Computational thinking digital media to improve digital literacy

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Abstract. Computational Thinking (CT) has been defined as an important skill that supports digital literacy in the industrial revolution 4.0. Computational Thinking contained in the informatics curriculum is classified as local content for several formal schools. Four key techniques (cornerstones) to Computational Thinking consist of abstraction, algorithm, decomposition and pattern recognition, are very important in the processes involved in formulating problems and the solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent. The research started by analysis, design, development, implementation and evaluation in series and give each other feedback to create an interactive learning media. The subjects of this study were students of grade IV and V of elementary school as great starting point for starting digital literacy as early as possible. Data collection techniques in this study are by observation, questionnaire, pre-test and post-test. The data analysis technique used was calculating the percentage of feasibility from the results of the questionnaire. The result is the use of CT learning media able to improve student’s understanding of CT in problem solving. The respondents could find the concept by themselves, analogically they can apply to similar problem. This is evidenced by the result of the post-test in similar questions from the pre-test. The respondents finally learnt how computer works, and this is important as basic creativity to improve digital literacy.

1. Introduction

A gadget has variety of diverse application features, it is like a double-edged knife that has many functions, but also potential to endanger the user, especially for the younger. A number of children who access the game and social media features even experience mental disorders due to addiction to devices in the mild to acute level. This is very possible due to the absence of assistance to children in adapting to very intense technological developments. The introduction of technology as a part of digital literacy through the subjects of Information and Communication Technology (ICT) is limited just using the applications. Giving provision of ICT should not only be on how to use it wisely. Computational thinking gives knowledge that builds critical power and creativity by learning the computing process itself. For future reason improving people digital literacy, computational thinking must be taught in formal education,
not just for as local content (especially in developing countries). The important thing is that computational thinking acts as the main base of an ICT Learning Building, as shown in figure 1. Computational Thinking is very important as digital literacy as a person's initial capital to interact with digital devices and its applications. One does not need to learn in depth about programming or coding, but it is very important to be able to learn how logic works as a critical power to overcome problems. The use of digital applications will be easier if someone understands how it works and its implications.

![Figure 1. ICT Learning Building](image)

Initially in 1080 Seymour Papert was credited as concretizing Computational Thought, then began to be popularized by Wing In 2006 and brought it to the attention of the international community, more research has been done on CT in education. Breakthrough technology has not fully increase Indonesian human index at the international level (United Nations Development Program, 2018). According to the behavior today, the younger are very addicted in using their gadgets. And so that education, both, devices and applications, hardware – software have not shown interrelated and supportive effort to gain some advantages of the technology, people only become consumers. There needs to be assistance in the use of ICT facilities, through data, technology and digital literacy. In general, learning ICT has to face the real one, the hardware. Due to this specific practical reason, gadget including the smartphone and tablet could be bought in affordable prices and it becomes semi-primary need nowadays. Beside it is a communication device, it contains of a lot of user needs, so it is vary in user age range.

In the previous curriculum, ICT was only about using word processors and graphics, so people have a poor understanding of what a computing career involves [1] and some other future works that will expand their competencies. In developing countries Indonesia digital literacy, is still need to be improved. Not all the people realize that this is very important, including in XXI future skills [2]. Digital literacy was introduced as ICT curriculum known as informatics in formal education. Although the government has rearranged the informatics as part of the curriculum, the implementation in school is still slow in response. Many schools do not have sufficient teacher whom computer science background to teach informatics at the general level including kindergarten, elementary school, junior high school and senior high school, in cities and even in rural area. In people’s opinion, ICT is new paradigm called informatics which has complicated sub-subject like programming. They have not realized yet the important of ICT learning through informatics which not only about programming and algorithm. Informatics-computational thinking in computer science is very interesting in some way of teaching it. Even in some countries such as US, UK, Scotland, German [3]–[9], ICT is very crucial in its own curriculum as in STEM-C (Science, Technology, Engineering, Mathematics and Computer). STEM teaching is equipped with computational
thinking skills, using ICT. It is very important to provide assistance to introduce digital technology that build the ICT application.

Computational Thinking is the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent [10-12]. Computational Thinking (CT) is one method of approach in the learning process. CT does not have an important role in developing ICT applications, but CT can also be used to support problem solving in all disciplines, including the humanities, mathematics and science. Students who study where CT is applied in the curriculum (learning process) can begin to see and compare the relationships between subjects, and between life inside and outside the classroom. Computational thinking is a problem-solving technique that is very broad in the area of its application, so having this ability is a must for someone who lived in the twenty-first century. Like playing music and learning foreign languages, Computational Thinking trains the brain to get used to proceed logically, structured, creative and reasonable. This is the main thing to build cognitive capacity, skill and smart attitude to be able to survive and sustain in the future.

