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Effectiveness of Demonstration Learning Model with Direct Instruction on The Development of Critical Thinking Skills in Elementary School Mathematics Learning

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ABSTRACT: The development of critical thinking in elementary school mathematics learning requires carefulness in choosing and applying the learning model. The purpose of this study was to determine the effectiveness between demonstration learning model and Direct Instruction model in elementary school mathematics learning on the development of critical thinking skills. This research is a quasi - experimental research, using quantitative data analysis and sampling using cluster random sampling. Data collection is by test. The research data were analyzed by stages: prerequisite analysis test, two-way variance analysis test of unequal cells, and further analysis of variance test. The results of the calculation of the analysis of variance test of two-way unequal cells obtained data that F_{count} (84.98) > F_{table} (3.91), and in the Anava further test, obtained data that the marginal mean of the demonstration learning model is 89.57 greater than the Direct Instruction model which has an average of 79.69. The conclusion of the research is that the demonstration learning model is more effective than the Direct Instruction model in developing critical thinking.

KEYWORDS: Demonstration Learning, Direct Instruction, critical thinking skills.

INTRODUCTION

Learning is a process for interaction activities between teachers and students in building knowledge and to solve problems. Taking into account the diverse learning styles of students, it is necessary to choose and determine a learning model that can accommodate the learning experience that has been previously owned. The definition of learning can be interpreted as an effort to acquire new knowledge, skills, and attitudes that are relatively permanent as a result of experience. This process involves interaction between individuals and their environment, either directly or indirectly (Panggabean, 2021).

Knowledge that is one of the ways to be able to solve problems in the community is mathematics. Juniati (2017: 283-291) explains that mathematics is a science or knowledge that involves patterns of thinking, as well as patterns of organizing a logic proof. This statement provides an understanding that problems in society need to be analyzed, synthesized, and evaluated, so that solutions can be found that provide goodness to the whole community. The stages of solving these problems are one form of how to use thinking patterns, namely critical thinking skills.

Critical thinking skills are the ability to analyze arguments through aspects of finding basic similarities and differences in the material or learning topics studied (Erlistiani, Syachruroji, & Andriana, 2020). According to Larasati and Syamsurizal (2022) Critical thinking skills are the ability to correctly conclude a problem, review and thoroughly examine the decisions taken. Meanwhile, according to Al Fanny and Roesdiana (2020) critical thinking skills are needed to analyze a problem to the stage of finding a solution to solve the problem. Septiany, et al., (2024) explained that: critical thinking is thinking that uses reason to solve a problem by first understanding the problem, expressing opinions or arguments clearly and being able to draw conclusions from existing problems. Based on the description above, researchers can synthesize that critical thinking skills are an ability to analyze, conclude or find solutions, appropriately review a problem or learning topic by looking for basic similarities and differences in the material or learning topics studied.

The need for skill development starting from elementary school has been realized by all educators. Hwang, Hand, & French (2023) explained that: the reason why critical thinking skills are important for elementary school students is to face and respond to the explosion of information in the digital era, build the quality of thinking, accuracy and rational thinking in students, develop students' ability to think logically, organizing problems, and solving various types of problems. The statement emphasizes that there are benefits if critical thinking skills are developed and owned by students since childhood. The benefits of developing critical thinking skills, Lau (2011: 175) explains that several characteristics support the thinking process, namely: 1) Able to understand the logical relationship between ideas; 2) Able to formulate ideas concisely and precisely; 3) Able to identify, build, and evaluate

arguments; 4) Able to evaluate decisions; 5) Able to evaluate evidence and be able to prove hypotheses; 6) Able to detect inconsistencies and common errors in reasoning; 7) Able to analyze problems systematically; 8) Able to identify the relevance and importance of ideas; 9) Able to assess one's beliefs and values; and 10) Able to evaluate one's thinking ability.

