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The Computational Thinking in Elementary School in the Indonesia New Curriculum: A Teacher's Perspective

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Abstract

In the 21st century, thinking is a very important ability, one of which is computational thinking. The purpose of this research is to explain a teacher's perspective on computational thinking (CT) in elementary school in the Indonesian New Curriculum. The qualitative method was used with a case study. The participant is Bandung's fourth-grade teacher. All teachers received questionnaires. A number of teachers were interviewed. Researchers use data collection tools as their primary tools. The supporting instruments are documentation studies, interviews, and field notes. The results show that teachers know about CT but are still confused about how to teach it in elementary school. They agree that CT is one of the most important skills in the 21st century. They do not understand all CT indicators, and they are unable to formulate CT queries or connect CT with technology. There should be training for teachers on how to integrate learning, technology, and CT.

Keywords: Computational thinking, elementary school, curriculum in Indonesia

Abstrak

Di abad 21 berpikir merupakan suatu kemampuan yang sangat penting, salah satunya adalah berpikir komputasional. Tujuan dari penelitian ini adalah untuk menjelaskan pandangan guru tentang berpikir komputasi di Sekolah Dasar dalam Kurikulum Baru Indonesia. Metode yang digunakan kualitatif dengan studi kasus. Pesertanya adalah guru kelas IV Bandung. Semua guru menerima kuesioner. Sejumlah guru diwawancarai. Alat pengumpul data adalah peneliti sebagai instrumen utama. Instrumen pendukungnya adalah studi dokumentasi, wawancara, dan catatan lapangan. Hasilnya menunjukkan bahwa guru sudah mengetahui tentang berpikir komputasi, namun masih bingung bagaimana cara mengajar berpikir komputasi di sekolah dasar. Mereka sepakat bahwa berpikir komputasi adalah salah satu keterampilan penting di abad ke-21. Mereka tidak memahami seluruh indikator berpikir komputasi, dan mereka tidak mampu merumuskan pertanyaan berpikir komputasi atau menghubungkan berpikir komputasi dengan teknologi. Harus ada pelatihan bagi guru tentang bagaimana mengintegrasikan pembelajaran, teknologi dan berpikir komputasi.

Kata kunci: berpikir komputasi, sekolah dasar, kurikulum di Indonesia

INTRODUCION

Every person today must be able to think critically, methodically, logically, artistically, and be able to relate to others effectively if science and technology are to advance. There is a connection between how kids think and how well they do in various academic courses (Tran et al., 2017). In the process of learning mathematics, the growth of a student's capacity for problem-solving thinking serves as the foundation for the learning that is done (Schoenfeld, A. H., & Sloane, A. H. 2016). Computational thinking is one of the thinking skills that is particularly significant in the twenty-first century.

Everyone in the world employs computational thinking as a core skill in the twenty-first century. Problem-solving skills can be aided by computational thinking, which is a skill required for success in the twenty-first century (Wing, 2008). It is crucial to integrate computational thinking into mathematics instruction because later students will work in the field (Denning, P. J., & Tedre, M. 2019). Computational thinking includes understanding and solving problems with adequate descriptions, reasoning at various levels of abstraction, and coming up with automatic solutions (Hsu, T. C., Chang, S. C., & Hung, Y. T., 2018; Selby, C., & Woollard, J., 2013). A cognitive skill known as computational thinking enables teachers to spot patterns, break down complex issues into manageable steps, organize and construct a set of methods to find solutions, and simulate data representations. Although it can be utilized to assist students in solving math problems, computational thinking is a learning method that is crucial in the creation of computer applications (Barr, D., Harrison, J., & Conery, L. 2011).

