JOIN (Jurnal Online Informatika)
Volume 6 No.1 | June 2021: 113-117
DOI: 10.15575/join.v6i1.677
p-ISSN: 2528-1682
e-ISSN: 2527-9165

The Importance of Computational Thinking to Train Structured Thinking in Problem Solving

[1]Rian Andrian, [2]Rizki Hikmawan
[1, 2]Universitas Pendidikan Indonesia, Indonesia

Article Info

Article history:

Received December 11, 2020
Revised April 08, 2021
Accepted April 15, 2021
Published June 17, 2021

Keywords:

Computational Thinking
Problem Solving
Structured Thinking

ABSTRACT

Ability to do problem solving will be greatly influenced by how the flow of thinking in decomposing a problem until it finds the root of the problem so that it can determine the best solution. There is currently a growing recognition around the world that all fields require a prerequisite ability, namely to think logically, in a structured manner, and use computational tools to rapidly model and visualize data. This ability is known as Computational Thinking (CT). In this study, the author applied the computational thinking key concept in a case study to train structured thinking in problem solving. Computational thinking key concept includes Decomposition, Pattern recognition, Abstraction, and lastly use algorithms when they design simple steps to solve problems. Based on our case study that has been model, the result shows us that Computational Thinking can be used to train structured thinking in problem solving in everyday life.

Corresponding Author:

Rian Andrian,
Department of Pendidikan Sistem Teknologi Informasi,
Universitas Pendidikan Indonesia,
Kampus Daerah Purwakarta, Indonesia.
Email: riandrian@upi.edu

1. INTRODUCTION

Various literature states that one of the skills that we must have today and in the future is Critical Thinking [1], [2] and problem solving capabilities [3]. Both skills are very closely related, in our daily activity we must be able to think critically so that we can see problems from all angles and understand how to analyze and evaluate the information they have, before making decisions to solve problems.

Ability to do problem solving will be greatly influenced by how the flow of thinking in decomposing a problem until it finds the root of the problem so that it can determine the best solution. Someone must be able to Structured thinking so that they can conduct problem mapping to decision making. Structured thinking is a process of putting a framework to an unstructured problem. Having a structure not only helps an analyst understand the problem at a macro level, it also helps by identifying areas which require deeper understanding [4], [5].

There is currently a growing recognition around the world that all fields require a prerequisite ability, namely to think logically, in a structured manner, and use computational tools to rapidly model and visualize data. This ability is known as Computational Thinking (CT) [6]–[9]. Computational thinking is the thought processes involved in formulating a problem and expressing its solution (s) in such a way that a computer human or machine can effectively carry out. Thinking like a computer scientist means more than being able to program a computer. It requires thinking at multiple levels of abstraction. Computational thinking will be a fundamental skill used by everyone by the middle of the 21st century. Just like reading, writing, and arithmetic [7], [10], [11].

Computing has made possible profound leaps of innovation and imagination as it facilitates our efforts to solve pressing problems (for example, the prevention or cure of diseases, the elimination of world hunger), and expands our understanding of ourselves as biological systems and our relationship to the world around us. These advances, in turn, drive the need for educated individuals who can bring the power of computing supported problem solving to an increasingly expanded field of endeavors [12].

2. METHOD

In this study, the author applied the computational thinking key concept in a case study. computational thinking key concept includes [7]:

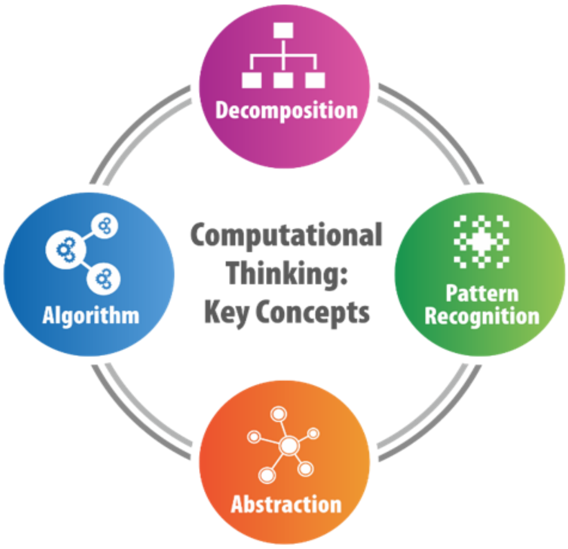

Figure 1. Computational Thinking key concepts

1. Decomposition
   Decomposition invites Us to break down complex problems into smaller, simpler problems. Decomposition is closely related to abstraction, this is a necessary step to be able to abstract these parts by selecting the most important elements, sorting them into categories, and placing them in a structured order.
2. Pattern recognition
   Pattern recognition will guide to make connections between similar problems and experience. Pattern recognition is when we identify the arrangements and relationships between parts of a data set. Pattern recognition is key to identifying causes and correlations and ultimately allows us to make predictions.
3. Abstraction
   Abstraction invites Us to identify important information while ignoring unrelated or irrelevant details. When we order the steps of a process, sort things into categories, or any other technique to simplify a complex idea or system, we are creating an abstraction.
4. Algorithms
   Lastly, we use algorithms when we design simple steps to solve problems. Furthermore, in Computational Thinking is thinking with algorithms where we think by sequencing the steps in solving the problem so that it becomes logical, sequential, orderly, and easily understood by others.

3. RESULTS AND DISCUSSION

In Indonesia today, many people misunderstand that computational thinking is a skill that must be learned by people who are experts in the field of computer programming. This point needs to be straightened out, computational Thinking is not always related to computers. We can use computational thinking techniques in everyday problems. When we are familiar with Computational Thinking, we will think more critically so that we can solve a problem properly, effectively and efficiently. So unconsciously we have implemented Computational Thinking in everyday life starting from easy things and even small things we have done with Computational Thinking.

Therefore, in this study we take a case study that exists in everyday life. Our case study in daily life is how to cook soup for the child. We will use computational thinking key concepts to resolve problems about how to cook soup for the child.

3.1. Decomposition

Decomposition is how to break down a complex problem into small problems to be solved. In making soup for children, we have to understand how to make soup, then we collect the ingredients, then we start making soup according to the steps. Here is the identification of problems in cooking soup for children:

1. What tools are needed to cook soup?
2. What ingredients are needed to cook soup for children?

From the problems that have been identified in cooking soup for children, we can decompose the problem as follows:

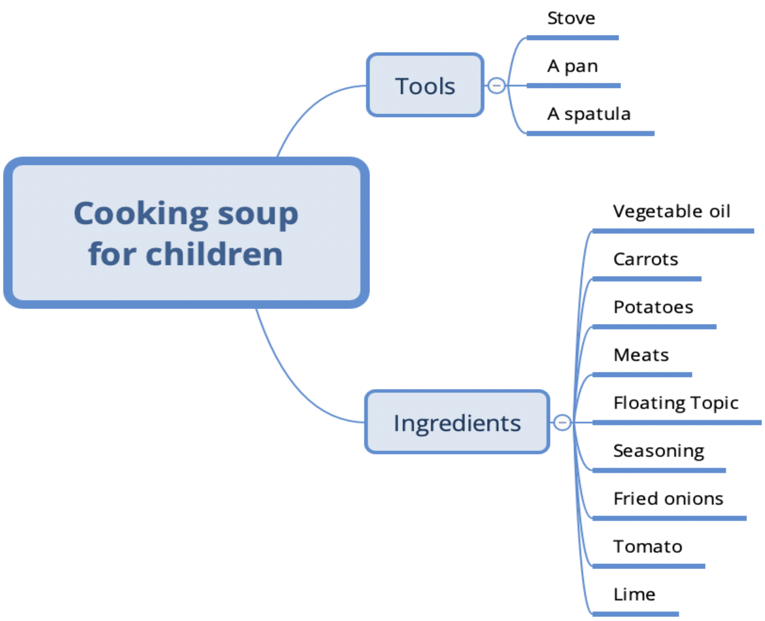

Figure 2. Problems Decomposition

3.2. Pattern recognition

Then in Computational Thinking there is what is called pattern recognition. Since we used to make soup for adults, we can also make soup for children because the process is almost the same. We can see that the patterns for making soup for adults and soup for babies are almost the same, although the ingredients are slightly different. The pattern of how to make soup is as follows:

1. Heat the water, then add the meat. Enter the spices that have been prepared. Cook until the meat is tender. If the water has shrunk too much, you can add more water.
2. After the meat is tender enough, add the carrots and potatoes. Cook until done and correct the taste. Add salt if it is not tasty.
3. Before the soup is removed from the stove, add the tomatoes.
4. Serve the meat soup with fried onions and a little lime juice.

