Vol. 9, No. 2 (2025) 229-238 ISSN: 2597-4866
Indonesian Journal of Primary Education

Improving computational thinking skills through unplugged coding on cube and block material for grade VI students of SDN 3 Sukahurip

Heris Apriadi*, Ajid Abdul Majid, Karlimah

Universitas Pendidikan Indonesia.
**Corresponding author:* herisapriadi24@upi.edu*, ajidabddulmajid83@upi.edu, karlimah@upi.edu

Received 13 September 2025; First Revised 20 October 2025; Accepted 27 November 2025
First Available Online 1 December 2025; Publication Date 1 December 2025

Abstract

This research aims to describe the implementation of unplugged coding, analyze the enhancement of computational thinking skills, and identify students' perceptions of using unplugged coding in learning cube and cuboid material. The background of this research is the importance of computational thinking (CT) skills in the 21st century and students' difficulties in understanding abstract geometric concepts. This study uses a qualitative approach with a case study design in grade VI at SDN 3 Sukahurip. Data collection was carried out through participant observation, in-depth interviews with students and teachers, and document analysis (student worksheets). The results show that unplugged coding activities such as "Dissecting 3D Shapes," "Net Hunting," and "Constructor Robot" were successfully implemented interactively and participatively. There are indications of an increase in students' computational thinking skills, including decomposition, pattern recognition, abstraction, and algorithmic thinking, as well as a better understanding of cube and cuboid concepts. Students expressed very positive perceptions, considering the learning more enjoyable, easier to understand, and collaborative. It is concluded that unplugged coding is an effective and promising approach for integrating CT development into mathematics learning in elementary schools

Keywords*: unplugged coding, computational thinking, cube and cuboid, case study, elementary school.*

INTRODUCTION

Computational thinking (CT) has become a crucial competency in the 21st century, relevant not only for computer scientists but also for individuals solving complex problems across various life domains (Wing, 2006; Grover & Pea, 2013). The importance of CT has also been recognized in the Indonesian educational context, where efforts to integrate it into the curriculum have begun to be encouraged to prepare students for global challenges (Susilo et al., 2021; Wulandari & Wilujeng, 2020). Computational thinking encompasses a range of cognitive skills such as decomposition, pattern recognition, abstraction, and algorithm design (ISTE & CSTA, 2011), which are fundamental to the development of higher-order thinking skills. Integrating CT into the elementary school curriculum is crucial to equip students with logical, structured, and systematic thinking skills from an early age (Kalogiannakis et al., 2021; Sembiring et al., 2019).

Geometry, particularly cubes and cuboids, is a topic in Phase C (grade VI of elementary school) mathematics learning that is often considered abstract and challenging for students (Battista, 1999). Initial observations of 20 student respondents at SDN 3 Sukahurip revealed significant difficulties: 55% of students had difficulty with spatial visualization and another 55% did not understand the concept of nets for geometric shapes. Furthermore, 50% of students felt confused in dissecting composite shapes and 50% experienced confusion in using formulas. In addition, 45% of students were unable to apply the essential logic of separation in solving geometric problems. These difficulties are in line with broader research reports in Indonesia, which show that students often experience difficulties in visualizing three-dimensional shapes, understanding their properties, and calculating volume and surface area (Rahayu & Hidayat, 2018; Jupri & Drijvers, 2016). These difficulties may stem from a lack of student engagement in meaningful learning processes and a lack of opportunities to develop spatial and algorithmic thinking skills (NCTM, 2000; Sari & Wijaya, 2019).

Existing learning challenges indicate that students require more interactive, visual, and logical learning. Unfortunately, the teaching methods used are often conventional, inadequately accommodating these needs. On the other hand, teachers need new, innovative learning strategies that don't always rely on high-tech, which may be limited in availability. One promising approach to addressing this challenge and simultaneously introducing CT is through unplugged coding activities. Unplugged coding refers to learning programming and CT concepts without the use of computers, but rather through games, physical activities, or simple props (Bell et al., 2009; Brackmann et al., 2017). This method is considered effective because it can reduce barriers related to technology access and programming anxiety (Putra & Syaripudin, 2022), and is more suited to the learning characteristics of elementary school students who are still at the concrete operational stage (Piaget, 1964; Futschek & Moschitz, 2010). Research in Indonesia also shows that unplugged activities can be an attractive alternative for introducing basic informatics and CT concepts in elementary schools (Pratiwi & Kuniarti, 2021), and have the potential to increase interaction and logical thinking in learning.

