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COMPUTATIONAL THINKING WITH AN OPEN-ENDED APPROACH USING INTERACTIVE POWERPOINT MEDIA: AN EXPERIMENT IN ELEMENTARY SCHOOLS

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Abstract

In terms of self-efficacy, the goal of this study was to examine and explain the computational thinking abilities of elementary school pupils who used an open-ended method using interactive PowerPoint media on statistical data. A quantitative methodology with a 3 x 2 factorial design was utilized in the investigation. The participants in this study were 4th-grade children from two distinct classes, each with 28 pupils. Statistics is the main subject, with diagramming as a sub-topic. The findings revealed that students who were taught using an open-ended approach with interactive PowerPoint media had different computational thinking abilities than those who were taught using a shuttered strategy. This is because students who receive an open-ended approach to learning can plan and solve problems based on their interests and thinking patterns, and they are also able to create diagrams using personal computers, making them pleased. Other findings suggest that pupils with high, medium, and low levels of self-efficacy have different computational thinking abilities. This is because students who have a high level of self-efficacy have more prior knowledge than students in other categories. The final finding demonstrates that self-efficacy and gaining computational thinking abilities have no connection. This study may be valuable in providing information about some learning and media that may be used to help people improve their computational thinking abilities.

Keywords: Computational thinking, Elementary students, Interactive PowerPoint, Open-ended approach, Self-efficacy, Statistics in elementary school.

1. Introduction

Computational thinking is a fundamental ability that everyone in the world uses in the twenty-first century. Computational thinking abilities can help with issue solving and are a necessary talent for success in the twenty-first century [1]. Because later pupils will enter the professional sector, it is critical to introduce computational thinking into mathematics education [2-4]. Understanding problem solvers with suitable descriptions, reasoning at various levels of abstraction, and finding automatic answers are all examples of computational thinking [5]. Computational thinking is a cognitive talent that allows educators to identify patterns, break down large problems into simple steps, arrange and design a series of procedures to find solutions and simulate data representations. Computational thinking is a learning strategy that plays a significant role in the development of a computer application, but it may also be used to help students solve problems in mathematics [4, 6, 7].

Mathematics is a branch of science that has a significant impact on pupils, hence it is studied at all levels of education [8]. Many students, however, believe that mathematics is a difficult topic, and as a result, their enthusiasm for learning it declines. This computational thinking talent is anticipated to aid students in tackling complex mathematical problems and boost their enthusiasm for learning mathematics. Computational thinking can be defined as a method of identifying, assessing, and applying effective and efficient solutions to issues. Computational thinking abilities, then, are the abilities to effectively answer an issue. Statistics is one of the maths materials that pupils must study in elementary school. Statistics gives students hands-on experience with the value of information and how it is presented. Furthermore, statistics in primary schools aim to help kids develop a strong literacy foundation [9].

Students will choose a solution based on their thinking process, which is known as self-efficacy while determining the solution. Self-efficacy is a person's belief in his talents, that he can do something or overcome a situation. Self-efficacy is defined as a person's conviction in his or her capacity or competence to complete a task, achieve goals, or overcome barriers and issues [10-12]. Use an open-ended approach to learning to acquire an effective solution in mathematics. The open-ended approach to learning is a way of teaching that begins with students being presented with a problem that has more than one correct method or answer. This is comparable to the notion of the open-ended approach proposed, which is a method of teaching in which the teacher presents students with a problem situation for which they can find solutions or answers in a variety of ways [13].

The development of the Covid-19 virus has had an impact on changing habits in a variety of industries, including education. The introduction of the learning-from-home policy transformed the traditional classroom learning system into a virtual or online learning system that could be completed at home [14, 15]. Technology can be used as a solution in distant learning in cases like this. Interactive power-points are one type of instructional medium that can be utilized in scenarios like these [16-18]. The purpose of interactive PowerPoint is to create interactive teaching materials by mixing different learning elements such as audio, video, text, or graphics, all of which are interactive, i.e. producing cause and effect [15].

