Exploring the computational thinking of our pre-service mathematics teachers in prepare of lesson plan

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Abstract. Computational thinking is indispensable to face the challenges of the 21st century, including education. Recently there are a lot of issues about the inclusion of computational thinking in the curriculum in Indonesia. Of course, this requires teachers in Indonesia to understand and apply computational thinking. One example of the application of computational thinking by the teacher is in preparing lesson plans. The purpose of this study is to analyze computational thinking in pre-service mathematics teachers in preparing lesson plans. Using qualitative methods, the subjects in this study were six pre-service mathematics teachers. The analysis is done by observing the steps taken by the subject in preparing lesson plans and conducting in-depth interviews to reveal the subject's computational thinking. The results revealed that generalizations were less visible in the preparation of lesson plans for pre-service mathematics teachers. Some teachers are not coherent in preparing lesson plans, due to lack of understanding of the usefulness of the lesson plans that are prepared. The findings of this study are that CT pre-service teachers can be classified into four types, namely full CT, less full CT, unfull CT, and non-CT. Suggestions or recommendations for further research are analyzing teachers who lack understanding about the preparation of the lesson plan, what the obstacles are, and how the solutions for it.

1. Introduction

Recently, the process of incorporating Computational Thinking (CT) into the curriculum has taken place in several countries. CT is an ability that every human should have. In line with [1] who states that the ability of CT is suitable or appropriate to be applied to a broad scope of various fields. CT is someone's way of solving a problem, not someone's way of thinking like a computer. CT uses logical thinking, algorithmic thinking, recursive thinking, abstraction, parallel thinking, matching patterns, and connecting processes. In the CT process, abstraction is the most important stage and is a high-level thinking process. Abstraction is used to define patterns and generalize them [2]. In other words, abstraction is a tool that enables the creation of large and complex systems of information by defining and generalizing from simple components. And vice versa, when faced with a very large and complex problem, the method used in CT is to reduce, enhance, transform, and simulate difficult problems into something that is easily solved. CT enables a person to be a more efficient problem solver by learning them to recognize computational problems and using a skilled problem-solving process approach [3].

Over the past few years, several studies have addressed CT [4]–[6]. CT is increasingly accepted in various circles which increases the motivation to direct CT into the curriculum and classroom [7]–
At this time, various fields are also exploring their connections to CT [11]–[13]. Furthermore, [6] describe CT as analytical thinking to solve problems, design systems, and understand one's behavior. The definition of CT for everyone is different from the definition of CT for scientists, engineers, and professionals [14]. CT is all about practice and increasing competence in problem-solving and the ability to formulate solutions [15], [16]. The focus of CT has shifted from being just a definition of how the CT process is in the classroom [17]. Teaching and learning in the classroom certainly cannot be separated from the learning plan prepared by the teacher. As stated by [18] that effective teachers need preparation, not only in mathematical knowledge but also with how students learn mathematics and mathematical pedagogy recommended by researchers and the professional community. Also, the latest recommendations indicate that teacher education programs should be planned around core teaching activities, such as working with students, observing lessons, analyzing lessons by identifying important aspects of lessons, preparing lesson plans, and practicing teaching [19]–[21]. The role of the learning plan is as a vehicle to control and develop learning. Analysis of the learning plan can provide insight into how the teacher understands the structure of the lesson in mathematics [22].

However, the lack of school resources for joint planning or teaching can pose challenges for the sustainability of the integrated curriculum [23], [24]. Many teachers may feel less prepared to teach in the interdisciplinary curriculum, because of the targeted scope of their education [25], [26]. Therefore, it is crucial not only to consider how unifying subjects can improve the curriculum but also practical considerations to prepare schools and teachers to implement the curriculum. Some studies suggest introducing pre-service teachers to curriculum integration during their course work as a means of increasing teacher effectiveness and confidence [27], [28].

Given the importance of the learning plan that must be prepared by the teacher, the series of steps taken by the teacher in preparing the plan must be well organized. So there is a need for research on how the process of making learning plans by the teacher. So far, there has been no research that reveals how the CT process of pre-service teachers in preparing lesson plans. It is expected that the results of this research can contribute knowledge to the wider community and may be considered by policymakers in making new policies.

