Implementing Computational Thinking Skills in Socio Scientific Issue (SSI) of Force Material Around Us at Elementary School

Yuli Yanti[1*], *Diah Rizki Nur* Kalifah[1], *Nurul* Hidayah[1]

[1]Universitas Islam Negeri Raden Intan Lampung, Jl. Endro Suratmin, Sukarame, Kecamatan Sukarame, Kota Bandar Lampung, Lampung, Indonesia

Abstract. Computational thinking is a sophisticated problem-solving approach based on computer science. Implementing computational thinking in elementary schools remains a challenge for education, particularly for teachers and students. Teachers must construct learning experiences using computational thinking to make the learning process more engaging, while students must solve issues logically, systematically, and effectively. This study aims to present an overview of the application of computational thinking in natural and social sciences (IPAS) learning and identify its application in fifth-grade elementary school students. The research employed a qualitative research design with a single one-shot case study. The research subjects were 40 fifth-grade students and four teachers. This investigation was conducted during a single meeting that followed the lesson plan for the force material around us. The findings revealed that (a) analysis of student activity data yielded a percentage of 81.25%; (b) the data analysis of student responses to learning yielded favorable results, approaching 100%. According to interviews and observations of CT (Computational Thinking) in SSI (Socio-scientific Issue) in IPAS subjects, implementing CT learning on the forces around us might bring up aspects of the CT foundation, such as pattern recognition decomposition, abstraction, and algorithms. The learning scenario is that students are requested to assess many types of activities that occur in everyday life. Additionally, students will outline various actions that use force.

1 INTRODUCTION

The computational thinking (CT) approach can help students improve their problem-solving skills [1]. Computational thinking skills are required as capital for Indonesian children to compete in the workforce. According to Kale in Cotton's book, computational thinking is a cognitive skill [2]. Computational thinking for students can also inspire them to keep an open mind when solving problems. This is consistent with Yasin[3], who argued that including CT as a basic ability in the school curriculum will teach children to reason and prepare them to solve complicated and open problems. Computational thinking becomes an ability that can

* Corresponding author: yuliyanti@radenintan.ac.id

help students tackle a variety of difficulties since it includes approaches that encourage students to simplify problems while also stimulating student creativity [4].

Computational thinking can be utilized at a young age, for example, in elementary school, when teachers introduce and include examples of computational thinking material in each subject or by addressing small problems that arise in everyday activities. By incorporating computational thinking into education, students can be trained and familiarized to handle problems quickly and in a structured manner. Students' success in dealing with problems can boost their confidence [5]. However, the current learning approach inhibits students' ability to build computational thinking skills [6]. However, the current learning approach inhibits students' ability to build computational thinking skills [6]. Teachers are accustomed to imparting knowledge to students utilizing formulas, after which students are encouraged to memorize (Gadanidis et al., 2017). As a result, this strategy reduces students' enthusiasm for improving computational thinking skills, yielding a poor impact [7–9].

The learning process also requires students to be self-sufficient in discovering the sources and information they seek rather than relying on what they learn from the teacher [10]. Students are encouraged to make decisions and share their opinions on environmental socio-scientific concerns, but the ability to study and evaluate evidence or information must be developed. One type of learning that can be used to teach students about environmental challenges in their surroundings is SSI learning. Socio-scientific Issue (SSI) is a science learning hub that sparks students' interest in science and helps them develop skills such as teamwork, problem-solving, and media literacy [11]. Socio-science is rarely addressed in textbooks, even though they are critical for making science lessons more relevant to everyday life. It provides direct learning benefits, such as increased appreciation for science, improved student reasoning in conversation, and improved students' capacity to analyze scientific data and information. It is a crucial component of science literacy [12].

