MATHEMATICS LEARNING MODEL BASED ON COMPUTATIONAL THINKING: PREPARING ELEMENTARY SCHOOL STUDENTS TO BE DISCIPLINED, INDEPENDENT, AND DIGNIFIED

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ABSTRACT

Objective: The research aims to evaluate the feasibility of a computational thinking-based mathematics learning model. Explore strategies for preparing disciplined, independent, and dignified students by applying the developed model in elementary schools.

Theoretical Framework: Computational Thinking (CT) is becoming a fundamental part of the way people think and understand the world. Mathematics offers fruitful opportunities for CT integration. Integrating mathematics with CT, allows students to acquire essential critical thinking and problem solving skills.

Method: The type of research in this article is qualitative evaluative. The research subjects were the principal, math teachers, and students of Klaten Elementary School in Central Java. Data collection methods were observation, interview, and documentation. Data validity with source and method triangulation. Data analysis techniques are flow model and constant comparison.

Results and Conclusions: The results of the research, the CT-based mathematics learning model is feasible based on the assessment of material, design, and language experts, and can improve learning activities and outcomes. Preparing students to be disciplined, independent, and dignified, based on strong religion, core character, lifestyle character, character respect for others. This means that CT-based mathematics learning is feasible to implement in elementary schools and can prepare students to be disciplined, independent, and dignified.

Significance: The research findings have a significant impact on primary schools. The impact is to improve the quality of character, learning process, thinking, and learning achievement. This means that the research results have a broad role in the development of primary school students.

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MODELO DE APRENDIZAGEM MATEMÁTICA BASEADO NO PENSAMENTO COMPUTACIONAL: PREPARANDO OS ALUNOS DA ESCOLA PRIMÁRIA PARA SEREM DISCIPLINADOS, INDEPENDENTES E DIGNOS

RESUMO

Objetivo: A pesquisa visa avaliar a viabilidade de um modelo de aprendizagem de matemática baseado no pensamento computacional. Explore estratégias para preparar estudantes disciplinados, independentes e dignos aplicando o modelo desenvolvido nas escolas de ensino fundamental.

Estrutura Teórica: O Pensamento Computacional (TC) está se tornando uma parte fundamental da maneira como as pessoas pensam e compreendem o mundo. A matemática oferece oportunidades frutíferas para a integração da TC. Integrar a mathematics com CT, permite que os alunos adquiram habilidades essenciais de pensamento crítico e resolução de problemas.

Método - O tipo de pesquisa neste artigo é qualitativo avaliativa. As disciplinas de pesquisa foram o diretor, professores de matemática e alunos da Klaten Elementary School em Java Central. Os métodos de coleta de dados foram observação, entrevista e documentação. Validade de dados com triangulação de origem e método. Técnicas de análise de dados são modelo de fluxo e comparação constante.

Resultados e Conclusões - Os resultados da pesquisa, o modelo de aprendizagem de matemática baseado em CT é viável com base na avaliação de especialistas em material, design e linguagem, e pode melhorar as atividades de aprendizagem e os resultados. Preparando os alunos para serem disciplinados, independentes e dignos, com base em religião forte, caráter central, caráter de estilo de vida, respeito de caráter para com os outros. Isso significa que o aprendizado de matemática baseado em TC é viável para implementar em escolas de ensino fundamental e pode preparar os alunos para serem disciplinados, independentes e dignos.

Significado: Os resultados da pesquisa têm um impacto significativo nas escolas primárias. O impacto é melhorar a qualidade de caráter, processo de aprendizagem, pensamento e realização de aprendizagem. Isso significa que os resultados da pesquisa têm um papel amplo no desenvolvimento do ensino fundamental.

Palavras-chave: pensamento computacional, digno, disciplinado, independente, aprendizagem de matemática.

1 INTRODUCTION

Learning mathematics with teaching materials that have been used so far is often considered difficult by students. Therefore, teachers use teaching aids as part of their responsibility in developing students' potential. This is in line with 21st century learning, in which teachers have roles as facilitators, collaborators, mentors, coaches, directors and students’ study partners, and able to provide choices and build students' sense of
responsibility in experiencing positive change. However, there are not a few Elementary School teachers who in learning mathematics are not yet responsible for using teaching aids and are not yet collaborative. These limitations encourage students to be less responsible, inactive, and difficult to achieve 21st century learning goals (Sutama, et al., 2022; Sulistyaningrum, et al., 2023).