The purpose of this study was to analyse and describe the computational thinking abilities of elementary school students who obtained an open-ended approach with interactive PowerPoint media on statistical material in terms of self-efficacy. The novelty of this study is to analyse the effect of an open-ended approach assisted by interactive PowerPoint media on computational thinking abilities in elementary schools, analyse differences in elementary school students' computational thinking based on self-efficacy levels, and analyse the interaction between learning and self-efficacy levels on computational thinking abilities.

2. Method

The researcher employed a Factorial Design 3 x 3 study design. In this study, there are two independent variables: learning and self-efficacy level. Students are separated into two groups when it comes to learning those who receive an open-ended approach and those who receive a scientific approach. In the meantime, students' self-efficacy is categorized into three categories: high, medium, and poor. The following are the 3 x 2 factorial designs used in research on computational thinking skill scores. The research was carried out through several stages.

The participants in this study were all fourth-grade pupils in Bandung's elementary schools during the academic year 2021/2022. The study was conducted on two study groups in a Bandung elementary school. Purposive sampling was used to choose schools because the chosen study groups were thought to be representative of the learning design to be implemented, and they had two parallel classes that matched the study's design. Thus, there were similarities in characteristics between one class group and the next. There are 28 students in each class, resulting in a total of 56 students.

The information gathered in this study is about computational thinking abilities and self-efficacy. These data are collected using a variety of ways, including test and non-test methods. The test method is used to gather data on computational thinking abilities. Meanwhile, data on students' self-efficacy was collected using the non-test technique. The exam questions for computational thinking abilities come in the form of a description of ten problems. The questions are prepared by first creating a question grid, then organizing questions with alternate answer keys and scoring guidelines for each item. Table 1 presents the indicators used in the matter of computational thinking ability.

Table 1. Computational Thinking Skill Instruments.

Indicator	Description
Decomposition	The ability to break complex problems into small or simple parts that are easier to understand and solve
Generalization	Ability to formulate solutions in general terms. Thus, they can be applied to different problems
Abstraction	Achievement targets that students have when learning mathematics
Algorithm	Ability to design a series of operations/actions step by step (step by step) on how to solve a problem
Debugging	Ability to identify, delete and fix errors

The self-efficacy questionnaire was developed to categorize students' self-efficacy levels. The questionnaire was developed based on a grid of indicators described in the operational definition of self-efficacy. In this study, operational self-efficacy is described as a student's self-assessment of confidence in their mathematical abilities to organize or take action to solve certain mathematical problems. In Table 2, the indicators used in the self-efficacy questionnaire in this study are presented.

Table 2. Self-efficacy indicator.

Indicator	Description
Beliefs	Students' confidence in their mathematical abilities
Choice of Activity	Choice of actions taken when facing mathematical problems
Goals	Achievement targets that students have when learning mathematics
Effort	The effort given by students in dealing with and solving mathematical problems
Persistence	Resilience and persistence in dealing with and solving mathematical problems
Interest	Student interest in mathematics subject

In this study, descriptive statistics and inferential statistics are used to analyse the data. The data from the pre-test and post-test findings of computational thinking skills were analysed using this descriptive statistical analysis technique. The mean, standard deviation, and range are all calculated using this method. The study hypothesis is tested using the inferential statistical analysis technique. The Two-Way ANOVA test was used to test the research hypotheses that resulted from this investigation.

3. Results and Discussion

3.1. Overview of computational thinking ability based on research

Table 3 explains the description of computational thinking skills for students who have received learning with an open-ended approach assisted by interactive and scientific PowerPoint media. Furthermore, it describes the description of computational thinking ability seen from the level of self-efficacy.

Table 3. Descriptive statistics computational thinking.

