International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Introducing Coding to Primary Students

Ni Made Dwijayani

Institut Teknologi dan Bisnis STIKOM Bali, Indonesia, 0000-0002-7408-2948, nimade_dwijayani[at]stikom-bali.ac.id
Corresponding author's institutional address: Jl. Raya Puputan No. 86 Renon - Denpasar, Indonesia

Authorship Contribution Statement

Ni Made Dwijayani: Conceptualization, Design, Analysis, Writing And Editing

Abstract: ***The application of coding usually involves computers and is carried out on students in high school or college. Basically, the concept of coding can be introduced to students since they are still in elementary school and without using a computer. Teachers can use teaching materials that are around students, one of which is Cepuk cloth from Nusa Penida. This research was conducted activity to students as an after-school activity. The data were collected by using observation, interviews and questionnaires. Data on student responses to the applied learning were collected at the end of the meeting using a questionnaire consisting of 20 statements. The average score obtained through the student response questionnaire was 3.37. In addition to collecting data on the practicality of worksheets, the results of the questionnaire also show that the use of worksheets can be accepted as learning outside of school. This can be seen from the results of student responses to statements numbered 15 to 20 who agreed and strongly agreed as much as 95.98%.***

Keywords: Cepuk, coding, mathematics

1.Introduction

The need to prepare students for work with skills in science, technology, engineering, and mathematics (STEM) is increasing and, in particular, computer science (National Research Council [NRC], 2012). Technology that provides easy access to information also has a huge impact on students being able to think and act creatively in solving problems (Jahnke & Liebscher, 2020). However, the development of education in Indonesia using technology has not been evenly distributed considering that Indonesia is an archipelagic country so it is still difficult to reach isolated areas (Syamsuar & Refliantor, 2018). Apart from geographical factors, another factor that greatly supports the use of technology in education is teacher competence. In fact, there are still many teachers who have not met the pedagogical competence to achieve the expected learning objectives (Purnasari & Sadewo, 2020). One of the inhibiting factors is the limitations of teachers in accessing information about technological developments. Various technologies, such as dynamic and interactive media, can be used as additional features in a student activity sheet. In this context, technology provides added value for student activity sheets, namely as an addition to the content explanation space (Pepin et al., 2017). In other words, the technology can be used to introduce or explain a particular topic more deeply, dynamically, and interactively. For example, learning about coding or coding.

Conventional thinking is more likely to focus on children who are interested in coding should develop strong math skills. However, it turns out that the opposite may also be true, coding can help children build math skills and make math learning more interesting and fun.

Embedding computational thinking practices in mathematics and science curricula, teaching, and assessment provides opportunities to better prepare students as creative and critical thinkers to meet future needs in the workforce (Grover & Pea, 2013). For students to prepare for successful careers, they need to go beyond a fact-focused math and science curriculum in each area. Teachers must be prepared for a multidisciplinary approach that combines mathematics, computing, and science to succeed in today's STEM fields.

Apart from the above, cultural introduction to students must also be carried out. The combination of learning that involves culture and coding in mathematics learning will certainly be something new for teachers and students. It is undeniable, applications and learning resources based on technology, information and education Communication (ICT) and internet-based are proven to be able to enrich the learning process and have a positive impact on students, one of which is in terms of increasing creativity, motivation and learning outcomes (C. S. Lin & Wu, 2016; M. H. Lin et al., 2017; Suson, 2019). The definition of coding is the process of testing, writing and improving code in forming a good program. Some examples of coding languages are PHP, C++, Java, HTML, VB, Javascript, C#, Objective-C, Python and ActionScript. One of the mathematical skills that must be possessed to understand coding is mathematical logic. The simplest mathematical logic is implication (if, then). This is the basis for running a program. Someone who wants to run a program using code must know what causes the program to produce the correct output.

