Development Of Collaborative Inquiry-Based Learning Model To Improve Elementary School Students' Metacognitive Ability

Intan Dwi Hastuti, Surahmat, Sutarto, Dafik

Abstract: This study aims to reports the results of collaborative based inquiry learning models development in elementary school students. The learning design is planned and adjusted to elementary school learning needs. The description of this study includes the result of evaluation from the experts, teacher and student assessments, as well as the assessment result of applying the developed learning model. The results of this development research show that; first, the collaborative based inquiry learning effectiveness testing is feasible from the experts' perspective; second, the collaborative based inquiry learning model effectiveness testing is feasible from the users' perspective; third, the collaborative based inquiry learning model effectiveness testing can improve the metacognitive abilities of students at SDN 1 Sandik, SDN 13 Ampenan, and SDN 43 Ampenan, and SDN 2 Sandik in West Nusa Tenggara Province. Overall, it can be concluded that the collaborative based inquiry learning model is a constructivist learning model, which in each stage will train metacognitive abilities so that the children's metacognitive abilities will increase. With the increasing of metacognitive abilities, problem solving abilities can also increase.

Index Terms: collaborative based inquiry, metacognition, elementary school, model development.

1. INTRODUCTION

The metacognition ability becomes the focus of education in Indonesia and even in the world (Glaser, 1990; Veenman & Elshout, 1994; Thomas, 2012). The metacognition skills are one of the 21st century skills that students need to practice and become key to success in 21st century science education (Thomas, 2012). Minister of Education and Culture Regulations No. 20 of 2016 emphasizes that the metacognitive aspect is one of the important components in elementary school standard of graduate competence in Indonesia. Metacognitive strategies help children understand and evaluate whether or not the goals have been achieved and to activate cognitive strategies used in the learning and thinking process (Yurdakul & Demirel; 2011). Metacognitive abilities can encourage higher-order thinking skills (Kuzle, 2013; Biryukov, 2014; Wismath, Orr, & Good, 2014). The metacognition involvement can help students in solving problems since metacognition can manage students' mental processes more effectively (Kim, Park, Moore, & Varma, 2013). Students' metacognitive abilities can be trained through student-centered learning activities. One of the student-centered learning models is inquiry. The inquiry learning model refers to the constructivist paradigm where students actively construct their knowledge. Inquiry learning activities are designed to resemble the activities of a scientist where students are involved to question, analyze ideas, design strategies, and discuss the results as well as the results' significance (Ellwood & Abrams, 2018). Inquiry learning can also improve metacognitive abilities (Kuhlthau, 2010; Seraphin., et al, 2012). The interaction in collaborative inquiry learning also encourages children's metacognitive activities. Hastuti et al (2016) explain that the influence of group discussions results in a shift of metacognitive activity, a condition in which students construct or rebuild their thinking in solving problems. Research conducted by Chiu and Kuo (2010) revealed that collaboration or group discussion has many benefits, one of them is to emerge the reciprocal scaffold.

The field research shows that the metacognitive abilities of elementary school students, especially in mathematics subjects are still low. Based on the instruments distributed in 8 schools in Lombok district and Mataram, West Nusa Tenggara, 70% of students are still at the lowest level. Strengthen more by the results from field observations, it showed that the learning process at SDN 1 Sandik, SDN 13 Ampenan and SDN 43 Ampenan is still teacher-centered, focused on textbooks, and emphasize the cognitive aspects. Besides, students are only involved in routine tasks or questions which are not kind of problem solving questions. So, these routine tasks have not been able to train students to think at a higher level. Teacher-centered learning habits are believed to produce passive students, meaning that there is no involvement of students' metacognitive activities (Rahmat & Chanunan, 2018). The use of learning methods that focus on teachers and textbooks does not give any significance because they do not involve students' psychological and attitudes (Guvercin & Verbovskiy, 2014). One of the best strategies to overcome problems that occur in elementary school students is to conduct research on learning models development. Student-centered learning models need to be developed because they are suitable for their needs. The collaborative based inquiry learning model is a learning model that combines inquiry learning models and cooperative learning models. Researchers believe that the collaborative inquiry-based learning model can improve the quality of learning, especially in improving students' metacognitive abilities in Mataram, West Nusa Tenggara.

Research Questions

Based on the results of field observations, the number of problems that are very important in elementary school mathematics learning in Mataram, West Nusa Tenggara was found. The right solution is needed to fix the problems. Thus,

- *Intan Dwi Hastuti, Universitas Muhammadiyah Mataram, , Indonesia, intandwihastuti88@ymail.com*
- *Surahmat, Universitas Islam Malang, Indonesia caksurahmat@yahoo.com*
- *Sutarto, IKIP Mataram, Indonesia, sutarto@ikipmataram.ac.id*
- *Dafik, Universitas Jember, Indonesia, d.dafik@unej.ac.id*

the following are the research questions to arise:

1. What is the valid Collaborative Based Inquiry Model to improve students' metacognitive abilities?
2. What is the practical Collaborative Based Inquiry Model to improve students' metacognitive abilities?
3. What is the effective Collaborative Based Inquiry Model to improve students' metacognitive abilities?