Previous research has shown that unplugged coding activities can positively improve various aspects of CT, such as problem-solving and algorithmic thinking skills in elementary school students (Del Olmo-Muñoz et al., 2020; Looi et al., 2018). Preliminary studies in several schools in Indonesia also indicate the positive potential of game-based activities and simple algorithms to improve understanding of mathematical concepts (Andini & Puspitasari, 2020). However, research that specifically examines the use of unplugged coding to improve CT in the context of learning cube and block material, especially to overcome the specific difficulties that have been identified at SDN 3 Sukahurip, still requires further exploration through an in-depth case study approach.

Based on the background strengthened by data on student difficulties and identification of learning gaps above, this study aims to explore how the use of unplugged coding can improve the computational thinking skills of sixth grade students of SDN 3 Sukahurip on the material of cubes and blocks.

The objectives of this case study are to:

1. Describe the implementation of unplugged coding activities in learning about cubes and cuboids in sixth-grade students at SDN 3 Sukahurip to address the need for interactive, visual, and logical learning.
2. Analyze the improvement in students' computational thinking skills (decomposition, pattern recognition, abstraction, and algorithms), particularly in overcoming difficulties in spatial visualization, understanding nets, and using formulas, after participating in unplugged coding learning on cubes and cuboids.
3. Identify student perceptions of the use of unplugged coding as an alternative to conventional learning methods in learning about cubes and cuboids.

This case study is expected to provide practical contributions for teachers in Indonesia in designing innovative and effective mathematics lessons to improve students' computational thinking skills, as well as provide theoretical input regarding the application of unplugged coding in the context of elementary school geometry learning as a strategy that does not rely on high technology.

RESEARCH METHODS

Research Approaches and Types

This research uses a qualitative approach with a case study research type. The qualitative approach was chosen because it aims to understand in depth the phenomenon of the use of unplugged coding in improving computational thinking skills in cube and block learning in a specific context in grade VI of SDN 3 Sukahurip (Creswell & Poth, 2018). Case studies allow researchers to investigate a case intensively and holistically, explore the process, and understand the complexity of naturally occurring situations (Yin, 2018;

Stake, 1995). The focus of this case study is on how unplugged coding is implemented and its impact on students' computational thinking skills in learning specific geometry material.

Place and Time of Research

This research will be conducted at SDN 3 Sukahurip, Cihaurbeuti District, Ciamis Regency, West Java Province. This location was selected based on initial observations that indicated a need to improve student interaction and understanding of geometry materials and the potential for implementing innovative learning strategies such as unplugged coding. The research is planned to be conducted in the even semester of the 2024/2025 academic year, with a timeframe covering the preparation stage, learning implementation and data collection, and data analysis for approximately 2 months (May-June 2025).

Research Subjects

The subjects in this study were 20 sixth-grade students of Phase C of SDN 3 Sukahurip who participated in mathematics learning on the topic of cubes and blocks. The selection of subjects was carried out by purposive sampling, where sixth-grade students were chosen because they were at an appropriate cognitive development stage to be introduced to the concept of computational thinking and because the material of cubes and blocks was part of their curriculum (Sugiyono, 2019). In addition to students, sixth-grade teachers who teach mathematics will also be involved as key informants to obtain data regarding the planning and implementation of learning.

Research Procedures

This research will be conducted through several main stages:

1. Preparation Stage
   - Obtain research permits from SDN 3 Sukahurip.
   - Conduct further preliminary studies and a literature review to deepen conceptual understanding.
   - Develop a lesson plan (RPP) that integrates unplugged coding activities into the cube and cuboid material.
   - Develop research instruments, such as observation guidelines, interview guidelines, and student worksheets (LKS) related to unplugged coding activities and questions to measure understanding of the cube/cubic cube concept and aspects of computational thinking.
   - Validate the instruments with experts (supervising lecturers) and conduct a limited pilot test.
2. Implementation Stage
   - Implement learning with unplugged coding activities on the cube and cuboid material in accordance with the developed lesson plan.
   - Collect data through participant observation during the learning process, in-depth interviews with students and teachers, and analysis of student work documents and field notes.
3. Final Stage
   - Analyze the collected data.
   - Compile a research report in the form of a scientific journal.

