International Journal of Psychosocial Rehabilitation, Vol.24, Issue 01, 2020
ISSN: 1475-7192

Improvement of Student Reasoning Skills through the Development Model of Advance Organizer on Open Ended Approach

[1] Joko Sulianto, [2] Sunardi, [3] Sri Anitah, [4] Gunarhadi, [5] Ryzal Perdana

Abstract: *Improving students' reasoning skills can be gained by improving the quality of learning oriented to higher-order thinking skills. Development of learning models is very necessary to improve students' reasoning skills. The purpose of this study is to produce a learning model that can enhance students' reasoning skills in mathematics in elementary school. The research approach used in development research consists of a preliminary stage, a development phase and a testing phase. Based on the analysis of research, it is inferred that: (1) It is necessary to develop a learning model oriented to students' reasoning skills in elementary schools, namely an advanced organizer model based on an open-ended approach, (2) the resulting development model meets the content validity with valid criteria, and validity constructs with very valid criteria, practicality of the advanced organizer model with very valid criteria, (3) an advanced organizer model based on an open-ended approach is effective for improving elementary school students skills on reasoning. The development is carried out to improve the reasoning skills as they are important in learning mathematics.*

Keywords*: Reasoning skills, advance organizer model based open-ended approach, fraction.*

I. INTRODUCTION

Professional teachers are needed in the development of good and effective learning. The development of good and effective learning is the focus of government attention. Students' quality can be improved by improving the quality of learning in class oriented to higher order thinking skills (HOTS). HOTS was implemented because the Program for International Student Assessment (PISA) rating was still low. The Ministry of Education and Development of the Ministry of Education and Culture [1] states that only 29% of students' mathematical abilities in Indonesia meet the minimum competency and 71% are below the minimum competency [2]. The government policy on free learning is a new challenge in the learning process to improve students' reasoning skills in school mathematics

[1]*Doctoral Student of Educational Science Program, Universitas Sebelas Maret, Surakarta, Indonesia. Email:* sulianto.jo@gmail.com
[2]*SDoctoral Program of Educational Science, Universitas Sebelas Maret, Surakarta, Indonesia.*
[3]*Doctoral Program of Educational Science, Universitas Sebelas Maret, Surakarta, Indonesia.*
[4]*Doctoral Program of Educational Science, Universitas Sebelas Maret, Surakarta, Indonesia.*
[5]*Doctoral Program of Educational Science, Universitas Sebelas Maret, Surakarta, Indonesia.*

numerical material. Reasoning is a skill in standard school mathematics processes. Reasoning skills are used in patterns and properties, mathematical manipulation in making generalizations, compiling evidence, or explaining mathematical ideas / statements [3]. Preliminary studies on reasoning skills carried out at school show that students have difficulty in explaining concept definitions, giving examples and not examples of concepts, characteristics of concepts, identifying traits or facts, making mathematical models, choosing problem solving strategies, choosing procedures in solving problems, expressing ideas, compiling and testing solutions, making conclusions and logical reasons. Brodie points out that most students do not like mathematics and want learning to end soon, students do not get the opportunity to convey ideas and make connections to ideas or ideas in learning mathematics from real life or contextual problems. Innovation is a must in education [4]. It is an activity to solve problems [5], attracting and evaluating [6]. Reasoning is a mental process for making sense arguing [7]. It belongs to reasons'presentation [8]. It is an activity to infer for summing up a content. It is also related to psychological on contributing ideas [9].