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2 METHOD

.This research is a research and development design that the learning model becomes its final product. The final product of the learning model has validity, practicality, and effectiveness criteria to improve metacognitive abilities. Research data were collected through observation, interviews, questionnaires, and test results. This study juxtaposes Nieven's (1999) theory of quality product criteria (valid, practical, and effective) and Borg and Gall's (1983) theory of research development modified by researchers.

2.1 Model Design Stages

There are three stages in this research development, those are (1) pre-development of the model; (2) model development and validation; 3) model implementation and testing. The pre-development stage includes field observations, literature reviews, and determination of the subject matter. At the model development and validation stage, the researcher prepares a learning kit (syllabus, lesson plan, student worksheet, test instrument) and then conducts a validation or feasibility test from the expert's point of view. Furthermore, at the model implementation and testing stage, the limited trials and large-scale trials were conducted. At the implementation stage, the practicality of the measured model using a collaborative based inquiry model contained in the learning implementation plan and student responses are evaluated. The implementation is carried out using the experimental and control class design. In the testing stage, an evaluation of the collaborative based inquiry model effectiveness is evaluated in improving the students' metacognitive abilities using the developed test instruments.

2.2 Research Subject

Subjects at the implementation and testing stage of collaborative based inquiry models are elementary school students obtained from the purposive sampling technique with a mathematic subject for grades 4 and 5 as the criteria. The reason why they become the focus or problem in this study is that they have low metacognitive abilities in mathematics.
Research for the limited trials was conducted at SDN 1 Sandik class A and B with the number of students for class A is 30 students and class B is 29 students. While the broad-scale test was conducted at SDN 13 Ampenan, SDN 43 Ampenan and SDN 2 Sandik with the total number of respondents in the three schools is 176 studentsModel implementation and testing was conducted in the odd semester academic year of 2019/2020 and was carried out during 8 meetings, with the following details; the first meeting was used for pretest, the second meeting up to the seventh meeting was the implementation of collaborative based inquiry model, and the eighth meeting was for post-test. There are four observers involved in this research.

2.3 Data, Source of Data, and Data Collection Tools

The research data consisted of pre-development model data, development data, model validation, implementation data and model testing. The interview guides, questionnaires, tests, and observation data were used as data collection tools. Teachers, students, and validators become the main source of the data.

2.4 Research Instrument

The research instrument consisted of 1) model validation sheet which was validated by four experts including content validity and construct validity, 2) device and instrument validation sheets (including syllabus validation sheets, lesson plans, student worksheets, metacognitive ability tests), 3) observation sheet of the learning implementation which aimed to determine the collaborative based inquiry model learning stages implementation. This observation was carried out by two observers, 4) learning activity observation sheet aims to determine student learning activities during the learning process using collaborative based inquiry. This observation was conducted by two observers, 5) students' responses questionnaire, and 6) metacognitive ability tests

2.5 Data Analysis Technique

There are five types of data analysis techniques in this study. Five of which are 1) analysis of model validity and supporting devices, 2) analysis of learning feasibility, 3) analysis of student learning activities, 4) Analysis of student responses, and 5) analysis of students' metacognitive abilities. The data of model validation and supporting instruments were analyzed using descriptive qualitative design by calculating the average score from validators. The Likert scale was used to measure validity. Scores obtained from expert judgment are then converted into qualitative data and being categorized. Furthermore, the level of validity (Va) is determined by calculating the average score of indicators and aspects for each expert by adapting the score interval. Models and instructional media are said to have a good degree of validity if the minimum level of validity achieved is valid. Analysis of the collaborative inquiry-based learning steps implementation contained in the Lesson Plan was conducted in a descriptive qualitative method with an average score obtained from two observers. The Likert scale was used in the instrument (very good, good, fair, poor, and very poor) The analysis of student learning activities was carried out descriptive qualitatively with an average score obtained from two observers. The Likert scale was used in the instrument (very good, good, fair, poor, and very poor). The analysis of student responses is provided in the table, then the percentage of students who select "Yes" is searched for each item. Furthermore, the percentage of student responses converted to the criteria; very weak, weak, sufficient, strong, and very strong. The collaborative based inquiry model is declared to be practical if the learning implementation and students learning activities are at least "good" and student responses are at least "strong". The data analysis of students' metacognitive abilities was analyzed by referring to the metacognitive rubric which also refers to three indicators of metacognitive skills which are; 1) planning, 2) evaluation, and 3) monitoring. The metacognitive ability rubric used in this study is a multilevel scale, which in the form of statements followed by columns indicating the scoring levels with a scoring scale according to the predetermined criteria. The data obtained in this study is quantitative data that is about metacognitive ability test scores that are analyzed descriptively