Data Collection Techniques and Instruments

To obtain comprehensive data, this study will utilize several data collection techniques:

Participant Observation: The researcher will be directly involved in classroom activities as a participant observer to closely observe the learning process, student interactions, enthusiasm, and application of students' computational thinking skills during unplugged coding activities (Moleong, 2017). Observations will be recorded in structured observation sheets and field notes.

In-Depth Interviews: Semi-structured interviews will be conducted with selected students (representing various ability levels) and the classroom teacher. Interviews with students aim to explore their understanding of the concept of cubes and cuboids, their learning experiences with unplugged coding, and the development of their computational thinking skills. Interviews with teachers aim to determine their perceptions, challenges, and reflections on the implementation of unplugged coding (Flick, 2018).

Document Analysis: Documents to be

analyzed include student worksheets (LKS) specifically designed for unplugged coding activities, student notes, and formative test results (if any) to identify changes or improvements (Bowen, 2009).

Field Notes: Researchers will take detailed field notes throughout the research process to record important events, reflections, and unexpected findings relevant to the research focus (Emerson et al., 2011).

The primary instrument in this research is the researcher themselves (human instrument), supported by observation guidelines, interview guidelines, worksheets, and test questions.

Data Analysis Techniques

Data analysis in this study will be conducted qualitatively, following the interactive model of Miles, Huberman, and Saldaña (2014), which includes three simultaneous streams of activity:

Data Condensation: The process of selecting, focusing, simplifying, abstracting, and transforming raw data emerging from written field notes, interview transcripts, and other documents. This includes summarizing, coding, and developing initial categories or themes.

Data Display: An organized collection of information that allows conclusions to be drawn and actions taken. Data will be presented in the form of descriptive narratives, matrices, or charts to facilitate understanding of patterns and relationships among data.

Conclusion Drawing/Verification: From the beginning of data collection, researchers begin searching for meaning, noting regularities, patterns(explanat ions), possible configurations, causal flows, and propositions. These conclusions are then verified throughout the study by seeking new data that supports or refutes initial findings.

Data Validity

To ensure the validity of the data and the credibility of the research findings, several checking techniques will be employed, including:

Triangulation: Using multiple data sources (observations, interviews, documents) and data collection methods (source triangulation and technique triangulation) to check the consistency of the findings (Patton, 2015; Denzin, 2017).

Peer Debriefing: Discussing initial findings and data interpretations with colleagues or supervisors who understand qualitative research methodology to gain input and alternative perspectives.

Member Checking: Confirming findings or data interpretations with research subjects (students or teachers) to ensure that what the researcher wrote aligns with what they intended or experienced (Lincoln & Guba, 1985).

Prolonged Engagement: Researchers will spend sufficient time in the field to build trust and gain a deep understanding of the research context.

RESULTS AND DISCUSSION

Result

This section presents the main findings from a case study on the use of unplugged coding to improve computational thinking skills in cube and cuboid material in sixth-grade students at SDN 3 Sukahurip. Data were obtained through participant observation, in-depth interviews with students and teachers, and document analysis in the form of student worksheets (LKS).

1. **Description of the Implementation of Unplugged Coding Activities in Learning Cubes and Blocks.**

The implementation of unplugged coding activities in learning about cubes and cuboids in sixth grade at SDN 3 Sukahurip was designed to be interactive and actively engage students. The learning took place over several sessions, focusing on computational thinking components integrated into understanding geometric concepts.

First Session is Introduction to Basic Concepts and Decomposition. Students were encouraged to identify objects around them that were shaped like cubes and cuboids. The **unplugged** activity began with "Dissecting Solid Geometry": students were given a picture of a compound solid geometry (consisting of several cubes and/or cuboids) and asked to decompose it into its basic constituent shapes individually on a worksheet. Observations showed that initially, approximately 40% of students appeared unsure about identifying the number of unit cubes in a complex compound geometry. The teacher guided by providing physical examples using unit cubes.

