Infinity Journal of Mathematics Education
Volume 15, No. 2, 2026
p-ISSN 2089-6867
e–ISSN 2460-9285
https://doi.org/10.22460/infinity.v15i2.p595-622

Numeracy website of local wisdom in mathematics learning: Metacognitive approach and mathematical reflective thinking ability

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Received: Dec 8, 2025 | **Revised**: Apr 8, 2026 | **Accepted**: Apr 11, 2026 | **Published Online**: May 2, 2026

Abstract

This research is motivated by the low numeracy ability and mathematical reflective thinking. The metacognitive approach trains students to understand problems, make connections, develop problem-solving strategies, and evaluate and reflect on their work. Numeracy in it is related to the context of local wisdom. This research aims to develop a numeracy website grounded in local wisdom, using a metacognition approach to improve mathematical reflective thinking skills. This research method uses DDR (Design and Development Research), which consists of identifying problems and defining the research focus, designing and developing products, implementing, evaluating, and communicating test results. The subjects of this research were 10 and 30 junior high school students. Data analysis was carried out using descriptive statistics and the normalized gain test to assess effectiveness. The instruments used were mathematical reflective thinking ability tests, education questionnaires, educational materials, media, and a student response questionnaire. The results of this study concluded that website media developed by media experts (89.5%), education (93.6%), and materials (95%) are very feasible and interesting, and student responses are very good or very positive (80.55%). This numeracy website can improve mathematical reflective thinking skills to a very high level (0.79).

Keywords:
Local wisdom, Mathematical reflective thinking skills, Metacognition, Numeracy, Website

How to Cite:
Nindiasari, H., Hendriana, H., Fathurrohman, M., Kurniawati, N. K., Nirmalasari, D., Rofiroh, R., & Ruhimat, A. (2026). Numeracy website of local wisdom in mathematics learning: Metacognitive approach and mathematical reflective thinking ability. *Infinity Journal*, *15*(2), 595-622. https://doi.org/10.22460/infinity.v15i2.p595-622

1. INTRODUCTION

Numeracy is an ability that needs to be developed, and one of the surveys applied in the Minimum Competency assessment (Aini et al., 2024; Purnomo et al., 2022; Setiyani et al., 2024). Numeracy or numeracy literacy is one of the students' abilities to recognize numbers, take facts, data, and analyze them both in the form of graphs, tables, and diagrams, and interpret from daily life problems (Pratiwi & Ariawan, 2020; Ristanto et al., 2019). This numeracy ability is still a problem and needs to be improved (Fauzan et al., 2024), students are not familiar with numeracy literacy issues (Setiyani et al., 2024), numeracy literacy skills still need to be trained, especially in the context and process (Aini et al., 2024; Karmila et al., 2026), numeracy literacy skills are not only important in Indonesia, in other countries such as Canada, Mexico, and Chile is very important to the numeracy literacy environment of the family (Susperreguy et al., 2022). With this reality, numeracy skills need to be overcome immediately.

On an international scale, children's mathematical literacy is measured through the PISA (Programme for International Student Assessment) study (Wijaya et al., 2024). The results of the latest survey in 2022 show a decrease in the average score of mathematical literacy ability in various countries. In 2022, the average score obtained for mathematical literacy skills was 480, which shows a decrease of 9 points from 2018 (Aksu et al., 2022). The average score of mathematical literacy ability is the lowest of the other 2 skills, namely science and reading (Aksu et al., 2022). Mathematical literacy is closely related to numeracy skills, as mathematical literacy requires individuals to use mathematical concepts to understand and solve real-life problems. International assessments such as the Programme for International Student Assessment (PISA) measure these skills in the context of numeracy in everyday life.

Numeracy or numeracy literacy, when reviewed based on its context, consists of personal, social, scientific, and cultural aspects. Cultural contexts can help in the process of strengthening mathematical concepts. Cultural contexts that involve daily activities can provide opportunities for students to understand and apply mathematical concepts practically (Supriadi, 2022). For example, a culture that involves geometric patterns in batik fabric can help students see how mathematics impacts as well as is relevant to real life. Numeracy Literacy in the question contains readings in the form of stimuli associated with daily life. (Setiyani et al., 2024). Stimuli that can be raised in reading about stories include local culture or wisdom (Pratiwi & Ariawan, 2020). Local wisdom can shape the character of students (Haka et al., 2024).

Learning based on local or cultural wisdom, if raised and integrated in the concept of mathematics, will advance the field of education that is responsive to culture (Nursyahidah et al., 2025). Learning based on local or cultural wisdom integrated with technology can strengthen the SDGs (Haris et al., 2025). The learning approach should be closer to the context of local wisdom (Imran et al., 2025). The local wisdom raised in this study is about the Banten culture.

Some local wisdom in Indonesia in numeracy literacy has been raised, namely the development of books with local wisdom (Cahya, 2023), the context of local wisdom on herbal medicine (Johar et al., 2022), and developing Biology books with local wisdom of Baduy Banten (Haka et al., 2024). The numeracy literacy assessment has been conducted based on

local wisdom (Citrawan et al., 2024), but it is not associated with online learning or websites. Based on this research, the development of numeracy based on local wisdom in the form of a website for mathematics learning has not been developed. The development of numeracy literacy with media other than websites, including by using non-website electronic modules (Nindiasari et al., 2022). Learning that is integrated with local wisdom has also been studied with Augmented Reality (Indrawan et al., 2024; Nindiasari et al., 2024).

The website is one of the mobile learning (M-Learning), which can help students to learn anywhere (Thao et al., 2019). Websites can be used as an alternative learning media, including in mathematics, and can increase learning motivation (Suripah & Susanti, 2022). Websites for delivering learning materials can also be said to be electronic modules (Marsia et al., 2024). Thus, websites are a medium that can be used to provide messages about learning, such as the benefits of electronic modules. This website can be used to develop certain abilities, such as in the fields of biology (Wals & Wichary, 2023), health (Marsia et al., 2024; Tao et al., 2019), and mathematics education (Murdiyanto et al., 2023; Thahir et al., 2020). According to these experts, no website in mathematics education related to the development of numeracy literacy has been developed.

Website media is the right medium to develop technology-based learning; this website media can also facilitate teaching materials, including selected capital materials, with website results that are suitable for use and can improve the learning process (Thahir et al., 2020). The use of websites can increase motivation to learn mathematics (Suripah & Susanti, 2022). Websites based on local wisdom can improve students' character, which is in line with the Pancasila profile (Haka et al., 2024). Website media is very effective for the learning environment in developing reflective thinking (Hourigan & Murray, 2010).

