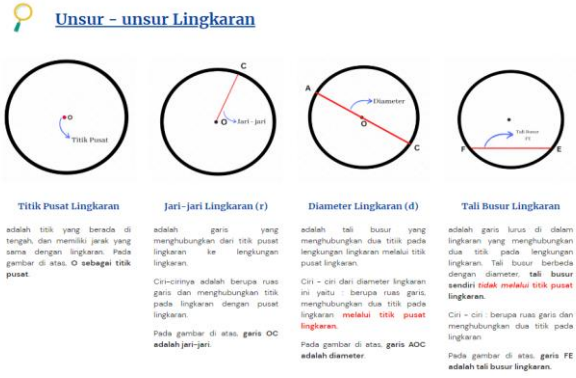
In addition to evaluations by media experts, assessments were also conducted by two subject matter experts, with the results presented in Table 7 below.

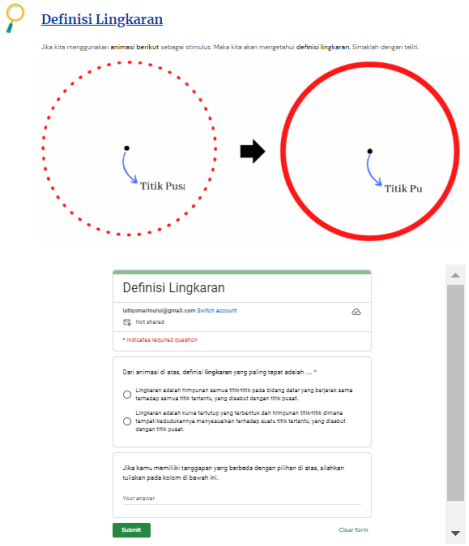
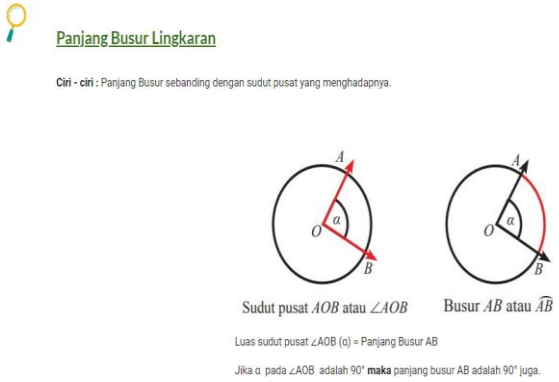
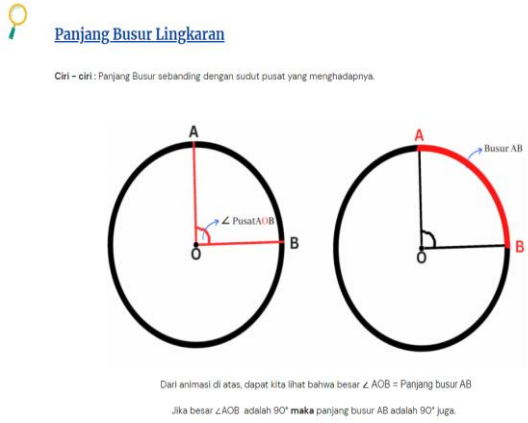
Table 7. Subject Matter Expert Assessment of Content

No	Aspect	Total average for each aspect
1.	Eligibility of content	4,50
2.	Feasibility of presenting learning media	4,80
3.	Indicators of Critical Thinking Ability	4,42
	Average	4,65

Similarly, the material experts' evaluation was classified as "Highly Valid" after the calculation phase, with an average total score of 4.65, consistent with the validity categories in Table 2, and also led to several recommendations for enhancements. These suggestions were likewise addressed in revisions. The enhancements are outlined in Table 8 below.

Table 8. Refinement of Learning Media Constructs

Learning media before revision	Learning media after revision
	

Learning media before revision	Learning media after revision
	
	

Following revisions based on the feedback, the researchers advanced to the implementation stage to assess the practicality of the now-validated learning media.

Implementation

The implementation phase aimed to assess the practicality of the designed and validated learning media (Agustarina et al., 2022). Learning media is considered practical if, upon trial by students, they encounter no difficulties in operating or understanding the content of the designed media (Komar et al., 2023). This phase involved a trial stage where students of high, medium, and low abilities participated. The assessment results from the students are based on aspects shown in Table 9 below.