4 FINDINGS

4.1 Research Question 1

Variables related to validity include the validity of the collaborative based inquiry model itself and the supporting tools and instrument. Validity includes content validity and construct validity. Moreover, variables related to the validity of supporting tools and instruments include; 1) syllabus and lesson plan validity, 2) textbooks validity, 3) students' worksheets validity, and 4) students' metacognitive ability test validity. The validated instrument aimed to assess the feasibility to be used as a research data collection tool. The instrument is said to have a good degree of validity if the minimum level of validity achieved is valid.. Based on the validation result, it shows an average score of 4.25 (Va> 4.20). This means that the collaborative based inquiry model developed has strongly valid criteria. Furthermore, based on the results of the validation of the lesson plan and metacognitive thinking ability tests, it shows an average score of 4.26 (Va> 4.20). This means that the learning tools and metacognitive thinking skills test as a supporter of the collaborative based inquiry model developed are highly valid.

4.2 Research Question 2

Variables related to the collaborative based inquiry model practicality include; 1) the learning implementation, 2) student learning activities, and 3) student responses. To measure the learning implementation conducted by teachers and student learning activities, the students' responses questionnaire was used. To measure student responses the student response questionnaire was used. Before being implemented, the observation sheet and questionnaire were first validated by two validators and the results showed that the observation sheet instrument and the students' responses questionnaire were highly valid. Based on the average score of learning implementation limited trial in SDN 1 Sandik in the experiment class from the second meeting to the seventh meeting respectively gained 4.63, 4.8, 4.71, 4.61, 4.72, 4.72, and 4 9 (performed very good if X> 4.20). This shows that the six meetings are categorized very good with an average score of 4.72. The scores of learning implementation large scale trial at SDN 13 Ampenan in the experiment class from the second meeting to the seventh meeting, respectively were 4.37, 4.5, 4.40, 4.58, 4.60, and 4.75 (performed very good if X> 4.20). Thus, it can be concluded that the six meetings are categorized very good with an average score of 4.53.
The scores of learning implementation large scale trial at SDN 43 Ampenan in the experiment class starting from the second meeting to the seventh meeting, respectively were 3.67, 3.87, 3.87, 3.67, 3.76, and 3.96 (performed good if 3.40 <X≤4.21). Thus, it can be concluded that the six meetings are categorized good with an average score of 3.80. The scores of learning implementation large scale trial at SDN 2 Sandik in the experiment class from the second meeting to the seventh meeting, respectively were 4.25, 4.29, 4.54, 4.40, 4.34, and 4.62 (performed very good if X> 4.20). Thus, it can be concluded that the six meetings are categorized very good with an average score of 4.40. Overall, the average score of learning outcomes in a broad trial involving three schools (SDN 43 Ampenan, SDN 13 Ampenan, and SDN 2 Sandik) was 4.24 with a very good implemented criteria (performed very good if X> 4.20). The results of learning activities during the learning process using a collaborative model based on inquiry were observed by two observers during the learning process for each meeting. Table 4 shows the average scores of learning activities limited trial in the SDN 1 Sandik in the experiment class from the second meeting to the seventh meeting respectively were 4.92, 4.96, 4.96, 4.92, 4.82 , and 4.94 (performed very good if X> 4.20). This shows that the first meeting until the seventh meeting was categorized very good with an average score of 4.92. The scores of learning implementation large scale trial at SDN 13 Ampenan in the experiment class from the second to the seventh meeting, respectively were 4.51, 4.51, 4.63, 4.52, 4.62, and 4.63 (performed very good if X> 4.20). Thus, it can be concluded that the learning activities of students starting from the second meeting to the seventh meeting are categorized very good with an average score of 4.57. The scores of students' learning activity large scale trial at SDN 43 Ampenan in the experiment class from the second meeting to the seventh meeting, respectively were 3.67, 4.51, 4.51, 4.61, 4.62, and 4.65 (performed very good if X> 4.20). Thus, it can be concluded that the learning activities of students starting from the second meeting to the seventh meeting are categorized very good with an average score of 4.42The scores of students' learning activity large scale trial at SDN 2 Sandik from the second to the seventh meeting, respectively were 4.61, 4.61, 4.75, 4.61, 4.75, and 4.75 (performed very good if X> 4.20). Thus, it can be concluded that the learning activities of students starting from the first meeting to the fourth meeting are categorized very good with an average score of 4.68. Overall, the average score of student learning activities in large scale trial involving three schools (SDN 43 Ampenan, SDN 13 Ampenan, and SDN 2 Sandik) was 4.56 with a very good implemented criteria (performed very good if X> 4.20).
Furthermore, the data about students' responses to the implemented learning, are concluded as follows. Based on the results of the analysis, the average responses of students in limited trials at SDN 1 Sandik (Class A) was 92.3% with a very strong category (very strong, if P = 81% -100%)The results of students' responses questionnaire at SDN 13 Ampenan showed that the average student response was 93.6% with a very strong category (very strong, if P = 81% -100%)The results of students' responses questionnaire at SDN 43 Ampenan showed that the average student response was 91,4% with a very strong category (very strong, if P = 81% - 100%)

TABLE 3

THE TABLE DISPLAYS POST-TEST RESULTS AND MEAN VALUES BETWEEN THE CONTROL CLASS AND THE EXPERIMENTAL CLASS.