Environmental challenges include waste-related pollution and forest and land fires [13–16]. According to the SSI viewpoint, the location and contextual nature of the learning environment, including the cultural atmosphere involving SSI stakeholders, is a vital aspect that must be used as student learning support in the early stages of learning for conceptualizing and solving scientific and social problems [17]. The difficulties raised in SSI learning highlight the importance of contextualizing socially based science concepts learned in the classroom. Information and communication technology-based tools can assist students in connecting social issues to bigger arguments [18]. This idea is corroborated by Klosterman, Sadler, and Brown [18], who claim that media provides a more diverse source of information and can help students relate what they learn in the classroom to what is happening in the outside world. In this scenario, computational technology can be utilized in various ways to discover sociological issues, and it has the potential to be a significant instrument for providing access to relevant social topics [19]. According to the description above, this study aims to present findings from implementing computing skills in socio-scientific concerns in elementary schools.

2 Research Methods

This study employed a descriptive qualitative research design with a field study approach. Descriptive qualitative research involves evaluating data to gather information regarding the utilization of computer skills in socio-scientific issues in elementary schools [20,21]. This study employed a descriptive qualitative research design with a field study approach. Descriptive qualitative research involves evaluating data to gather information regarding the utilization of computer skills in socio-scientific issues in elementary schools [20,21]. This study was conducted in SD N 3 Way Laga, SD N 2 Sukaraja, and MIN 7 Bandar Lampung in the fifth grade during the odd semester, with 40 students and four teachers as the

https://doi.org/10.1051/e3sconf/202448204001

participants. The study's subject is the force surrounding us (the effect of force on direction, speed, shape, and force-related activities). Data collecting techniques were questionnaires via Google Forms, interviews, and documentation during the learning activities.

This study utilized qualitative data analysis. This study used several qualitative data analysis approaches, including content, narrative, and discourse analysis. The researcher used content analysis to help determine the research theme or content. The theme of this study was computational thinking in socio-scientific issues. Researchers used narrative analysis to determine the methods and learning media that were frequently or currently used by teachers in schools to provide learning materials to students. Furthermore, discourse analysis was used to examine how individuals interact. This study used discourse analysis to analyze student interactions with teachers through direct question and response and teacher assessment using previously provided Google Forms. The measuring instruments for this study are described as follows:

$$\boxed{\mathbf{X} \longrightarrow \mathbf{O}}$$

Fig. 1. Design Research

Description:

X : The implementation of computational skills in socio-scientific issues in elementary school

O : The results of the implementation of computational skills in socio-scientific issues in elementary schools, which consist of:

1. Students' ability to solve problems through computational skills in socio-scientific issues on the material of forces around us (the effect of force on direction, motion, shape, and activities that utilize force).
2. Student's response to the implementation of computational skills in socio-scientific issue

3 Findings and Discussion

3.1 The Planning of CT-integrated Learning

This study used the problem-based learning model to integrate CT into the learning process. The learning was carried out in a single cycle, beginning with learning planning, moving on to learning implementation, and finally, learning reflection. Learning about forces around us relied on students' capacity to think about decomposition, pattern identification, abstraction, algorithms, and generalization. On July 24, 2023, the learning activities took place at SD Negeri 3 Way Laga, SD Negeri 2 Sukaraja, MIN 7 Bandar Lampung for 4 x 35 minutes. The learning outcome showed that students showed numerous forms of forces and their consequences on object direction, speed, and shape. The learning objectives were to identify the numerous forces involved in daily activities and use them to assist individuals in overcoming everyday challenges. Learning activities began with an introduction that included greetings, praying together, ice-breaking by singing the song *"Tangan Ke Atas Menggapai Bintang"* to get students to focus on learning, then presented learning objectives and a brief schedule. The learning activities were student-centered. The students were separated into small groups of five to prepare any items brought from home or school. Each group selected one of several items, including a table, chair, door, book, pencil, shoe, and ball. They must break down the major pieces of the object that define its main characteristics. They were shown instances of activities such as pulling, pushing, and lifting that can modify and influence the direction of an object.