2. Methodology
This research is a qualitative descriptive study. The subjects in this study were six pre-service mathematics teacher candidates. Subject selection criteria are subjects chosen based on their qualifications, namely pre-service mathematics teacher candidates. Subject selection uses purposive sampling. The instruments in this study are the researchers themselves and interview guidelines. This research begins by selecting the subject first; then, the chosen subject will be asked to make a one-semester lesson plan. The lesson plan referred to in this study is the RPP. After that, the researcher analyzes the lesson plans made by the subject. After getting the results of the analysis, the researcher conducted in-depth interviews with each subject related to the lesson plan prepared by the subject. After that, researchers reduce the data of research results. Then the researchers conclude the results of the study.

3. Result and Discussion
Some CT-related studies have been carried out, such as [15], [29]–[33]. But the results of these studies mostly discuss the theoretical framework of CT in the field of education [34], [35] and CT students when working on or solving math problems [36], [37]. In this study, the CT discussed is the CT pre-service teacher when preparing lesson plans in mathematics learning. Of the six CT subjects performed, they gave different results.

Subject IN

Some steps taken when preparing a semester learning plan include: Analyze and prepare all the needs of both the learning material and the problems faced by students in understanding each mathematics learning material in one semester. In one semester, there are several chapters of
mathematics material that students need to learn. Before the lesson plan is better prepared if all the required subject matter is prepared in advance, so the preparation of lesson plans is easier to do. Therefore she will prepare all the necessary materials in advance. From some of the material chapters, there must be some material that experiences problems when it is delivered to students. Could be, there might be material that requires media, tools, or unique methods so that the learning material provided can be well received. So she will also analyze problems that may arise and require specific solutions to mathematical content.

Examining the condition and character of students to adjust the methods and media that are appropriate to the development of students. Arranging lesson plans not only provides an interesting set of plans but also must pay attention to the conditions and character of students, related to the environment such as what is around students, do students need special solutions in participating in learning activities. But that does not mean the treatment of students must be done differently, but rather to find the results of the analysis of how the method to be carried out can be accepted as a whole.

Finding a solution to every problem that might be experienced in some or every learning material for one semester. After she analyzes problems that may or is accustomed to appear when providing learning materials and analysis of the conditions and character of students during learning activities, I try to make and arrange solutions that are appropriate to the existing problems. For example, in the material "Equality and Linear Inequality One Variable," students usually have difficulty in digesting and understanding the material well so that they need space for discussion with classmates and friends in groups to be able to open up and think critically.

Sorting the material so that students will study for one semester. After preparing the material and finding solutions that might arise during the learning process, I will sort the material starting from the material that must be given at the first meeting, the second until the end, according to the applicable curriculum. IN writes down the class identity that she teaches. Develop lesson plans by beginning to write the class identity that I teach. The intended identities include the name of the school, subject, class/semester, time allocation.

Develop Competency Standards, Basic Competencies, and Indicators. Develop minimum competency standards or competencies that are expected to be achieved in one semester, basic competencies or competencies that must be mastered by students in mathematics material taught and indicators that are measurable characteristics or evidence that students have reached basic competencies, so they can serve as a reference for the ongoing implementation of the learning process. By setting competency standards, basic competencies, and indicators, it can be used as a reference in the sustainability of the preparation of the RPP and the sustainability of the learning activities process.

Write down the learning objectives. Where this goal is about changes in student behavior that is expected after being given mathematics learning at odd grade 7th junior high school. Learning objectives on each material discussed are different, adapted to the material to be studied, and the needs of students. For example, in the material "Equation and Inequality of One Variable Linear," the goal of students to learn the material is that one of them is students can apply the linear equation and inequality of one variable to problems in daily life. Compile the learning material used for learning activities. The learning material is expected to be by the applicable curriculum and be able to open students' insights. This material is in accordance with the material prepared previously, which was discussed in point 1.