Group	N	Mean	Std. Deviation	Std. Error Mean
Experimental class	30	8.77	1.906	.348

The results of students' responses questionnaire at SDN 2 Sandik showed that the average student response was 92,76% with a very strong category (very strong, if P = 81% - 100%)
Overall, the results of the students' response questionnaire showed that the average response in the broad trial involving 3 schools (SDN 13 Ampenan, SDN 43 Ampenan, and SDN 2 Sandik) was 92.59% with a very strong category.

4.3 Research Question 3

To measure the effectiveness of a collaborative based inquiry model, the metacognitive thinking ability test which refers to three indicators is used, they are 1) planning, 2) evaluating, and 3) monitoring. The metacognitive thinking ability test is given to students as a pre-test and post-test. Data from test results were analyzed using descriptive and inferential statistics. Descriptive statistics are used to show the means and standard deviations, while the independent-sample t-test inferential statistics are used to test the effectiveness of guided inquiry between the experimental class and the control class (Hilton et al, 2004). The significance level used to compare the average scores of the experimental and control classes is 5%. The prerequisite before doing the t-test is to test the normality and homogeneity of the sample. A homogeneity test is carried out to see the same variance (homogeneous) from the sample. The statistical data analysis is measured using SPSS software for both limited trials and large scale trials.

The result of pre-test and average score between control class and experimental class in SDN 1 Sandik limited trial test can be shown in Table 1.

The average score of the experimental class was 4.73 (SD = 1,856), while the control class was marked by an average score of 4.31 (SD = 1,713). The difference in pre-test scores between the two groups was [t (59) = 0.627, p> 0.05],

TABLE 5

THE TABLE DISPLAYS PRE-TEST RESULTS AND MEAN VALUES BETWEEN THE CONTROL CLASS AND THE EXPERIMENTAL CLASS.

Group	N	Mean	Std.Deviation	Std.Error Mean
Experimental Class	89	4.74	1.749	0.185
Control Class	87	4.40	1.814	0.194

meaning that it was not significant at alpha .05 levels. This shows that the two groups were equal before the treatment was conducted

Table 3 shows the post-test results of the experimental class, the average score was 8.77 (SD = 1,906), while the average score of the control class was 7.07 (SD = 1,193). Furthermore,

TABLE 6

THE DATA BELOW PRESENTS THE COMPARISON OF PRE-TEST SCORE OF EXPERIMENT CLASS AND CONTROL CLASS SCORE USING INDEPENDENT SAMPLE T-TEST

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre test	Equal variances assumed	.517	.473	1.263	174	.208	.339	.269	-.191	.869
	Equal variances not assumed			1.263	173.387	.208	.339	.269	-.191	.869

Table 5 shows that the significance (2-tailed) of the independent t-test was 0.00 (p = <0.05). Therefore it was significant. This result shows that the two classes have differences in students' metacognitive abilities in solving fraction problems after the application of collaborative-based inquiry learning models. Based on these results, it can be concluded that there is a significant influence on the application of collaborative-based inquiry learning models in improving students' metacognitive abilities in solving problems. To measure the effectiveness of the collaborative-based

TABLE 1

THE TABLE DISPLAYS PRE-TEST RESULTS AND THE MEAN BETWEEN THE CONTROL CLASS AND THE EXPERIMENTAL CLASS

Group	N	Mean	Std.Deviation	Std.Error Mean
Experimental Class	30	4.73	1.856	0.339
Control Class	29	4.31	1.713	0.318

inquiry model in large-scale trials, an independent sample t-test is used. Large-scale trials were conducted at SDN 13 Ampenan, SDN 43 Ampenan, and SDN 2 Sandik. Data normality tests on large-scale trials were examined before further analysis was done. The total number of respondents in the three schools was 176 students. The result of the analysis

TABLE 2

THE DATA BELOW PRESENTS THE COMPARISON OF PRE-TEST SCORE OF EXPERIMENT CLASS AND CONTROL CLASS SCORE USING INDEPENDENT SAMPLE T-TEST

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post test	Equal variances assumed	2.995	.085	6.822	174	.000	1.662	.244	1.181	2.143
	Equal variances not assumed			6.836	170.263	.000	1.662	.243	1.182	2.142

shows that the pre-test score of both the experimental class and the control class are equivalent or not significantly different. It can be seen in Table 5 and Table 6.