II. LITERATURE REVIEW

Reasoning Ability

Students' reasoning ability on many facets and flat figure in the less category, research with this qualitative approach only described the reasoning ability of students with the highest score of 56.41 sufficient criteria and the lowest value of 10, 25 criteria is not good [10]. The skills to work on the problem (drill), lack of chanches given, in his research reasoning can be improved by applying the 5-E learning cycle model [11]. The learning of mathematics in schools with a sufficient percentage of 67.5%, describe mathematical reasoning skills criteria are not good with a percentage of 35.55%, research only describes by not making efforts to improve students' reasoning skills [12]. Low gained score in math for the 60 as the passing grade [13]. Students' reasoning ability in the category was quite good [14]. The ability to think critically and mathematically creative students increased by using an advanced organizer model [15]. The application for inquiry is also essential to have reasoning for students. Hypermedia can assist them to learn math. It is also attractive by the given chance to do so [16]. Students' reasoning abilities can be improved by applying realistic mathematics educatioan (RME) approach can be seen from (1) the ability to present mathematical statements in writing (2) the ability to draw conclusions from the answers of problems and, (3) the ability to analyze mathematical situations by using patterns and relationships [17]. Saleh, Prahmana, Isa, & Murni. (2018) mathematical reasoning can be improved by applying the Indonesian realistic mathematics approach (PMRI). The learning process needs to be adjusted so that abstract objects in mathematics can be visualized through objects Concrete as a bridge to enter the knowledge that students have. Advance Organizer's metacognitive strategies are prospective [18]. Investigation of students in junior high schools in Japan shows that the presentation of open problems can help students find ideas or new ideas in solving mathematical problems [19].

Based on a preliminary study, a literature review and previous research results identified a gap between expectations and facts in the field. Permendikbud No. 22 of 2016 concerning the standard of the learning process regulates that the Learning Process in the education unit is held interactively, inspiratively, fun, challenging, motivates students to participate actively, and the principles of learning with answers that are multi-dimensional truth. The facts from the results of existing studies indicate that the implementation of learning has not yet reached the standard of the learning process. The application of active learning that involves reasoning skills has not been widely applied. Students' reasoning skills need to be improved by presenting open ended problems. Legally supported by the government in accordance with Ministry of Education and Culture Regulation number 22 of 2016 regarding the standard of the learning process as outlined in the principle that emphasizes single answers towards learning with answers the truth of which is multidimensional, it was developed by integrating the open-ended approach in the advanced organizer model.

The advance organizer model is designed to strengthen students 'cognitive structures, students' knowledge about certain subjects and how to manage, clarify and maintain such knowledge well. The cognitive structure must be in accordance with the type of knowledge [20]. Advance organizer is a model to help students organize information connecting it to a larger cognitive structure that reflects the organization of knowledge itself. Advance organizer models do not have the stages or procedures specified [21]. While the open-ended approach is oriented to problems that are formulated to have multiple answers that are correctly called open problems [22]. From the study above shows that in managing knowledge, how to construct new knowledge can be helped by providing open problems to students, thus learning will provide chances for them to process information or knowledge possessed to solve problems or make new statements based on information already held. Advance organizer learning is more effective for students 'mathematical reasoning so that advance organizer learning can help develop students' creative activities and mathematical thinking patterns through simultaneous problem solving.

III. METHOD

The approach used is research and development. The research procedure that will be used is phase I: preliminary study, stage II: development stage, development stage includes: (a) development of product design, (b) product prototype development, and (c) product trial, phase III: testing phase product. The preliminary study stage was carried out at the Semarang elementary school by distributing questionnaires to 45 teachers or principals in the city of Semarang. Data analysis used in the preliminary study was a qualitative descriptive analysis technique. In analyzing the data, it was done reduction, display, and conclusion drawing / verification. The development phase includes: (a) development of product design, (b) validity of product design, (c) Product testing. The steps of the learning system design are as follows: (1) identifying learning objectives, (2) conducting instructional analysis, (3) analyzing student characteristics and learning context, (4) formulating specific learning objectives, (5) developing assessment tools or instruments, (6) develop learning strategies, (7) develop and select teaching materials, (8) design and develop formative evaluations, (9) make revisions, (10) design and develop summative evaluations.