The ability to think reflexively is a person's ability to predict and interpret a case based on mathematical concepts, a person's ability to find simple formulas, draw analogies from two similar cases, and the ability to predict answers in solving mathematical problems (Aldahmash et al., 2021). By thinking reflectively, students are not only able to give answers but also able to explain the processes that occur in their minds (Salido & Dasari, 2019).

The ability to think critically is closely related to the ability to think reflectively. Because critical thinking is a deliberate and reflective process (Gadot & Tsybulsky, 2025). Therefore, mathematical reflective thinking is one of the high-level mathematical thinking skills that must be possessed by every student in improving critical thinking skills, but unfortunately, reflective thinking skills are still rarely introduced by teachers (Salido & Dasari, 2019). This is because there is a relationship between the two, namely the ability to interpret, conclude, predict, and solve problems in everyday life.

A case study conducted by Salido and Dasari (2019) supports this, that the ability to think reflectively in students has not been developed optimally. A case study by Rahmi et al. (2020) also found that students' mathematical reflective thinking skills are generally still relatively low. The low ability to think mathematical reflective in students is caused by the mathematics learning process not being able to support the improvement of reflective thinking skills in students optimally (Rahmi et al., 2020). In addition to being integrated with the media, this ability needs to be approached with various approaches, including the Mathematics Realistic Education (RME) approach, where with this approach the numeracy literacy ability

is better (Fauzan et al., 2024; Saraswati et al., 2026), literacy learning with card games, which show good results (Rasid et al., 2022), and with a metacognitive approach in the field of natural sciences (Tegeh et al., 2021).

Teachers play a crucial role in implementing the metacognitive approach, including through the following activities: 1) asking questions that focus on what and why; 2) developing various aspects of problem-solving that can improve student achievement; 3) in the problem-solving process, students must actually do it independently or in groups so they directly experience the twists and turns of the process leading to a solution (An & Cao, 2014). Metacognitive strategies are provided to guide students in collaboration (Jbeili, 2012). These metacognitive skills are crucial for academic improvement (Craig et al., 2020). The process of managing information involves metacognitive thinking (metacognitive knowledge and skills) (Tegeh et al., 2021).

Metacognitive abilities strongly support e-learning websites (Beege et al., 2023). Therefore, a local wisdom numeracy website will be developed with a metacognitive approach to improve reflective mathematical thinking skills. This research has not been widely studied, particularly on local wisdom numeracy websites with a metacognitive approach for reflective mathematical thinking skills. Existing studies only discuss virtual laboratory websites for self-regulation (Al-Duhani et al., 2024), websites as a medium for mathematics learning during the COVID-19 pandemic to increase learning motivation (Suripah & Susanti, 2022), designing websites for capita selecta lessons in mathematics (Thahir et al., 2020), and developing a website design for local Baduy Banten wisdom in biology learning (Haka et al., 2024). Based on the description above, there is a relationship between numeracy literacy and mathematical reflective thinking skills, and a metacognitive approach and website media based on local wisdom. Numeracy literacy, which is the ability to interpret, conclude, analyze, and solve mathematical problems in everyday life, can be honed through mathematical reflective thinking skills, because there is a relationship in its indicators. To develop all these abilities, they are trained with a metacognitive approach, because in this approach stage hones mathematical reflective skills and numeracy literacy, namely at the stages of evaluating, making connections, and understanding problems. Meanwhile, its development through website media is based on local wisdom, because this media is rarely developed and has many benefits for improving achievement and learning motivation, as well as local wisdom as one of the contexts that can be raised in numeracy literacy.

Furthermore, there is research on websites for problem-solving and reflective thinking levels, but not related to numeracy and local wisdom (Namvar et al., 2009). The purpose of this research is to develop a numeracy website based on local wisdom with a metacognitive approach in improving mathematical reflective thinking skills, and to determine the feasibility and effectiveness of a numeracy website based on local wisdom with a metacognitive approach. Thus, this research will examine the problems: (1) How to develop a numeracy website based on local wisdom with a metacognition approach in improving mathematical reflective thinking abilities, (2) What is the feasibility and effectiveness of a local wisdom-based numeracy website with a metacognition approach to improve mathematical reflective thinking abilities?

2. METHOD

2.1. Research Design

The goal to be achieved in this research is a numeracy website media for students to improve their mathematical reflective thinking skills, which is integrated with the context of local wisdom and a metacognitive approach. The metacognitive approach applied in this study is a strategy to raise students' awareness of their ability to control their thinking activities, through asking metacognitive questions to understand problems, connecting existing knowledge with new knowledge, developing problem-solving strategies, and conducting evaluations or reflections (de Almeida & de Castro, 2023). Examples of questions are as follows: What can you understand from the question above? What strategy is appropriate for solving the question? After you have done it, are you sure about your answer? So, the method used in this development is DDR (Design and Development Research). The DDR method is one of the development methods, intending to build an empirical answer? for the creation of certain products, both instructional (for learning) and non-instructional. The steps of DDR, according to Ellis, are identifying problems and describing the focus of research, designing products, developing products, implementing, evaluating, and communicating test results (Ellis & Levy, 2010).

2.2. Research Procedure

The research procedure can be seen in Figure 1.

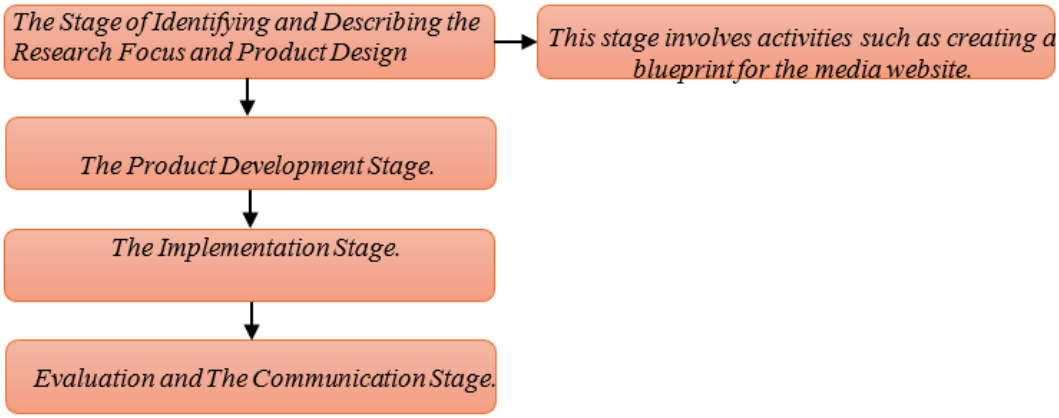

Figure 1. DDR research procedure

The first stage is the stage of identifying and describing the research focus. At this stage, the research team determines the objectives and targets of the research, determines the model, procedures, and scope of the research, as well as the participants involved in the research.