Table 9. Students' assessment of the practicality of learning media

Aspect	Average
Content/Material	4,08
Serving	3,92
Language	4
Views	4,08
	4,02

The evaluation from the students, who will be the users of this learning media, was categorized as “Practice” after a calculation phase because it achieved an average total of 4.02, fitting the practicality category in Table 2 and resulting in some recommendations for improvement. One suggestion from the students was to add a summary to the learning media. The learning media, having been revised according to these suggestions, will be used in the evaluation phase.

Evaluation

The final stage is the evaluation. The researchers assessed the effectiveness of the learning media design by administering two validated test questions to determine if the learning media supports the development of students' critical thinking abilities. The execution of the evaluation is depicted in Figure 13 below.

Figure 13. Implementation of Evaluation

The problems presented in the test questions relate to everyday life contexts for problem-solving. The test questions given to the research subjects are shown in Figure 14 below.

Soal Tes 1

Fatimah adalah pengusaha perhiasan terkenal di kota Palembang. Kali ini, ia menerima pesanan untuk cincin pernikahan. Fatimah akan membuat dua model cincin yang dibuat dari bahan baku keping perak yang panjangnya 1 meter. Model cincin pertama jari-jarinya 35 mm, dan model cincin kedua jari-jarinya 28 mm.

Berapakah jumlah cincin yang dapat dibuat oleh Fatimah? Dan berapakah panjang keping perak yang tersisa setelah membuat dua model cincin tersebut?

Figure 14. Test Question 1

The problem-solving in test question 1 includes indicators of the critical thinking process stages. Here is a response from a student in group 2 shown in Figure 15 below.

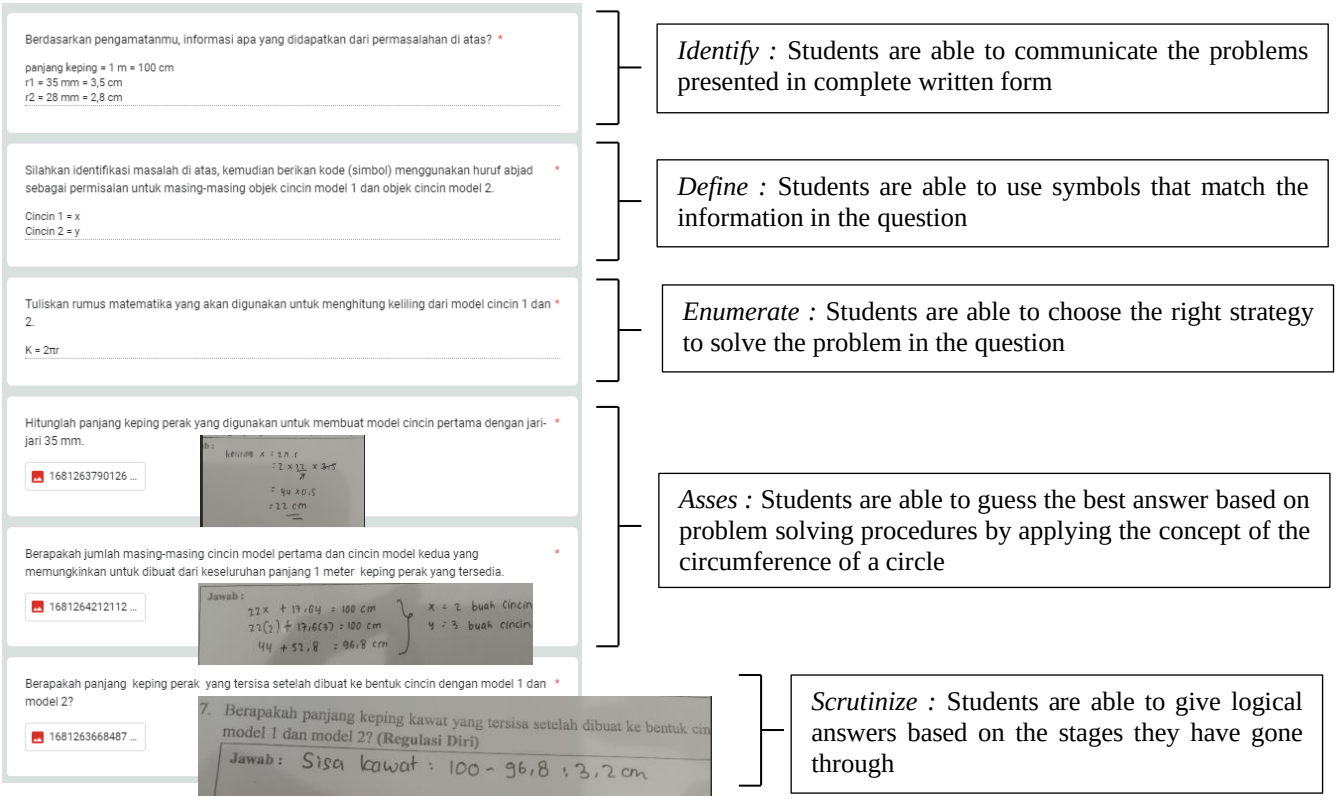


Figure 15. Group 2 Answer Results

Based on group 2's response in Figure 15, the students met all five descriptors of each indicator according to Facione (2020) critical thinking stages, IDEAS. In test question 2, students were given a problem related to the context of a coaster's base. Test question 2 is shown in Figure 16 below.