The development of critical thinking skills in elementary schools in mathematics learning has criteria that need to be understood by all parties. Sihotang (2018) suggests that the criteria for critical thinking include: 1) Raising important questions and problems, formulating clearly and thoroughly; 2) Gathering and assessing relevant information, using abstract ideas to interpret it effectively; 3) Drawing conclusions and solutions with strong reasons, strong evidence and testing them using relevant criteria and standards; 4) Open-minded by using various alternative systems of thought, while recognizing, assessing, and looking for relationships between all assumptions of practical implications; and 5) Able to overcome confusion, being able to distinguish between facts, theories, opinions, and beliefs.

The criteria described above can be grouped into several aspects. Aspects of critical thinking skills in this study, researchers took the theory of Fecione (1990: 3) which explains that critical thinking skills, including: interpretation, analysis, inference, evaluation, explanation, and self-regulation, but someone who has critical thinking skills does not have to fulfill all aspects of critical thinking as a cognitive ability: The interpretation aspect is one's ability to understand and express the meaning of a situation, data, judgment, rule, procedure, or varied criteria; The analysis aspect is one's ability to clarify conclusions based on the relationship between information and concepts, and the question at hand; The inference aspect is one's ability to identify the elements needed to make a rational conclusion, by considering information relevant to a problem and its consequences based on existing data; The evaluation aspect is one's ability to assess the credibility of a statement or other representation of one's opinion or assess a conclusion based on the relationship between information and concepts, with the question at hand; and The explanation aspect is one's ability to express one's reasoning when providing justification for logical evidence, concepts, methodologies and criteria based on existing information or data, where this reasoning is presented in the form of an argument.

The urgency of the need for research focused on critical thinking skills is from the test analysis results. The results of the odd semester end test (UAS) in the 2024/2025 academic year in class III, 35 elementary schools (SD) in Ngrampal-Sragen sub-district with the criteria that many students are more than or equal to 20 and less than 20, obtained data that the range of mean scores is 47.21 to 73.35, range 30 to 40, and standard deviation 9.67 to 12.36; so it can be interpreted that learning with a direct learning model and utilizing printed media books and LKPD, has not provided optimal value results. This leads to the understanding that learning needs to reveal the meaning of symbols, not the method of memorizing formulas or memorizing the pattern of solving a problem. The concept of direct learning should be utilized for learning that is directly related to the object or movement of a skill. Wintarti and Abadi (2021) explain that the Direct Instruction learning model is a good learning model for teaching about rules, procedures, basic skills. Supartini (2021) explains that direct learning is a learning model in which the teacher transforms information or skills directly to students, learning is goal-oriented and structured by the teacher. Meanwhile, Yanti (2019) explains that the direct learning model is specifically designed to develop student learning about procedural knowledge and declarative knowledge that is well structured and can be learned step by step.

Based on the description above, researchers can conclude that the direct learning model is a form of learning that transforms learning concepts and knowledge procedures to students who do not have much understanding of the material being studied. The explanation above confirms that conventional learning used by teachers is to direct to the form of skills, such as: practicing certain styles in swimming, marching line exercises. As for teaching rules and procedures, for example, teaching practice is monotonous, so it does not provide opportunities for students to explore knowledge.

The low level of mathematics learning in the third grade of SD Sragen sub-district needs to be changed and use a demonstration learning model. Kinait et al. (2022) explain that the demonstration learning model is a teaching model that uses demonstrations to clarify an understanding or to show how to do something to students. Demonstration model is one method that is quite effective because it helps students to find answers with their own efforts based on correct data (Nonik et al., 2018). Siniakon et al., (2021) explain that the demonstration model is a teaching model by demonstrating goods, events, and sequences either directly or through the use of teaching media relevant to the subject matter being presented. Meanwhile, Yusrida and Siregar (2019) explain that the demonstration learning model is teaching by demonstrating items, events, rules and the sequence of carrying out an activity, either directly or using teaching media that is relevant to the subject matter or material being presented. Some of the above opinions can be synthesized that the demonstration learning model is a learning method that is quite effective because it helps students to find answers with their own efforts by demonstrating using items, events, and sequences either directly or through the use of media.