The second stage is the product design stage. This stage involves creating a website blueprint, preparing the elements required for the website, such as creating a website storyboard, developing user guides, creating teaching materials, and questions based on local cultural content, etc. The third stage is the product development stage. This stage involves compiling the design and the supporting media that have been created and compiled into a unified website, tailored to the needs of the designated activities.

During the implementation stage, the website, with its local wisdom context, will be tested by experts and subject to both limited and large-scale trials. Expert testing will be conducted by education experts, media experts, and content experts to ensure its feasibility. After the experts have certified the website as feasible, a limited trial will be conducted on 10 students at a junior high school in Serang City. A limited test was conducted on 10 students at a junior high school. The background of this problem was related to the low numeracy and literacy skills at the school. This trial aims to obtain information and suggestions regarding website development.

The evaluation stage is the stage of assessing whether the product developed, namely the local wisdom numeracy website with a metacognitive approach, can improve mathematical reflective thinking skills. At this stage, an effectiveness test is carried out through a normalized gain test, which aims to see the increase in mathematical reflective thinking skills before and after using the local wisdom-based numeracy website media with a metacognitive approach. This activity applies a quantitative approach, an experimental method with the one-group pretest-posttest design. The research subjects were students at State Junior High School 7, Serang City, Banten Province, as many as 30 students. Finally, the communication stage, this stage is the stage of disseminating the research product. This activity was carried out through a community service forum in collaboration with the Nusantara Mathematics Organization of Banten Province and a meeting of junior high school mathematics teachers.

2.3. Data Collection Techniques and Instruments

The data collected in this study are quantitative and qualitative data obtained from the Education Expert Validation Questionnaire Instrument given to education experts to validate the numeracy website from education experts, the material expert validation questionnaire given to junior high school mathematics experts, to validate from mathematics material experts, the media expert validation questionnaire given to digital media experts, to validate the numeracy website from digital media experts, the respondent questionnaire given to junior high school students to know the responses and suggestions for the numeracy website, as well as the mathematical reflective thinking ability test given to 30 junior high school students, to see the increase in mathematical reflective thinking ability after using the website media. The aspects and indicators of the questionnaires are described in Tables 1 to 5.

The data obtained will be processed using descriptive statistical analysis. Data obtained from the education expert validation questionnaire, material expert validation questionnaire, media expert validation questionnaire, and respondent questionnaire using a Likert scale will be processed using the following formula:

$$\rho = \frac{Observed\ Score}{Expected\ Score} \times 100\%$$

The data obtained from the reflective thinking ability test instrument will be processed using the N-Gain test to see the improvement before and after using the local wisdom context numeracy website product on mathematical reflective thinking ability, with the n-gain formula using the formula from Hake's theory (2002), namely:

$$g = \frac{S_1 - S_0}{S_{max} - S_0}$$

With S_0 = Initial score; S_1 = Final score; and S_{max} = Maximum score.

3. RESULTS AND DISCUSSION

3.1. Results

This research consists of several stages: identifying and describing the research focus, product design, which involves creating a website media design (blueprint), product development, and implementation.

3.1.1. Identification Stage

In this stage, a Focus Group Discussion (FGD) was conducted with mathematics teachers in Banten Province to determine the material to be covered on the website, local wisdom, and the required design. The results of this activity indicate that, for Junior High School (SMP) level, the materials include: Social Arithmetic, Number Patterns, Curved-Sided Solids, Similarity, Geometry and Measurement, Statistics, Integers, Ratio Comparison, Equal and Inverse Ratio Comparisons. The local wisdom to be covered relates to the Bantenese culture in Indonesia. This culture includes the Baduy culture, an indigenous tribe found in the Banten region. The indicators for reflective mathematical thinking skills are: (1) Ability to interpret a case based on the mathematical concepts involved; (2) Ability to identify mathematical concepts or formulas involved in complex mathematical problems; (3) Ability to evaluate/verify the validity of an argument based on the concepts/properties used; (4) Ability to draw analogies from two similar cases; (5) Ability to analyze and clarify questions and answers; (6) Ability to generalize and analyze generalizations; (7) Ability to distinguish between relevant and irrelevant data; (8) Ability to solve mathematical problems (Nindiasari et al., 2016). A metacognitive approach is used to integrate conceptual understanding and solve numeracy problems. Students are encouraged to first understand the problem, determine problem-solving strategies, connect previous knowledge with current knowledge, and reflect (Cabrera et al., 2022).

3.1.2. Product Design Stage

In the design stage, the script and storyboard for the local wisdom-based numeracy website are designed. The script is structured based on the menu that will be displayed on the website. Appendix A is one of the scripts developed for the website.

Appendix A shows that the script material will be included in the menus on the Numeracy website. The menu includes Level, core competencies, material descriptions, exercises, summaries, tests, and answer keys. Metacognitive questions serve as awareness questions for understanding concepts and solving problems. The Storyboard, a flowchart designed for the website, can be seen in Figure 2.

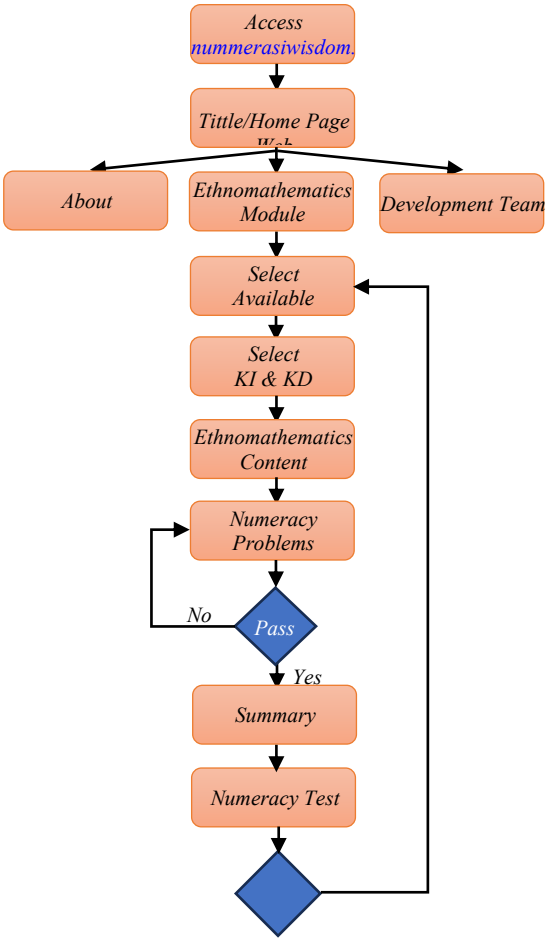

Figure 2. Numeracy website storyboard flow

Figure 2 is a storyboard of the website design that will be developed. Starting by accessing the website link, then the home page appears, where there is an About menu, the ethnomathematics module, and the developers. In the module menu, there are options available: Core Competency and Basic Competency options, Ethnomathematical content, and numeracy problems. If you pass, complete the summary and numeracy test. If you do not pass the numeracy problem-solving, you will continue to solve the problem.