Lifting, pulling, and pushing objects requires learners to think in a pattern recognition method to answer the teacher's earlier questions: "What activities do they do?" (the teacher provides the picture) and "How do you shift or change objects to move?". To discover how objects are lifted, dragged, or pushed, students consulted books and the Internet and took notes on the content about force. After gathering this information, the students focused on the effect of force on the direction, speed, and shape of objects and the benefits of force on the activities they engaged in. This step is known as generalization, in which students focus on the big picture and the significance of the learned materials. Next, students completed a challenge to answer the teacher's earlier question. They must think algorithmically to provide step-by-step instructions for problem-solving involving the influence of force on an object and activities that use force. The challenge for learners was to experiment. Every student can choose one of three experiments to show during class. The first activity involved students opening and closing a classroom door. The second activity involved students playing a ball game and writing in a notebook. In the third experiment, the students changed positions by rearranging tables and chairs. Then, the students and their groups prepared a report based on the results of their experiments and presented it in class. One or two other students were chosen to try the group's experiments that demonstrated. The exercise continued with determining which group had the best presentation and work results. The best work outcomes are achieved by groups that successfully carry out experiments by the stages and present them to the class appropriately. Other groups were also recognized for their best experiments and presentations.

The activity was concluded by calculating the voting results for the group that achieved the best experimental results. The teacher then invites students to reflect on the activities they completed. The reflection questions were: (a) What material have you understood? (c) What material is not understood? (c) Is there anything you wish to know more about? (d) How did you feel throughout the learning process? Furthermore, the teacher reinforces the material by discussing the effect of force on the direction, speed, and shape of objects and activities that use force in everyday life. Then, the students prayed and closed the lesson. The full learning series was tailored to the problem-based learning approach, and CT was interwoven with social scientific issues.

3.2 Students'Responses toward the Learning Activities

This study also examined students' responses to learning. Students filled out a questionnaire at the end of learning that could describe their perceptions of learning with computational thinking in social scientific issues on the material of forces around us. The following is a table of students' responses to learning with CT in social scientific issues on the material of forces around us (the effect of force on the direction, motion, and shape of objects and activities that utilize force).

Table 1. Students'Responses toward the Learning Activities

No	Statements	Yes	No
1	I always pay attention to the teachers' and my friends' explanations.	100%	0%
2	I like natural and social science subjects more after participating in learning using computational thinking.	100%	0%
3	I feel excited after learning natural and social science and participating in learning using computational thinking.	100%	0%
4	I try to do the problems given well.	100%	0%
5	I am interested in following this kind of learning again.	100%	0%
Total Average		100%	0%

The table implies numerous conclusions to be taken about the results of the students' responses. The first indicator discusses students' responses to "paying attention to explanations given by teachers and friends," with 100% positive responses. The second indicator, which measured students' preferences for IPAS learning over computational thinking, had a 100% positive response. The next indicator is the students' level of excitement after participating in IPAS learning utilizing computational thinking, which received 100% positive responses. The next indicator is that students try to answer the questions correctly with a full response rate of 100%.

Furthermore, the last indicator is that students are eager to repeat the learning activities and achieve 100% responses. Overall, 100% of students approved of using computational thinking to learn about the forces surrounding us. The positive response is based on the percentage of learners replying "yes" (providing a positive response) reaching over 90%. The student's response to computational thinking-based learning is positive, as evidenced by the 100% response rate.

Learning activities incorporating computational thinking into scientific issues about forces around us allowed students to learn how to use the fundamentals of computational thinking, such as decomposition, pattern recognition, abstraction, and algorithms. Decomposition occurs when students analyze images of common activities involving force and the effect of force on the direction, speed, and shape of objects. Abstraction skills are developed when students are asked to locate and categorize key and irrelevant elements in a case or activity problem that requires force. The worksheet allows students to solve problems by sequencing numerous actions through experiments built on the algorithm's base. Additionally, the teacher conducted student observation activities as part of the research on implementing computational thinking in learning. The table 2 summarizes the findings from the evaluation of student observations during learning