The application of coding usually involves computers and is carried out on students in high school or college. Basically, the concept of coding can be introduced to students since they are still in elementary school and without using a computer. Teachers can use teaching materials that are around students, one of which is Cepuk cloth from Nusa Penida.

Previous research shows that the use of Cepuk cloth in mathematics learning provides benefits to students, namely 1) students find the concept of shifting and reflection on their own, 2) reduce students' perceptions that mathematics is only an abstract formula, and 3) foster

students' self-confidence that mathematics is close to mathematics. with his life (Dwijayani, 2020). The results of this study indicate that applying ethnomathematics in learning gives positive results to students.

Ethnomathematics itself is a way of expressing mathematical ideas based on thought and practice based on culture/daily life used by certain groups (Ajmain, 2020). Learning using an ethnomathematical approach implies that mathematics learning is based on or influenced by culture as the basis for students to understand mathematics more clearly (Heryan, 2018). In this study, the ethnomathematics in question is the typical Cepuk cloth of Nusa Penida which has the concept of pattern and flat geometry that is suitable for learning at the elementary school level. The purpose of this research is to develop a learning process that has previously been carried out using the concept of e-learning ethnomathematics on Cepuk cloth and combining it with the concept of coding (if, then). One of the concepts that can be used is the concept of determining the pattern.

The pattern of repeating colors on Cepuk cloth can be used as material for making worksheets in this study. For example, the Cepuk cloth used previously had four colors, namely red, yellow, white and blue. If students are given the premise that the four color patterns are repeated sequentially. When students are asked the color of the pattern made now is a yellow color pattern, then the student can determine the next color pattern. If the difficulty level of the question is increased, for example "If the current color pattern is white, then the third pattern after that is ...". In addition to answering questions with words, students are also given the opportunity to draw patterns related to flat shapes, namely kites. Learning about color patterns is of course still using the concept of shift/translation carried out in previous studies.

Based on the results of previous studies, it is necessary to carry out further research using the concept of Cepuk cloth in collaboration with the use of basic coding concepts for elementary school students.

2.Methodology

Research Design

This research is a descriptive study with a case study approach that aims to provide an overall picture (Nassaji, 2015) related to the introduction of ethnomathematical-based coding on Cepuk cloth obtained from student responses and compiling a related concept as an after-school activity in mathematics lessons at SDN 4 Dauh Puri.

The first focus of this research was carried out by collecting data by means of observation, interviews and questionnaires. The subjects observed were fourth grade students at SDN 4 Dauh Puri. The data collected from this research is how to arrange activities after formal learning that links the basic concepts of coding with mathematical concepts contained in the Cepuk Kurung cloth. There are several concepts that will be observed such as the concept of flat shapes, geometric transformations, and patterns.

Quantitative research was carried out after obtaining information related to student responses after getting to know ethnomathematics-based coding on Cepuk cloth. The concept is applied to the fourth-grade students of SDN 4 Dauh Puri. The subject was chosen because the mathematical concepts introduced by coding and ethnomathematics were in accordance with the learning topics in class IV. The purpose of this quantitative study was to obtain student response scores related to the introduction of ethnomathematical-based coding on Cepuk cloth. Data obtained using a questionnaire instrument given to students after participating in activities outside school hours using the concept of coding recognition.

The student response data were analyzed descriptively, namely by calculating the average student response score ($\overline{X}$) with the following formula.

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where :

$\overline{X}$ = average student response score

X_i = student response score

= number of students

Student responses, the opinions of students and teachers were categorized into four, namely strongly agree (score 4), agree (score 3), disagree (score 2), and strongly disagree (score 1). The average student response score is determined by adding up the scores for each statement in the questionnaire and then determining the average.

Sample and Data Collection

The data obtained in this study are qualitative and quantitative data in the form of observations, interviews and questionnaires for fourth grade students related to the concept of repeating patterns and flat shapes. The data is then analyzed so that conclusions can be drawn regarding the use of coding on Cepuk cloth as an ethnomathematical method in learning mathematics.