This explanation provides an understanding that the demonstration learning model is a space to clarify in building mathematical concepts for students. demonstration model is one form of concretizing the stages in building mathematical concepts. This is because the demonstration learning model has benefits for students. Julyananda et al. (2022) explained that the benefits of the demonstration learning model are: improve concept understanding, because demonstration learning makes abstract concepts more concrete and easy to understand; strengthen memory, because direct experience gained through demonstration tends to be easier to remember than verbal explanation alone; and increase interest in learning.

Effectiveness of Demonstration Learning Model with Direct Instruction on The Development of Critical Thinking Skills in Elementary School Mathematics Learning

Demonstration and direct learning models need to be compared for the development of critical thinking skills. Experiments to support both models in their effectiveness in developing critical thinking skills need the support of learning motivation from students. Ratna & Yahya (2022) explain that motivation is a change in energy within a person characterized by affective arising (feelings) and reactions to achieve goals. Winkel (2004: 526) explains that learning motivation is the overall driving force within students that causes learning. Meanwhile, Uno (2017: 23) explains that learning motivation is an internal and external drive in students who are learning. Based on the above understanding, it can be concluded that learning motivation is the totality of the power possessed by students to bring about learning, so that the desired goals are achieved. This statement provides an understanding of the other side that supports the learning of mathematics to be maximized, namely the need to build a desire from within students to give a positive response in participating in learning. the desire that arises from within students to learn mathematics is called intrisik motivation.

Based on the description above, the development of critical thinking in elementary school mathematics learning requires carefulness in choosing and applying the learning model. Thus, the purpose of this study is to determine the effectiveness between the demonstration learning model and the Direct Instruction model in elementary school mathematics learning on the development of critical thinking skills. To realize this goal, the researcher set the research title, namely: Effectiveness of Demonstration Learning Model with Direct Instruction on Critical Thinking Skills Development in Elementary School Mathematics Learning.

RESEARCH METHOD

This research is quantitative with the research design is Pretest-Posttest Control Group Design. The feature of the research is that all groups are given a pretest before being given treatment / treatment and then observed the results. This experimental research is to investigate the effect of two independent variables simultaneously, namely the demonstration learning model and the direct learning model on one dependent variable, namely critical thinking skills. The study population was all third grade students in Ngrampal-Sragen sub-district. The sampling technique used was cluster randam sampling.

Data collection techniques using tests. The incoming data were tested for prerequisites, including tests: normality, homogeneity, analysis of variance (Anava) two-way with unequal cells, using the formula:

$X_{ijk} = \mu + \alpha_i + \beta_i + (\alpha\beta)_{ij} + \varepsilon_{ijk}$ (Budiyono, 2016:229)

and further test of two-way analysis of variance, using the Scheffe method, which was formulated:

$$F_{i;j} = \frac{\left(\overline{X_i} - \overline{X_j}\right)^2}{RKG\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}$$ (Budiyono, 2016: 215)

Notes:

$F_{i;j}$ = the value of F_{obs} on the comparison of the i-th row and the j-th row

$\overline{X_i}$ = mean at row i

$\overline{X_j}$ = mean of row j

RKG = mean square error obtained from the calculation of analysis of variance

n_i = i-th sample size

n_j = j-th sample size

RESULTS AND DISCUSSION

The samples of the experimental and control groups in this study were grouped into three criteria, namely high (group-1), medium (group-2), and low (group-3). The Pre-Test results are organized in table 1.

Table 1. Descriptive Statistics

	N	Range	Min	Max	Mean	SD
Pre-Test_Kel1. Control	42	30	50	80	60.36	8.219
Pre-Test_kel2.Control	33	35	45	80	60.45	9.045
Pre-Test_kel3.Control	17	35	45	80	60.29	9.432
Pre-Test_kel1.Experiment	43	30	50	80	60.23	8.378
Pre-Test_kel2.Experiment	32	35	45	80	60.94	9.370
Pre-Test_kel3.Experiment	16	35	45	80	60.62	8.732
Valid N (listwise)	16					

The mean and standard deviation of control groups 1 to 3 were: 60.36 and 8.22; 60.45 and 9.05; and 60.29 and 9.43, respectively. While the experimental groups 1 to 3 were respectively: 60.23 and 8.38; 60.94 and 9.37; and 60.62 and 8.73.