The product validation instrument uses an assessment sheet with indicators including: the need for model development, development of models based on current knowledge, construct validity, theoretical support for the model, implementation of the model, and practicality of the model. Product validation is carried out by an assessment by 5 experts. Product trials are conducted to collect data used as a basis for determining product eligibility. The trial was conducted 2 times, namely: (1) the initial field trial was carried out in 5 (five) elementary schools in Semarang city with 6 (six) teacher trial subjects, (2) field trials, field trials were conducted in 2 elementary school in the city of Semarang. The subjects in this study were 199 Grade 4 students at Sarirejo Elementary School and 4th grade students at Sendangmulyo 04 Elementary School in Semarang. In the initial trial phase the data was collected with a validation assessment sheet for the advance model. The product feasibility assessment sheet uses an assessment sheet with indicators including: the need for model development, development of models based on current knowledge, construct validity, theoretical support for the model, implementation of the model, and practicality of the model. At the field trial stage the instrument used in collecting data was the test instrument. Test instruments are distinguished by pretest and posttest questions. The test used in the field trial stage is in the form of summative questions on the 10-item fractional material. Analysis of the data used for qualitative data in the initial trial was a descriptive analysis technique. Data analysis techniques in field trials are used by t-test. At the testing stage the method used is the quantitative method. The design used in this study was pre-experimental design with one group pretest-posttest method. The population in this study were Wonotingal public elementary school students and Candi 01 public elementary school, Semarang. The subjects in this study were 206 students. The instrument used in collecting data at the product testing stage is an instrument with a written test technique in the form of summative questions. To test the normality of data, IBM SPSS statistics version 20 Kolmogorov Smirnov is used, if the significance value> 0.05 can be concluded that the data is normally distributed. To see whether the students' reasoning ability in posttest is better than pretest, a statistical t-test is used. For t-test statistical tests used IBM SPSS statistics version 20.

IV. RESULTS AND DISCUSSIONS

Data at the preliminary study stage based on a questionnaire distributed to 45 respondents gave the following picture: regarding the implementation of the 2013 curriculum all schools had implemented the 2013 curriculum and the conceptual understanding of the curriculum implementation of some respondents was already good. One respondent's answer is as follows: students in the learning process are expected to be able to complete basic concepts not only to be able to do the problems correctly but must be able to reason so they really understand. Seeing the responses and answers of teachers, in the implementation of the 2013 curriculum, teachers already have sufficient knowledge about learning that is appropriate or expected in the 2013 curriculum. Regarding the implementation of ongoing learning, respondents gave diverse responses: scientific thematic learning, authentic assessment of the learning process and outcomes.

Table 1. Research data from preliminary studies

No	Aspects Observed	Done/Yes/ Important/ Necessary	Not yet/ No
1	The learning model helps in increasing aspects of student reasoning by 2013 curriculum.	44(97,78%)	1(2.22%)
2	Aspects of student reasoning are important abilities that need to be improved in the 2013 curriculum.	45(100%)	0
3	Development of learning models is needed to uplift elementary schools students’ skills on reasoning.	44(97,78%)	1(2.22%)
4	Concept of learning’s definition on material needs to be given an explanation	42(93.33%)	3(6.67%)

5	Students need to be given the opportunity to give examples and not examples of concepts of learning materials.	44(97,78%)	1(2.22%)
6	Students modelling in math and the problem solving are very important for them.	45(100%)	0
7	Students are given the opportunity to argue or ideas in solving problems..	45(100%)	0
8	Students ability to solve problems according to procedures is very important	42(93.33%)	3(6.67%)
9	Students' ability to draw conclusions and provide logical reasons is very important.	43(95.56%)	2(4.44%)
10	It is needed for students to learn model	45(100%)	0
11	Existing of model in learning are essential for reasoning	25(55.56%)	20(44.44%)
12	Learning models developed give chances to convey perspectives about material	42(93.33)	3(6.67%)
13	The model developed accommodates students' opportunities to develop ideas freely	35(77.78%)	10(22.22)
14	Models developed provide opportunities for students to convey a variety of answers in answering a question.	44(97,78%)	1(2.22%)
15	The learning model developed gives students the opportunity to interact with the social environment	45(100%)	0
	Recommendations: It is recommended to expand model of learning by reasoning for primary students	45(100%)	0

From Table 1. Research data from the results of the preliminary study can be seen that 100% of respondents gave an agreed response to the development of an advanced organizer model based on an open-ended approach to improve student reasoning in mathematics in elementary schools. Because respondents view that reasoning ability is a very important part to be improved in the 2013 curriculum. Learning models must provide opportunities for students to submit ideas / ideas, draw conclusions or make generalizations, give opinions or reasons and give students opportunities to answer with a variety of answers that are true and is an open question [23]. The results of the study show that guided inquiry learning is effective in improving students' reasoning skills. The Advance organizer learning model also strongly supports mathematical reasoning abilities because most students carry out mathematical manipulation and emphasize acquiring the knowledge or information presented before learning that can be used by students to compile and interpret new information in support of mathematical reasoning abilities. Tthe application of the advanced organizer model can improve students' mathematical communication skills [24]. There are two important factors that enable students to learn rules by reasoning (1) teachers ask questions and provide opportunities for students to explain thinking, (2) provide opportunities for students to engage with concrete and semi-concrete objects, this study also provides some insight which is useful in the order of teaching fraction operation rules and has implications for teaching mathematics and teacher education [25].

