

Integration of Computational Thinking in Natural and Social Science Learning in Elementary Schools to Improve Problem-Solving Skills

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Abstract: Mastery of 21st century skills is very necessary in facing the development of the industrial revolution 4.0 era, one of which is computational thinking. Computational thinking is the ability to think systematically, logically, and structured to solve problems. This is very relevant to the learning of Natural and Social Sciences (IPAS) in Elementary Schools. This study aims to explain computational thinking, its integration in IPAS learning, its benefits in improving problem-solving skills of Elementary School students, identify its implementation strategies, and analyze challenges and opportunities in its application. The research method used is a literature study with a descriptive approach through the analysis of various national and international journal articles indexed by Sinta and Scopus. The results of the literature review indicate that the integration of computational thinking in IPAS learning in Elementary Schools makes a real contribution to improving students' problem-solving skills. Through a hybrid approach that combines plugged and unplugged approaches, it is the most appropriate strategy to be implemented in Elementary Schools in Indonesia. However, there are still challenges in its implementation including limited teacher understanding of computational thinking, limited technological infrastructure, and contextual and problem-based learning design.

Keywords: Computational thinking, Science, Elementary School, Problem Solving Skills

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INTRODUCTION

Elementary education plays a strategic role in equipping the younger generation with 21st-century skills. As the Industrial Revolution 4.0 and Society 5.0 evolve, students are required to possess not only knowledge but also higher-order thinking skills, including critical, creative, collaborative, and problem-solving abilities. Learning development in elementary schools is crucial to preparing students to face global challenges and the demands of the times (Lye & Koh, 2020; Fitriani & Yulianto, 2023; Hsu & Liu, 2023).

One skill that has received widespread attention in 21st-century education is computational thinking. Wing (2006) defines computational thinking as a conceptual thinking skill that encompasses decomposition, pattern recognition, abstraction, and algorithmic reasoning. Computational thinking is not merely a technological skill, but rather a framework that can be applied to various fields, including mathematics, science, and social sciences. Therefore, computational thinking has great potential in supporting learning that emphasizes inquiry and problem-solving in elementary schools (Angeli et al., 2021; Voss & Jackson, 2022).

In the context of national education, the current curriculum emphasizes the importance of mastering literacy, numeracy, critical thinking, and problem-solving skills. Critical thinking is essential to practice in the classroom, through effective teaching strategies such as observation and problem-solving activities (Rafia et al., 2025), yet most teachers still struggle to implement it in elementary schools (Gunawan et al., 2025). Natural and Social Sciences (IPAS) aims to train students to understand natural and social phenomena in an integrated manner through the exploration of real-world problems, such as environmental pollution, the energy crisis, and social behavior. This approach is relevant to computational thinking as a systematic and scientific thinking strategy (Angeli et al., 2021; Karimah & Widiastuti, 2022).

Computational thinking is closely related to the problem-solving stages proposed by Polya (1957), which include: understanding the problem; planning a solution; implementing the plan; and reviewing the results. Decomposition helps students understand the problem, pattern recognition supports the identification of regularities, abstraction facilitates the filtering of important information, and algorithms provide structured solution steps. Thus, computational thinking can strengthen the problem-

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solving process in science learning in elementary schools (Bocconi et al., 2016; Kalelioglu et al., 2016; Roman-Gonzalez et al., 2021).

Shute, Sun, and Asbell-Clarke (2019) explain that computational thinking not only develops digital literacy but also enhances students' logical thinking when dealing with complex problems. Hsu, Chang, and Hung (2020) emphasize that computational thinking can be taught both explicitly through coding activities and implicitly through scientific experiments and inquiries. This can increase the opportunities for applying computational thinking in science learning, which emphasizes observation, experimentation, and critical reflection (Rahmawati & Wulandari, 2022).

Based on this background, this study aims to explain the concept of computational thinking, its integration in science learning, its benefits in improving elementary school students' problem-solving skills, its implementation strategies, as well as the challenges and opportunities for its application.