The results of observations at public elementary school 1 Gergunung Klaten showed that students’ responsibility for learning has not met the expectations. This is because students’ learning responsibilities were not optimal, which could be seen in terms of doing assignments, when students were often not serious enough in doing the task and in the end the task was not completed. Apart from that, the students lacked a sense of responsibility and were unable to utilize their time well. This can be seen when learning activities took place, there were students who joke with their friends, so their study time was wasted.

If students’ learning responsibilities are not increased, it will result in decreased learning outcomes, the development of students’ potential cannot be achieved, and there is a lack of self-discipline. Thus, appropriate ways are needed to guide and assist students in dealing with low levels of learning responsibility, both from family and from school. Parents can help remind children of their responsibilities as students at home, while competent school officials can help students overcome their problems.

Having responsible behavior is a characteristic of cultured students as well as having faith in God Almighty. Students who have been accustomed to developing a conscience from an early age will feel guilty when everything they do and respond to is detrimental to other parties. A sense of responsibility in students grows and develops along with the progress of the aspects of physio-psychosocial development. Ways to instill, grow, and develop awareness of responsibility in attitude and behavior can be done through habituation and exemplary teachers in learning activities, as well as instilling piety to God Almighty.

Regarding responsible behavior, students should base their assumptions by recognizing the fact that in social relations they need one another to realize the good values of life, which can support their own existence. Responsible attitude then develops not only at the personal level, but also in relationships with other people, such as when working in groups.
Responsibility is a behavior that determines how a person reacts to situations, and requires moral decisions (Astuti, 2005). Responsibilities in East Africa are implemented in a critical reflection of technological change (Golding & Batiibwe, 2021). A person with a higher level of moral development has a higher level of responsibility, so that in the use and/or development of technology, they pay great attention to moral values. On the other hand, someone who has a low level of moral development will also have low level of responsibility (Sjarkawi, 2008).

Responsibility is physical and mental readiness to accept obligations or tasks, which must be carried out sincerely. Responsibility for learning can be seen from the student’s readiness to accept obligations or tasks wholeheartedly, carry out tasks well, accept the risks of every action, not blame others, admit and apologize for mistakes made, study diligently, work diligently on assignments, and have a study schedule (Mania, 2015). Responsibility as a task in a psychic process, takes place in subjective active interaction with the environment which results in a change.

Solid learning in the collaboration of students and teachers will be able to develop good cognitive abilities and emotional aspects, so that learning responsibility will grow (Cook-Sharter, 2010a). According to (Mustari, 2011), a person is said to be responsible if he shows the following characteristics: 1) always strives for his own progress, 2) chooses the right and straight path, 3) is always alert, 4) maintains his own honor, 5) has commitment on duty, 6) carrying out duties to a good standard, 7) admitting all actions, 8) keeping promises, 9) daring to take risks in words and actions.

Responsibility in the United Arab Emirates is largely towards learning for oneself, but it is lacking in supporting others (Ayish & Deveci, 2019). Responsibility in Iceland lacks shared values (Agudelo, Jóhannsdóttir, & Davidsdóttir, 2019). Responsibilities in Türkiye relate to social, emotional, and cognitive matters (Çağırgan & Soytürk, 2021). The concept of responsibility in Brazil is related to ethics that generate morality towards users (Patrus, at al, 2013). The concept of responsibility in Canada builds on deep understanding and broad participation (Moss & Beatty, 2010).

The concept of responsibility from several experts mentioned above is different from the concept of responsibility referred to in this study. In this study, the responsible attitude consists of discipline, sportsmanship, obedience to the rules, and commitment to the task both individually and in groups.
Based on this description, to have high morals, it is necessary to develop a responsible attitude from an early age continuously, both in the family and in learning at school. There are two objectives of this study. 1) To describe the process of learning mathematics with teaching aids in elementary school. 2) Exploring the improvement of responsible attitude through these activities: a) opening, b) core, and c) closing mathematics learning in elementary school.

2 THEORITICAL FRAMEWORK

Computational Thinking (CT) is becoming an increasingly important aspect of how individuals think about and interpret the world (Ansori, 2020; Wing, 2011). CT can be viewed as the foundation for effective issue formulation and computational solution generation (Chen, et.al., 2017; Eickelmen, 2019). Seymour Papert at time 1993 proposed CT, and Jeannette Wing at time 2006 pioneered it. According to (Wing, 2011), computational thinking is a basic talent employed by everyone in the globe in the twenty-first century. CT also teaches the brain to think logically, systematically, and artistically.