3.1.3. Product Development Stage

After compiling the design, the next step was to develop the website product with supporting media. This resulted in a website accessible at https://numerasiwisdom.com/. This local wisdom-based Numeracy website displays an opening screen when users access the Numeracy link. The website then includes ethnomathematics content, understanding mathematical concepts through Banten culture, improving numeracy literacy, and practicing reflective mathematical thinking skills. All of this is integrated with a metacognitive approach.

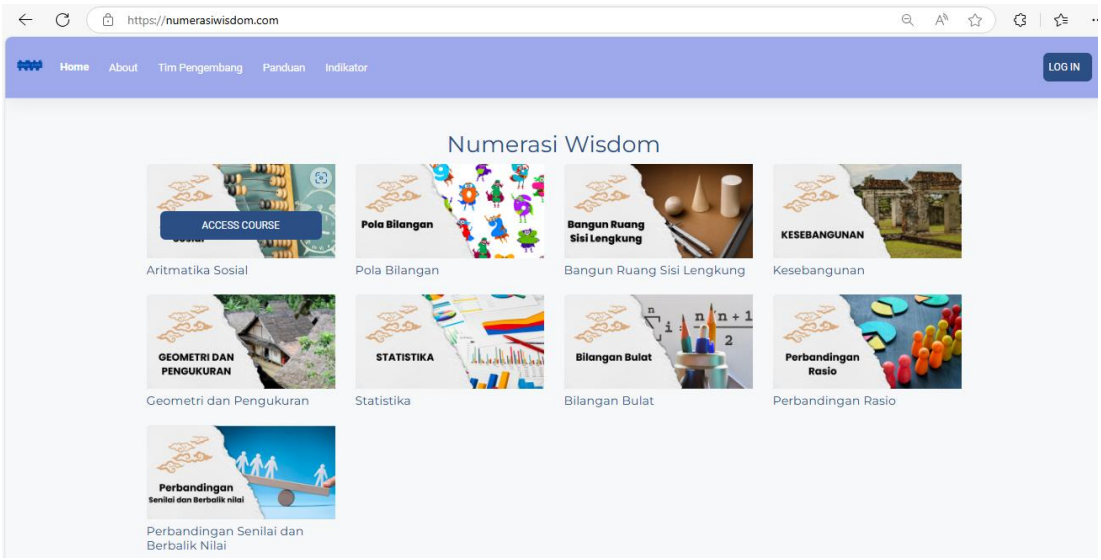

Figure 3. Initial access to the numeracy website

Figure 3 shows several menus for junior high school mathematics materials. There are eight topics: Social Arithmetic, Number Patterns, Curved-Sided Solids, Similarity, Geometry and Measurement, Statistics, Integers, Ratio Comparison, Equivalent Proportions, and Inverse Ratio. Accessing each topic provides several menu options, including: Learning Indicators, Material Description Indicators, Numeracy Practice, Summaries and Formative Tests, and Summaries and Bibliography.

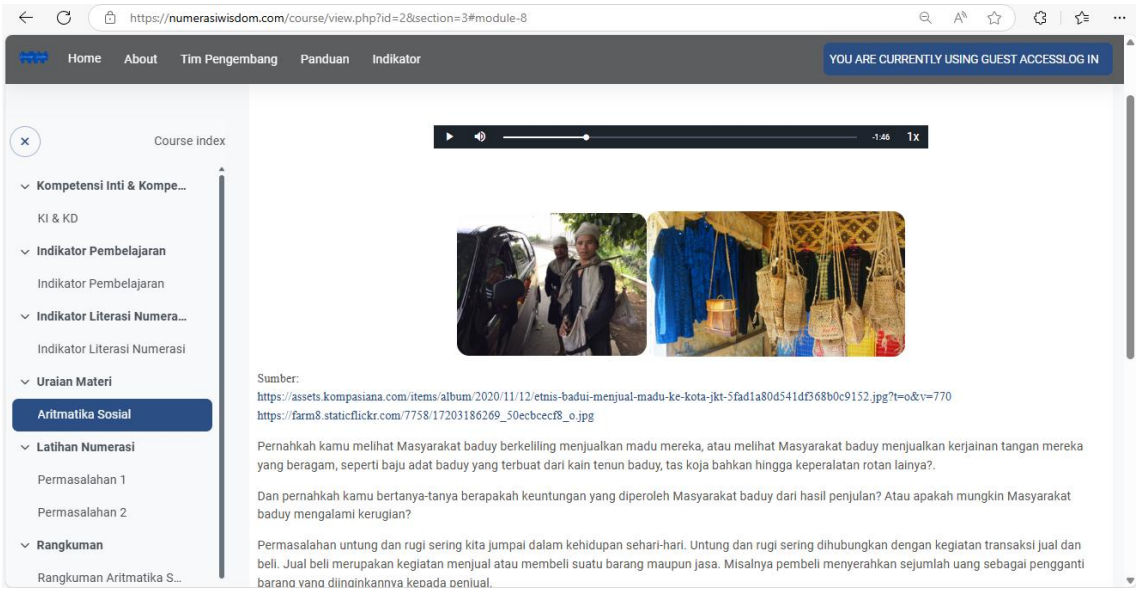

Figure 4. Understanding concepts with context through the Banten culture

Figure 4 shows one of Banten's cultural traditions, highlighted in this context by the Baduy people. The Baduy people often sell rattan bags called "koja bags," and traditional Baduy clothing made from traditional Baduy knitting. These displays emphasize the concept of social arithmetic. The social arithmetic associated with this concept is the understanding of

profit and loss, earnings, and capital. This conceptual understanding is integrated with the cultural context, thus training students in literacy.