Product Development Design

Development Advance organizer is a model to help students organize information connecting it to a larger cognitive structure that reflects the organization of knowledge itself. Advance organizer models do not have the stages or procedures specified. The advance organizer model is oriented to how knowledge is managed, how the mind works in processing new information, and how teachers can apply these ideas to learning. While the open-ended approach is oriented to problems that are formulated to have multiple answers that are correctly called open-ended problems or open problems. The main objective of the advanced organizer model is to help teachers manage and transfer diverse information as useful and efficient as possible. Obtaining information is a valid educational goal and that certain theories can guide teachers in transmitting a variety of information to students. The teacher acts as a manager of learning material and presents information through lectures, reading and providing assignments to the learner in integrating what has been learned. The main objective of the advanced organizer model is in line with the goals of open-ended learning, which is to help develop creative activities and mathematical mindsets of students through simultaneous problem solving. The development of an open-ended advance organizer model is an integration of the open-ended approach in the advanced organizer model. The syntmatic of the advanced organizer model based on the open-ended approach is as follows: stage (1) initial arrangements, activities include: directing students to the material to be studied, recalling related information; stage (2) is an advance organizer presentation, activities include: classifying lesson objectives, presenting organizers, identifying conclusive characteristics, giving examples, presenting context, repeating, presenting open problems, encouraging awareness of students' knowledge and experience; stage (3) is a presentation of a learning task or learning material, its activities include: presenting material, maintaining attention, clarifying processing, clarifying the rules of learning material that makes sense, and stage (4) is strengthening cognitive processing, its activities include: using reconciliation principles integrative, encourages active reception learning, evokes a critical approach to the subject, clarifies.

The social system of this model the teacher must maintain control of the intellectual structure, it is important to link learning material with the organizer and help students differentiate new material from material that has been previously learned. in the third stage however the learning situation, the idea must be more interactive, students need to be stimulated to ask questions and provide responses. Teachers' assignments to students are directed with the aim of clarifying the meaning of new learning materials, distinguishing those meanings from and reconciling them with existing knowledge, making them relevant to students personally, and helping them improve critical approaches to knowledge

Product Validation

Product learning models developed need to be validated by experts to get product models that are conceptually tested. The validator consists of learning model experts, subject matter experts, evaluation experts, and instructional media experts. Validation consists of content validity and construct validity. The results of product validation can be seen in the following Table 2:

Table 2. Content validation results

No	Content Validity	Kriteria

1	Need for developing a valid model	80	Valid
2	Designed based on up-to-date knowledge	78,57	Valid

Based on table 2, the advanced organizer model based on the open-ended approach fulfills aspects of content validity. it means that the development of the model is done based on needs, namely improving the ability of student reasoning by developing an advanced organizer learning model based on an open-ended approach in elementary school, the development of the model is based on the literature that is in accordance with the need to improve students' reasoning abilities. That the development of this model uses references of the latest research journals.

Table 3. Results of construct validation

No	Validity Constraints	Value	Criteria
1	Summary of the advance organizer model based on the open-ended approach	79,69	Valid
2	Theoretical support model	79,69	Valid
3	Implementation of the advanced organizer model based on the open-ended approach	81,25	Very Valid

Based on table 3, the advanced organizer model based on the open-ended approach fulfills aspects of construct validity. An overview of the model was developed based on the need to improve student reasoning. In the aspect of implementing the model, it reaches very valid criteria, meaning that the syntax stages can provide a clear sequence description, the social system is able to provide a picture of the participation of teachers and students, the support system can logically support the smooth learning process.

Table 4. Results of assessment of practicality of the model

No	Practicality Model	Score	Criteria
1	Practicality model	85,94	Very Valid

Table 4. Practicality of learning shows that learning tools that are made meet the aspects of assessment, the suitability of the formulation of learning objectives and indicators of achievement of competence, the compliant learning steps, and the developed model is easy to use in the learning process. Field Trial Preliminary field testing in this study is a product readability test. The instruments used in the study are the teacher's manual, student's manual, and learning device. In the initial field trial activities involved 6 subjects of elementary school teachers.