The use of CT aided in the formulation of a study of mathematics learning in Turkey that was adapted to the constructive approach (Arseven, Ayla, 2015). A study found that using Scratch to teach mathematics improves learners’ discipline and independence (Burmann, Schaefer, & Maloney, 2007; Meerbaum-Salant, Armoni, & Ben-Ari, 2013). Programmed learning improves students learning discipline and independence (Özoran, Çağltay, & Topallı, 2012). CT research (Hooshyar, 2021) found that learners with varying prior knowledge and learning attitudes improved their abilities, conceptual understanding, and overall knowledge.

Research with fifth and sixth graders (Sáez-López et.al., 2016), found that students enjoyed working with the Scratch visual programming tool, enjoyed the activity, found the Scratch programming environment fun, and felt motivated. Likewise, research conducted (Calder, 2010; Taylor, Harlow, & Forret, 2020) found that Scratch programming is motivating and engaging for learners.

The results of previous research on the integration of CT in mathematics have used web-based game media and project-based learning strategies following computer steps (Astuti, Syahza, & Putra, 2023). Math and science offer particularly fruitful opportunities for CT integration, given the inclusion of math and CT as practices in the Next Generation Science Standards (Rich, Yadav, & Larimore, 2020).
The integration of mathematical concepts with computational thinking principles allows students to develop a deeper understanding of both, while acquiring critical thinking and problem-solving skills that are essential in the modern world that is increasingly linked to technology. Computational thinking-based mathematics learning models can be designed to achieve the desired goals internationally. It is also important to continue to review and update this research as current practice in the field of mathematics and computing education develops.

3 METHODOLOGY

Overall, this study uses research and development methods. The type of this study is qualitative with an ethnographic design. According to (Indriyani, 2023; Sutama, 2019), qualitative research was conducted on natural objects. Furthermore, (Sudarti, 2023; Sutama, 2019) stated that ethnographic research design is the work of describing a habit of a group of people. This research was conducted at public elementary school 1 Gergunung Klaten located at Jalan Yaqowiyu No.48, Krajan, Gergunung, Northern Klaten, Klaten District, Central Java. The research was conducted from May 2023 to the end of December 2023.

The data in the study consisted of primary and secondary data. Primary data is data obtained directly from the original source, namely the results of interviews and observations of an event during the research. All information about improving responsible attitudes in learning mathematics was extracted through in-depth interviews from research subjects, namely the principal, teachers and grade 4 students at public elementary school 1 Gergunung Klaten. The researcher was present as a key instrument.

Secondary data were obtained from documentation, which were research data from intermediary media, whether in the form of books, notes, existing evidence, or archives, both published and not generally published. Data analysis techniques were carried out using the flow method (Sutama, 2019). The cyclical data analysis process consists of data collection, data reduction, data presentation, verification and drawing conclusions.
4 RESULTS AND DISCUSSION

4.1 THE PROCESS OF LEARNING MATHEMATICS WITH TEACHING AIDS IN ELEMENTARY SCHOOLS

The process of learning mathematics with teaching aids in Elementary Schools (Public Elementary School) is carried out in the following ten steps (Sutama, et al., 2022; Sutama, et al., 2021).

a. Selection of teaching aids that are adapted to the teaching material

The teacher chooses teaching aids according to the material to be taught. Examples of mathematical teaching aids at the research location include abacus, geometric objects, number cards, number lines, and analog clocks. The selection of teaching aids is in accordance with the opinion of experts who stated that mathematics teaching aids in elementary schools must consider the learning objectives and abilities of students (Zahardjil, 2023a).

b. Opening

This activity uses teaching aids to provide simple examples that illustrate mathematical concepts. The teacher at the research location introduced the mathematical concepts studied by providing an overview and explaining the relevance of these concepts in everyday life. Teachers also use visual aids to provide simple examples that illustrate concepts, this is in line with expert opinions (Pinto, 2023).

c. Demonstration, using teaching aids related to the mathematical concepts being taught