Since mathematics is a scientific field that significantly affects students, it is studied at all educational levels. However, a lot of students feel that mathematics is a challenging subject, and as a result, their interest in learning it wanes. It is predicted that this aptitude for computational thinking will help students solve challenging mathematical issues and increase their enthusiasm for the subject. It is possible to define computational thinking as a technique for locating, evaluating, and implementing effective and efficient solutions to problems. Therefore, computational thinking skills are the capacity to provide a solution (Kong, S. C., & Abelson, H. 2019). One of the math topics that students are required to study in primary school is statistics. Students gain practical experience with the value of information and how it is presented through statistics. Additionally, statistics in primary schools work to give students a solid foundation in literacy.

Introducing computational thinking in elementary school is increasingly recognized as an effective way to develop foundational problem-solving and critical thinking skills in young learners. It's important to ensure that computational thinking activities are age-appropriate, engaging, and aligned with the curriculum (Angeli, C., & Giannakos, M. 2020). Integrating computational thinking across multiple subjects, such as math, science, and language arts, can provide meaningful and interdisciplinary learning experiences for elementary school students. Teachers can seek professional development opportunities and resources specifically designed for introducing computational thinking to young learners. By cultivating computational thinking skills at an early age, students can develop a strong foundation for future learning and problem-solving in the digital age.

The Indonesian Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) launched the Merdeka Curriculum in 2021. The Merdeka Curriculum idea seeks to provide schools and instructors flexibility in developing and implementing curricula in accordance with student characteristics, regional potential, and local requirements. The Merdeka curriculum places a strong emphasis on character development, skills, and knowledge that are

applicable to the social, cultural, and economic circumstances of the region. As part of attempts to educate students for problems in the digital age, Indonesia's Merdeka Curriculum has acknowledged the significance of developing computational thinking abilities. Are teachers prepared to teach independently and support CT in learning?

METHOD

The qualitative method was used with a case study. The participant is Bandung's fourth-grade teacher. All teachers received questionnaires. A number of teachers were interviewed. Researchers use data collection tools as their primary tools. The supporting instruments are documentation studies, interviews, and field notes. The research was conducted in May 2023. among grade 4 teachers. The teachers were interviewed regarding their knowledge of computational thinking. Then the teacher was observed during the learning process to see the extent to which the teacher applied computational thinking skills in classroom learning.

The analysis data technique is coding and constant comparison with framework analysis (familiarization, identifying a thematic framework, indexing, charting mapping, mapping, and interpretation). Validate the accuracy of the findings through triangulation, member checking, and an external audit.

Interviews were assessed. While listening to the first audio, the researcher thought about how the teacher's response related to related material. In order to ascertain each attribute standpoint of the teacher on computational thinking, the researcher carefully listened to the results of the interview during the second recording. Determining these is an important step in the data analysis process since it facilitates the understanding of valuable data. These characteristics are revealed via a literature analysis that identifies each response that reflects pertinent themes in the literature.

RESULT AND DISCUSSION

1. Teachers have known about CT but are still confused about how to teach it in elementary school

El-Hamamsy, et al. (2022) mentioned that that the ability of the teacher to master CT is crucial for the success of CT instruction. Xu, W., Geng, F., & Wang, L. (2022). Relations between computational thinking, reasoning ability, and creative thinking in young children.

The capacity to structure issues, break them down into distinct steps, see patterns, use them to develop answers, and generalize and apply knowledge to new situations are all aspects of computational thinking. These are fundamental skills in computer science and related subjects that are necessary for problem-solving, building a grasp of abstraction, and encouraging creativity.

Computational thinking can be used in a variety of ways within the Independent Curriculum, including in disciplines like mathematics, natural sciences, English, and computing. Algorithms, coding, problem-solving, data analysis, and computational modeling are among the topics that students might study. Computational thinking can also be used in group projects and cross-curricular learning. For instance, it is possible to urge students to develop and use technological solutions to local issues.

It should be emphasized, though, that each school and location may have a different approach to incorporating computational thinking within the Independent Curriculum. The Ministry of Education and Culture or other relevant educational institutes in Indonesia can be contacted for more information on how computational thinking is included in the Independent Curriculum.

