Computational Thinking and Coding for Kids Training for Elementary School Teachers

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ABSTRACT

Computational thinking and coding are thinking skills that are recently expected to be acquired by elementary school children as the era of the industrial revolution 4.0 requires students to be familiar with the use of technology. In some developed countries, the two skills have been included in elementary school curriculum. However, the situation is different in the context of Indonesia since teachers or instructors who are able to provide these skills are inadequate. Therefore, this training was intended to socialize and educate the application of coding and computational thinking, especially to elementary school teachers so that they have the ability to equip their students with those skills. The participants of this training were teachers of Labschool UPI Purwakarta. The training was conducted in one day containing the concepts and practices of ICT and computational thinking as well as coding for kids. The result of satisfaction questionnaire distributed to the participants after the training shows a good level of satisfaction in terms of training materials, delivery of materials, and the usefulness of activities as much as 71,4%, 57,1% and 92,9% consecutively. The teachers hope that follow-up trainings are carried out to increase their knowledge and ability in developing technology-based learning.

Keywords: *children, coding for kids, computational thinking, elementary school*

1. INTRODUCTION

The characteristics of learning that appear in the digital era of the 21st century require the academic community to adapt to technology development, create ideas, interact as well as collaborate in social matters by looking at various aspects that will be applied. Responding to the situation, Indonesian Minister of Education and Culture, Nadiem Makarim, introduces the 4C Policy standing for Collaboration, Communication, Critical thinking, and Creativity. This policy is also strengthened with computational thinking slogan, which has begun to be discoursed and planned to be implemented in Indonesian education system starting from elementary schools, junior high schools, to senior high schools. This is in line with **(Mgova, 2018)** which clearly states that in the 21st century, problem solving skills combined with computational thinking skills such as problem formulation, decomposition, algorithms, pattern recognition and abstraction thinking skills are important.

Computational thinking is a term related to the practices of problem-solving skills by reasoning and analysis. Basically, computational thinking is not only related to computers, but also to concepts and thought processes that are used to support problem solving in multidisciplinary sciences. Computational thinking skills also refer to the skills of direct problem solving actions through systematic steps **(Danoebroto & Listiani, n.d.)**. Related to this, the ability to solve problems needs to be trained from an early age so that children are trained and proficient in solving problems. Therefore, teaching computational thinking skills is critical to facilitate children developing their problem-solving skills.

The process of understanding computational thinking in children especially in K-12 is complex, requiring systemic change, teacher involvement, and significant resource development. To make it easier, collaboration with the computer science education community is critical to this effort **(Barr & Stephenson, 2011)**. Moreover, computational thinking can be taught since the elementary school level by making connections to a subject or by providing examples of solving simple problems found in daily activities **(Rosadi et al., 2020)**.

The integration of computational thinking in education is important as it offers various benefits, namely: 1) improving students' analytical thinking skills; 2) allowing students to have a better understanding of programming, that the goal is to solve problems and not just about code; 3) improving students' views on programming and boosting their self-confidence; and 4) having the possibility to be used as a clear indicator of academic success, this is because computational thinking scores have a strong correlation with academic success in general **(Lockwood & Mooney, 2017).** In addition, computational thinking also encourages children to be active and able to independently solve their various problems.

One of the efforts to improve computational thinking is to teach coding for kids. Case studies on the use of coding for children especially using ScratchJr provide an impact in creating a framework to support children's exploration of computational thinking and development of computer science skills **(Sullivan & Bers, 2019).** Seeing its importance, in Singapore the coding for fun program has become a compulsory subject taught to elementary school students with additional learning materials on artificial intelligence and cybersecurity **(Lady et al., 2021; Franedya, 2019)**. This is different from what is in Indonesia, where materials on coding for kids and computational thinking are only taught in non-formal education institutions such as after school courses. Even then, it is limited to big cities. All those make coding for kids and computational thinking less popular. Added to the mentioned problems is the limited human resources as mentioned by **(Fajri & Utomo, 2019)** on the lack of teachers or instructors who can provide these skills to students.