Second Session is Introduction to Net Patterns and Abstraction. The "Net Hunt" activity was introduced. Students were presented in groups with various net images and asked to predict which ones would form a cube and which ones would form a cuboid. They then attempted to fold them. Through this activity, students learned to recognize valid net patterns. Analysis of the worksheets (LKS) showed that after this activity, 75% of students were able to draw at least two types of nets for cubes and cuboids correctly, an improvement from the initial estimate where many only recognized one type. Students were also encouraged to abstract the main properties of cubes and cuboids (number of sides, edges, vertices) through group discussions.

Third Meeting is Algorithmic Thinking in Constructing and Solving Problems. The "Robot Constructor" activity was used, in which one student acted as the "programmer" providing step-by-step instructions (algorithm) to another student (robot) to construct a cube or cuboid from cardboard with a net pattern or from unit blocks. Instructions were clear and sequential, for example: "Take the base," "Fold side A up," "Glue side A to side B." Observations showed student enthusiasm. Initially, the instructions were often ambiguous, but after several trials and discussions, the quality of the algorithms students created improved.

During implementation, the teacher acted as a facilitator, providing guidance and encouraging discussion. Student engagement was generally high, indicated by enthusiasm in participating in activities, asking questions, and discussing with their group mates.

2. Improving Students' Computational Thinking Skills

Based on analysis of observation data, interviews, and worksheet documents, there were indications of an increase in students' computational thinking skills in several aspects.

Decomposition: Before the intervention, baseline data indicated that 50% of students were confused about dissecting compound geometric shapes. After the "Dissecting Solid Geometries" activity and discussion, follow-up worksheet analysis indicated that approximately 70% of students were able to decompose simple compound geometric shapes into their component cubes and cuboids correctly and systematically. One student (Student A) stated in an interview, "Previously, when I saw stacked images, it was confusing, Sis. But after I was taught to separate the cubes and cuboids, it became easier to count them."

Pattern Recognition: Difficulty understanding nets (55% of students based on baseline data) appeared to decrease. Through the "Hunting Nets" activity, students not only memorized but also began to recognize the visual patterns that form solid geometric shapes. The worksheet results showed an increase in students' ability to identify and draw valid nets. Observations showed students actively discussing why a net pattern succeeded or failed to form a shape.

Abstract: Students begin to identify and cite the main properties of cubes and cuboids (number of sides, edges, vertices, and shape of the edges) without always having to see physical examples. In discussions, they can explain the fundamental differences between cubes and cuboids based on these properties. One teacher interviewed said, "The children now understand the difference between a cube and a cuboid not just from their names, but also from their characteristics, for example, that all the sides of a cube are squares."

Algorithmic Thinking: The "Robot Constructor" activity explicitly trains this skill. Initially, many students provided incomplete or out-of-order instructions. However, after reflection and revision, they were able to organize the steps more logically and efficiently. For example, the instructions for constructing a net of a cuboid became more structured: "1. Draw a base rectangle measuring LxW. 2. Draw two rectangles with vertical sides measuring LxH on the long side of the base. 3. Draw two rectangles with vertical sides measuring LxH on the wide side of the base. 4. Draw a lid rectangle measuring LxW on one of the vertical sides of the LxH." This improvement is also seen in the way they solve word problems related to volume, where they start to write down more systematic steps.

3. Student Perceptions of the Use of Unplugged Coding

Interviews with students revealed very positive perceptions of learning using unplugged coding activities. Some key themes that emerged were:

- More Fun and Interactive Learning: Nearly all students interviewed stated that learning became more exciting and less boring. One student (Student B) said, "Learning feels like playing, Sis. It's fun, and I don't get sleepy. Usually, I just write in a book."
- Facilitates Understanding of Abstract Concepts: Physical activity and the use of props are felt to help visualize abstract concepts. Student C stated, "I used to be confused about what a net looks like. After making my own out of paper, I can now imagine what it looks like when opened." This aligns with the reduction in spatial visualization difficulties previously reported by 55% of students.
- Improved Collaboration: Many activities are done in groups, which students reported improved collaboration and discussion skills. "I enjoy working in groups, and I can ask my friends if I don't understand."
- Not as Intimidating as Computer "Coding": The term "coding" may initially sound complicated, but the unplugged approach makes it more accessible. Student E stated, "I thought coding was difficult, like on a computer. Turns out it's possible to do it using toys like this."