The average score of experimental class was 4.74 (SD = 1,749), while the control class gained 4.40 (SD = 1,814). The difference in pre-test scores between the two groups was [t (176) = 0.473, p> 0.05], meaning that it was not significant at

TABLE 8

THE DATA BELOW PRESENTS THE COMPARISON OF THE POST-TEST SCORE OF EXPERIMENT CLASS AND CONTROL CLASS SCORE USING INDEPENDENT SAMPLE T-TEST

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre test	Equal variances assumed	.239	.627	.909	57	.367	.423	.465	-.509	1.355
	Equal variances not assumed			.910	56.884	.367	.423	.465	-.508	1.354

alpha .05 levels. This shows that the two groups were equal before the treatment was conducted.

TABLE 4

THE DATA BELOW PRESENTS THE COMPARISON OF THE POST-TEST SCORE OF EXPERIMENT CLASS AND CONTROL CLASS SCORE

USING INDEPENDENT SAMPLE T-TEST

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post-test	Equal variances assumed	6.030	.017	4.084	57	.000	1.698	.416	.865	2.530
	Equal variances not assumed			4.115	48.945	.000	1.698	.413	.869	2.527

Table 7 shows the results of the experimental class post-test, the average score was 8.71 (SD = 1,746), while the control class average score was 7.05 (SD = 1,470). Furthermore, Table 5 shows that the significance (2-tailed) of independent t-test was 0.00 (p = <0.05). Therefore, it was significant. This shows that the two classes have differences in the students' metacognitive abilities in solving problems after applying the collaborative-based inquiry-learning model. Based on these results, it can be concluded that there is a significant influence on the application of collaborative-based inquiry learning models in improving students' metacognitive abilities in solving problems..

5 DISCUSSION

This study aims to report the results of the design of the development of Collaborative Based Inquiry learning models in elementary school students. The result of the product in this study is a mathematics-learning medium for elementary school students. Before the learning media are implemented in the classroom, the researcher first conducts a feasibility test on the experts (validator). Validation test results from experts have been declared valid, so the learning media developed are suitable to be implemented. The implementation of the developed learning media aims to see students' metacognitive abilities. The application of collaborative-based inquiry learning models turned out to have a positive effect, where students' metacognitive abilities increased. Collaborative learning is an effective method that has many benefits to encourage the emergence of the reciprocal scaffold where students can build mutual knowledge, and share understanding (Slavin, 1990; Johnson & Johnson, 2009; Chio & Kuo, 2010). On the other hand, pure inquiry creates difficulties for students especially for elementary school students (Klahr and Nigam 2004). Therefore, to overcome these difficulties, collaborative learning is involved (De Jong 2006; Gijlers et al. 2009; Reiser 2004). The process of students debating related to decision making and explaining ideas turned out to be very helpful for students in conducting collaborative investigations (Gijlers et al. 2009). Combining collaborative learning and inquiry learning turns out to support the process of student discovery and improve their learning performance (Okada and Simon 1997). Thus, a combination of collaborative and inquiry learning is suggested as a possible way to design student science learning (Bell et al. 2010; Gijlers et al. 2009). Inquiry learning can also help

TABLE 7

THE TABLE DISPLAYS POST-TEST RESULTS AND MEAN VALUES BETWEEN THE CONTROL CLASS AND THE EXPERIMENTAL CLASS

Group	N	Mean	Std. Deviation	Std. Error Mean
Experimental class	89	8.71	1.746	.185
Control class	87	7.05	1.470	.158

students develop their metacognition skills, critical thinking, and logical reasoning (Kuhlthau, 2010; Seraphin., Et al., 2012; Fuad et al., 2017; Prayogi et al., 2018; Suardana et al., 2018). Moreover, the type of inquiry learning that is suitable for elementary school students is a guided inquiry learning since they do not have enough experience in inquiry learning yet (Suastra, 2017; Margunayasa., Et al; 2018). Guided inquiry, in this case, can be emerged from group discussions, where students can exchange their ideas by asking questions, giving explanations, and negotiating so that this activity will greatly assist them in completing the investigation task. The learning process that emphasizes the metacognitive thinking ability now is not only involved in middle and high school students. Tarrant & Holt (2017) in their book explain the information clearly on how to develop a metacognitive approach to elementary school students. Children will have metacognitive abilities if they are accustomed to engage in metacognitive activities starting from the lower classes. The inquiry learning model has been proven can improve students' metacognitive abilities, critical thinking, logical reasoning, and creative problem solving (Kuhlthau, 2010; Seraphin., Et al., 2012; Thaiposri & Wannapiroon, 2015; Fuad et al., 2017; Suardana et al., 2017; al., 2018; Prayogi et al., 2018). It is a learning model designed to expose students to scientific experience through questioning, building hypotheses in response to questions, and testing the hypotheses based on data to form a deep understanding of scientific methodology, critical thinking development, self-regulation, and understanding of certain topics (Eggen & Kauchak, 2012). Inquiry learning activities are designed to resemble the activities of a scientist, where students are involved to question, analyze ideas, design strategies, and discuss the results and the significance of the results (Ellwood & Abrams, 2018). The increasing of metacognitive abilities will teach the students to control and monitor their progress, correlate the relationship between new information and the initial knowledge, and plan to choose the suitable strategies. Those will lead students to solve the problems successfully. Metacognition skills are also one of the 21st century skills that students need to practice to have higher-order thinking skills. The implications of this study are: (1) meet the elementary school students' learning needs especially for mathematics subjects in Mataram, West Nusa Tenggara which is shown by students' enthusiasm in learning mathematics. The learning material is easy to understand because it also involves teaching aids, (2) ease the teachers in providing material. Through group discussion assisted with teaching aids, students can directly practice and involve in discovering activities, (3) become a source of supporting references in learning mathematics that refers to the 2013 curriculum (K-13)..