The type of data generated in this study is primary data obtained from observations, interviews and questionnaires. There are three techniques used in collecting research data, namely observation, interviews and questionnaires. The respondents in collecting data that support this research are fourth grade students at SDN 4 Dauh Puri and three class teachers who have taught fourth grade.

Analyzing of Data

Data analysis technique is the most decisive step of a research, because data analysis serves to conclude the

research results. Data analysis can be done through the following stages:

1. Research Stage

a. Planning

At this stage the activities carried out are as follows:

- The researcher designs the class to be sampled.
- Researchers make research instruments that will be used for research.

b. Implementation

At this stage the activities carried out are as follows:

- Researchers carry out learning on the research sample.
- Researchers try out, analyze and define research instruments.

c. Evaluation

At this stage, the researcher analyzes and processes the data that has been collected using a predetermined method.

d. Preparation of reports

At this stage, the activities carried out are compiling and reporting research results.

2. Research Instruments

The instruments used in this study were observation sheets, interview questions and questionnaires. The procedures carried out in the preparation of this instrument are as follows.

a. Planning

The planning stage was carried out by researchers and classroom teachers. At this stage, it is determined the subject matter under study and the questionnaire used. In addition, researchers and teachers also designed worksheets that were used by students as after school activities which were carried out every Tuesday and Friday.

b. Making Questionnaires and Worksheets

The making of questionnaires and worksheets was carried out by researchers based on the plans that had been made.

c. Research Implementation

The study began by observing the school environment and conducting interviews with classroom teachers and several students related to learning using ethnomathematical concepts. After completing the observations and interviews, the data obtained were used as material for discussion with the class teacher to prepare student worksheets. After the worksheets are arranged according to the agreement of the researcher and the class teacher, the worksheets are distributed to students to be done voluntarily because this worksheet is an additional activity outside of classroom learning. In four meetings by working on worksheets, students were asked to respond to the activities they had done. The results of student responses are then used as material for the implementation of learning on a large scale (several levels) and further research. The practicality category of the worksheet is calculated based on the practicality data in the previous stage of research using the criteria in table 1 below.

Table 1: Worksheet Practicality Criteria

Score	Criteria
$3,5 \leq Pr \leq 4,0$	Very High (Very Practical)
$2,5 \leq Pr < 3,5$	Height (Practical)
$1,5 \leq Pr < 2,5$	Enough (Less Practical)
$1,00 \leq Pr < 1,5$	Less (Very Impractical)

The worksheets in this study must at least reach the high category, which is in the range $2,5 \leq Pr < 3,5$ of scores to be declared practical and can be used in classroom learning. The table above is a table of practicality criteria compiled in previous studies.

3.Findings / Results

Data on student responses to the applied learning were collected at the end of the meeting using a questionnaire consisting of 20 statements. The average score obtained through the student response questionnaire is 3.37. By using the practicality criteria given in previous studies, it can be stated that the introduction of coding using the pattern concept on Cepuk cloth is in the Practical category because the average is in the 2.5≤Sr<3.5 interval according to table 1.

In addition to collecting data on the practicality of worksheets, the results of the questionnaire also show that the use of worksheets can be accepted as learning outside of school. This can be seen from the results of student responses to statements numbered 15 to 20 who agreed and strongly agreed as much as 95.98%.

In the suggestion section, there are students who state their reasons for not agreeing to use the worksheet. Among them were some students who stated that they were not really interested in learning mathematics and some students stated that it was difficult to understand learning if it was not explained directly by the teacher. Regarding students' responses to the use of Cepuk cloth, the researchers tried to provide several solutions. First, in limited face-to-face learning activities, the teacher brings a cloth with a Cepuk motif so that students feel more real with the content on the worksheet. Related to students' interest in learning mathematics, teachers and researchers are still discussing more interesting learning methods so that students do not feel burdened when learning. Figure 1 is a screenshot of the student's response.