Discussion

The findings of this study indicate that the use of unplugged coding activities has positive potential in improving the computational thinking skills of sixth-grade students at SDN 3 Sukahurip on the topic of cubes and cuboids, while also enhancing their understanding of these geometric concepts.

1. Implementation of Unplugged Coding and Enhanced Computational Thinking

Implementation descriptions demonstrate that well-designed unplugged coding activities can be effectively integrated into mathematics learning. Activities such as "Dissecting a Geometric Shape" directly practice decomposition, the ability to break down complex problems into smaller, more manageable parts (Wing, 2006; Grover & Pea, 2013). Students' improved ability to decompose composite shapes supports this.

The "Hunting for Nets" activity not only enhances visual-spatial understanding of nets but also hones pattern recognition skills. Students learn to identify which visual patterns form the correct three-dimensional shape, a fundamental skill in CT (ISTE & CSTA, 2011). These findings align with research by Brackmann et al. (2017) which showed that unplugged coding activities can develop CT skills such as pattern recognition in elementary school students.

The development of abstraction skills is evident when students begin to focus on the essential properties of cubes and cuboids. They learn to filter out irrelevant details and focus on the core characteristics of geometric shapes, which is the essence of abstraction in CT. The "Robot Constructor" activity significantly encourages students to develop algorithmic thinking, namely designing a series of clear, logical, and sequential instructions to achieve a specific goal (Bell et al., 2009). Students' initial difficulty in providing precise instructions, followed by improvement through iteration, reflects the authentic learning process of designing algorithms.

These findings are consistent with several studies in Indonesia. For example, research by Putra and Syaripudin (2022) also showed that unplugged coding learning can improve elementary school students' computational thinking skills. Similarly, Pratiwi and Kuniarti (2021) found that implementing CT through unplugged activities was effective and engaging for elementary school students. The results of this case study strengthen the argument that the unplugged approach is a feasible and effective way to introduce CT, even in specific mathematics topics like geometry, in the Indonesian elementary school context. The use of simple props and physical activities helps bridge abstract geometric concepts with students' concrete understanding, appropriate to their stage of cognitive development (Piaget, 1964; Futschek & Moschitz, 2010).

2. Overcoming Learning Difficulties and Student Perceptions

Initial data indicates that various student difficulties (spatial visualization, understanding nets, dissecting composite shapes, using formulas) appear to be partially addressed through an unplugged coding approach. The interactive, visual, and logical nature of unplugged activities addresses previously identified student needs. Students' highly positive perceptions suggest that learning is more enjoyable, easier to understand, and collaborative, which are important factors in increasing motivation and engagement. This aligns with general findings that active, student-centered learning methods tend to be more effective (e.g., research by Andini & Puspitasari (2020), although in the context of ethnomathematics, emphasizes the importance of meaningful learning). Active engagement and hands-on experience in "making" and "commanding" appear to provide deeper understanding than conventional, perhaps more passive, methods.

Furthermore, the finding that students did not feel intimidated by "coding" when presented in an unplugged format suggests that this approach successfully eliminates the psychological barriers that might arise if CT is introduced directly through computers to beginners at a young age. This supports the argument that teachers need new strategies that do not rely on high-tech devices, especially in schools with limited access to technology.

Practically, the results of this study provide concrete examples for teachers, particularly at SDN 3 Sukahurip and other elementary schools in Indonesia, of how unplugged coding can be integrated into mathematics learning to improve not only understanding of the material but also computational thinking skills. The series of activities described can be adopted and adapted to suit individual contexts.

Theoretically, this study contributes to an understanding of how various components of computational thinking can be developed in an integrated manner through specifically designed geometry learning activities. This case study also provides empirical evidence from the Indonesian context regarding the effectiveness of unplugged coding.