Post-Test results for the mean and standard deviation are organized in table 2, as follows:

Table 2. Descriptive Statistics

	N	Range	Min	Max	Mean	SD
Post-Test_Kel1. Control	42	30	70	100	80.12	8.517
Post-Test_kel2.Control	33	30	70	100	79.55	8.603
Post-Test_kel3.Control	17	30	70	100	79.41	9.334
Post-Test_kel1.Experiment	43	20	80	100	90.58	6.566
Post-Test_kel2.Experiment	32	20	80	100	90.00	7.931
Post-Test_kel3.Experiment	16	25	75	100	88.13	7.274
Valid N (listwise)	16					

The mean and standard deviation of control groups 1 to 3 were: 80.12 and 8.52; 79.55 and 8.60; and 79.41 and 9.33, respectively. While the experimental groups 1 to 3 were respectively: 90.58 and 6.57; 90.00 and 7.93; and 88.13 and 7.27. Based on the table above, there is an increase in the average score in control groups 1 to 3, respectively: 19.76, 19.10, and 19.21. While the increase in the average score in experimental groups 1 to 3 respectively: 30.35, 29.06, and 27.51.

The test data needs to be tested for prerequisites which include: normality test, homogeneity test, and balance test. The normality test results are arranged in table 3 as follows:

Table 3. Tests of Normality

	Kolmogorov-Smirnov[a]		
	Statistic	Df	Sig.
Experiment_Pre-Test	0,884	91	0,070
Experiment_Post-Test	0,978	91	0,075
Control_Pre-Test	0,847	91	0,065
Control Post-Test	0,821	91	0,072

The basis for decision making is if the calculated significant value (sig. count) > 0.05, then the data comes from the population. Based on table 3 above, the sig. value of the experimental and control groups is 0.07, 0.08, 0.07, and 0.07 respectively, which is greater than 0.05. So it can be concluded that the sample comes from a population with normal distribution.
The results of the homogeneity test with a significant level of 0.05 were compiled for the Pre-Test learning outcomes in table 4 as follows:

Table 4. Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Pre-Test Learning Outcomes	Based on Mean	0,025	1	181	0,874
	Based on Median	0,061	1	181	0,806
	Based on Median and with adjusted df	0,061	1	180,283	0,806
	Based on trimmed mean	0,037	1	181	0,847

While the results of the homogeneity test for Post-Test learning outcomes, are arranged in table 5, as follows:

Table 5. Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Post-Test Learning Outcomes	Based on Mean	1,706	1	181	0,193
	Based on Median	0,926	1	181	0,337
	Based on Median and with adjusted df	0,926	1	147,122	0,337
	Based on trimmed mean	1,688	1	181	0,196

The basis for decision making in the Homogeneity test is sig.count> 0.05, so it can be interpreted that the sample is homogeneously distributed. Based on tables 4 and 5 obtained Based on Mean each sig. count Pre-Test (0.87) > 0.05 and sig.count Post-Test (0.19) > 0.05, so it can be concluded that the sample has a Homogeneous distribution.
The results of the balance test with a significant level of 0.05 are compiled Pre-Test learning outcomes in table 6 as follows:

Table 6. Independent Samples Test

		Levene's Test for Equality of Variances				
		F	Sig.	t	Df	Sig. (2-tailed)
Hasil Belajar Pre-Test	Equal variances assumed	0,025	0,874	0,132	181	0,895
	Equal variances not assumed			0,132	180,946	0,895

The basis for decision making is sig. count> 0.05, so it can be interpreted that the experimental group and the control group have the same average (balanced). Based on table 6 above, it is found that sig. count (0.895) > 0.05, so it can be interpreted that the two groups have the same mean (balanced).

The hypothesis test results in this study used analysis of variance (Anava) two-way unequal cells. Analysis of variance is carried out with the following procedure:

H_{0B} : $\alpha_i = 0$ for each $i = 1, 2, 3$; Demonstration learning model or Direct learning model in mathematics learning does not result in the development of critical thinking skills.