Table 5. Content validation results

No	Content Validity	Score	Criteria
1	The need for model development	91,66	Very Valid
2	Designed based on current knowledge	92, 26	Very Valid

The results of the teacher's assessment show that the model developed according to the needs of achieving the criteria is very valid. An advanced organizer model based on an open-ended approach was developed based on cutting-edge knowledge, the development of the model is based on literature that is in accordance with the need to improve students' reasoning abilities. The development of this model uses references of the latest research journals

Table 6. Results of construct validation

No	Construct validation	Score	Criteria
C	Summary of the advanced organizer model based on the open-ended approach	90,62	Very valid
2	Theoretical support of the model	92,70	Very valid
3	Implementation of the advanced organizer model based on the open-ended approach	89,16	Very valid

Aspect of conformity of development goals to improve student reasoning in accordance with 21st century graduate competency needs that place reasoning as an ability that must be taught in schools through mathematics and language subjects. The developed model is supported by appropriate theoretical studies. In the aspect of implementing an advanced organizer model based on an open-ended approach, it shows that the developed model has clear syntax stages and provides a logical and systematic sequence of learning activities.

Table 7. Results of the practicality assessment of the model

No	Practicality of the model	Score	Criteria
1	Practicality of the model	92,708	Very Valid

An assessment of the practicality of the learning model can be seen in Table 7. Practical learning shows that the learning tools that are made meet the aspects of assessment, the suitability of the formulation of learning objectives and indicators of achievement of competence, the concordance of learning steps, finally the developed model is easy to use in the learning process. Thus the product developed meets all learning components and can be used easily in the learning process in elementary schools. Main field testing Before the statistical t-test is performed, the requirements test is performed, the results of the requirements test, namely the normality of the pretest and posttest data, can be seen in Table 8 below:

Tabel 8a. Result of Normality Test Analysis on Pretest Data

		Students Reasoning
N		199
Normal Parametersa,b	Mean	59,25
	Std. Deviation	16,894
Most Extreme Differences	Absolute	,061
	Positive	,059
	Negative	-,061
Kolmogorov-Smirnov Z		,855
Asymp. Sig. (2-tailed)		,457

The results of the normality test analysis above indicate that the data are normally distributed with an index of 0.457 = 45.7%> 5% meaning Ho is received, the data is normally distributed.

Tabel 8b. Result of Normality Test Analysis on Posttest Data

		Students Reasoning
N		199
Normal Parameters a,b	Mean	64,97
	Std. Deviation	15,759
Most Extreme Differences	Absolute	,055
	Positive	,055
	Negative	-,055
Kolmogorov-Smirnov Z		,781
Asymp. Sig. (2-tailed)		,576

The results of the normality test analysis above indicate that the data are normally distributed with an index of 0.576 = 57.6%> 5% meaning Ho is received, the data is normally distributed. Based on the results of data normality testing and it is known that the data are normally distributed, the next step is to test the hypothesis using the t-test to find out whether the students' reasoning abilities for pretest and posttest are the same or different. The results of the t-test test analysis can be seen in the following Table 9:

Tabel 9. Result Analysis of Field Trial

Class		N	Mean	Std. Deviation	Std. Error Mean
Student Reasoning	1 Pre	199	59,25	16,894	1,198
	2 Pos	199	64,97	15,759	1,117

Independent Samples Test

Student Reasoning	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Equal variences assumed	1,037	0,309	-3,498	396	0,001	-5,729
Equal variences not assumed			-3,498	394,101	0,001	-5,729

From Table 9, the value of F = 1, 037 is obtained. Because the value of 1.037 = 103.7%> 5%, the data has the same variant. Because the variable variance values are the same, note the value of sig. (2-tailed) on the assumed equal variances that is 0.001 = 0.1% <5% means that the students' reasoning ability at different pretest and posttest.