6 CONCLUSION

Based on the results of the validation of the lesson plan and metacognitive thinking ability tests as a supporter of the

collaborative based inquiry model developed are highly valid.
Variables related to the collaborative based inquiry model practicality include; 1) the learning implementation, 2) student learning activities, and 3) student responses. Overall, the average score of learning implementation and student learning activities in large scale trial involving three schools were very good implemented criteria. Overall, the results of the students' response questionnaire showed that the average response in large scale trial involving was a very strong category. Based on these results, it can be concluded that there is a significant influence on the application of collaborative-based inquiry learning models in improving students' metacognitive abilities in solving problems. Based on independent-sample t-test result can be concluded that there is a significant influence on the application of collaborative-based inquiry learning models in improving students' metacognitive abilities in solving problems.

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REFERENCES
[1] Ambrose, S. A., & Lovett, M. (2014). Prior knowledge is more than content: Skills And Beliefs Also Impact Learning. Applying Science of Learning in Education, 1(2), 7-19.
[2] Aminah, M., Kusuma, Y., Suryadi, D., & Sumarmo, E. (2018). The Effect of Metacognitive Teaching and Mathematical Prior Knowledge on Mathematical Logical Thinking Ability and Self-Regulated Learning. International Journal of Instruction, 11(3), 45-62.
[3] Arends, R. (2012). Learning to Teach. Ninth Edition. New York: McGraw-Hill.
[4] Bell T, Urhahne D, Schanze S, Ploetzner R. (2010). Collaborative inquiry learning: models, tools, and challenges. Int J Sci Educ, 32(3), 349–377
[5] Biryukov, P. (2014). Metacognitive Aspects of Solving Combinatorics Problems. Journal Mathematic Teaching And Learning, 25(1), 1-19.
[6] Borg, W., & Gall, M. (1983). Educational Research: An Introduction (4 th ed). White Plains, NY: Longman Inc.
[7] Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-Explanations: How Students Study And Use Examples In Learning To Solve Problems. Cognitive Science, 13, 145–182
[8] Chinn, C. A. dan Malhotra, B. A. (2002a) Epistemologically authentic inquiry in schools: A theoretical framework for evaluating inquiry tasks. Science Education, 86(1), 175-218.
[9] Chiu, M., &Kuo, S. (2010). From Metacognition to Social Metacognition: Similarities, Differences, And Learning. Journal of Education Research, 3(4), 321-338.
[10] De Jong, T. (2006). Computer simulations technological advances in inquiry learning. Science 312(5773), 532–533
[11] Dekker, R., & Elshout-Mohr, M. (1998). A Process Model For Interaction And Mathematical Level Raising. Educational Studies in Mathematics, 36, 303–314.
[12] Eggen, P., & Kauchak, D. (2012). Strategi dan model pembelajaran. Jakarta: Indeks.
[13] Ellwood, R., & Abrams, E. (2018). Student's Social Interaction In Inquiry-Based Science Education: How Experiences Of Flow Can Increase Motivation And Achievement. Cultural Studies of Science Education, 13(2), 395–427
[14] Ergul, R., Simsekli, Y., Calis, S., Ozdilek, Z., Gocmencelebi, S., & Sanli, M. (2011). The effects of inquiry-based science teaching on elementary school students' science process skills and science attitudes. Bulgarian Journal of Science and Education Policy, 5(1), 48–68.
[15] Fuad, N.M., Zubaidah, S., Mahanal, S., & Suarsini, E. (2017). Improving Junior High Schools' Critical Thinking Skills Based on Test Three Different Models of Learning. International Journal of Instruction, 10(1), 101-116.
[16] Glaser, R. (1990). The reemergence of learning theory within instructional research. American psychologist, 45(1), 29-39
[17] Gu, X., Chen, X., Zhu, W., & Lin, L. 2015. An intervention framework designed to develop the collaborative problem-solving skills of primary school students. Educational Technology Research & Development, 63(1): 143-159.
[18] Gulbahar, Y., & Tinmaz, H. 2006. Implementing PBL And E-Portofolio Assessment in an Undergraduate Course. Journal of Research on Technology in Education, 38(3), 309-327.
[19] Guvercin, S., & Verbovskiy, V. (2014). The effect of problem proposing tasks used in mathematics instruction to mathematics academic achievement and attitudes toward mathematics. International Online Journal of Primary Education, 3(2), 59-65.
[20] Hacker, D. J., Dunlosky, J., & Graesser, A. C. (Eds.). (1998). The educational psychology series. Metacognition in educational theory and practice. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.
[21] Hastuti, I. D., Nusantara, T., Subanji.,&Susanto, H. (2016). Constructive Metacognitive Activity Shift in Mathematical Problem Solving. Educational Research and Reviews, 11(8), 656-667
[22] Hastuti, I., Surahmat., Sutarto., & Dafik. (2019). Analysis of the Effect of Guided Inquiry Learning in Improving Metacognitive Ability of Elementary School Students in Fractional Materials. International Journal of Instruction, (review)
[23] Hogan, K. (1999). Thinking aloud together: A test of an intervention to foster students' collaborative scientific reasoning. Journal of Research in Science Teaching, 36(10), 1085–1109.
[24] Hussain, A., Azeem, M., & Shakoor, A. (2011). Physics Teaching Methods: Scientific Inquiry Vs Traditional Lecture. International Journal of Humanities and Social Science, 1(19), 269-276.
[25] Huysken, K., Olivey, H., McElmurry, Ghao, M. (2019). Assessing Collaborative, Project-based Learning Models in Introductory Science Courses. Journal of the Scholarship of Teaching and Learning, 19(1), 6-28.
[26] Johnson, D. W., & Johnson, R. T. (2009). An Educational Psychology Success Story: Social Interdependence Theory And Cooperative Learning. Educational Researcher, 38(5), 365-379.
[27] Kershner, R, Warwick, P., Mercer, M., & Staarman, J. K. (2012). Primary children's management of themselves and others in collaborative group work: 'Sometimes it takes patience …'. Education 3–13: International Journal of