H_{1B} : there is at least $\alpha_i \neq 0$ for each $i = 1, 2, 3$; Demonstration learning model or Direct learning model in mathematics learning results in the development of critical thinking skills.

The significance level α=0.05, the critical region is $F_{count} > F_{table}$ (0.05, 2, 177).
The computation result shows that F_{count} (84.98) > F_{table} (3.91), so it is concluded that H_{OB} is rejected. So it can be concluded that the demonstration or direct learning model results in the development of critical thinking skills.

Testing the demonstration learning model with direct learning to compare its effectiveness in achieving critical thinking development using the Scheffe method, the data is organized in table 7, as follows:

Table 7. Mean Post-Test Results

Learning Model	Average Learning Outcome			Marginal
	High	Medium	Low	Average
Demonstration Model	90,58	90,00	88,13	89,57
Conventional Drill Practice	80,12	79,55	79,41	79,69
Marginal Average	85,35	84,77	83,77	

Anova follow-up testing to determine the effectiveness of the two procedural learning models in achieving the development of critical thinking skills. The data is organized in table 8, as follows:

Table 8. Summary of Multiple Comparisons between Row Cells

H_0	F count	(pq-1) F t_{able}	P
$\mu_{ij} = \mu_{ik}$	11981.65	6.08	Tolak H_0
$\mu_{ij} = \mu_{ik}$	11945.95	6.08	Tolak H_0
$\mu_{ij} = \mu_{ik}$	5763.92	6.08	Tolak H_0

The basis of decision is H_O: accepted if $\mu_{ij} = \mu_{ik}$; both learning models have the same effectiveness in developing critical thinking skills; H_1: accepted if $\mu_{ij} \neq \mu_{ik}$: both models have different effectiveness in developing critical thinking skills. Significance 5%, The results of the calculation can be interpreted that: 1) demonstration learning model is more effective than direct learning model for High criteria group with F count (11981.65) > F table (6.08); demonstration learning model is more effective than direct learning model for High criteria group with F count (11945.95) > F table (6. 08); and demonstration learning model is more effective than direct learning model for Medium criteria group with F count (11981.65) > F table (6.08); and demonstration learning is more effective than direct learning model for Low criteria group with F count (5763.92) > F table (6.08). The conclusion of the Anova

further test is that the demonstration learning model is more effective than the direct learning model in learning mathematics that develops critical thinking skills because F count> F table (6.08) for all criteria.

DISCUSSION

The demonstration learning model in mathematics learning is concluded to be more effective in developing critical thinking skills than the direct learning model. This is because the demonstration learning model is in line with the stages of learning that begin with concrete, semi, and abstract stages in elementary school mathematics learning. The concrete stage is realized in the form of objects or media that can be manipulated, such as: physical movement, folded, or formed according to the specified mathematics learning objectives. Physical activity (movement) is identical to the concrete stage to build understanding of mathematical concepts in demonstration learning. This is explained by Kinait, Waworuntu, and Mewengkang (2022) that a teaching model that uses demonstrations to clarify an understanding or to show how to do something to students is a demonstration learning model.

In contrast to the direct learning model, building understanding of mathematical concepts is carried out by making material in a structured and abstract form because it uses lectures, asking questions, and giving assignments (working on student worksheets), and is directed at achieving learning objectives. This is also explained by Supartini (2021) that direct learning is a learning model in which the teacher transforms information or skills directly to students, learning is goal-oriented and structured by the teacher. The existence of differences between the demonstration learning model and the direct learning model is in line with research from Rustina (2021) in science learning, which provides an understanding that the demonstration learning model can have a positive effect on improving the learning outcomes of grade II students at SD Negeri 65 Palembang, that demonstration learning has provided positive results because it is able to provide understanding to students.