Write down the right learning method. Learning methods are arranged and adapted to the character of students in receiving learning. Each material may require different methods of conveying to students. Develop learning media that is appropriate and following the ability of students towards how to receive the material. Choosing and preparing learning media in the hope that they can make it easier for teachers and students in the learning process. She chooses learning media that are practical and easy to use besides being effective to facilitate students in understanding the material. For example, the material "Set" uses colored drawing media to make it easier for students to understand the set's perspective.
Write down learning resources that can be used or accessed by students to support their learning abilities. Learning resources can be in the form of objects, images, or tools/materials used for learning activities. The learning resources that I used to compile this lesson plan were student handbooks, other similar reference books, and the internet. Or students can learn from books or other references that can support students' knowledge. Make a scenario or plan of learning steps that will be carried out in the learning process. In the form of the initial, core, and closing activities. I can write the initial activity in the form of a brief introduction about the content of learning materials, the relationship between learning materials with the daily lives of students, and explanations about instructional activities that students must pay attention to during learning activities. I can arrange the core activities by writing down the material I will teach, examples, and some practice questions that students will do. Then the closing activity can be in the form of a follow-up between the teacher and students. Write down evaluations, assessments. This assessment can be in the form of student worksheets (written tests) or oral examinations. Where in this assessment the purpose is knowing. After the first material lesson is complete, I will compile the lesson plan for the second material and so on until the lesson plan for the last content.

Subject RA

Analyze and prepare all the needs of both the learning material and the problems faced by students in understanding each mathematics learning material in one semester. Then, analyzing the condition and character of students in general to adjust the methods and media that are appropriate to the development of students. Prepare and sort the material that students will study for one semester.

Start compiling the lesson plans in sequence, starting from preparing the lesson plans for the first meeting, continued with the second meeting, then continued until the last meeting. Arrange lesson plans by beginning to write the class identity that she teach. Paying attention and writing competency standards, fundamental competencies, and indicators that can be used as a reference for the continuity of the learning process. Define and write learning objectives. Where this goal is about changes in student behavior that is expected after being given mathematics learning at odd grade 7th junior high school. Compile material used for learning activities. Choosing the right learning method, adapted to the character of students in receiving knowledge. Prepare and use appropriate learning media and following students' abilities in how to receive the material. With the hope of using learning media can further facilitate teachers and students in the learning process.

Creating and writing scenarios or plans of learning steps to be carried out in the learning process. In the form of the initial, core, and closing activities. With expectations When the implementation of learning takes place, learning can be carried out mature.

Subject HN

Adjust everything that is arranged in the learning plan is following the needs of students. HN writes down the class identity that she teaches. Pay attention to and write competency standards, fundamental competencies, and indicators that can be used as a reference for the sustainability of the learning process. Determine learning objectives. Where this goal is about the expected behavior of students after being given mathematics learning. Prepare material used for learning activities. Choosing the right learning method, following the character of students in receiving knowledge. Prepare and use appropriate learning media and following students' abilities in how to receive the material. With the hope of using learning media can further facilitate teachers and students in the learning process.

Include learning resources that can be used or accessed by students to support their learning abilities. Creating and writing scenarios or plans of learning steps to be carried out in the learning process. In the form of the initial, core, and closing activities.
Subject HI

See the syllabus issued by the government as a reference for learning. Annual and semester programs compile yearly programs such as middle test, final test, which are adjusted to the academic calendar. Selecting material and improving effective learning models if done in class. Arranging RPP according to the applicable regulations.

Subject EF

First, EF looks at the latest RPP references, to adjust the types of learning models that are suitable for use with technology collaboration, look for material references, practice questions, learning media to be applied. Compile RPP following the predetermined constituent components, namely RPP identity, Core Competencies, Basic Competencies, Learning Indicators, Steps "learning, learning media, learning resources, assessment techniques."

Subject TA

When making lesson plans one semester, he searched with the help of the internet to find lesson plans that were readily available on the internet and compiled with a few changes. He also used the RPP of other teacher with same subject to teaching.