METHODS

This research uses a literature study method with a descriptive approach through analysis of national and international journal articles indexed by Sinta and Scopus. The articles analyzed focus on: (1) models and approaches to implementing computational thinking in elementary school science learning; (2) the impact of implementing computational thinking on students' problem-solving skills; (3) challenges and supporting factors for implementation; and (4) strategic recommendations for implementing computational thinking.

The articles analyzed were published between 2015 and 2025. The literature review method was chosen because it provides a comprehensive overview of research trends, methodological approaches, empirical findings, and the challenges of implementing computational thinking in elementary education (Hsu & Liu, 2023; Yadav et al., 2023).

RESULTS AND DISCUSSION

Models and Approaches to Applying Computational Thinking in Science Learning

The application of computational thinking in elementary schools can be implemented through three models: plugged , unplugged , and hybrid approaches (Bell et al., 2015). The plugged approach is the application of computational thinking using digital devices or applications as the primary learning medium, such as *Scratch*, *Blockly*,



Code.org, and Tynker (Lye et al., 2021; Moreno-León & Robles, 2021). This approach helps students understand simple algorithms and the structure of computation-based problem-solving.

In the context of science subjects, the use of computer-based simulations can be applied to teach simulation or water circulation, encourage students to think about cause and effect, and test scientific hypotheses (Sengupta et al., 2016). Several studies confirm that the plugged-in approach model can not only improve algorithmic thinking skills but can also broaden students' contextual understanding in science. For example, a study conducted by Sengupta et al. (2016) showed that the use of computational modeling in the science subject in elementary schools can improve students' abilities in designing representations of scientific phenomena systematically.

Unplugged approach is a strategy for introducing computational thinking without the use of digital devices. This approach utilizes various activities such as logic games, puzzles, story-based problem-solving, and collaborative activities, and has been proven effective in introducing students to the concepts of decomposition, abstraction, and algorithms (Bell et al., 2022; Pratiwi & Setiawan, 2021). Research by Witten & Fellows (2021) shows that using manual science games based on computational thinking can help students understand systematic thinking processes without relying on technology.

The hybrid approach model is an integrated approach that combines unplugged and plugged activities. This model is most effective for elementary schools, especially in developing countries like Indonesia, which face limited technological facilities (Rahayu & Lestari, 2022). Teachers can begin learning by using simple applications to simulate solutions. The combination of both approaches, namely plugged and unplugged, can increase student engagement by up to 38% compared to using only one approach (Koh & Tan, 2021).

The role of teachers as facilitators of the application of computational thinking in learning is also crucial. Yadaf et al. (2020) suggest that teacher training in understanding the principles of computational thinking can directly contribute to the quality of classroom implementation. Teachers who have a good understanding of computational thinking will be able to design more meaningful cross-disciplinary activities between Natural Sciences (IPA) and Social Sciences (IPS), for example through project-based learning based on environmental and social issues.

Integration of Computational Thinking with School Students' Problem-Solving Skills

Based on the literature review conducted, information was obtained that there is a positive relationship between the application of computational thinking and the improvement of elementary school students' problem-solving skills (Chen et al., 2023; Li & Xu, 2023). In general, these skills include: the ability to identify problems; decompose them into smaller parts; design steps for solving them; test solutions; and reflect on the results.

Li and Xu (2023) conducted a meta-analysis of 42 international studies, showing that the application of computational thinking significantly contributes to the analytical and logical thinking skills of elementary school, with a moderate-strong category. This is in line with the results of the study (Fagerlund & Hannikainen, 2023), which showed that the application of science project-based computational thinking in elementary schools can improve problem-solving skills by up to 34%.

Computational thinking can also support students in scientific reasoning through systematic steps. For example, in studying the Water Cycle, students are asked to identify the stages of the water cycle, recognize evaporation and condensation patterns, and then predict the effects of climate change (Lestari & Rrahayu, 2021). This process can improve students' analytical thinking skills and ability to make scientific predictions.