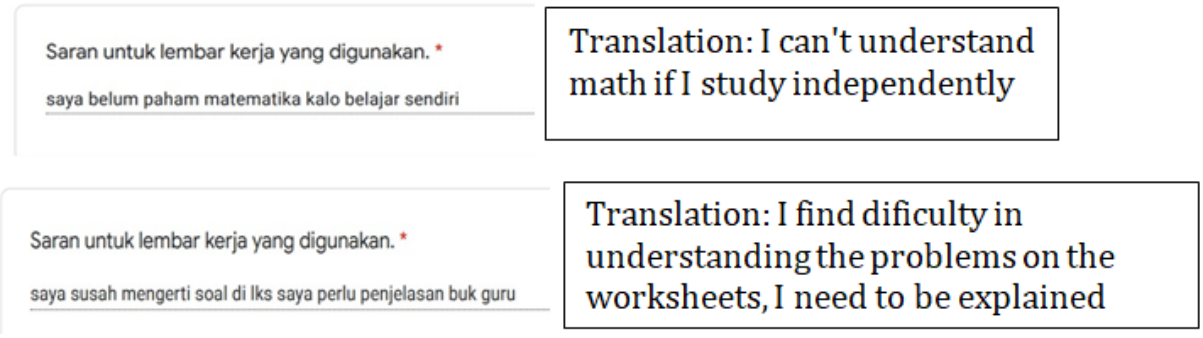

Figure 1: Student's responses

The implementation of this research begins by providing opportunities for students to pay attention to the worksheets that have been given by the researcher. On the worksheet, there are several questions that students can answer along with the reasons. Take a look at the pattern made by Cepuk fabric craftsmen below.

Figure 2: Kain Cepuk as question material

Transcript 1: Example of Communication Between Students (S) and Researchers (R)

[1] R : If the craftsman will print a pattern from the Cepuk cloth above, with the color that
appears first color is red, then the next color printed is...
[2] S1 : Blue color, ma'am..
[3] R : Very good, why is it blue?
[4] S1 : Because from the picture seen after the red color is blue.
[5] R : That's right. Are there alternative answers?
[6] S2 : Me (while raising hand). White, ma'am.
[7] R : Why is it white?
[8] S2 : Because if you look from right to left, after red is white, ma'am.
[9] R : Okay, very good.

The other question was like this: "The craftsman will create a new color pattern for a Cepuk cloth which consists of 4 colors, namely black, red, green, and blue. The craftsman wants black to always appear side by side with red, green is always between blue and red. What is the result of the coloring of the Cepuk cloth?"

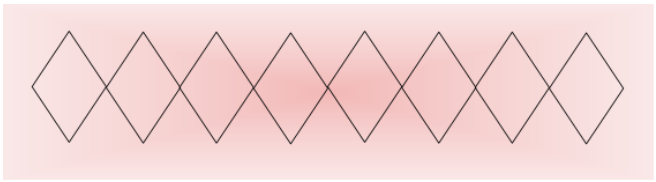

Figure 3: Picture the Cepuk fabric pattern in question

Some of student's responses are seen below.

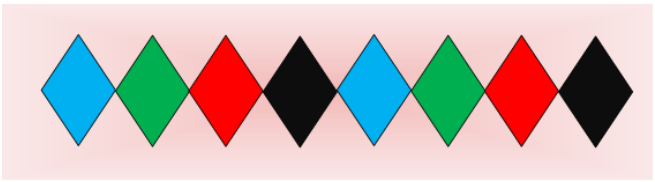

Figure 4: Student's Response (S3)

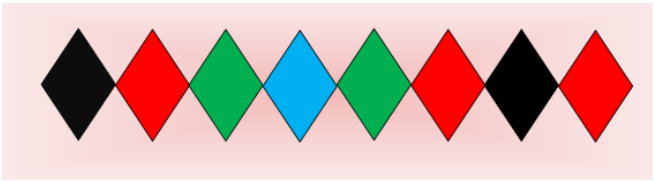

Figure 5: Student's response (S4)

4.Discussion

From the results presented, it can be observed that learning activities using the concept of coding are practically in the very practical category. Although there were many external factors in this study, considering that researchers were not fully able to monitor student behavior during home learning, there were some interesting findings that could be considered as supporting factors for the results obtained.