The teacher at the research location demonstrated the use of teaching aids and explained the tools related to the mathematical concepts being taught. As an example, it can be illustrated, learning the operation of calculating addition, the teacher at the research site uses an abacus tool. This is in accordance with the opinion of experts who stated that an abacus can be used to illustrate the steps for addition (Azhari, 2023a).

d. Contextual application, linking mathematical concepts to real-world situations

Teachers at the research location help students relate mathematical concepts to real world situations. For example, the research teacher used a ruler to measure objects around the classroom. This activity is in accordance with the expert opinion who stated that in teaching measurements the teacher is better off using a ruler or scales (Shalihah, 2023).
e. Joint practice

Students participate in joint practice activities using teaching aids. Students at the research location were given examples by the teacher to participate in joint practical activities using teaching aids. The research teacher gave an example of the question "Ana had 5 oranges, and Ana bought 3 more oranges. How many oranges does Ana have in total? Students are asked to solve the problem using real objects (oranges). This is in accordance with the expert opinion who stated that in solving problems with teaching aids it is better for the teacher to provide guidance and positive reinforcement when students solve problems. (Apriliyani, 2023a).

f. Group or individual activities

Students are given the opportunity to work in groups or individually to solve math problems. Students at the research location were given the opportunity to work in groups or individually to solve math problems using real object props. This is in line with the opinion of experts who stated that it is important to involve students in various tasks, such as problem solving, mathematical games, or concept exploration with teaching aids (Rosalina, 2023).

g. Discussion and reflection, to discuss solutions found by students

After the students complete the task with props, the teacher holds a class discussion to discuss the solutions found by the students in collaborative learning. This is in line with expert opinion who stated that at the end of the discussion the teacher associates students' ideas with relevant mathematical concepts (Azhari, 2023b).

h. Evaluate, observe and measure students' abilities about mathematical concepts learned with visual aids

Teachers at the research location asked questions to measure students' understanding of mathematical concepts learned using teaching aids. One example of a question from the teacher at the research site was, "Dedi bought 8 toy trucks and 5 toy cars. How many toys does Dedi have in total? To solve this problem the teacher provides properties in artificial objects (trucks and toy cars). This activity is in line with expert opinion who stated that evaluation can take the form of writing questions, math games, or creative projects (Apriliyani, 2023b).

i. Repetition and expansion, mathematical concepts are repeated in different contexts and expanded with more complex material
Teachers at the research location repeat mathematical concepts in different contexts and are expanded with more complex material using marble props. As an illustration carried out by the teacher of the research site, namely Andi has 6 red marbles and 4 blue marbles. Calculate the ratio between the number of red marbles and blue marbles owned by Andi? Expanded context, in a class, there are 24 female students and 36 male students. Calculate the proportion of female students to the total students in the class? (using papercut props). This concept is in line with expert opinion who stated that in repetition and expansion teachers can use different teaching aids to develop students' understanding in depth (Zahardjil, 2023b).

j. Conclusion and enrichment, summarizing concepts that have been learned and providing additional enrichment

The teacher at the research location concludes the learning by summarizing the concepts that have been learned and providing additional enrichment. This is in line with expert opinion which states, that at the end of learning it is necessary to hold reflections, conclusions, postes, and follow-up enrichment (Winarsih, et.al., 2023).

4.2 IMPROVING RESPONSIBLE ATTITUDE IN MATHEMATICS LEARNING ACTIVITIES IN ELEMENTARY SCHOOLS

4.2.1 Improving Responsibility in the Opening Activities of Mathematics Learning in Elementary Schools

Preliminary activities for mathematics learning in elementary schools where the research was conducted, namely conditioning readiness to learn, perception, motivation, and analyzing goals and learning process plans. The implementation of improving responsible attitude in the opening of learning activities, both the results of observations, document analysis, and interviews in elementary schools where the research was conducted is described as follows:

Collaborative activities of teachers and students in conditioning readiness to learn are carried out by saying and answering greetings, tidying up the place of study and one of the students leading prayers, forming groups with certain rules and checking student attendance and health (observations; results of interviews with teachers). This activity is in line with expert opinions who stated that mathematics learning to be optimal for students should be ready to learn with the support of teachers respecting each other (Putri, et al, 2023; Sutama, et al, 2023).
Activities that conditioned students to be ready to learn were meaningful for sharing and taking responsibility at the beginning of learning. Engaging students for responsibility in planning and implementing initiatives early in learning as a basis for progressive action. Such participation helps satisfy students feeling confident and belonging. This finding is in accordance with the opinion (Ruhmana, et al., 2023; Sutama, Anif, Prayitno, Sari, 2019) who stated that planning is a fundamental function of management that underlies the success of processes and results.