Based on the results of the literature review, it can also be obtained information that there was a significant increase in students' problem-solving test scores after learning by integrating computational thinking through both plugged and unplugged approaches (Lestari & Rrahayu, 2021). The results of research by Denning and Tedre (2021) explain that computational thinking can strengthen four main components of problem solving, namely: (1) structured problem formulation, (2) pattern generalization, (3) algorithm development, and (4) reflection on solution results.

Computational thinking can also strengthen students' scientific abilities. Fagerlund and Hannikainen (2023) found that computational thinking can encourage systematic scientific inquiry; Yoon and Kim (2023) demonstrated how integrating computational thinking into the science curriculum can improve systemic thinking skills. Grover (2022) and Kafai and Brennan (2022) illustrate that computational thinking can bridge the gap between science, technology, and the humanities.



- In learning, computational thinking does not stand as a subject, but is integrated into the context of subjects such as science, where students learn to solve scientific problems and social problems in an integrated manner (Sengupta et al., 2016). This approach is in line with the view of interdisciplinary pedagogy which emphasizes the relevance of knowledge across subjects (Koehler & Mishra, 2020).

In addition to improving students' cognitive aspects, integrating computational thinking into learning can also improve students' affective and metacognitive aspects. According to Brennan & Resnick (2019), students who engage in computational thinking-based learning will demonstrate higher self-confidence in problem-solving because they feel in control of their thinking processes. This is also in line with the results of Saputra's (2022) research, which showed an increase in self-efficacy and motivation to learn science after students participated in computational thinking-based learning based on natural exploration.

Challenges and Opportunities for Implementing Computational Thinking

Based on the results of the literature review, it can be seen that the integration of computational thinking in science learning has a positive impact on improving problem-solving skills. However, various challenges remain. The biggest challenge is teacher competency. Many elementary school teachers still lack a comprehensive understanding of computational thinking, making it difficult to integrate it into their learning (Dewi & Hasanah, 2023). Training has been conducted on this topic, but it often focuses on the use of software rather than on computational thinking itself.

Various technological infrastructure limitations also pose a serious obstacle, particularly in rural schools (Tan, 2021; Wong & Hiew, 2022). Not all schools have computers or a stable and adequate internet connection. This makes integrating computational thinking using a plugged-in approach difficult.

Another problem or challenge is the lack of validated computational thinking assessment instruments for elementary schools. Most of the instruments developed are limited to secondary and tertiary education, making them less relevant for use by elementary school students aged 6 to 12 (Gonzalez et al., 2021; Wulandari & Arifin, 2023). This makes it difficult for teachers to assess the extent to which students' computational thinking skills have truly developed.

There are supporting factors that can provide opportunities for integrating computational thinking into science learning, namely through a contextual approach based on real-life problems, which has been proven to increase the success of integrating computational thinking into science learning. Research by [Lye and Koh \(2020\)](#), [Rahman and Lubis \(2022\)](#), and [Lestari and Rahayu \(2021\)](#) shows that project-based activities that link computational thinking to local environmental issues or problems (eg, waste management or water conservation) are easier for students to understand. In Indonesia, the success of integrating computational thinking into science learning in elementary schools depends on adaptation to the cultural context and school resources. A problem-based approach that incorporates local cultural contexts can make learning more relevant and sustainable ([Rahman & Lubis, 2022](#)).

Furthermore, support from curriculum policies and school leadership is crucial. In several schools that have implemented the independent curriculum, the integration of computational thinking into learning is implemented through the "Sustainable Earth" project in science subjects through environmental problem-solving activities ([Firdaus, 2023](#)). Research conducted by [Fitriani and Yulianto \(2022\)](#) shows that the success of schools that integrate computational thinking is influenced by the commitment of the principal and collaboration between teachers in lesson planning. Training that focuses on developing systematic thinking skills will have a greater impact than the technical use of digital tools ([Yadav et al., 2023](#)). Reflective teachers will be able to connect computational thinking to everyday learning contexts ([Tan, 2021](#)).