3.3. Abstraction

Then when we make soup for our children, we don't pay attention to how the stove works, because we think it is not important. This is related to abstraction in Computational Thinking.

3.4. Algorithms

Creating algorithms is the last step to get solutions for cooking soup for children, the algorithms must sequence the steps logically, detail and start from the initial process of making it to the process of serving it. Here is our algorithm for cooking soup for children:

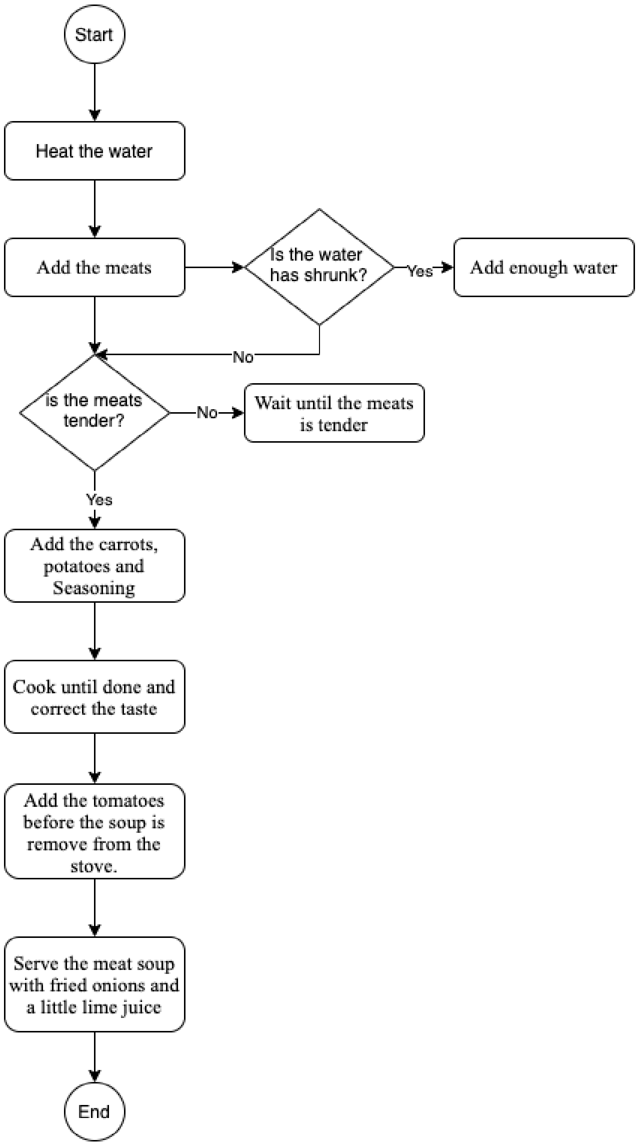

Figure 3. Algorithms for cooking soup for children

The algorithm above tells us how to make soup for children. The algorithm is obtained by applying the computational thinking method in everyday life. Based on the case studies above, we can also see that computational thinking actually exists in everyday life, not only when creating a program for computers. We believe that computational thinking can be used to train structured thinking for problem solving.

4. CONCLUSION

Ability to do problem solving will be greatly influenced by how the flow of thinking in decomposing a problem until it finds the root of the problem so that it can determine the best solution. There is currently a growing recognition around the world that all fields require a prerequisite ability, namely to think logically, in a structured manner, and use computational tools to rapidly model and visualize data. This ability is known as Computational Thinking (CT). Thinking like a computer scientist means more than being able to program a computer. It requires thinking at multiple levels of abstraction. Computational thinking will be a fundamental skill used by everyone by the middle of the 21st century. Just like reading, writing, and arithmetic. In this study, the author applied the computational thinking key concept in a case study. computational thinking key concept includes: Decomposition, Pattern recognition, Abstraction, and Algorithms. Based on our case study that has been model, the result shows us that computational thinking can be used to train structured thinking for problem solving in everyday life.

ACKNOWLEDGEMENTS

This research was supported by our colleagues from Department of Pendidikan Sistem Teknologi Informasi, Universitas Pendidikan Indonesia, Kampus Daerah Purwakarta. We also thank to Vania Natali from Universitas Katolik Parahyangan who provided insight and expertise that greatly assisted the research through a webinar that has been held by the Department of Pendidikan Sistem Teknologi Informasi, Universitas Pendidikan Indonesia, Kampus Daerah Purwakarta.

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