Apperception activities were carried out through questions and answers about the material that has been mastered by students associated with the new material to be learned. As a result of observations, elementary school teachers at the research site stimulated questions about the concept of subtracting integers with number line props.

Figure 1. The concept of integer subtraction

![Figure 1. The concept of integer subtraction](image)

Source Prepared by the Author

Such exploratory questions can help students to understand, that subtraction of numbers with negative integers is equivalent to adding numbers with the opposite of subtraction: \( a - (-b) = a + b \). This, in the improvement of responsible attitude, is an encouragement for students to plan and assess their own actions. According to (Sutarni, Sutama, Prayitno, Sutapa, 2023; Sutama, et al., 2019) this includes planning in character education management, namely responsibility activities related to determining the strategy for its formation.

Motivational activities were carried out by showing the teaching material learned and were useful, both in the learning process and in everyday life. The results of observations were obtained through questions and answers. The teacher asked the students three (3) benefits of integers in everyday life. This motivational activity showed that the improvement of responsible attitude by asking students about what will be done someday if the situation at hand utilizes integers. These findings are in line with (Rosyida, et al., 2023; Sulistiyo, et al., 2023; Sutama, et al., 2020) who stated that the application
of character-based school culture to develop learning responsibilities begins with asking students about the steps that will be taken to complete a task.

The next activity is to analyze the objectives and learning process. Analysis is obtained from the observations of students when observing *power point* impressions and forming groups with predetermined rules. This activity can be interpreted as giving time to students to accept responsibility. The results of interviews with elementary school teachers where the study showed that students will not turn into responsible people in a short time. Continuously such activities are repeated, so that students are always responsible about their learning activities. That is, if the teacher wants a change from not knowing to knowing, then the teacher needs to plan a repeat of relevant activities to achieve the same change goals. This finding is in line with the results of the study (Adnan, et al., 2021; Sutama, et al., 2020) who concluded, that the application of character education needs to begin with planning, through identifying character values that are development priorities, and compiling implementation steps accompanied by repetition.

Through the analysis of the Learning Implementation Plan (LIP) document and interviews with teachers, it was found that in instilling character, teachers need to make plans written on LIP and implemented in learning. Furthermore, the teacher said, to plan character cultivation, the first step is to set indicators of character values (learning responsibility) and compile achievement steps. Research results (Ramlan, et.al., 2023; Sutama, et al., 2020) concluded, among others, that teachers set moral values that are priorities and develop achievement strategies. These activities are so that the implementation of character education achieves optimal goals.

### 4.2.2 Instilling responsibility in core mathematics learning activities in elementary school

The core activities of learning mathematics with teaching aids in elementary schools where the research was conducted consists of teaching material concept development activities, group controlled exercises, and independent exercises. From the results of observations of student activities in developing the concept of teaching material, students in groups actively discuss and find their own concepts/formulas of teaching material with teacher facilitators.

As an illustration, an example of developing teaching materials about the discovery of the surface area formula of the tube. The activity of students in groups with
tube props (made of cardboard) made their nets by cutting off the top lid and the base and blanket and drawing as figure 2. Then students find the area of each building (completing the points on the Worksheet Learners (WL) provided), for example the top cover: Area, and so on until students can conclude / find the formula for the surface area of the tube. = \pi \ldots

The activity of instilling responsible attitude with the development of the concept of teaching material through these findings is the involvement of students in the implementation of initiatives. This activity can satisfy students' need to feel confident. This finding is supported by the results of research which states that the assignment method has advantages for developing an attitude of student learning responsibility (Fuadi, et al., 2021; Sutama, et al., 2020). This means that learning activities through the development of mathematical concepts are very necessary in the development of an attitude of responsibility, so that students feel satisfied in learning.

\begin{equation}
\text{Surface area of tube} = \text{area of tube blanket} + \text{top side area} + \text{base}
\end{equation}

\begin{equation}
= (2\pi r \times t) + \pi r^2 + \pi r^2
\end{equation}

\begin{equation}
= (2\pi r \times t) + 2\pi r^2
\end{equation}

\begin{equation}
- 2\pi r (t + r)
\end{equation}

Source Prepared by the Author

The results of the observation of student activities in controlled exercises, where students in groups discuss solving problems related to concepts developed in previous activities and teachers as facilitators. The activity of instilling an attitude of responsibility in controlled exercises through group discussions is an involvement of students in giving time and encouraging to assess their own responsibilities (Novitasari, et al., 2020a; Sutama, et al., 2020).