Model Effectiveness Test

Before analyzing the research data, it is necessary to test the requirements before conducting the t-test, the results of the requirements test, namely the normality of the pretest and posttest data can be seen in Table 10 below:

Table 10a. Results of analysis of the Test Normality Test Data Field Test

		Student Reasoning
N		206
Normal Parametersa,b	Mean	65,62
	Std. Deviation	18,947
Most Extreme Differences	Absolute	,093
	Positive	,054
	Negative	-,093
Kolmogorov-Smirnov Z		1,330
Asymp. Sig. (2-tailed)		,058

The results of the normality test analysis above indicate that the data are normally distributed with an index of 0.058 = 5.8%> 5% meaning Ho is received, the data is normally distributed.

Table 10b. Results of analysis of Posttest Normality Test Data on Field Test

		Student Reasoning
N		206
Normal Parameters a,b	Mean	75,17
	Std. Deviation	15,845
Most Extreme Differences	Absolute	,088
	Positive	,065
	Negative	-,088
Kolmogorov-Smirnov Z		1,262
Asymp. Sig. (2-tailed)		,083

The results of the normality test analysis above indicate that the data are normally distributed with an index of 0.083 = 8.3%> 5% meaning Ho is received, the data is normally distributed. Based on the results of data normality testing and it is known that the data are normally distributed, the next step is to test the hypothesis using the t-test to find out whether the students' reasoning abilities for pretest and posttest are the same or different. The results of the t-test test analysis can be seen in the following Table 11:

Table 11. Results of Analysis of Field Implementation Tests

Class		N	Mean	Std. Deviation	Std. Error Mean
Student Reasoning	1 Pre	206	65,62	18,947	1,320
	2 Pos	206	75,17	15,845	1,104

Independent Samples Test

Student Reasoning	F	Sig.	t	df	Sig.(2-	Mean

					tailed)	Difference
Equal variences assumed	14,328	0,000	-5,550	410	0,000	-9,551
Equal variences not assumed			-5,550	397,561	0,000	-9,551

From Table 11, the value of F = 14, 328 is obtained. Because the value of 14,328 = 1432.8%> 5%, the data have the same variant. Because the variance values of the same variables note the value of sig. (2-tailed) on the asumed equal variance that is 0,000 <0.05 means that the students' reasoning ability at the time of the pretest and posttest is different.

The quality of reasoning abilities (analogies and generalizations) of junior high school students is low, which is only 49% of the ideal score [26]. Likewise, the results of students' mathematical reasoning abilities are still classified low. Achieving the lowest reasoning ability in aspects provides an explanation of models, facts, characters, relationships or patterns that exist [27]. Students' mathematical reasoning abilities can be improved by applying the learning process of Problem Based Learning models [28]. The instructional design of RME informs the task completion step where students develop mathematical ideas and procedures through solving challenging problems so as to enhance students' reasoning skills [29]. The development of an advanced organizer model can improve student learning activities and outcomes, the results of this study support the results of the research conducted, namely the development of an advanced organizer model can improve student reasoning in elementary schools [30]. Motivation, attention, relevance, self-confidence, and satisfaction of classroom learning with better project-based advance organizer learning. This supports the results of research into the development of an open ended-based advanced organizer model to improve student reasoning [31]. Classes with advanced organizer learning can improve critical and creative thinking skills [32]. The prototype of questions developed using the open-ended approach has a positive potential effect on student learning outcomes, as indicated by variations in student answers [33].

From the results of the study indicate that the development carried out can solve problems in research. Students' reasoning skills can be improved by developing it to fraction material in grade 4 elementary school. The implication of this research is that the teacher or school must provide learning resources / textbooks that present open problems, students in learning using this model get many opportunities to convey ideas / ideas in solving problems or make arguments in making generalizations.

V. CONCLUSION

All respondents agreed that the aspect of reasoning was an important ability in the 2013 curriculum. For the development of learning models in improving student reasoning 97.78% agreed to be developed, 100% of respondents gave recommendations to develop learning models oriented to students' reasoning abilities in elementary schools. Based on the results of data analysis at the field trial stage to find out whether the pretest and posttest students' reasoning abilities are the same or different. It can be concluded that an advanced organizer model based on an open-ended approach is effective for improving students' reasoning in elementary schools on fraction material. Based on data analysis at the product testing stage to find out whether an advanced organizer model based on an open-ended approach is effective for improving student reasoning. It can be concluded that the advance organizer learning model based on the open –ended approach is effective in improving students' reasoning on fraction material in elementary school.