The learning process carried out with the demonstration learning model is different from the direct learning model, the differences include: the material is connected to the physical movement object and gives a trigger question to stimulate students to think; creating a comfortable atmosphere for learning; ensuring students are able to follow the demonstration; and providing opportunities for students to actively build mathematical concepts according to the ability of students. This is in line with the concept of Sanjaya (2011:75) which explains the stages of implementing demonstration learning, namely: 1) starting the demonstration with activities that stimulate students to think, 2) creating a soothing atmosphere by avoiding a tense atmosphere, 3) ensuring that all students follow the demonstration by paying attention to the reactions of all students, and 4) providing opportunities for students to actively think further according to what is seen from the demonstration process. Unlike the case with the direct learning model whose stages, namely: giving mathematical material given is memorized and summarizes formulas, gives questions, and practices working on student worksheets. This is also in line with Julianto's concept (2011: 6) that the Direct Instruction model uses a lecture method as well as a demonstration which makes it easier for students to understand the material.

The demonstration learning model implemented by teachers in elementary schools in the Ngrampal sub-district of Sragen Regency can be analyzed to develop critical thinking skills, namely: clarifying the material with physical movement, providing assessment or assessment for the linkage of the meaning of movement with mathematical concepts, building concepts inductively, namely concluding empirical experiences that are built. This is in line with the concept of Jacon and Sam (2008: 142) which explains that the stages of critical thinking learning are: 1) clarification, knowing the problem, such as understanding, identifying relevant data, and formulating the main problem, 2) conducting assessments, analyzing information, looking for important questions, and finding logical reasons in the process of solving problems, 3) formulating inferences, making conclusions based on relevant information, and 4) implementing strategies, evaluating steps and results, and looking for alternative solutions. These stages do not exist concretely in the direct learning model, so that the results of the analysis of variance test of two-way unequal cells obtained data that F count (84.98) > F table (3.91), In the Anava further test, the data obtained that the marginal mean of the demonstration learning model is 899.57 greater than the Direct Instruction model which has an average of 79.69. The acquisition of these results is in line with the results of research from Mulyati (2021) which explains that the application of the demonstration model can improve the science learning outcomes of fourth grade students of SDN 005 Simpang Raya, Singingi Hilir District in the 2018/2019 academic year. This is because the demonstration learning model has built the concept well and students can explore the concepts in the lesson given.

The effectiveness of the demonstration learning model is better than the direct learning model in developing critical thinking skills, because the results of the multiple comparison test between row cells for all criteria F count, namely: High criteria (11945.95); Medium criteria (11981.65); Low criteria (5763.92) (5763.92) higher than F table (6.08). This shows that the benefits of the demonstration learning model are able to improve understanding of concepts with physical movement, able to strengthen memories because it is carried out directly by students, clarify the meaning of the concept in its application because it uses procedures that students understand and can do. this is in line with the concept of Julyananda (2022) which explains that the benefits of the demonstration learning model are: 1) improving concept understanding, demonstrations make abstract concepts more concrete and easy to understand. By directly seeing the process or event, students can more easily imagine and remember the information; 2) strengthen memory, direct experience gained through demonstration tends to be easier to remember than verbal explanation alone.

This is because it involves more of the five senses of learners; 3) increase interest in learning, interesting and interactive demonstrations can increase motivation and interest in learning; 4) clarify procedures, demonstrations show the right steps in performing a task, so that learners can follow and practice it themselves; and 5) avoid misunderstandings, by seeing first-hand, students can avoid misunderstandings that might occur if they only listen to verbal explanations.

CONCLUSION

Based on the description above, the results of the two-way analysis of variance test of unequal cells obtained data that FHitung (84.98) is greater than FTabel (3.91), which means that the effect of the demonstration learning model and direct learning model is able to develop critical thinking skills. The results of the marginal mean of the demonstration learning model are 899.57 greater than the Direct Instruction model which has an average of 79.69, which means that the demonstration learning model is better in developing critical thinking skills compared to the direct learning model. The effectiveness of the demonstration learning model is more effective than the Direct Instruction model in the development of critical thinking can be seen from the Anava follow-up test obtained from the results of the multiple comparison test between row cells. These results for the F count criteria, namely: High criteria (11945.95); Medium criteria (11981.65); Low criteria (5763.92) (5763.92) are higher than the F Table (6.08).

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