The main characteristics of the learning carried out are the provision of questions to initiate the introduction of concepts and the bridge between the previous concept and the concept to be studied as well as the opportunity to carry out multi-directional interactions during learning. This can be seen in the interactions in Transcript 1. In several previous studies, prompting questions played a large role in optimizing the learner's concept construction process (Haviger & Vojkůvková, 2015).

In addition to problem formulation and limited guidance through prompting questions, the key to the successful introduction of this coding concept lies in the multi-directional interactions that occur between researchers

and students as well as between students. This is interesting because based on previous research, classical learning that takes place face-to-face, multi-way interaction is known to have a major impact on learning activities and outcomes (Shan et al., 2014). Usually this form of interaction will be optimal if it is supported by the application of social normal and directed mathematical social norms, for example by sorting the results of the discussion from the simplest answers to the most complex answers (Güven & Dede, 2017). This is also done in this study. Students are given simple questions first and then followed by more complex questions. As can be seen in Figure 4 and Figure 5.

The question in Figure 3 contains 2 conditions, namely, red is always side by side with black and green is always between red and blue. In Figure 4 it can be seen that students started coloring with blue then continued with green and red. This is in accordance with the second condition. Then students continue to color it with black. The goal of the student is to use the first condition, where red always coexists with black. However, the next pattern is a repetition of the blue, green, red, black color pattern. This causes black to coexist with blue. The results of this S4 answer indicate that students are still not able to fully understand the requirements of the questions given. If it is associated with coding, it will certainly make an output error in the printing process. Logic is closely related to the ability to understand questions. Understanding concepts that are not supported by the ability to think logically will give good intuition to students in understanding concepts but not in solving problems (Ahmar, A.S. et al, 2018).

The answer of the S4 student in Figure 5 shows that the student started with black, red, green, blue. From this color pattern, it can be seen that students have met the first and second requirements. Then the next pattern is green, red and black. When viewed as a whole, the patterns made are black, red, green, blue, green, red, black. Students' answers indicate that the output obtained from the condition of the question is correct. From this result, it can be said that the students' mathematical logic is very good. If analyzed, students are able to apply the commutative law, because in the question it is stated that the green color must always be between red and blue. But there is a pattern that puts green in between blue and red. Students are already aware of the meaning of the word "between". Then for the first requirement, students already understand the concept of "side by side". So black can appear before or after red.

These varied student answers provide opportunities for students whose answers are different or who do not understand the requirements of the questions to learn about understanding. Students' mathematical logic skills can be continuously honed by applying the concept of coding in several learning materials. Previous research has shown that the introduction of programming to students showed positive impacts towards student's logical thinking enhancements (Othman, et all, 2015). The introduction of coding to students can encouraging creativity and problem solving (Siegle, 2017).

5.Conclusion

The introduction of coding to students can help students to practice enhancing their logic and understanding the context of a problem. This can be achieved because students are given questions in order of difficulty. In addition, the introduction of coding also helps students to communicate better with other people such as teachers and other students.

6.Recommendations

The introduction of coding should be done since elementary school age. The activity can be started by asking students questions related to sequence, pattern, and repetition. Coding introduction activities can be carried out as a light after school activity and are not mandatory for students to do. At the end of the activity, there can be a sharing session with all students regarding their impressions of answering the coding worksheet.

7.Limitations

The limitation of this coding recognition lies in the variety of students' abilities in solving problems, so that in the future teachers or other researchers must really understand students' abilities and compose content that is in accordance with the learning topics that students have or are currently studying. This will make students more interested in learning. However, mentoring by teachers is still very much needed because this research involves elementary school students.