As a qualitative case study, these findings are contextual and not intended to be generalized to a broader population. The depth of analysis may be limited by the number of subjects involved. The involvement of the researcher as the primary instrument also carries the potential for subjectivity, although various techniques to maintain data validity were employed. Furthermore, the measurement of computational thinking skill improvement was primarily descriptive and did not use standardized quantitative instruments.

Further research could explore the impact of unplugged coding on mathematics or other subjects at the elementary school level. Comparative studies comparing the effectiveness of unplugged coding with other learning methods using a quasi-experimental design with a larger sample size could provide more generalizable evidence. The development and validation of a standardized instrument to measure elementary school students' computational thinking skills in the Indonesian context is also an important area of research. Furthermore, longitudinal research could examine the long-term impact of early introduction of CT through an unplugged approach.

CONCLUSION

Based on the results of a case study on the use of unplugged coding to improve computational thinking skills in cube and cuboid lessons in sixth-grade students at SDN 3 Sukahurip, the following conclusions can be drawn.

Implementation of Unplugged Coding: Unplugged coding activities were successfully implemented in cube and cuboid lessons through a series of structured, interactive, and participatory activities. These activities included "Dissecting Solid Shapes" to practice decomposition, "Hunting for Nets" for pattern recognition and abstraction, and "Robot Constructor" to develop algorithmic thinking. The teacher acted as a facilitator, and students demonstrated high engagement and enthusiasm throughout the learning process.

Improved Computational Thinking Skills: The use of unplugged coding showed positive indications of improving several aspects of students' computational thinking skills. Students demonstrated progress in decomposition (decomposing composite shapes), pattern recognition (identifying valid nets), abstraction (understanding the essential properties of solid shapes), and algorithmic thinking (structuring logical instructions). This improvement also resulted in a better understanding of cube and cuboid concepts, particularly in overcoming difficulties with spatial visualization and understanding nets.

Student Perception: Students had very positive perceptions of learning cube and cuboid material using unplugged coding activities. They considered this method more fun, interactive, facilitated understanding of abstract concepts, fostered collaboration, and was less intimidating than their initial perception of the term "coding."

Overall, this study concluded that unplugged coding is an effective and promising approach for integrating the development of computational thinking skills into mathematics learning (particularly geometry) at the elementary school level. This approach not only helps students better understand the subject matter but also equips them with essential 21st-century thinking skills in a way that is engaging and appropriate to the characteristics of elementary school students.

Elementary school teachers are recommended to consider implementing unplugged coding activities as an innovative learning strategy, not only for geometry but also for other relevant materials. Support in the form of training for teachers to design and implement unplugged coding activities effectively is needed. Further research on a larger scale and using mixed methods could be conducted to test the effectiveness of this approach more broadly.

BIBLIOGRAPHY

Andini, D. W., & Puspitasari, R. D. (2020). pengaruh model pembelajaran berbasis masalah dengan pendekatan etnomatematika terhadap kemampuan pemecahan masalah matematis siswa sekolah dasar. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 4(2), 916-927.*

Battista, M. T. (1999). the importance of spatial structuring in the development of geometric thinking. *Teaching Children Mathematics, 6(3), 170–177.*

Bell, T., Witten, I. H., & Fellows, M. (2009). computer science unplugged: an enrichment and extension programme for primary-aged students. *University of Canterbury.*

Bowen, G. A. (2009). document analysis as a qualitative research method. *Qualitative Research Journal, 9(2), 27-40.*

Brackmann, C. P., Román-González, M., Robles, G., Moreno-León, J., Casali, A., & Barone, D. (2017). development of computational thinking skills through unplugged activities in primary school. *In Proceedings of the 12th Workshop on Primary and Secondary Computing Education (pp. 65-72). ACM.*

Creswell, J. W., & Poth, C. N. (2018). qualitative inquiry and research design: choosing among five approaches *(4th ed.). Sage Publications.*

Del Olmo-Muñoz, J., Cózar-Gutiérrez, R., & González-Calero, J. A. (2020). computational thinking in early childhood education: a systematic literature review. *Computers & Education, 148, 103799.*

Denzin, N. K. (2017). the research act: a theoretical introduction to sociological methods. *Routledge.*

Emerson, R. M., Fretz, R. I., & Shaw, L. L.