Table 2. Students'Activities in Computational Thinking Application

No	Observed Indicators	Students'Activity Percentage	
		Yes	No
1	Paying attention to what the teacher says	100%	0%
2	Asking questions	100%	0%
3	Expressing an opinion	66,7%	33,3%
4	Presenting the results of the discussion	100%	0%
5	Responding to other students' answers	83,3%	16,7%
6	Writing or copying relevant notes from the discussion results in teaching and learning activities	100%	0%
7	Working on student worksheets	100%	0%
8	Working on something outside the learning topic and leaving without permission	0%	100%
Total average		81,25%	18,75%

Based on the findings, it is possible to conclude that the students learning with computational thinking on social scientific issues of IPAS in the forces around us material in the fifth grade were active at an average of 81.25%. Furthermore, the highest indicator of learning was paying attention to what the teacher says during the learning process, asking questions, presenting discussion results, and writing or copying relevant notes from the results of discussions in teaching and learning activities. The data was acquired from observations carried out on July 24, 2023, specifically during the teaching and learning activities employing computational thinking in socio-scientific issues on the force around us material.

3.3 Teachers' Understanding of the Learning Model

The teachers have implemented the learning model in classroom learning; in each lesson, as indicated by the lesson planning done in the lesson plan, they included learning models in their lesson plans. Teachers' plans began by selecting a learning model in which they could fulfill the learning objectives that had been defined. The interview findings revealed the following:
I have taught employing learning models through modifying the classroom setting. The models utilized are various and appropriate to all subjects, sometimes with contextual models. I always use models that attract students' attention and motivate them to learn.

How do teachers know which learning model to use in class? Elementary school teachers are familiar with active or 21st-century learning models that prioritize student-based learning, student abilities, collaboration and communication in groups, and students' freedom of ideas and ideas in learning. Using the model, the teacher is only a guide and facilitator in classroom learning.

According to the findings of interviews with school teachers who teach IPAS lessons, they can teach well using models. They employ a variety of models, including project-based Learning (PjBL) and discovery learning models. Teachers have the initiative to use appropriate learning approaches for the subject matter.
I teach IPAS in the fifth grade of elementary school, and I frequently utilize the PjBL model, the Discovery learning model, and other models like contextual and problem-based learning. This model suits the themes and materials I will present in class. Teachers, as strategic figures in managing learning in the classroom, can make strategic efforts while also understanding the appropriate learning models. Many books and articles highlight 21st-century learning models, including models that engage students in learning, prioritize discussion groups, and present students with a problem phenomenon that they must solve.

3.4 Computational Thinking Skills for Elementary School Teachers

Socio-scientific issues (SSI)-based learning is an extension of Science, Technology, and Society (STS) and Problem-based approaches that situate scientific knowledge in a social context to give students a sense of how science applies in the real world [22]. SSI is the deliberate utilization of scientific themes that require students to engage in dialogue, discussion, and debate [23]. Various topics have been mentioned as potential sources of Socio-Scientific Issues, including discussions about nuclear power, global warming, genetic testing, cell research, transplantation, biofuels, and so on [23].

The interview findings revealed that madrasah teachers know Computational Thinking (CT):
Computational Thinking (CT) as a problem-solving technique is increasingly vital in preparing the next generation to compete in the digital economy. Learning models and Computational Thinking (CT) must be introduced gradually and consistently to deepen students' knowledge. Insight into Computational Thinking (CT) for elementary school teachers is still not uniformly disseminated; only instructors who participate in Computational Thinking (CT) training can grasp or understand Computational Thinking (CT).

The findings of interviews with teachers describe how elementary school teachers know about Computational Thinking (CT). The teacher's answer leads to a learning model that can activate students in the classroom. The interview responses are as follows:
Providing more learning models can engage students and provide an overview and insight into how to learn effectively. By being accustomed to PBM and applying the concept of

Computational Thinking (CT), students can be helped to better grasp the problem by collecting all of the data and then beginning to explore solutions based on the situation.