Computational thinking refers to a problem-solving approach that draws on principles and practices used in computer science. It involves breaking down complex problems into smaller, more

manageable parts, identifying patterns and algorithms, and developing logical and systematic solutions. Computational thinking is not limited to computer science; it can be applied to various disciplines and everyday situations.

Teachers who are knowledgeable about computational thinking understand its key components and how to incorporate them into their teaching practices. Here are some aspects that teachers should be familiar with:

a. Decomposition: Teachers should guide students by breaking down complex problems into smaller, more manageable parts. They help students identify the main components and understand the relationships between them.
b. Pattern Recognition: Teachers encourage students to identify patterns and similarities within problems. This involves recognizing common elements, trends, or recurring structures that can help develop generalized solutions.
c. Abstraction: Teachers assist students in identifying the essential details and disregarding irrelevant information. They help students focus on the core concepts and generalize the problem to develop a more abstract solution.
d. Algorithmic Thinking: Teachers guide students in creating step-by-step instructions or algorithms to solve problems. They help students think sequentially and logically, considering different scenarios and potential outcomes.
e. Evaluation and iteration: Teachers teach students to evaluate and refine their solutions. They promote a growth mindset, encouraging students to iterate and improve their algorithms based on feedback and testing.

Teachers knowledgeable about computational thinking can integrate it into various subjects, such as mathematics, science, and even the humanities. They can design activities and projects that allow students to apply computational thinking skills in real-world contexts. Professional development programmes, workshops, and resources provided by educational organizations can help teachers enhance their understanding of computational thinking and its application in the classroom. Additionally, collaboration and sharing experiences with other teachers can contribute to the ongoing development of computational thinking teaching practices.

2. They agree that CT is one of the most important skills in the 21st century

Computational thinking is widely recognized as one of the most important skills in the 21st century. In an increasingly digital and technology-driven world, computational thinking provides individuals with a structured approach to problem-solving and a mindset that can be applied in various domains. Here are a few reasons why computational thinking is considered important in the 21st century:

a. Problem-solving: Computational thinking equips individuals with the ability to break down complex problems into smaller, manageable parts. It helps identify patterns, develop algorithms, and devise logical solutions. This skill is valuable across disciplines and professions as it fosters critical thinking and analytical reasoning.
b. Digital literacy: Computational thinking builds a foundation for digital literacy by providing an understanding of how computers and digital systems work. It enables individuals to navigate technology, understand algorithms, and make informed decisions in a digital environment.
c. Technological innovation: The 21st century is marked by rapid technological advancements. Computational thinking empowers individuals to understand and engage with technology creatively. It promotes innovation, as individuals can develop new applications, design solutions, and harness the power of technology to address societal challenges.

d. Automation and data analysis: As automation and data analysis become increasingly prevalent, computational thinking skills are vital for individuals to effectively leverage these technologies. Computational thinking enables individuals to understand and work with algorithms, process large datasets, and make data-driven decisions.
e. Collaboration and interdisciplinary problem-solving: Computational thinking encourages collaboration and interdisciplinary problem-solving. It helps individuals communicate ideas effectively, work in teams, and combine different perspectives to solve complex problems. This skill is crucial in the interconnected and globalized world of the 21st century.

Overall, computational thinking provides individuals with a structured and systematic approach to problem-solving, along with the ability to leverage technology effectively. It enhances critical thinking, creativity, and collaboration, making it an important skill in the 21st century across various domains and professions.

3. They do not understand all CT indicators, and they are unable to formulate CT queries or Teachers may face several challenges when designing learning experiences based on computational thinking (CT). Here are some common difficulties they may encounter:

a. Lack of knowledge and expertise: Teachers may feel inadequate in their understanding of CT concepts, principles, and tools. They may need to invest time and effort in professional development to acquire the necessary knowledge and skills to incorporate CT into their teaching.
b. Limited resources and infrastructure: Implementing CT in the classroom often requires access to appropriate technology tools, software, or hardware. However, not all schools may have the necessary resources or infrastructure to support hands-on CT activities, such as coding or robotics.
c. Time constraints: Teachers often face time constraints due to a packed curriculum and various academic requirements. Integrating CT into their teaching may be perceived as an additional workload, requiring them to find ways to align it with existing content without sacrificing other essential learning objectives.
d. Pedagogical shift: Integrating CT into the classroom requires a shift in teaching strategies and pedagogical approaches. Teachers may need to move away from traditional instruction and adopt more student-centered, inquiry-based, and problem-solving approaches. This shift can be challenging and may require support and guidance from instructional coaches or professional learning communities.
e. Assessment and evaluation: Assessing and evaluating students' CT skills and understanding can be challenging. Traditional assessment methods may not capture the multifaceted aspects of CT, such as problem-solving, algorithmic thinking, or debugging. Teachers may need to explore alternative assessment strategies, such as project-based assessments, peer evaluations, or portfolios. Differentiation and diverse learners: Students come with diverse backgrounds, abilities, and interests. Designing CT learning experiences that cater to the needs of all learners can be challenging. Teachers need to consider differentiation strategies, provide scaffolding, and offer various entry points for students with different skill levels and learning styles.
f. Integration across subjects: CT has interdisciplinary connections and can be integrated into various subjects beyond computer science.

However, collaborating with teachers from other disciplines to integrate CT into their curricula may require additional coordination, planning, and a shared understanding of CT concepts. To address these difficulties, teachers can seek professional development opportunities to enhance their CT knowledge and skills, collaborate with colleagues, explore open-source or low-cost CT resources, and gradually incorporate CT into their existing teaching practices. Additionally, seeking support from administrators, accessing external experts, and fostering a supportive school culture can help alleviate some of the challenges associated with designing CT-based learning experiences.

Formulating CT queries involves constructing questions that encourage deep analysis, evaluation, and reasoning. To connect CT with technology, you can focus on exploring the implications, limitations, ethical considerations, and potential biases related to the use of technology. Here's a step-by-step guide to formulating CT queries and connecting them with technology:

a. Identify the technology topic: Choose a specific technology-related concept, application, or issue that you want to analyze critically. For example, artificial intelligence (AI), data privacy, social media algorithms, or automation in the workplace.
b. Define the key components: Break down the chosen topic into its essential components. This will help you understand the different aspects you need to consider while formulating your CT queries. For example, if you choose AI, key components may include algorithms, data collection, bias, or job displacement.
c. Analyze the implications: Explore the potential consequences or impacts of the technology. Consider both positive and negative aspects. Some CT queries could be: How does the use of AI algorithms in social media affect the information we consume and our perceptions of reality? What are the ethical implications of using facial recognition technology for surveillance purposes? Evaluate the limitations: Assess the limitations or challenges associated with the technology.
d. Reflect on societal impact: Consider the broader societal impact of the technology. Analyze its effects on employment, social dynamics, education, or access to resources. Some CT queries could be: How does automation in industries like manufacturing or transportation affect employment rates and job stability? What is the role of technology in bridging the digital divide and ensuring equal access to information?

By formulating CT queries and connecting them with technology, you can develop a deeper understanding of the subject matter, uncover potential issues, and engage in critical discussions about the implications and future developments of technology.

CONCLUSION

Computational thinking is one of the thinking skills that is particularly significant in the twenty-first century. The goal of this study is to clarify a teacher's viewpoint on computational thinking in Indonesia's new elementary curriculum. The case study method was qualitative. The participant is a fourth-grade teacher in Bandung. Questionnaires were given to all teachers. There were interviews with several teachers. The primary tool used by researchers is data collection. Interviews, field notes, and documentation studies are the supporting resources. The findings indicate that although teachers are aware of CT, they are still unsure about how to teach it in an elementary setting. They all concur that CT is one of the most crucial skills in the twenty-first century. They are unable to create CT inquiries or make connections between CT and technology, and they do not comprehend all CT indicators. Teachers’ ought to receive training on how to combine learning, technology, and CT.

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