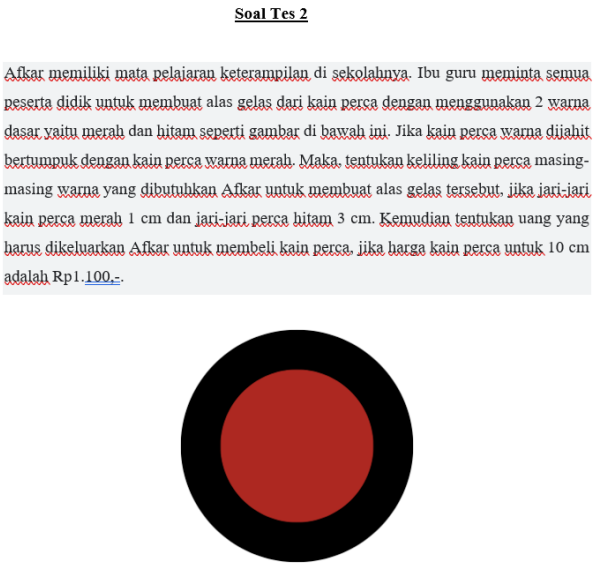


Figure 16. Test question 2

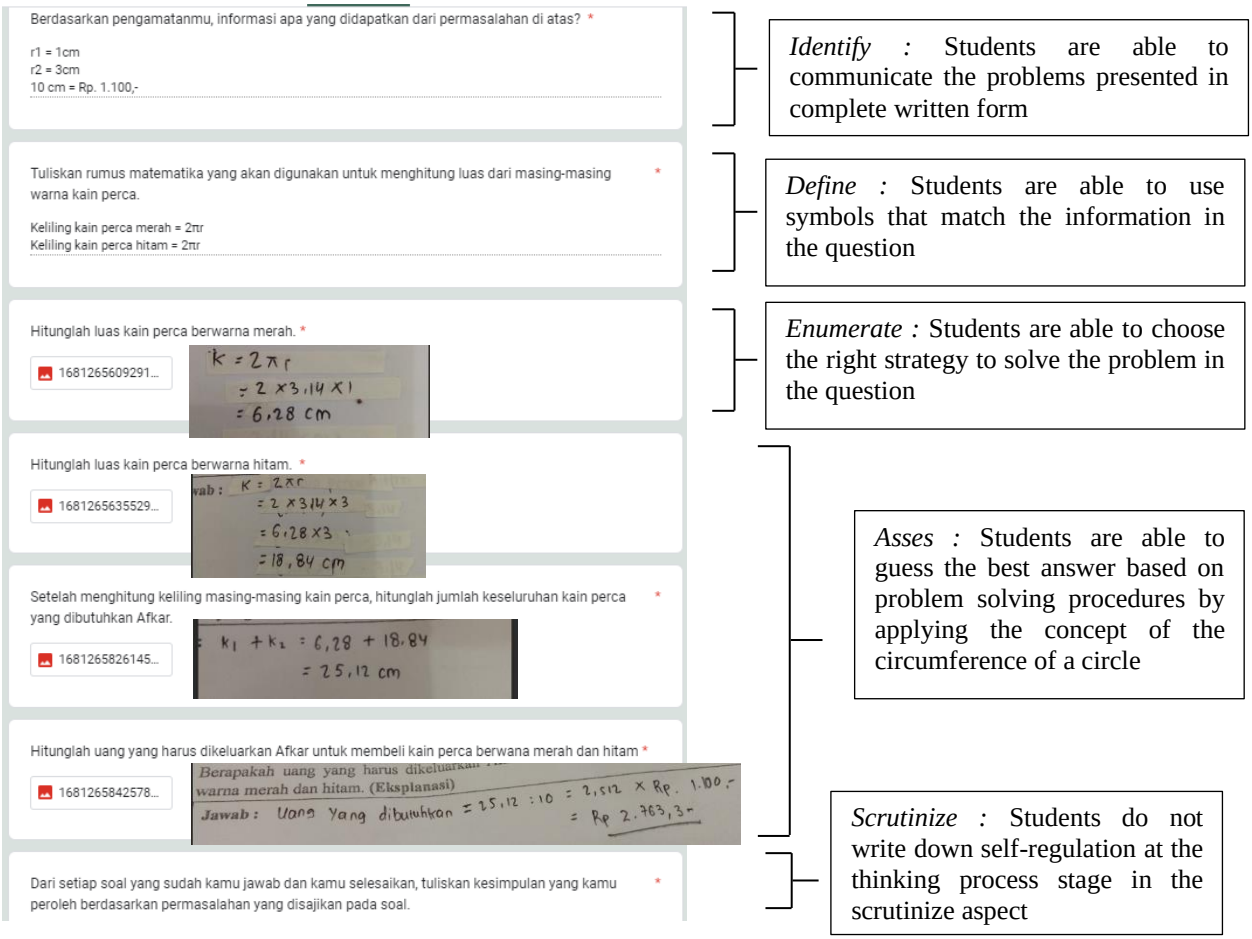


Figure 17. Group 1 Answer Results

From the given question, the scoring results for the students' critical thinking process stages according to IDEAS are detailed in Table 10 below.

Table 10. Percentage of Achievement of Students' Critical Thinking Ability Indicators According to Facione (2020)

Aspect	Percentage (%)
Identify (I)	88,89
Define (D)	100
Enumerate (E)	100
Assess (A)	88,89
Scrutinize (S)	66,67
Average	**88,89**

The validity criteria for learning media based on content include the material's alignment with learning objectives to support students' critical thinking abilities, while the construct criteria encompass concepts of display quality, usage, and application. This research on the development of Google Sites-based learning media presents animations to help students analyze incomplete material sequences, explore given options, and conclude independently, thus enabling them to solve presented problems.

In the test execution, students' responses were analyzed based on Facione's critical thinking stages, IDEAS. From the test results of 31 students divided into high, medium, and

low groups, the average percentage of students' critical thinking ability was 88.89%, with the high and medium groups categorized as "very critical" and the low group as "critical". Students with high and medium abilities met all five critical thinking indicators completely and perfectly, as shown in Table 4.9 regarding the Criteria for Students' Critical Thinking Ability Based on Indicator Achievement by Group Category. This is because the learning media accustomed students to interpreting, analyzing, evaluating, and concluding independently, so when presented with problems, they were able to inventory the intended information completely (Hidayatillah et al., 2022; Munawwarah et al., 2020). However, the low-ability student group, as seen in Figure 4.40 at the identify and assess stages, had written down information and solved the problem using a chosen strategy, but not completely because they did not rewrite some units as they should have and did not complete the solution, affecting the score calculation. This result aligns with the findings of Wahyudi et al., (2019). For the scrutinize stage, the low group thought they focused too much on the assess stage and believed they could solve the problem but needed more time, similar to the research conducted by Sari et al., (2023).