Primary, Elementary and Early Years Education, 42(2), 201–216.
[28] Kim, M. C., & Hannafin, M. J. (2011). Scaffolding problem solving in technology-enhanced learning environments (TELEs): Bridging research and theory with practice. Computers & Education, 56(2), 403–417
[29] Kim, Y., Park, M., Moore, T., & Varma, S. (2013). Multiple Levels of Metacognition And Their Elicitation Through Complex Problem-Solving Tasks. Journal of Mathematical Behavior, 32(2), 377-396.
[30] King, F., Goodson, L., & Rohani, F. (1993). Higher Order Thinking Skills. Assessment & Evaluation Educational Services Program. New York: Kluwer Academic.
[31] Klahr, D., & Nigam, M (2004) The Equivalence Of Learning Paths In Early Science Instruction: Effects of Direct Instruction And Discovery Learning. Journal of Science Education & Technology, 15(1), 661–667
[32] Krathwohl, D. (2002). A Revision of Bloom's Taxonomy: An Overview. Theory into Practice, 41(4), 212-218.
[33] Kuhlthau & Todd. 2007. Guided Inquiry: A framework for learning through school librariesin 21st century schools. New Jersey: CISSL.
[34] Kuhn, D., Black, J., Keselman, A., & Kaplan, D. (2000). The Development Of Cognitive Skills to Support Inquiry Learning. Cognition And Instruction, 18(2), 495–523
[35] Kuzle, A. (2013). Patterns of Metacognitive Behavior During Mathematics Problem-Solving in a Dynamic Geometry Environment. International Electronic Journal of Mathematics Education, 8(1), 20-40.
[36] Lawrie, G., Mattew, K.,Bailey., & Kavanagh. (2014). Technology Supported Facilitation And Assessment Of Small Group Collaborati Ve Inquiry Learning In Large First-Year Classes. Journal of Learning Design, 7(2), 120-135
[37] Limon, M., & Carretero, M. (1997). Conceptual Change And Anomalous Data: A Case Study in The Domain of Natural Sciences. European Journal of Psychology of Education, 12(2), 213-230.
[38] Margunayasa, I. G., Dantes, N., Marhaeni, A. A. I. N., & Suastra, I. W. (2019). The Effect of Guided Inquiry Learning and Cognitive Style on Science Learning Achievement. International Journal of Instruction, 12 (1), 737-750.
[39] Nieveen, N. (1999). Prototyping to Reach Product Quality. Netherlands: Kluwer Academic Publisher.
[40] Okada, T., & Simon, H. A. (1997). Collaborative discovery in a scientific domain. Cognitive Science, 21(2), 109–146.
[41] Pape, S. J., Bell, C.V., & Yetkin, I. E. (2003). Developing mathematical thinking and self regulated learning: a teaching experiment in a seventh-grade mathematics clasroom. Educational Studies in Mathematics.Vol. 53 No. 3, 179-202.
[42] Prayogi, S. (2013). Implementasi Model Inquiry Untuk Mengembangkan Kemampuan Berpikir Kritis Mahasiswa Pendidikan Fisika. Laporan Hail Penelitian. LPPM IKIP Mataram
[43] Prayogi, S., Yuanita, L., & Wasis. (2018). Critical Inquiry Based Learning: A Model of Learning to Promote Critical Thinking Among Prospective Teachers of Physic. Journal of Turkish Science Education, 15(1), 43-56
[44] Radovan, M. (2019). Cognitive And Metacognitive Aspects of Key Competency "Learning To Learn". Pedagogy, 133(1), 28-42.
[45] Rahmat, I & Chanunan, S. (2018). Open Inquiry in Facilitating Metacognitive Skills on High School Biology Learning: An Inquiry on Low and High Academic Ability. International Journal of Instruction, 11(4), 593-606.