(2011). writing ethnographic fieldnotes (2nd ed.). *University of Chicago Press.*

Flick, U. (2018). an introduction to qualitative research (6th ed.). *Sage Publications.*

Futschek, G., & Moschitz, J. (2010). learning algorithmic thinking with tangible objects. *In Proceedings of the 4th International Conference on Informatics in Schools: Situation, Evolution and Perspectives (ISSEP 2010) (pp. 121-132). Springer.*

Grover, S., & Pea, R. (2013). computational thinking in k–12: a review of the state of the field. *Educational Researcher, 42(1), 38-43.*

ISTE & CSTA. (2011). operational definition of computational thinking for k-12 education.

Jupri, A., & Drijvers, P. H. M. (2016). student difficulties in mathematizing word problems in algebra. *EURASIA Journal of Mathematics, Science and Technology Education, 12(9), 2481-2502.*

Kalogiannakis, M., Papadakis, S., & Zourmpakis, A. I. (2021). gamification in science education. *A systematic review of the literature. *Education Sciences, 11(1), 22.*

Lincoln, Y. S., & Guba, E. G. (1985). naturalistic inquiry. *Sage Publications.*

Looi, C. K., How, M. L., Wadhwa, B., Kim, M. S., & Wu, L. K. (2018). embodied learning: an initial study of a primary school mathematics trail with tangible technology. *Educational Technology & Society, 21(1), 204-218.*

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). qualitative data analysis: a methods sourcebook (3rd ed.). *Sage Publications.*

Moleong, L. J. (2017). metodologi penelitian kualitatif (edisi revisi). *PT Remaja Rosdakarya.*

National Council of Teachers of Mathematics (NCTM). (2000). principles and standards for school mathematics. *NCTM.*

Patton, M. Q. (2015). qualitative research & evaluation methods (4th ed.). *Sage Publications.*

Piaget, J. (1964). Part I: cognitive development in children: piaget development and learning. *Journal of research in science teaching, 2(3), 176-186.*

Pratiwi, N. K., & Kuniarti, E. (2021). implementasi computational thinking melalui kegiatan unplugged pada siswa sekolah dasar. *Jurnal Basicedu, 5(5), 3999-4007.*

Putra, A. P., & Syaripudin, T. (2022). pembelajaran coding unplugged untuk meningkatkan keterampilan computational thinking siswa sekolah dasar. *Jurnal Pendidikan Dasar Nusantara, 8(1), 13-24.*

Rahayu, W., & Hidayat, W. (2018). analisis kesulitan belajar siswa smp pada materi geometri. *JPMI (Jurnal Pembelajaran Matematika Inovatif), 1(5), 859-866.*

Sari, D. P., & Wijaya, A. (2019). analisis kesalahan siswa dalam menyelesaikan soal matematika model PISA pada konten ruang dan bentuk. *Kreano, Jurnal Matematika Kreatif-Inovatif, 10(1), 1-9.*

Sembiring, R. K., Hadi, S., & Dolk, M. (2019). reforming mathematics learning in indonesian classrooms through *RME. ZDM Mathematics Education, 41(3), 433-447.*

Stake, R. E. (1995). the art of case study research. *Sage Publications*.

Sugiyono. (2019). metode penelitian kuantitatif, kualitatif, dan r&d. alfabeta.

Susilo, H., Hidayat, A., & Trapsilasiwi, D. (2021). integrasi keterampilan abad 21 dalam pembelajaran di era revolusi industri 4.0. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, 6(3), 321-328.*

Wing, J. M. (2006). computational thinking. communications of the ACM, 49(3), 33-35.

Wulandari, D., & Wilujeng, I. (2020). implementasi computational thinking dalam kurikulum 2013. *Prosiding Seminar Nasional Pendidikan FKIP UNTIRTA, 3(1), 120-127*.

Yin, R. K. (2018). case study research and applications: design and methods (6th ed.). *Sage Publications.*