CT is actually not a new thing and cannot only be applied in an ICT environment. This critical-analytical ability can be applied to various other sciences. ICT education as a form of community digital literacy enrichment is still done partially on the hardware and its use, so it is often hampered by the reason that infrastructure does not support. Though CT can be taught even without having to rely on the availability of infrastructure. Viewed from the minimum number of participants and the results that were not optimal from all elementary school (SD) participants to High School Levels throughout Indonesia who participated in the CT competition (Bebras Challenge 2018). The Bebras Challenge is organized by Bebras Indonesia as one of the community initiatives engaged in the CT field. This competition was attended by 1561 participants with an average value of 32.09 while for the maximum value that could be achieved was 100 (www.bebras.org). This competition is followed by 3 categories, namely Standby for Elementary (Primary) equivalent, Raisers for Middle School (Junior High School) equivalent and Enforcement for High School (High School) and the equivalent. Based on this matter, the socialization of CT to educational institutions is considered still far from expectations.

From the description above, this study aims to create a CT learning media through digital games that are expected to become media that can introduce CT to students who are also expected to improve digital literacy in students. Providing interesting learning media alternatives in the form of theory and problem to train the critical thinking and mapping problems with CT concepts for the best solution.

2. Methodology

This learning media development model uses the ADDIE development model. According to Benny A. Pribadi (2009: 125) explains there are 5 stages in the ADDIE development model, Analysis (Analysis), Design (Design), Development (Development), Implementation (Implementation), and Evaluation (Evaluation). The analysis start from the user requirements, as shown in Figure 2 as Use Case. The
computational thinking learning media provides learning content about abstraction, algorithm, decomposition and pattern recognition.

Learning material that is compiled consists of simple learning materials that are equipped with examples of problems and solutions. Storyboard and Activity Diagrams are designed as a benchmark in designing using Construct2. After all before being tested on users, the media must go through validation tests by material experts and media experts the feasibility of media by the media and material expert. The media expert test has given overall result on the average on 81.25% which is included in the very decent category, meaning that this learning media is an efficient appearance, where technical errors in the media are very few and easy to use. So it permitted to the next test. While the score of the material test are 75% and 80.05% for learning and content aspect in order.

3. Result and discussion
The respondent of this study were student of K-10 of elementary school. Some instruments were used to gain the data including questionnaires, pre-test and post-test. The questionnaires, given to students, was the SUS (System Usability Scale) questionnaire developed by John Brooke [13], that consisting of 10 items of questions that use a 5 point Likert scale in the form of strongly disagree to strongly agree.

Figure 3, 4, 5 and 6 represent the content of the learning media, which can be accessed randomly by the user, do not have to be sequential. Abstraction takes the example of the name of a famous tourist destination in Indonesia, namely Wakatobi, which turned out to be a series of 4 islands (Wangi-Wangi, Kaledupa, Tomia and Binongko).

Algorithm elements are introduced through sequential processes in serving typical food in the form of fried rice. In the production process a cook must prepare ingredients and equipment, process them in sequence so as to produce the ordered food. The order from the initial state, process and final state is an algorithm which developed a step-by-step solution to the problem, or the rules to follow to solve the problem. While on the decomposition, the rule is breaking down a complex problem or system into smaller, more manageable parts, as shown on Figure 3 which mapping some schedules into well organized.
Figure 4. Theory of algorithm of fried rice receipt

Figure 5. (a) Theory of decomposition; (b) Problem of decomposition

Figure 6. Theory of algorithm of fried rice receipt

Talking about pattern recognition is about looking for similarities among and within problems that might be drive to the alike solution.

Comparison of Learning Outcomes taken from the value of the pre test and post test given to respondents from elementary school students with processing time of 20 minutes each. The results of the pre test was on the average on of 74.28 and the post test scored is 83.57. It means that student learning
outcomes use computational thinking learning media higher than before. While from the SUS test gained the average score of 70.0 that it can be said that the SUS score is in the Marginal High or Good category.

4. Conclusion
Based on the results of media testing and material testing conducted, computational thinking learning media is appropriate to be tested delivered to respondents. The results of the pre-test and post-test students showed an increase in the value of the test results which indicated the learning media was able to improve students’ understanding on CT which was expected to be able to increase student’s digital literacy levels.

Acknowledgements
The authors would like to express my very great appreciation to Universitas Muhammadiyah Surakarta for allowing the authors to conduct the research, and special thanks for everyone who contributed in this study especially to the Bebras Community, students of Al Azhar Syifa Budi Elementary School in Surakarta and the editors for the constructive criticism and suggestions.

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