4. Discussion

Subjects with the initial IN do CT quite well. Decomposition is done by simplifying complex problems into simpler problems, namely dividing several analyzes. In line with [38] which suggests that decomposition is done by breaking down / simplifying tasks into smaller parts to form well-managed parts. Supported by [39] that complex problems need to be broken down into subproblems to be solved more effectively. The analysis includes analysis of learning materials and difficulties faced by students, analysis of methods and learning media that are appropriate to the character of students, determine the suitable lesson plan format, create learning scenarios, create questions for learning assessment. When analyzing learning material and problems faced by students, IN performs abstraction by ignoring student problems that are not related to learning material. To find out students' issues, the subject IN conducted observations and interviews with their students. The generalization carried out by IN is by making a lesson plan in the same format as the first lesson plan it made. In compiling the lesson plan, IN carries out a series of steps, starting from the beginning to the last. The activities carried out are algorithmic. Supported by [39], Algorithms always start with the specified starting point and endpoint specified, and the problem solver determines the set of steps that need to be followed to start from start to finish. However, IN takes one unnecessary step, namely the step of making lesson plans for the second material and so on. He realized this and immediately confirmed his answer. IN activity is debugging.

Subject RA and HN, decomposition is done by analyzing learning material in one semester, preparing learning media, and the RPP format. This analysis is needed because it is difficult to improve the ability of teachers to be more effective without being able to analyze student learning [19]. Abstraction has not been seen in the activities carried out by these two subjects. They compile RPP for the next material to adjust to the RPP made previously. It shows that both teachers made generalizations. The steps taken by the two are still not in order; there are activities that should be done first instead of being done at the end. It causes the preparation of lesson plans to be longer. For example, learning material should be prepared before making lesson plans, so that learning activities will be evident in the scenario created by the teacher. So it appears that algorithmic is not done well. Both of these teachers did not conduct learning evaluations. So debugging also does not appear when they are compiling RPP. Subject HI and EF are less communicative in the interview process, and decomposition is less clear, the steps taken in preparing lesson plans are based on the internet as a reference source. Abstraction is entirely invisible for these three teachers, so generalizations are also
very minimal. The three teachers admitted that they did not understand in preparing the lesson plans. Subjects TA do not do CT at all because they draw up their lesson plans only by downloading them from the internet or using their fellow teacher's lesson plans. It is following [40] who states that several pre-service teachers still have some problems in preparing their lesson plans.

Teachers are also needed to do CT in their learning to teach CT to a mathematics class. However, for most teachers, they have not done CT because they are still confused about what is needed in CT [41]. It can be minimized because the understanding of computational thinking, pedagogical abilities, technological knowledge, and teacher confidence can be improved in a relatively short time through professional learning [32].

5. Conclusion
Based on the results and discussion, the researcher examines and expresses the conclusion that teachers with high or full CT, carry out a complete CT process including decomposition, abstraction, generalization, algorithmic, and debugging. Generalization is less obvious because the process carried out is an activity to compile a series of learning scenarios, not the process of solving mathematical problems. In contrast, the teacher with unfull CT is doing the CT process only partially or incompletely, namely abstraction and algorithmic, which is less visible and does not do the debugging process. Teachers with low CT do the CT process very minimally, which is only a simple and algorithmic decomposition which is not ordered as well. Non-CT teachers are teachers who only prepare lesson plans by downloading lesson plans that are already available on the internet. That is due to the lack of teacher knowledge in terms of making learning plans.

The findings of this study are that CT pre-service teachers can be classified into four types, namely full CT, less full CT, unfull CT, and non-CT. Full CT is the teacher who does the five CT processes in preparing lesson plans, namely decomposition, abstraction, generalization, algorithmic, and debugging. The less full CT is a teacher who does only a partial CT process, which is only three to four steps. In research, only decomposition, generalization, and algorithmic. The unfull CT is a teacher who only takes one or two CT steps. In this study, the teacher only decomposes and is algorithmic. Non-CT teachers are teachers who do not do the CT process at all, i.e., they only download lesson plans from the internet. Suggestions or recommendations for further research are analyzing teachers who lack understanding about the preparation of the lesson plan, what the obstacles are, and how the solutions for it.

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