Active group work helps develop students into responsible students. Among students at the research location, during controlled exercises there were those who were less active in discussions and delegated responsibility to their group friends. This was
immediately anticipated by the teacher by asking students what they would do in learning. From the results of interviews with teachers, information was obtained that at that time the teacher asked what students would do. This teacher's action has the meaning of preventing students from dodging and giving. Because, the reason given is only to avoid responsibility. This finding is supported by research results which stated that teachers must be able to place students as the center of learning, get used to discussing solving problems, and not just in groups but all must be active with the teacher as a facilitator. (Novitasari, et.al., 2020b; Cook-Sharter, 2010b).

The results of the analysis of WL documents, as an illustration of examples of problems discussed in controlled exercises are problems of daily life, namely "figure 3 of a tube-shaped gasoline oil tank". The outside of the tank will be painted. If the cost of paint per m² is IDR 80,000.00. Calculate the cost to paint the tank!

![Figure 3. Tubular Tank](Source Prepared by the Author)

<table>
<thead>
<tr>
<th>Solution</th>
<th>Answer:</th>
</tr>
</thead>
</table>
| Known:   | Tube surface area = $2\pi r (\ldots+\ldots) \text{ m}^2$  
$t = \ldots \text{ m}$  
$d = 1.4 \text{ m} \rightarrow r = \ldots \text{ m}$  
$\text{Cat/m}^2 \text{ Fee} = \text{Rp} \ 80,000$  
$\text{Asked:}$  
The cost of painting tubes?  
Tube surface area = $2\times\ldots \times 0.7\times(\ldots+3.5) \text{ m}^2$  
Tube surface area = $4.4\times\ldots \text{ m}^2$  
Tube surface area = $\ldots \text{ m}^2$  
So the cost needed to paint the tank = $\ldots \times \text{Idr}$  
$80,000 = \text{Idr} \ldots$. |

WL like the example mentioned above is very important to guide students during learning time without a teacher. Students are guided to find concepts and solve problems with stimulus, that is, some have been filled and some need to be filled with students with their creativity. With this WL, parents must always play an active role in training students to have a sense of responsibility in their learning tasks. This is in line with the results of research which states, students will learn optimally with the help of real stimuli and
experienced by students themselves, so that in turn students achieve optimal learning outcomes (Sutama, et al, 2021; Baiduri, 2019).

4.2.3 Encouraging Responsibility in the Closing Activities of Learning Mathematics in Elementary Schools

Closing activities for mathematics learning using teaching aids at the elementary school where the research was conducted included reflection, conclusion, post-test, follow-up and closing greeting activities. Based on the results of observations, reflection on mathematics learning is carried out through questions and answers regarding the following things: 1) which material has been mastered, 2) which material has not been mastered, 3) the reasons why students have not mastered the teaching material, and 4) alternative solutions for teaching and learning activities at the next meeting. The results of interviews with the elementary school teachers where the research took place explained that the question and answer activity related to the activities that had been carried out was a way of involving students in taking on learning responsibilities. This participation will help students to be confident. This finding is in line with the opinion of experts, namely that character education needs to be evaluated with the aim of knowing the level of program achievement, the obstacles to program implementation, and establishing policies to overcome these obstacles. (Patriana, et al., 2023; Sutama et al, 2023).