So, the question that arises is how to teach coding to children? Of course, the treatment of teaching coding for children is different from teaching adults. Children need to be stimulated in a fun way and fortunately, learning programming languages can now be learned easily and with fun **(Sandy, 2020).**

There are several stages where each has its own target to make children interested in learning programming. When starting to learn coding, children do not need to be introduced directly to the real programming language. At the introduction stage, children learn basic algorithms (problem solving steps) before they finally learn to use tools in coding. Children is also introduced to basic programming concepts such as sequences, loops, or conditional concepts in fun and age-appropriate activities. Other approach in teaching coding to children is in the introduction stage, they learn basic algorithms by making simple animations, then in the next stage they learn transformation so that the characters in games look more interesting. Finally, children learn how to make more interactive functions from these characters so that in the end they can make the games they want **(Permatasari, 2020; Yu et al., 2020).**

Based on the previously mentioned explanation, there is a need for socialization, education, and training in implementing learning computational thinking and coding for kids to Indonesian teachers. Therefore, the training was carried out to meet the need. The prospective participants of the training were pre-service teachers as it was hoped that these young teachers could become models and agents in implementing the method of teaching computational thinking and coding for kids in any elementary school they taught.

2. METHODS

Basically, there are certainly differences in teaching computational thinking and coding for kids between to elementary school teachers and to students majoring in Information and Communication Technology. Teaching computational thinking and coding for kids to elementary school teachers should be packaged as attractively as possible so that it is easy for them to teach what they learn in the training to elementary school students.
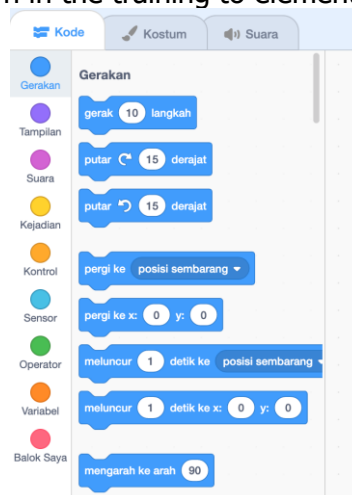
Figure 1. Command code block in Scratch

This Community Service Program is intended to be a kind of Training of Trainers (ToT) of which participants are going to teach coding for kids and computational thinking later on to elementary school students. Therefore, the participants of the program were young teachers at the Laboratory School of Universitas Pendidikan Indonesia, Purwakarta Campus. They were

chosen because they are young teachers, so it is easier for them to understand programming and have better ICT literacy. The Laboratory School was chosen as it is a pilot school of the university and the COVID-19 pandemic was still in progress. Throughout this program, the participants were given two one-day trainings which included the practices of introducing and packaging coding and computational thinking for kids. Moreover, the participants were also given knowledge of how to introduce those two things above to children. In addition, the participants were also given introductory materials on ICT literacy & security awareness.

Broadly speaking, the implementation of this community service program was carried out in two stages as follows: (a) In the preparation stage, which coincided with the Covid-19 outbreak, the Community Services team had to plan the right implementation method to stay safe and avoid the emergence of new clusters. To do so, the workshop was then carried out in a form of blended learning, where the offline meeting was attended by a maximum limit of 50% of the total room capacity, which is only 10 people, and online opening ceremony in form of webinar that was attended by any person who wished to know the workshop such as elementary school teachers in Purwakarta Regency, parents, and prospective students. The workshop activities were carried out by implementing COVID-19 health protocols such as requiring participants to wear masks and have their body temperatures checked; and (b) the implementation was carried out in two events, namely online and offline. The offline workshop was carried out in one day on September 3rd, 2021 at the Computer Lab Lt. II UPI Purwakarta Campus, attended by 8 participants from the UPI Purwakarta Laboratory Elementary School. Meanwhile, the online activity was held on September 4th, 2021 using Zoom application.

3. RESULTS AND DISCUSSION

The next stage after preparation is implementation. The activity was carried out in one day on September 3rd, 2021 at the Computer Lab Lt. II UPI Purwakarta Campus. The workshop was attended by 8 participants and started from checking the participants' body temperatures by the committee with a maximum temperature tolerance of 36^0C. When the participants met the temperature qualifications, then they registered by filling out the attendance list and getting ID cards as well as seminar kits. The implementation of registration used a queue system with a distance of 1 meter between the participants. Then they were directed to enter the room guided by the committee according to the place that had been arranged. When all participants were seated, the workshop was opened with a direct speech of the Director of UPI Purwakarta Campus, Prof. Turmudi M.Ed., M.Sc., Ph.D, and online a direct speech of the Head of PGSD Study Program Dr. Hafiziani Eka Putri., M. Pd as shown in figure 2.