Limitation and Suggestion for Further Research

The development of students' critical thinking skills is highly dependent on the learning media utilized by educators to provide meaningful learning experiences, especially when the material involves solving contextual problems in everyday life. Learning media tailored to needs will maximize student understanding of the studied material, particularly for training critical thinking skills, which are crucial in the 21st century and should be nurtured from an early age. Therefore, educators must innovate in designing and developing learning media focused on critical thinking abilities to solve daily life-related problems.

CONCLUSIONS

The research conducted, it can be concluded that the Google Sites-based learning media for circle material meets the criteria of being valid and practical, and supports the development of students' critical thinking abilities. Test results indicate that students were able to solve nearly all aspects of critical thinking stages and meet the descriptors for each aspect. This Google Sites-based learning media includes circle material that integrates aspects of the IDEAS critical thinking stages according to Facione. Future research is encouraged to design Google Sites-based learning media that covers all core materials of circles to provide a comprehensive learning medium for eighth-grade circle material.

ACKNOWLEDGMENT

Gratitude is extended to the principal of SMP Negeri 24 and all staff involved in the research phase. Thanks also go to all validators involved, Dr. M. Win Afgani, S.Si., M.Pd, Mr. M. Irsadi Farista, M.Pd., and Adleti Martha Romana, S.Pd.

AUTHOR CONTRIBUTIONS STATEMENT

In this research project, NI led the conceptualization and design of the Google Sites-based learning media, focusing on integrating critical thinking stages into the educational content. HH was instrumental in data collection and analysis, conducting interviews, surveys, and tests to assess the media's impact on student learning outcomes. BM specialized in the validation

and testing phase, ensuring the learning media met educational standards and contributed effectively to enhancing students' critical thinking skills.

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