Class	Self-efficacy	Mean	Std. Deviation	N
Open Ended Approach	Low	68.13	2,588	8
	Medium	75.83	4.174	12
	High	86.25	3536	8
	Total	76.61	7.824	28
Scientific Approach	Low	56.88	2,588	8
	Medium	68.33	4.924	12
	High	78.13	2,588	8
	Total	67.86	8,968	28
Total	Low	62.50	6.325	16
	Medium	72.08	5.882	24
	High	82.19	5.154	16
	Total	72.23	9,435	56

Table 3 shows that students who receive learning using an open ended approach have a computational thinking ability of 76.61 with a standard deviation of 7.824, which is higher than the average computational thinking ability of students who receive learning using a scientific approach that only uses a scientific approach. The average score was 67.86, with a standard deviation of. Students with high levels of self-efficacy have the highest average score of 82.19, which is 10 points more than those with medium levels, who have an average of 72.08, and students with low levels only have an average of 72.08. The average computational reasoning ability score is 62.50.

According to the score's description, learning with an open-ended approach and PowerPoint media can help with computational thinking skills. Students are not coerced to study since the open-ended method allows them to establish plans for completion from a context based on their own lines of thinking [19, 20]. In the meantime, interactive PowerPoint media allows students to create diagrams in a creative and engaging way [21].

3.2. The differences in the acquisition of students' computational thinking abilities

According to descriptive statistics, students who receive open-ended approach learning have a greater average computational thinking capacity than students who receive scientific learning, however this must be demonstrated using an average exam. Table 4 displays the findings of the average test output using the two-way ANOVA test with learning and self-efficacy as independent variables.

Table 4. Output ANOVA two way.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4209.524a	5	841,905	61.322	0.000
Intercept	281937.565	1	281937.565	20535.665	0.000
class	1083.398	1	1083,398	78.912	0.000
SE	3101.711	2	1550.856	112.961	0.000
Class * SE	35.938	2	17.969	1.309	0.279

With the research hypothesis (H1) that there are variations in the computational thinking capacity of students who receive open-ended approach and scientific learning, Table 4 in the class or learning row shows a significance of 0.000 and the score is smaller than = 0.05, H1 is accepted. As a result, it may be argued that pupils who receive an open-ended approach to learning and those who receive scientific learning have different computational thinking abilities.

Students who are taught utilizing an open-ended method using interactive PowerPoint media are better able to carry out the reasoning process according to their mindsets [17, 18, 22]. As a result, students with different thinking styles and different sorts of prior knowledge are better able to learn [23-25]. Furthermore, interactive PowerPoint media is extremely ideal for students' interests since there are components of technology that are presented in learning; thus students are excited about learning because the media utilized has established a productive disposition [25]. Furthermore, students' activities include creating bar charts using PowerPoint and preparing presentations based on the diagrams they have created.

Mathematical action activities are critical for expanding pupils' knowledge and ensuring that information is retained in long-term memory.

Furthermore, with the research hypothesis (H1) that there are variations in students' computational thinking abilities in terms of self-efficacy, Table 4 in row SE or self-efficacy indicates a significance of 0.000 and the score is smaller than = 0.05, H1 is accepted. As a result, disparities in students' computational thinking abilities in terms of self-efficacy might be deduced. Table 5 also reveals the differences in computational thinking abilities between groups to establish which group has the best computational thinking ability.

Table 5. Post-hoc output based on self-efficacy.

(I) SE	(J) SE	Mean Difference (IJ)	Std. Error	Sig.
High	Medium	10.10*	1.196	0.000
	Low	19.69*	1,310	0.000
Medium	High	-10.10*	1.196	0.000
	Low	9.58*	1.196	0.000
Low	High	-19.69*	1,310	0.000
	Medium	-9.58*	1.196	0.000

Table 5 reveals that all significance is 0.000, which is less than = 0.05, for post-hoc based on self-efficacy. Based on the amount of self-efficacy, it may be determined that there are variances in computational thinking abilities. The mean difference score can be used to identify whether the group is more. The mean difference between the high and medium groups is 10.10, indicating that the high group outperforms the medium, and the mean difference between the high and low groups is 19.69, indicating that the high group outperforms the low group. The mean difference between the medium and low groups is 9.58, indicating that the medium group outperforms the low. As a result, it may be stated that pupils with high self-efficacy scores are the most successful.