Figure 2. Documentation of the opening ceremony: Opening speech from the Director of UPI Purwakarta and the Head of the PGSD Study Program

Furthermore, the provision of the first material with the topic of ICT literacy and security awareness in children was delivered by Nuur Wachid Abdulmajid. S.Pd., M.Pd as shown in figure 3.

Figure 3. Documentation of ICT literacy and *security awareness* material.

In the second session, the material was given by the chief executive, Dewi Indriati Hadi Putri. S.Pd., M.T with the topic of the benefits of training coding and computational thinking in children as shown in figure 4.

Figure 4. Documentation of the benefits of teaching coding and computational thinking in children material.

Figure 5. Exploration session of coding for kids.

The third session was providing coding practice materials to children using a scratch application guided by Taufik Ridwan. S.T., M.T and continued with the exploration session which was followed enthusiastically by the participants. In this session, the participants made

programming for children using simple programming languages, namely the code blocks which is available in the scratch application tools. The best participants who made the program were given a module prize by the committee as shown in figure 5.

The last activity was filling out questionnaires to get the participants' responses to the activities. The activity was closed by the chief executive, Dewi Indriati Hadi Putri. S.Pd, MT. followed by a group photo session and the distribution of the certificates as shown in figure 6.

Figure 6. Photo session with attendance.

The online implementation started from the virtual background design stage and preparation for the zoom meeting (figure 7 and 8). For the material, it was still the same as offline activities which consisted of 3 materials, namely ICT literacy and security awareness, the benefits of training coding and computational thinking in children, and coding practicum for kids using the scratch application.

Figure 7. Virtual background for webinar.

Figure 8. Online attendances.

To find out the responses of the participants to the workshop activities, the next step was to give a questionnaire as an evaluation before the last session (a group photo session). Through the questionnaire form, two types of data were obtained, namely qualitative data and quantitative data. In the questionnaire there are 8 questions whose answers contained numbers to indicate the scale of approval of the statements on the questionnaire starting from a scale of 1 to 4 with criteria from poor to very good. The questionnaire covered two main aspects, namely the presenters and the implementation of the training. Quantitative data was processed by calculating the percentage using equation 1 as follow.

$$\frac{Obtained\ value}{Maximum\ value}\ x\ 100........[1]$$

The number of participants are 8 people so that the maximum score obtained is 32 or a maximum percentage of 100% if all participants answer on a scale of 4. While the value obtained depends on the participants' entries. If all participants give a score of 1, the lowest

number is 8 or a minimum percentage of 25%. Based on this, the difference between the maximum percentage and the minimum percentage is 75%.

Community service team uses a Likert scale of 1 to 4, thus the interval class is also divided into four levels. The interval value obtained is 18.75% with the following calculation: (75%)/4 . The results of the conversion as well as the level of satisfaction are shown in Table 1.

**Table 1. The level of participants' satisfaction to workshop implementation**

No	Percentage range	Description
1.	81,26% - 100%	Very good
2.	62,51% - 81,25%	Good
3.	43,76% - 62,50%	Fair enough
4.	25,00% - 43,75%	Not good