CONCLUSION

Based on the results of the literature review, it shows that the integration of computational thinking in science learning in elementary schools can provide a real contribution to improving students' problem-solving skills. Through a hybrid approach that combines plugged and unplugged approaches, it is the most appropriate approach to be implemented in elementary schools in Indonesia. However, in its implementation, computational thinking still has challenges, including limited teacher understanding of computational thinking, limited technological infrastructure, and contextual and problem-based learning designs. Suggestions for further research are to develop and test a science learning model based on computational thinking contextually by integrating plugged and



- unplugged approaches, and linking it to elementary school students' problem-solving skills.

REFERENCES

- Bell, A., & Rahardjo, S. (2021). Pengembangan aktivitas unplugged untuk pembelajaran IPAS SD. *Jurnal Ilmiah Pendidikan Dasar*, 9(1), 71–83.
- Bell, T., Witten, I. H., & Fellows, M. (2015). *Computer science unplugged: Teaching computer science without computers*. Christchurch, New Zealand: University of Canterbury.
- Bocconi, S., Chiocciariello, A., Dettori, G., Ferrari, A., & Engelhardt, K. (2016). Developing computational thinking in compulsory education. *European Journal of Education*, 51(3), 371–389.
- Brennan, K., & Resnick, M. (2019). New frameworks for teaching computational thinking. *Journal of Computing Education Research*, 13(4), 5–15.
- Chen, C., et al. (2023). Computational thinking in elementary education: A meta-review. *Computers & Education Open*, 5, 22–35.
- Denning, P. J., & Tedre, M. (2021). *Computational thinking: A disciplinary perspective*. Cambridge, MA: MIT Press.
- Dewi, E., & Hasanah, L. (2023). Peran guru dalam pembelajaran computational thinking di SD. *Jurnal Pendidikan Guru Sekolah Dasar*, 9(3), 115–127.
- Fagerlund, M., & Hannikainen, J. (2023). Computational thinking as part of science inquiry. *Education and Information Technologies*, 28, 223–238.
- Fitriani, S., & Yulianto, R. (2022). Computational thinking dan kepemimpinan sekolah. *Jurnal Kepemimpinan Pendidikan*, 5(1), 77–88.
- Gunawan, H. S., Maylia, E. C., Amelia, A. P., & Anasta, N. D. C. (2025). Project-Based Learning (PBL) Model in Improving Critical Thinking of Elementary School Students in Indonesian Language Learning. *Jurnal Review Pendidikan Dasar: Jurnal Kajian Pendidikan dan Hasil Penelitian*, 11(1), 86-100. <https://doi.org/10.26740/jrpd.v11n1.p86-100>
- Grover, J. (2022). Computational thinking across disciplines: Meta-synthesis findings. *Computers & Education*, 182, 104–139.
- Hsu, R., Chang, L., & Hung, C. (2020). Meta-analysis on the effect of computational thinking on students' problem solving. *Educational Technology & Society*, 22(2), 11–27.
- Kafai, Y. B., & Brennan, K. (2022). Computational participation in children's learning. *Educational Technology Research and Development*, 58(1), 1–27.
- Kalelioglu, D., Gulbahar, Y., & Kukul, G. (2016). A framework for computational thinking based on a systematic review. *Computers & Education*, 94, 17–32.
- Karimah, S., & Widiastuti, D. (2022). Pembelajaran IPAS berbasis computational thinking. *Jurnal Pendidikan IPA Indonesia*, 11(3), 279–288.