The next activity is drawing conclusions. In this activity, students write the essence of learning activities that have been carried out under the guidance of the teacher. The concluding activity is carried out through question and answer with short entries. The results of observations regarding the activity of drawing conclusions are as follows:

“A tube shape is a space shape that has ... and ... shapes ... of the same size and is enveloped by ... . The characteristics of a tube, among others, are that it has ... vertex, the base and lid are shaped like ..., and has three side planes, namely ... side, ... side, and .... side. The lid and top of the tube are shaped ... with radius (...), so the formula: Area of the base of the tube = area of ... = 2πr². For the radius you can use π = ... or ... . Perimeter of the base/cover of the tube = circumference ... = 2πr. Tube cover area = p x l = ... x ... = 2πrt. Surface area of the tube without cover = base area + Cover area of the tube = ... + ... = ... (... + ...). Surface area of the tube = ... x base area + cover area of the tube = .. (π r²) + ... = ... (r + t )”.
From this activity, we can see that by reading the conclusions of a study, students can understand what was explained before without having to read the complete learning notes. Such conclusions contribute to the development of students' metacognitive self-concept. This self-concept reciprocally provides color in forming an attitude of learning responsibility. These findings are in line with research results from (Fridayanti, et al., 2023; Sutama, Anif, Prayitno, Sari, 2019) which stated that metacognition is a set of skills that allows students to become aware of how they learn and to evaluate and adapt skills to become more effective.

The closing activity for mathematics learning related to the post-test was carried out with an oral or written test. The results of interviews with elementary school teachers at the research location said that oral tests were carried out at the end of each lesson before the teaching material for one Basic Competencies (BC) was completed. A written test is carried out at the end of each lesson after each BC is completed. Examples of post-test questions both oral and written are as follows:

- Oral test question: “A frog jumps to the right front three jumps. Then the frog turned around nine jumps. Where is the position of the frog now?”
- Written test question: “A shark is 200 meters below sea level, the top of a hill is 800 meters above sea level. If an airplane is 2 kilometers above a hill, how many kilometers is the distance between the shark and the airplane?”

Both the oral test questions and the written test are HOTS questions in accordance with 21st century learning. The results of interviews with elementary school teachers at the research site stated that post-tests carried out in mathematics learning, apart from showing variance in learning outcomes, were also used as motivation for students to evaluate their attitude of responsibility. This finding is in line with research results from (Almanshur & Sutama, 2023; Hayati & Kamid, 2019) which concluded that assessing mathematics learning outcomes can be used to diagnose the strengths and weaknesses of students' responsibilities in participating in learning activities.

Follow up on the findings for the next mathematics learning activity, namely 1) Giving assignments to review the concept of teaching material and practice questions from the material just discussed, and 2) Giving assignments to study the next concept of teaching material and looking for problems to be discussed at the following meeting (based on the results of several observations). This finding was then confirmed by the elementary school teacher at the research site who said that follow-up activities.
minimized giving assignments in the form of working on new problems. Students tend to be overwhelmed when they have to do assignments with new material, so they don't do it themselves and in turn students neglect their learning responsibilities.

The actions of elementary school teachers at the research site who never give homework to work on new problems can be interpreted as students' self-efficacy in learning responsibilities. This is very important, because self-assessment of responsibility for organizing and implementing learning actions is necessary to achieve optimal results (Hidayati, et al., 2020).

In short, the teacher at the elementary school where the research was conducted said that the closing greetings were led by one of the students in turn every day after completing the learning activities with prayers according to their respective religions. This finding can be interpreted that character, in general and in particular a sense of responsibility, does not depend much on the teacher, but rather on the maturity and ethical capacity of the teacher with whom students interact. (Rusnilawati, et al., 2023).

5 CONCLUSION

The process of learning mathematics with teaching aids in elementary schools is carried out through the following stages: a) Selection of teaching aids; b) Introduction; c) Demonstration; d) Contextual application; e) Joint practice; f) Group or individual activities; g) Discussion and reflection; h) Evaluation; i) Repetition and expansion; j) Conclusion and enrichment.

Activities to improve students' responsible attitudes include: a) Opening activities, which are carried out at the beginning of each study, question and answer activities regarding apperception, developing motivation, analyzing goals and the learning process. b) Core activities, which are carried out through concept development, controlled exercises, and independent exercises. c) Closing activities, which are carried out in reflection activities, making conclusions, post-tests, follow-up, and closing greetings.

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encouragement so that we can conduct research. We also thank the head of the Klaten Education Office, the head and teachers of public elementary school 1 Gergunung Klaten, Central Java, who had provided assistance during the research process so that the research was able to be carried out according to the planned time.

6 SIGNIFICANCE

The findings of this study have significant implications for primary school education. These impacts are: a) improved learning quality; b) improved thinking skills; c) character development; d) relevance to the real world; and e) improved learning achievement. Thus, the results of this study have a broad role in education and learning in elementary schools.

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