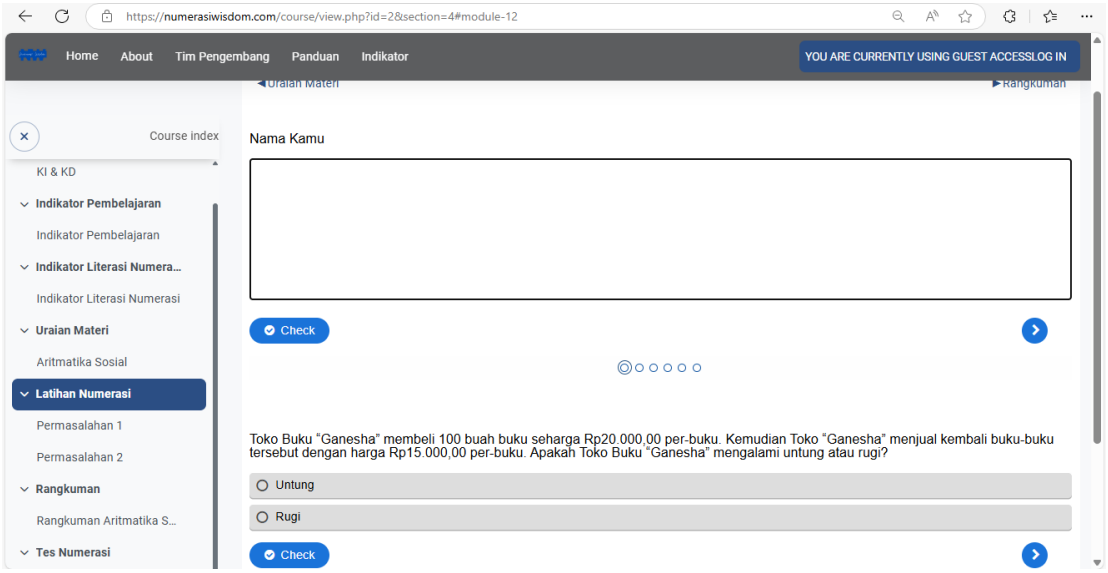

Figure 5. Numeracy exercise

Figure 5 is one of the numeracy exercise features. Students are also trained in reflective mathematical thinking skills, including the ability to interpret and conclude whether the social arithmetic problem results in a profit or a loss. Solving these problems is guided by a metacognitive approach by increasing awareness and control of their thinking activities. For example, in the concept of understanding number patterns.

One example is the topic of number patterns. Understanding this material with local Indonesian wisdom from Java, in this case gamelan, and the problem: training students to conclude by asking questions: "Can you determine at what beat the next beat begins? What sequence pattern is formed? A number sequence pattern is a sequence of numbers whose writing follows a certain pattern." Another advantage of the website is that numeracy tests are designed with the context of local wisdom, for example, on similarity, within the Banten cultural context, namely the Grand Mosque.

3.1.4. Implementation Stage

The Implementation Stage includes expert testing and a limited scale test. This expert testing includes media experts, education experts, and material experts. The number of each expert consists of 3 people, who are experts in their fields. Based on the experts' suggestions, feedback was provided to improve the website. These suggestions included sharpening the metacognitive question-posing menu in implementing a metacognitive approach and enriching the content with Banten's local wisdom. The test was limited to 10 junior high school students as research subjects. Table 1 shows the results of the material expert test.

Table 1. Results of material expert tests

No	Aspect	Indicators	Average score
1	Numeracy Literacy Material	The material is in accordance with the learning objectives and numeracy literacy indicators	4
		Exposure to material supports students' numeracy literacy skills	4
2	Stimulus, Context, Litnum Question content examples and evaluation	Stimulus for numeracy literacy questions	4
		Content on numeracy literacy questions	3.67
		Context on numeracy literacy questions	3.67
		Cognitive Level on numeracy literacy questions	3.33
		Form of numeracy literacy questions	3.67
3	Learning Activities with a Metacognitive Approach	Using a Metacognitive learning approach in understanding numeracy literacy	3.67
4	Formative test	Stimulus on the problem	3.67
		Question form	3.67
		Context and content in the question	4
		Overall score	**3.76 (95%)**
		Interpretation	**Very suitable and very interesting**

Table 1 shows an average score of 3.76 for the material expert test, with a 95% score in the very suitable and very interesting categories. Indicators that received a score of 4 include: The material is in accordance with the learning objectives and numeracy literacy indicators; Exposure to the material supports students' numeracy literacy skills; Context and content in the question.

Table 2. Results of the education expert test

No	Aspect	Indicators	Average score
1	Material on the Website Numeracy	Material aligns with learning objectives and numeracy literacy indicators	4
2	Interactive	Interactive in understanding material and solving numeracy literacy problems	3.5
		Interactive in raising self-awareness in controlling thinking	3.5
3	Metacognitive approach in helping solve numeracy literacy problems	Metacognitive approach in the form of Metacognitive Awareness	4
		In solving numeracy literacy problems	4
		Metacognitive approach in the form of Metacognitive Regulation	3
4	Website Systematics Aspect	In solving numeracy literacy problems	3
		Metacognitive approach in the form of Metacognitive Evaluation in solving problems and understanding numeracy literacy problems	4
		Overall Score	**3,67 (93.6%)**
		Interpretation	**Very suitable and very interesting**

Table 2 shows the results of the educational expert test, with an average overall score of 3.67 with a percentage of 93.6%, with the categories very suitable and very interesting. Several indicators that received a score of 4 include: Metacognitive approach in the form of Metacognitive Awareness; Material aligns with learning objectives and numeracy; in solving numeracy literacy problems; in solving numeracy literacy problems; Metacognitive approach in the form of Metacognitive Evaluation in solving problems and understanding numeracy literacy problems.

Table 3. Media expert test results

No	Aspect	Indicators	Average score
1	Appearance	Design used	4
		Color selection	3.5
		Background	3.5
		Letters	4
		Buttons	3
		Image display	3.5
		Layout	3.5
		Background sound	3
2	Use	Easy to use	4
		Easy to navigate	4
		Interactivity	3.5
		Instructions for use	4
		Menu options	3
		Button usage	3.5
Overall Score			**3.64 (89.5%)**
Interpretation			**Very suitable and very interesting**

Table 3 shows the results of the media expert test, with an average overall score of 3.64 and a percentage of 89.5%, with the categories very suitable and very interesting. Scores of 4 were obtained for the following indicators: Design used, Letters, Easy to use; Easy to navigate; Instructions for use.

Limited Scale Test

The limited test was conducted on 10 junior high school students at a school in Serang City, Banten Province. Table 4 summarizes the results.

Table 4. Limited scale test summary

Aspect	Average	Interpretation
Numeracy Literacy Material and Development	3.25	Very good
Website Learning Approach Trains Numeracy Literacy Skills	3.32	Very good
Interactive Website Motivates Students	3.20	Very good
Media Presented on the Numeracy Website	3.10	Very good

Aspect	Average	Interpretation
Sustainability of Numeracy Literacy e-modules for Students	3.30	Very good
Effectiveness of the Website in Training Numeracy Literacy Questions	3.10	Very good
Context and Stimulus in Numeracy Literacy Questions	3.30	Very good
Overall Interpretation		**Very positive**

Table 4 shows that student responses to using the local wisdom-based Numeracy website with a metacognitive approach to improve reflective mathematical thinking skills were very positive.