Teachers who know Computational Thinking (CT) only through training that is infrequently seen and that teachers have only attended once:
Students have become used to passive lecture learning models without engaging students in interaction. Due to time constraints, not all students are actively participating. Teachers have limited knowledge of Computational Thinking (CT), even though elementary school teachers recognize that students must acquire solutions that they can apply later in the field or the community. Strengthening elementary school teachers' training and socialization about computational thinking (CT) is vital. Teachers are willing to follow and implement well if more in-depth training about computational thinking (CT) is provided.

3.5 Implementation of Learning Models and Computational Thinking in Socio-Scientific Issues in IPAS Subject

Seymour Papert introduced computational thinking in mathematics between 1980 and 1996. At the time, it concentrated on two areas of computing: the generation of new and improved thinking and improvements to the pattern of knowledge access [24]. Wing J. M. used the term again in 2006. The new issue is that Wing used a modified Computational Thinking approach. Wing argued that computational thinking could be a helpful basic skill for problem-solving, system design, and understanding human behavior in the twenty-first century [25].

Computational thinking is a problem-solving method with a technical approach to computer science (informatics). Computational thinking requires a person to design issues that include decomposition, pattern recognition, abstraction, and algorithms, which are some of the fundamental ideas of computer science. The table below describes the outcomes of researchers' observations regarding the implementation of Computational Thinking in IPAS subjects in elementary schools.

Table 3. The Result of Observation on the Implementation of Computational Thinking in IPAS Subjects in Elementary Schools

No	Computational Thinking Indicators	The Implementation of Computational Thinking in IPAS Subject
1	Decomposition Decomposition is the first step in breaking a complex problem into smaller parts.	Students understand the material of force through simple experiments, such as the frictional force between the foot and the floor, and so on.
2	Pattern recognition Pattern recognition is the second step in the computational thinking approach, which recognizes if there is a pattern and determines its order.	The teacher allows the students to find as much information as possible from the Internet or other media to broaden the information obtained.
3	Abstraction Abstraction is the generalization of the problem by focusing on the big picture and what is important.	After students get information or general knowledge about force, the teacher then asks students to find out whether there is an effect of force on other objects and whether there are human activities that require force in everyday life.
4	Algorithms Algorithms are strategies that can be used to determine step-by-step instructions on how to solve a problem. Step on how to solve a problem	After everything the teacher asks is done, students in groups will answer and present their findings in front of the class.

According to interviews with elementary school teachers who teach IPAS subjects, the solution to the problem is based on specific materials. Furthermore, the student's problem-solving skills must be guided and directed, especially in class the fifth grade, as he stated below:

"*The problem-solving ability may not always be sufficient. The teacher must guide and assist the students. One example is in the force around us learning material, so they do not immediately seek answers on the Internet or other sources. I must direct the influence of force on direction, velocity, shape, and what activities use force*."

Applying problem-solving using the Computational Thinking approach in IPAS learning uses the available media resources and technologies. Furthermore, problem-solving requires training because fifth-grade students represent a transition from low to high grades. Problem-solving at the school level differs; for example, elementary school students are still not prepared to be invited to discuss problem-solving.

4 Conclusion

The function and objective of computational thinking is to solve problems. These issues are not limited to computer science but also extend to other areas of problem-solving. Computational thinking can teach students to solve problems structured and systematically. According to field research, applying Computational Thinking to fifth-grade students in the IPAS subject requires direction and stimulus in problem-solving. Its application to the forces around us learning material can reveal features of the CT structure, such as the breakdown of pattern recognition, abstraction, and algorithms. The learning scenario is that students are requested to assess many types of activities that occur in everyday life.

Additionally, students will outline various actions that use force. Students' response to the implementation of CT in SSI on the force around us learning material was positive, with a score of 100%. Student efforts in implementing CT in SSI received a percentage of 81.25%. This study is expected to help elementary school teachers implement CT-based learning. Further research is required to utilize CT in additional subjects fully.