Self-efficacy is very significant in learning since it has an impact on learning success [26]. Self-efficacy aids in the development of positive attitudes and learning motivation in students. Self-efficacy also makes kids independent and gives them a lot of fighting power when it comes to tackling challenges [27, 28].

3.3. Interaction of learning approach and Self-efficacy

Table 4 shows that the Anova two-way output in the Class*Self Efficacy row has a significance of 0.279 and a score greater than = 0.05, indicating that learning and self-efficacy do not affect primary pupils' computational thinking. Furthermore, Fig. 1 displays the line indicating that learning and self-efficacy have no interaction.

Figure 1 shows how the open-ended approach, and the scientific approach are very beneficial for students with high self-efficacy, according to their level of self-efficacy. Students with high self-efficacy scored significantly higher than students with moderate and low self-efficacy in open-ended classes. When compared to pupils with low self-efficacy, students with moderate self-efficacy perform better.

Students with high self-efficacy outperformed students with moderate and low self-efficacy in a lesson using a scientific method. When compared to pupils with low self-efficacy, students with moderate self-efficacy perform better. Because open-ended learning allows students to apply their style of thinking, it can be inferred that learning with an open-ended approach is particularly suitable for students with various degrees of self-efficacy [29-31]. Furthermore, interactive PowerPoint media is extremely beneficial in increasing students' motivation, engagement, and learning, which is in line with previous studies [17, 18]. Thus, students' productive attitudes about learning mathematics can be established [32-34]. This is also good information for improving current strategies in learning mathematics, as done in previous studies [35-49]. Indeed, this can improve and add information for developing teaching and learning process, especially facing pandemic condition [14, 15, 50-53].

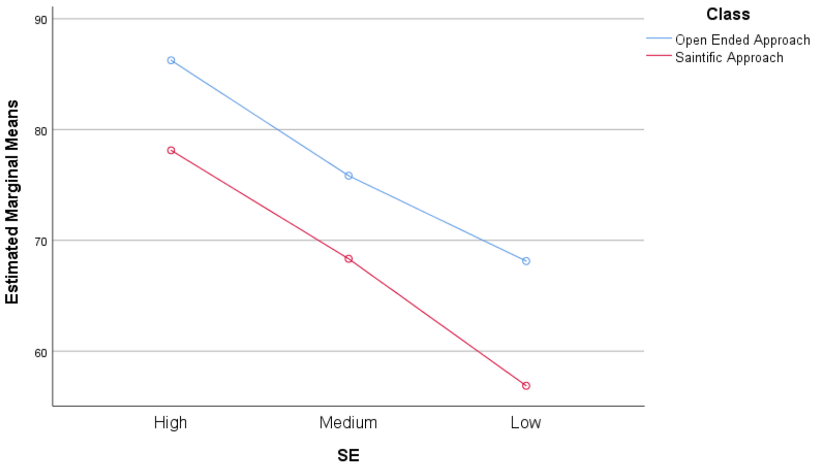

Fig. 1. Interaction of Learning with self-efficacy.

4. Conclusion

The purpose of this study was to analyse and describe the computational thinking skills of elementary school students who obtained an open-ended approach with interactive PowerPoint media on statistical material in terms of self-efficacy. The research method used is using a quantitative approach with a 3 x 2 factorial design. The sample in this study was 4th-grade students from 2 different classes, each of which amounted to 28 people. The material taught is statistics with the sub-material of making diagrams. The results showed that there were differences in the computational thinking ability of students who received learning using an open-ended approach assisted by interactive and scientific PowerPoint media. This is because students who receive the open-ended approach to learning are facilitated to plan and solve problems according to their interests and thinking patterns, besides that students are facilitated to make diagrams using personal computers. Thus, students feel happy. Other results show that there are differences in computational thinking ability between students who have high, medium, and low levels of self-efficacy. This is because students with high self-efficacy have better prior knowledge than other categories. The third result shows that there is no interaction between self-efficacy and learning computational thinking skills. This research can be useful to provide information related to some learning and media that can be implemented in facilitating computational thinking skills.

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