3.1.5. Evaluation Phase

The evaluation phase was conducted with students of State Junior High School 7, Serang City, Banten. A total of 30 students participated in learning using the Numeracy website. This effectiveness test was conducted to assess improvements in reflective mathematical thinking skills. Website use activities took place both in and out of class. In class, the students were guided and assisted by the teacher.

Figure 6. Students using the website in class

Figure 6 shows that students using the website are trained in local wisdom-based numeracy and guided by metacognitive questions to improve their reflective mathematical thinking skills. The local wisdom-based numeracy website is also used outside of class via smartphones. Student responses after this learning session were very positive (see Table 5).

Table 5. Summary of questionnaire response results to the local wisdom-based numeracy website

No	Aspect	Indicators	Average score
1	Clarity of Material	Understanding the Material on the Website	3.1
		The material presented is tailored to students' needs	3.4
2	Metacognitive Learning Approach	Application of a metacognitive approach on the website	3.3
		Asking questions can develop thinking.	3.3
3	Interaction on the Website	Interaction on the Numeracy Website and Motivation.	3.3
4	Media presented on the website	Images and Features on the Numeracy Website	3.2
		The voice-overs clarify the use of the numeracy website.	3.2
		The website's colors and backgrounds support interest in reading the local wisdom numeracy website.	3.2
5	Sustainability of website use	Sustainable use of the local wisdom-based numeracy website	3.3
6	The effectiveness of numeracy websites in training numeracy literacy questions	The website is effective in training numeracy literacy.	3.1
7	Context and stimulus in numeracy literacy questions	The reading material presented is relevant to the local wisdom context and engaging.	3.3
Overall score			**3.2 (80.55%)**
Interpretation			**Very good and very positive**

The implementation stage also examined the effectiveness of reflective mathematical thinking skills. In the implementation of learning using the website, an initial test of reflective mathematical thinking skills was conducted, and after this activity, students were given a final test. Both tests showed a very high improvement of 0.79, with an initial score of 52 and a final score of 90.

3.1.6. Communication Stage

The communication stage was conducted through teacher meetings in a Numeracy workshop. This activity introduced a numeracy website based on local wisdom using a metacognitive approach to improve reflective mathematical thinking skills. The reflective mathematical thinking skills examined included: (1) Interpreting: Being able to interpret a case based on the mathematical concepts involved; (2) Identifying mathematical concepts or

formulas involved in complex mathematical problems; (3) Evaluating/verifying the validity of an argument based on the concepts/properties used; (4) Being able to draw analogies from two similar cases; (5) analyze and clarify questions and answers, (6) Can generalize and analyze generalizations, (7) Can distinguish between relevant and irrelevant data; (8) Can solve mathematical problems (Nindiasari et al., 2020). This communication activity received very good attention and response from mathematics teachers who are members of the Mathematics Teachers' Conference.

3.2. Discussion

A numeracy website for junior high school students can improve reflective mathematical thinking skills. This significant improvement is due to the website's design being guided by a metacognitive approach. This metacognitive approach can also improve literacy and numeracy (Tegeh et al., 2021). The metacognitive approach on the website includes metacognitive questions, such as how to control one's thinking, how to understand, develop problem-solving strategies, connect previous mathematical material with current knowledge, and reflect (Chen et al., 2025). Furthermore, there is a link between reflective mathematical thinking skills and metacognitive skills. Reflective thinking is part of critical thinking, and these skills can be trained through the website (Nagel et al., 2020). The website's integration with metacognitive skills has been shown to influence a person's abilities (Pei & Suwanthep, 2019). A good metacognitive strategy will influence critical thinking skills (Shen et al., 2024).

This website, a computer-based learning environment, can help improve reflective thinking skills supported by a metacognitive approach. This aligns with several studies linking computer-based learning environments with metacognitive approaches to improving reflective mathematical thinking skills (Duangnamol et al., 2018; Nurazizah et al., 2025). Metacognitive awareness can also help one's proximal domain (Potgieter & van der Walt, 2022). The difference with this research is the use of digital media for numeracy websites based on mathematical wisdom. Metacognitive abilities significantly influence students' mathematics achievement (Craig et al., 2020).

This numeracy literacy website, with a metacognitive approach, improves reflective mathematical thinking skills by encouraging students to consciously reflect on their actions, control their thinking activities, be aware of their thoughts, and consciously plan various strategies to improve their thinking accuracy. analyzing problems before solving them, understanding the underlying mathematical concepts (Laamena & Laurens, 2021). Thus, reflective mathematical thinking skills are facilitated in a metacognitive approach, as they involve controlling thinking activities and are trained to improve thinking accuracy. Reflective thinking skills are crucial because they enable conscious and logical decision-making in solving complex problems (Syamsuddin et al., 2020). The use of website learning can support reflective thinking skills (Hourigan & Murray, 2010).

Local wisdom integrated into learning media can enhance students' positive attitudes toward learning, a finding that aligns with research by Damopolii et al. (2024), which related local wisdom to students' conservative attitudes. Local wisdom-based learning can improve reflective mathematical thinking skills, with online website learning in line with research that online learning based on local wisdom can improve higher-order thinking skills (Asmara et

al., 2026; Hidayat et al., 2025; Hikmawati et al., 2024; Leton et al., 2025; Utari et al., 2025). In addition, local wisdom integrated into the numeracy website helps improve reflective mathematical thinking skills. This is because thinking is related to critical thinking skills, in line with studies that the integration of local wisdom can help critical thinking skills (Syahfitri & Muntahanah, 2024).

4. CONCLUSION

The Banten local wisdom-based numeracy website for reflective mathematical thinking skills using a metacognitive approach was developed in several stages: (1) identification, (2) product design, (3) product development, (4) implementation, (5) evaluation, and (6) communication. Based on expert testing, this website product is highly feasible and attractive. Students, in response to the feasibility test, expressed positive feedback on the local wisdom-based numeracy website for reflective mathematical thinking skills. There was a significant increase in reflective mathematical thinking skills after being provided with the local wisdom-based numeracy website with a metacognitive approach. Therefore, it is recommended to implement this website to improve reflective mathematical thinking skills. For further research, it is expected that a wider effectiveness test can be conducted in several schools.