Based on these criteria and obtained data on the questionnaire and then processed using equation 1, the results obtained are graphs as shown in Figure 9 and Figure 10.
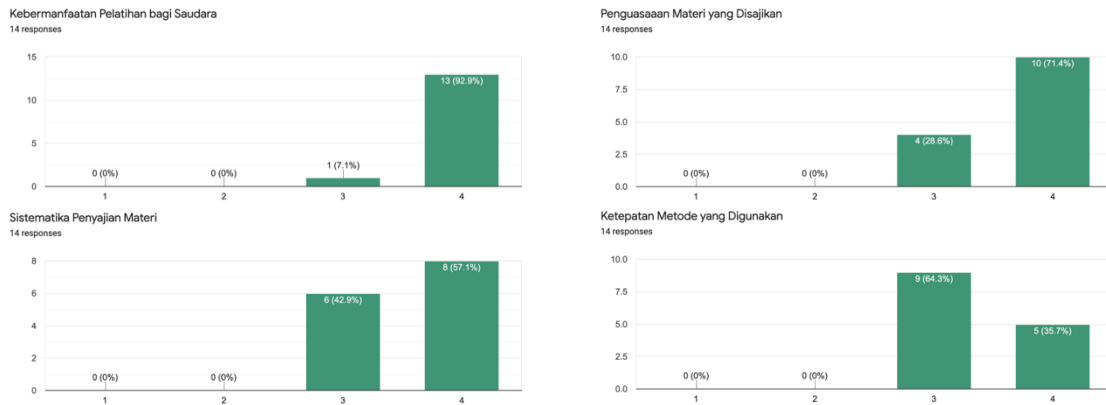
Figure 9. Community service questionnaire results.

Based on the results of the questionnaire in Figure 9, it was found that the majority of participants chose a scale of 3 and 4. Then participants were given other questions to fill out. The results for the follow-up questionnaire are shown in figure 10.
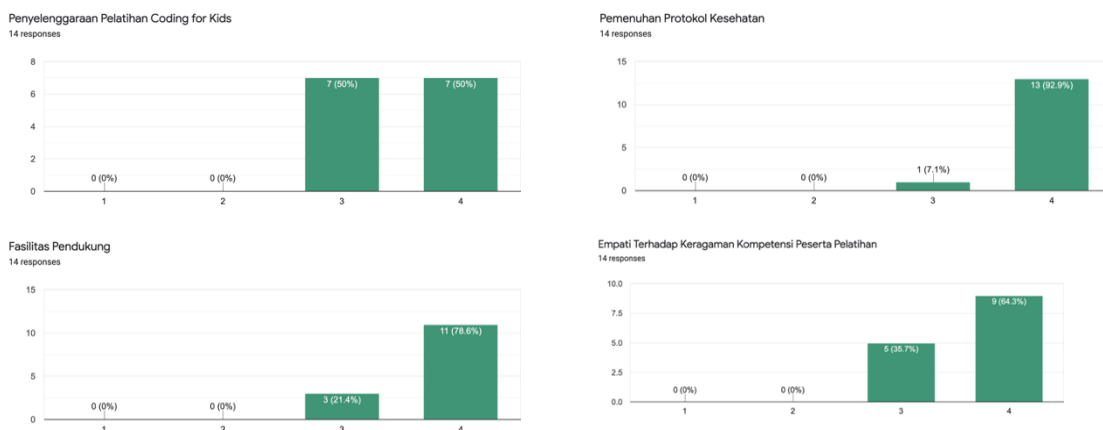
Figure 10. Community service continuation questionnaire results

Qualitative data obtained from participants' answers in the form of essays filled with suggestions in order to improve the implementation of similar workshops in the future. Figure

11 is an excerpt from the responses written by the participants regarding consumption, the friendliness of the committee, the affordability of the workshop venue and facilities:

Figure 11. Participants' responses to the workshop activities

Other results regarding responses to coding and computational thinking materials can be seen below (figure 12 and 13).
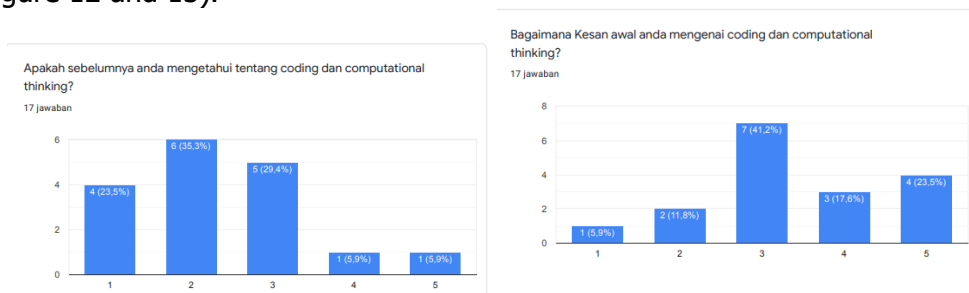

Figure 12. Initial response of participants before training/workshop.