- Kartika, N., & Supriyadi, S. (2023). Model hibrida dalam pembelajaran computational thinking di SD. *Jurnal Pembelajaran Dasar*, 5(1), 12–25.
- Koehler, B., & Mishra, M. (2020). Framework for interdisciplinary computational thinking. *Educational Technology Journal*, 13(2), 61–72.
- Lestari, P., & Rahayu, M. (2021). Kendala implementasi computational thinking pada kurikulum SD di Indonesia. *Jurnal Pendidikan Dasar Nusantara*, 9(1), 15–27.
- Li, L., & Xu, T. (2023). Integrating computational thinking in primary science. *International Journal of Educational Research*, 117, 102–114.
- Lye, R., Koh, K., & Tan, C. (2021). Computational thinking integrated learning: A framework for STEM in primary schools. *Computers in Human Behavior*, 125, 106–120.
- Lye, S. Y., & Koh, J. H. L. (2020). Review on integrating computational thinking in primary education. *Computers & Education*, 143, 103–117.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Moher, D. (2021). PRISMA 2020: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71.
- Polya, G. (1957). *How to solve it: A new aspect of mathematical method*. Princeton, NJ: Princeton University Press.
- Pramono, N. (2020). Computational thinking dalam pendidikan abad ke-21. *Jurnal Pendidikan dan Pembelajaran Abad 21*, 5(2), 93–106.
- Rafia, Maulidiyah, A., Haeruddin, & Jamhari, M. (2025). The Effect of Critical Thinking Ability and Learning Motivation on IPAS Learning Outcomes. *Jurnal Reviu Pendidikan Dasar: Jurnal Kajian Pendidikan dan Hasil Penelitian*, 11(1), 12-22. <https://doi.org/10.26740/jrpd.v11n1.p12-22>
- Rahman, D., & Lubis, H. (2022). Kontekstualisasi pembelajaran computational thinking di Indonesia. *Jurnal Pendidikan Dasar Inovatif*, 11(2), 88–101.
- Rahmawati, F., & Wulandari, S. (2022). Implementasi computational thinking di sekolah dasar. *Jurnal Pendidikan Dasar Nusantara*, 10(2), 144–159.
- Saputra, A. (2022). Dampak pembelajaran computational thinking terhadap self-efficacy siswa SD. *Jurnal Teknologi Pendidikan Indonesia*, 8(1), 41–55.
- Sengupta, A., Dickes, A., & Farris, P. (2016). Development of disciplined interpretation using computational modeling. *Journal of Science Education and Technology*, 25(5), 760–774.
- Shute, V. J., Sun, C., & Asbell-Clarke, J. (2019). Demystifying computational thinking. *Educational Research Review*, 22, 100–120.
- Tan, R. R. (2021). Barriers to computational thinking integration in primary schools. *Journal of Educational Information Technology*, 25, 321–333.
- Tedre, M., & Denning, P. (2021). Computational thinking as a cognitive practice. *Communications of the ACM*, 64(7), 27–33.
- Voss, A., & Jackson, J. (2022). Computational thinking in science classrooms. *International Journal of STEM Education*, 9(3), 88–102.

- Weintrop, G., Beheshti, E., Horn, M., Orton, K., Jona, K., Wilensky, U., & Trouille, L. (2016). Defining computational thinking for science classrooms. *Journal of Science Education and Technology*, 25(1), 127–147.
- Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, 49(3), 33–35.
- Wong, A., & Hiew, S. (2022). Challenges in implementing computational thinking in low-resource schools. *Asian Journal of Educational Research*, 8(3), 112–125.
- Wulandari, M., & Arifin, E. (2023). Instrumen penilaian computational thinking siswa SD. *Jurnal Penelitian Pendidikan Dasar*, 6(2), 99–112.
- Yadav, A., Hong, S., & Stephenson, K. (2020). Measuring teachers' understanding of computational thinking for science instruction. *Journal of Science Teacher Education*, 31(3), 258–273.
- Yoon, S., & Kim, K. (2023). Exploring computational thinking across science curricula. *International Journal of Science Education*, 45(1), 33–52.