Declarations

Author Contribution : HN: Conceptualization, Visualization, Writing - original draft, and Writing - review & editing; HH: Conceptualization, Visualization, Writing - original draft, and Writing - review & editing; MF: Supervision, and Validation; NKK: Formal analysis, Methodology, and Writing - review & editing; DN: Formal analysis, Methodology, and Writing - review & editing; R: Formal analysis, Methodology, and Writing - review & editing; AR: Formal analysis, Methodology, and Writing - review & editing.

Funding Statement : The author discloses no receipt of the following financial support for this article's research, authorship, and publication.

Conflict of Interest : The authors declare no conflict of interest.

Additional Information : Additional information is available for this paper.

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Appendix A

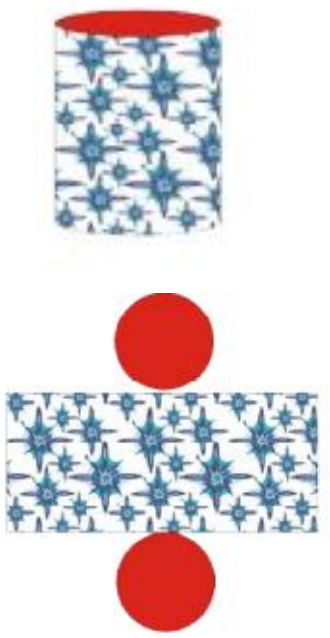
Website script template

Aspect	Description
Level	Junior High School
Material	Curved Side Space Building
Core competencies and basic competencies	**Core Competencies:** 1. Demonstrate honest, disciplined, responsible, caring (tolerant, cooperative), polite, and self-confident behavior in interacting effectively with the social and natural environment within their social circle and existence. 2. Understand knowledge (factual, conceptual, and procedural) based on curiosity about science, technology, art, and culture related to visible phenomena and events. 3. Experiment, process, and present in the concrete realm (using, analyzing, assembling, modifying, and creating) and the abstract realm (writing, reading, calculating, drawing, and composing) in accordance with what is learned in school and other sources with similar perspectives/theories. **Core Competencies:** Generalize the surface area and volume of various curved-sided geometric shapes (cylinders, cones, and spheres).
Indicators Numeracy Literacy Indicators	1) Given a contextual story stimulus and an image of a tumpeng (rice cone) shaped like a bamboo basket (besek). Students are able to determine the volume and surface area of a cylindrical besek (besek) shaped like a cylinder without a lid and a half-sphere. 2) Given a contextual story stimulus and an image of a tumpeng shaped like a jug. Students are able to determine the volume and surface area of a jug shaped like a hemisphere and a cone. 3) Given a text stimulus and an image of a drum (bedug). Students can obtain information from the text and image. 4) Given a text stimulus and an image of a drum (bedug). Students are able to solve a contextual problem related to the painted surface area of the Boscha building.
Indicators of Mathematical Reflective Thinking Ability	**No** / **Mathematical Reflective Thinking Indicators** 1. Can interpret a case based on the mathematical concepts involved 2. Can identify mathematical concepts or formulas involved in complex mathematical problems 3. Can evaluate/verify the validity of an argument based on the concepts/properties used 4. Can draw analogies from two similar cases 5. Can analyze and clarify questions and answers 6. Can generalize and analyze generalizations 7. Can distinguish between relevant and irrelevant data 8. Can solve mathematical problems
Domain/ Sub Domain	Geometry and measurement / Buildings and Geometry

Aspect	Description
Description	**Tube**

1. Tube Opening

In everyday life, tube openings can be found on wrapping paper that wraps tube-shaped cans.



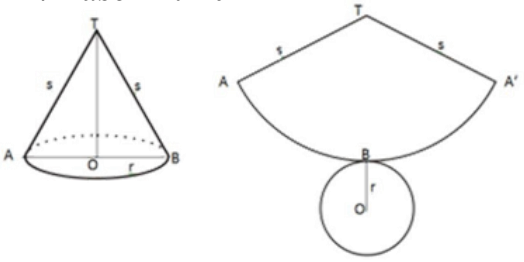
The image above shows that the opening of the cylinder is formed by two circles as the base and roof, and one rectangle as the cylinder cover. The surface area of the cylinder can be calculated by adding the areas of the base, roof, and the cylinder cover. For a cylinder with a base radius of r and a height of t, the surface area is:

a. Area of the base $= \pi r^2$
b. Roof area $= \pi r^2$
c. Area of blanket
$$= around\ the\ base \times tube\ height = 2\pi rt$$
d. The total surface area of the cylinder
$$= \pi r^2 + \pi r^2 + 2\pi rt = 2\pi r^2 + 2\pi rt = 2\pi r(r + t)$$

2. Tube Volume

$$V\ Tube = \pi r^2 t$$

Information:
V Tube = tube volume
r = tube radius
t = tube height



Cone

1. Cone Aperture

A conical aperture is formed by a circular sector as the curved surface and a circle as the base. The figure below shows a cone with a radius of r and a slant height of s.

The surface area of a cone is obtained by summing the area of the base and the curved surface area. In the figure above, the surface area is:

a) Area of the base $= \pi r^2$

b) Area of blanket $= Juring\ area\ TABA'$

$$= \frac{Circle\ Area\ T\ \times Arc\ Length\ ABA'}{Circumference\ T}$$

$$= \frac{\pi s^2 \times 2\pi r}{2\pi s}$$

$$= \pi rs$$

c) Total Surface Area of a Cone $= \pi r^2 + \pi rs$

$$= \pi r(r + s)$$

2. Volume of a Cone

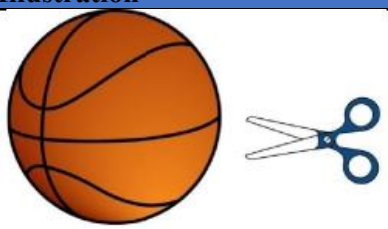
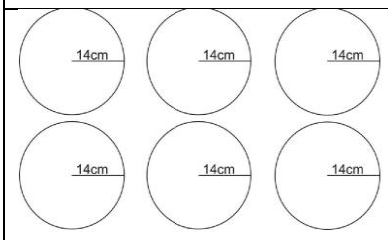
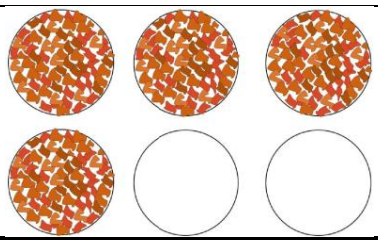
$$V\ cone = \frac{1}{3}\pi r^2 t$$

Information:

- V Cone = Volume of Cone
- r = cone radius
- t = cone height

Balll

1. Ball opening

Illustration	Treatment
	A spherical basketball with a radius of 14 cm is cut into small pieces using scissors.
	Six circles with a radius of 14 cm are drawn on a piece of paper.
	All the small pieces of the basketball are attached to the provided circle areas, and it turns out that all the pieces can fill four of the circle areas.