References

1. S. S. Wardani, R. D. Susanti, and M. Taufik, SJME (Supremum J. Math. Educ. **6**, 1 (2022)
2. I. Muslimawati, E. M. Kafi, C. Aprinastuti, and M. Wadina, Indones. J. Elem. Educ. Teach. Innov. **2**, 72 (2023)
3. W. Susanti, S. Kom, and M. Kom, *Pembelajaran Aktif, Kreatif, Dan Mandiri Pada Mata Kuliah Algoritma Dan Pemrograman* (Samudra Biru, 2021)
4. M. Mut-Puigserver, M. Magdalena Payeras-Capellà, J. Castellà-Roca, and L. Huguet-Rotger, Appl. Comput. Inf. Technol. 135 (2018)
5. M. E. Rosadi, W. Wagino, N. Alamsyah, M. Rasyidan, and M. Y. Kurniawan, J. Solma **9**, 45 (2020)
6. G. Gadanidis, R. Cendros, L. Floyd, and I. Namukasa, Contemp. Issues Technol. Teach. Educ. **17**, 458 (2017)
7. E. Payton, J. Khubchandani, A. Thompson, and J. H. Price, J. Community Health **42**, 1118 (2017)
8. M. Tedre and P. J. Denning, in *Proc. 16th Koli Call. Int. Conf. Comput. Educ. Res.* (2016), pp. 120–129
9. M. G. Supiarmo, S. Azizah, S. Putrawangsa, and I. Sujarwo, in *Pros. SI MaNIs (Seminar Nas. Integr. Mat. Dan Nilai-Nilai Islam.* (2020), pp. 277–284

10. R. K. S. Laksono and Y. Wibowo, J. Pendidik. Sains Indones. (Indonesian J. Sci. Educ. **10**, 752 (2022)
11. I. Miranti and F. Refelita, J. Chem. Educ. Integr. **2**, 58 (n.d.)
12. M. I. Sholeh, Orbital J. Pendidik. Kim. **2**, 37 (2018)
13. R. N. Febriana, D. I. Suryani, and A. N. Taufik, J. Pendidik. MIPA **13**, 445 (2023)
14. N. Nazilah, L. K. Muharrami, I. Rosidi, and A. Y. R. Wulandari, Nat. Sci. Educ. Res. **1**, 192 (2018)
15. A. R. Putriana, J. PAJAR (Pendidikan Dan Pengajaran) **4**, 80 (2020)
16. R. D. Sari, R. Agustini, and W. Widodo, Stud. Learn. Teach. **2**, 10 (2021)
17. N. Nurdiyanti, M. Wajdi, and N. Fadhilah, JIPI (Jurnal IPA Pembelajaran IPA) **6**, 33 (2022)
18. E. Pratiwi and E. Sudibyo, J. Educ. Dev. **9**, 273 (2021)
19. P. S. Rosmana, S. Iskandar, N. W. Nengsih, R. Nafiisah, and V. I. Al-fath, Innov. J. Soc. Sci. Res. **3**, 3097 (2023)
20. S. Sartika, D. Indriani, and K. Limiansih, Innov. J. Soc. Sci. Res. **3**, 2588 (2023)
21. D. Sartina, S. Maylani, and K. Limiansih, Prima Magistra J. Ilm. Kependidikan **4**, 294 (2023)
22. U. M. Jannah, S. A. Rohmah, and F. M. Noor, Thabiea J. Nat. Sci. Teach. **2**, 45 (2019)
23. M. Imaduddin and Z. Khafidin, Thabiea J. Nat. Sci. Teach. **1**, 102 (2018)
24. F. R. Widyawati and H. Hafidz, Turots J. Pendidik. Islam **5**, 168 (2023)
25. S. Maharani, T. Nusantara, A. R. As'ari, and A. Qohar, Madiun Perpustakan Nas. Katalog Dalam Terbit. (2020)