References

[1] Ajmain, Herna & Sitti Inaya Masrura. (2020). Implementasi Pendekatan Etnomatematika dalam Pembelajaran Matematika, SIGMA (Suara Intelektual Gaya Matematika), 12 (1), 45-54.
[2] Ansari Saleh Ahmar et al 2018 J. Phys.: Conf. Ser. 1028 012167.
[3] Dwijayani, N M. (2021). Mathematical concepts using Kain Cepuk Nusa Penida. J. Phys.: Conf. Ser. 1918 042066.
[4] Grover, S., & Pea, R. (2013). Computational thinking in K-12 a review of the state of the field. Educational Researcher, 42(1), 38-43.
[5] Güven, N. D., & Dede, Y. (2017). Examining social and sociomathematical norms in different classroom microcultures: Mathematics teacher education perspective. Kuram ve Uygulamada Egitim Bilimleri, 17(1), 265-292. https://doi.org/10.12738/estp.2017.1.0383.
[6] Haviger, J., & Vojkůvková, I. (2015). The Van Hiele levels at Czech secondary schools. Procedia - Social and Behavioral Sciences, 171, 912-918.HTTPS://DOI.ORG/10.1016/J.SBSPRO.2015.01.209.
[7] Jahnke, I., & Liebscher, J. (2020). Three types of integrated course designs for using mobile technologies to support creativity in higher education.

Computers & Education, 146, 103782. https://doi.org/10.1016/j.compedu.2019.103782

[8] Lin, C. S., & Wu, R. W. (2016). Effects of web-based creative thinking teaching on students' creativity and learning outcome. Eurasia Journal of Mathematics, Science and Technology Education, 12(6), 1675-1684. https://doi.org/10.12973/eurasia.2016.1558a.

[9] Lin, M. H., Chen, H. C., & Liu, K. S. (2017). A study of the effects of digital learning on learning motivation and learning outcome. Eurasia Journal of Mathematics, Science and Technology Education, 13(7), 3553-3564. https://doi.org/10.12973/eurasia.2017.00744a

[10] Nassaji, H. (2015). Qualitative and descriptive research: Data type versus data analysis. Language Teaching Research, 19(2), 129-132. https://doi.org/10.1177/1362168815572747.

[11] National Research Council. (2012). A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. The National Academies Press

[12] Othman, Mahfudzah & Mohd Ekhsan, Hawa & Osman, Mohd & Hamid, Jiwa & Muhd Zain, Nurzaid & Jamaluddin, Muhammad Nabil Fikri & Mazlan, Umi & Jan, Nora & Ahmad, Hanisah. (2015). Enhancing Logical Thinking and Reasoning Skills Through Collaborative Learning in Programming.

[13] Pepin, B., Choppin, J., Ruthven, K., & Sinclair, N. (2017). Digital curriculum resources in mathematics education: foundations for change. ZDM, 49(5), 645-661. https://doi.org/10.1007/s11858-017-0879-z

[14] Purnasari, P. D. & Sadewo, Y. D., 2020. Perbaikan Kualitas Pembelajaran Melalui Pelatihan Pemilihan Model Pembelajaran dan Pemanfaatan Media Ajar di Sekolah Dasar Wilayah Perbatasan. Jurnal Publikasi Pendidikan, 10(2), pp. 125-132.

[15] Siegle, Del. (2017). Technology: Encouraging Creativity and Problem Solving Through Coding. Sage Journal, 40(2), 117-123. https://doi.org/10.1177/1076217517690861

[16] Suson, R. L. (2019). 21st Century Instruction: Accelerating students outcome in. International Journal of Education, Learning and Development, 7(6), 24-29.

[17] Syamsuar & Refliantor, 2018. Pendidikan dan Tantangan Pembelajaran Berbasis Teknologi Informasi di Era Revolusi Industri 4.0. E-Tech, 6(2), pp. 1-13.