Aspect	Description
	From the experiment above, it can be seen that the area of a sphere with radius r is $4\pi r^2$ **2.** Ball volume $$V\ Ball = \frac{4}{3}\pi r^3$$ Information: - V Ball = Volume of Ball - r = ball radius **Metacognitive Questions** Is there any previous material that can be related to today's material? What can you conclude?
Numeracy exercises integrated with mathematical reflective thinking indicators, answer keys and discussions.	1. In Banten, there is a tradition of making woven bamboo containers called "besek." Besek are used as containers for various purposes, such as food or small tools. These besek are usually shaped like a tube or cylinder with a hemispherical lid. Mr. Budi, a besek craftsman, wants to make a bamboo besek shaped like a tube with a hemispherical lid. The height of the tube is 30 cm, and the diameter of the base is 14 cm. a. Calculate the total volume of the besek (volume of the tube + volume of the hemispherical). b. Calculate the total surface area of the besek (surface area of the tube + surface area of the hemispherical). Metacognitive Questions 1) What do you understand from the problem above? 2) Is the available data sufficient to solve the problem? 3) What strategy is appropriate for solving the problem? 4) After you have completed the task, are you confident in your answer? 2. What do you understand? In Banten, there is a tradition of making pottery or ceramics, which are often used as containers for storing water or food. One frequently made pottery form is a jug, which is shaped like a hemisphere at the bottom and a cone at the top. Mrs. Siti, a pottery craftswoman, wants to make a jug with a hemisphere at the bottom and a cone at the top. The diameter of the hemisphere is 28 cm, and the height of the cone is 48 cm. a. Calculate the total volume of the jug (volume of the hemisphere + volume of the cone). b. Calculate the total surface area of the jug (surface area of the hemisphere + surface area of the cone without the base). Metacognitive Questions 1) What do you understand from the problem above? 2) Is the available data sufficient to solve the problem? 3) What strategy is appropriate for solving the problem? 4) After you have completed the problem, are you confident in your answer?

Aspect	Description
Answer key and discussion of numeracy exercises	1. a. Volume of besek = Volume of cylinder $V_{tube} = \pi r^2 t$ + Hemispherical volume $V_{half\ ball} = \frac{1}{2}(\frac{4}{3}\pi r^3)$ $V_{total\ besek} = V_{tube} + V_{half\ ball} = \pi r^2 t + \frac{2}{3}\pi r^3 = \frac{22}{7}(7)^2(30) + \frac{2}{3}\left(\frac{22}{7}\right)(7)^3 = 4620 + \frac{2156}{3} = \frac{16016}{3}\ cm^3$ b. Total surface area of the besek = $L_{surface\ of\ the\ tube\ without\ a\ lid} + L_{half\ ball}$ Total surface area of besek = $\pi r\ (r + 2t) + \frac{1}{2}(4\pi r^2) = \pi r\ (r + 2t) + 2\pi r^2$ Total surface area of besek = $\frac{22}{7}(7)\big(7 + 2(30)\big) + 2\left(\frac{22}{7}\right)(7)^2$ Total surface area of besek = 1474 + 308 = 1782 cm^2 2. a. Jug volume = hemispherical volume + cone volume Jug volume = $V_{\text{hemispherical volume}} + V_{cone}$ Jug volume = $\frac{1}{2}(\frac{4}{3}\pi r^3) + \frac{1}{3}\pi r^2 t$ Jug volume = $\frac{1}{2}\left(\frac{4}{3}\right)\left(\frac{22}{7}\right)(14)^3 + \frac{1}{3}\left(\frac{22}{7}\right)(14)^2(48)$ Jug volume = $\frac{17248}{3} + 9856 = \frac{17248}{3} + \frac{29568}{3} = \frac{46816}{3}$ b. Length of the painter's line $s = \sqrt{r^2 + t^2} = \sqrt{14^2 + 48^2} = \sqrt{196 + 2304} = \sqrt{2500} = 50$ cm Total surface area of the jug = Surface area of the hemisphere + surface area of the cone without the base. Total surface area of the jug = $\frac{1}{2}(4\pi r^2) + \pi rs$ Total surface area of the jug = $\frac{1}{2}(4)\left(\frac{22}{7}\right)(14)^2 + \frac{22}{7}(14)(50)$ = 1232+2200 = 3432 cm
Summary	1. Tube a. Tube Surface Area $= 2\pi r(r + t)$ b. Tube Volume $= \pi r^2 t$ 2. Cone a. Surface Area of a Cone $= \pi r(r + s)$ b. Cone Volume $= \frac{1}{3}\pi r^2 t$ 3. Ball a. Surface Area of a Ball $= 4\pi r^2$ b. Ball Volume $= \frac{4}{3}\pi r^3$
Test	1. In Banten, there is a tradition of making "bedug," a large drum used to accompany traditional music and religious ceremonies. The bedug is cylindrical in shape, with the ends covered with circular animal skins.  Source: https://kumparan.com/berita-terkini/mengenal-kesenian-rampak-bedug-dari-provinsi-banten-21jeWS0wbp4

Aspect	Description
	Mr. Hasan wants to create a new drum. The drum is cylindrical, 1 meter tall, and 70 cm in diameter. Both ends are covered with circular animal skins. Metacognitive questions: a) What do you know about the volume and surface area of a cylinder? What are the formulas? b) Determine the steps you need to take to calculate the total volume of the drum and its surface area. c) Calculate the total volume of the drum. d) Calculate the total surface area of the drum (including both lids).
Feedback	b. Steps to calculate the total volume of the drum and its surface area Known The diameter of the cylinder = 70 cm, so the radius = 35 cm The height of the cylinder is 1 meter = 100 cm 1) Asked Total volume of the drum. Total volume of bedug = volume of cylinder = $\pi r^2 t$ - Surface area of the drum Surface area of the drum = surface area of the cylinder = $2\pi r(r+t)$ c. Total volume of the drum = volume of the cylinder = $\pi r^2 t = \frac{22}{7}(35)^2(100) = 385000$ d. Total surface area of the bedug = $2\pi r(r+t) = 2\left(\frac{22}{7}\right)(35)(35+100) = 29700$
Expected answer	a. Surface Area of the Cylinder= $2\pi r(r+t)$ Tube Volume = $\pi r^2 t$ b. Total volume of the drum = volume of the cylinder = $\pi r^2 t$, Surface area of the drum = surface area of the cylinder = $2\pi r(r+t)$ c. $385000\ cm^3$ d. $29700\ cm^2$