Furthermore, participants were asked about how they felt after participating in the material in this training. The answers from the participants both offline and online are as follows:
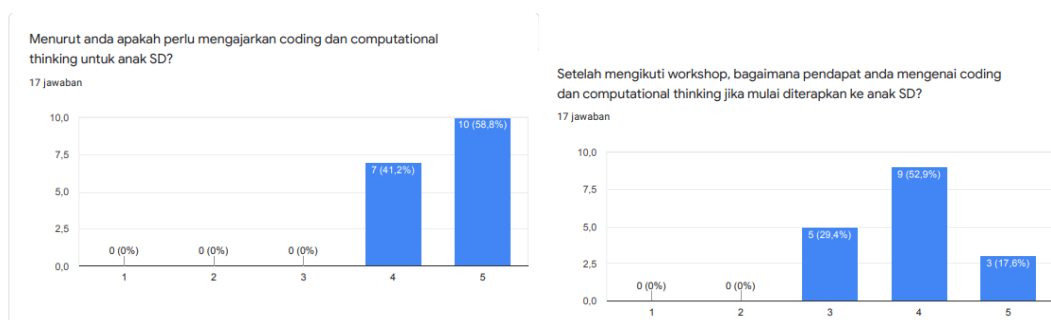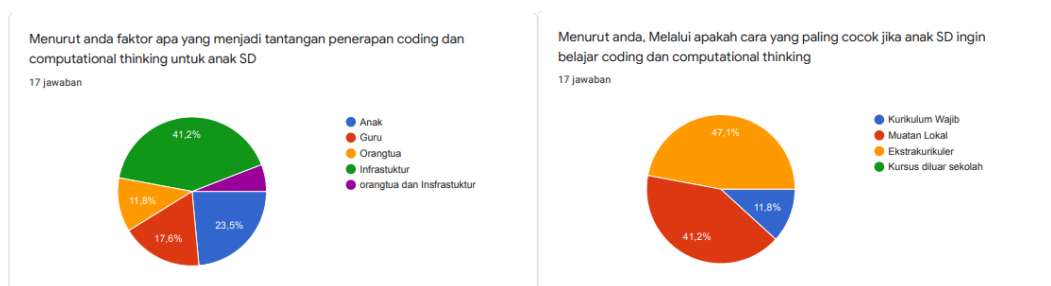

Figure 13. Participants' responses after the training/workshop.

Furthermore, participants were asked about the factors that challenge the implementation of coding for kids and computational thinking and what methods are suitable in teaching those to children. The result is as in Figure 14.

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Figure 14. Percentage of responses to opportunities and application of computational thinking

Overall, the participants' suggestions are to give positive feedbacks to Community Services team, for example the need for more time allocation for the implementation of activities, and the continuity of collaboration with the UPI Purwakarta Laboratory Elementary School in the future in creating technology-based learning media innovations. Based on the given questionnaire, participants understand the presented materials well and will apply them in classroom learning. Regarding these suggestions, the community service team realizes that during this pandemic the committee is obliged to limit the implementation time according to the covid 19 health protocol. In the future, it is hoped that similar workshop activities can be carried out even better in terms of material and techniques. The collaboration between UPI Purwakarta and Labschool UPI Purwakarta will continue to improve the quality of teachers in the labschool.

4. CONCLUSIONS

The implementation of the Community Service raised topics related to coding for kids and computational thinking training for children as well as understanding ICT literacy. These two things are very important, because online learning conditions more often require the application of technology in every activity. To be more effective in applying online learning in technology, children can improve their skills in using technology.

In this training, there are several suggestions from participants, namely to provide positive things to community service implementers, for example the need for more time allocation for the implementation of activities, the existence of continuous collaboration with SD Laboratorium UPI Purwakarta in the future in creating technology-based learning media innovations. Regarding these suggestions, the community service team realizes that during this pandemic the committee is obliged to limit the implementation time according to the covid 19 health protocol. In the future, it is hoped that similar training activities can be carried out even better in terms of material and technical.

ACKNOWLEDGEMENTS

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