[46] Reiser, B. (2004). Scaffolding Complex Learning: The Mechanisms Of Structuring And Problematizing Student Work. J Learn Sci, 13(1), 273–304.
[47] REs H., Saab N., Van, W., de Jong, T., & Van, H. (2009). Interaction Between Tool And Talk: How Instruction And Tools Support Consensus Building In Collaborative Inquiry Learning Environments. Journal of Computer Assisted Learning, 25(3), 252–267
[48] Saab, N., Joolingen, W., & Wolters, B. (2012). Support of the collaborative inquiry learning process: influence of support on task and team regulation. Metacognition Learning, 7(1), 7-23
[49] Sarac, S., Onder, A., Karakelle, S. (2014). The Relations Among General Intelligence, Metacognition and Text Learning Performance. Education and Science, 39(173), 40-53.
[50] Seraphin, K. D., Philippoff, J., Kaupp, L., & Vallin, L. M. (2012). Metacognition as means to increase the effectiveness of inquiry-based science education. Science Education International. 23(4), 366-382.
[51] Slavin, R. (1990). Cooperative learning: Theory research and practice. Englewood Cliffs, NJ: Prentice Hall.
[52] Suardana, I N., Redhana, I W., Sudiatmika, A. A. I. A. R., & Selamat, I N. (2018). Students' Critical Thinking Skills in Chemistry Learning Using Local Culture-Based 7E Learning Cycle Model. International Journal of Instruction, 11(2), 399-412.
[53] Suastra, I W. (2017). Pembelajaran Sains Terkini: Mendekatkan Siswa dengan Lingkungan Alamiah dan Sosial Budaya. Singaraja. Universitas Pendidikan Ganesha.
[54] Tarrant, P & Holt, D. (2016). Metacognition in The Primary Classroom. Abingdon: New York
[55] Tarrant, P., & Holt, D. (2016). Metacognition in The Primary Classroom. New York: Abingdon.
[56] Teaching and Learning by Inquiry-based Learning Activities Using Social Network and Cloud Computing. Procedia Social and Behavioral Sciences, 17(4), 2137-2144
[57] Teaching and Mathematical Prior Knowledge on Mathematical Logical Thinking Ability and Self-Regulated Learning. International Journal of Instruction, 11(3), 45-62
[58] Thaiposri P, & Wannapiroon, P. (2015). Enhancing Students' Critical Thinking Skills Through
[59] Thomas, G. P. (2012). Metacognition in science education: Past, present and future considerations. In G.J. Fraser, K. G. Tobin, C. J. McRobbie (Eds.) Second international handbook of science educations, (pp. 131-144). New York: Springer.
[60] Veenman, M. V., &Elshout, J. J. (1994). Differential effects of instructional support on learning in simultation environments. Instructional science, 22(5), 363-383.
[61] Verawati, N. (2013). Implementasi model inquiry untuk mengembangkan keterampilan berpikir kritis mahasiswa pendidikan fisika pada pokok bahasan hukum Hooke. Jurnal Pendidikan Biologi BIOTA, 6(1), 77-86
[62] Wismath, S., Orr, D. & Good, B. (2014). Metacognition: Student Reflections on Problem Solving. Journal on Excellence in College Teaching, 25(2), 69-90.

[63] Ya-Hui, W. (2012). A Study on Metacognition of College Teachers. The Journal of Human Resource and Adult Learning, 8(1), 84-9.

[64] Yenilmez, A., Sungur, S., & Tekayya, C. (2005). Investigating students' logical thinking abilities: the effects of gender and grade level. Hacettepe Universitesi Egitim Fakultesi Dergisi, 28, 219-225.

[65] Yurdakul, B., & Demirel, Ö. (2011). Contributions of Constructivist Learning Approach to Learners' Metacognitive Awareness. International Journal of Curriculum and Instructional Studies, 1(1)..