REFERENCES

[1] Ministry of Education and Culture. (2016). Minister of Education and Culture Regulation number 22 regarding Basic and Secondary Education Process Standards. Jakarta: Ministry of Education and Culture.

[2] Ariyana, Y., et al. (2019). The learning handbook is oriented to higher order thinking skills. Jakarta: Directorate General of Teachers and Education Personnel Ministry of Education and Culture.

[3] Sadiq, F. (2008). Reasoning, problem solving and communication in learning mathematics. Yogyakarta: Department of National Education Center for Teacher Upgrading (Mathematics Upgrading).

[4] Astawan, I. G., Sudana, D. N.. Kusmariyatni, N., & Japa, I. G. N. (2019). The STEAM integrated panca pramana model in learning elementary school science in the industrial revolution era 4.0. International Journal of Innovation, Creativity and Change, 5(5), 26-39.

[5] Suharnan. (2005). Cognitive psychology. Surabaya: Heroine.

[6] Schunk, D. H. (2012). Learning theories and educational perspective. Boston: Pearson.

[7] Fisher, A. (2009). Critical thinking is an introduction. Jakarta: Erlangga.

[8] Fauzan, L. (2019). Professional identity of middle school counsellors in East Java, Indonesia, and the development efforts. International Journal of Innovation, Creativity and Change, 5(5), 60-72.

[9] Arianto, A. S., Sulianto, J., Azizah, M. (2019). Analysis of mathematical reasoning abilities of fourth grade students at SD N Gayamsari 02 in the city of Semarang. Synectic Journal, 2 (2), 136-149.

[10] Hidayati, K., N. (2013). Improving students' mathematical reasoning abilities through the learning cycle learning model "5e" by using teaching aids on grade V students of SDN Mudal 03 boyolali. Accessed from http://eprints.ums.ac.id/23192/17/11._ scriptpublikasi.pdf

[11] Nashihah, D., Sulianto, J., & Untari, M., A., U. (2019). Classification of mathematical reasoning abilities of fourth grade students of SD Negeri Tambakrejo 02 Semarang. Indonesian Journal of Educational Research and Review. 2 (2). 203-209.

[12] Hidayatullah, M., S., Sulianto, J., Azizah, M. (2019). Reasoning ability analysis in terms of mathematical problem solving abilities. Thinking Skills and Creativity Journal. 2 (2), 93-102.

[13] Pamungkas, T., Alamsyah, & Turmudi. (2016). The ability to think critically and creatively as well as students' mathematical self-esteem through the advanced organizer model. Journal of Mathematics Education, 1 (2), 119-128.

[14] Parjayanti, A. D., & Wardono. (2013). Comparative study of learning models between inquiry and advance organizer for mathematical reasoning. Kreano Journal, 4 (1), 64-72.

[15] Savuanov, I & Ovsyannikova, I. (2014). Paradigm of the "open-approach" method in mathematics teaching: Focus on mathematical problem solving. International Reviews on Mathematical Education, 23 (2), 32–37.

[16] Triawan, E & Zanthy, L., S. (2019). Improving the Mathematical Reasoning Ability of Grade X Vocational Students through the Realistic Mathematics Education (RME) Approach. Journal On Education, 1 (3), 507-514.

[17] Saleh, M., Prahmana, R.C.I., Isa, M., & Murni. (2018). Improving the Reasoning Ability of Elementary School Students through the Indonesian Realistic Mathematics Education. Journal on Mathematics Education, 9 (1), 41-54.

[18] Namira, Z., B., Kusumo, E., & Prasetya, A., T. (2004). The Effectiveness of Metacognitive Strategies aided by Advance Organizer to Improve Student Chemistry Learning Outcomes. Journal of Chemical Education Innovation, 8 (1), 1271-1280.

[19] Imai, T. (2000). The influence of overcoming fixation in mathematics towards divergent thinking in open-ended mathematics problems on Japanese junior high school students. International Journal of Mathematical Education in Science and Technology, 31 (2), 187-193.

[20] Joyce, B., Weil, M., & Calhoun, E. (2009). Models of teaching. Yogyakarta: Student Library.

[21] Dell'Ollio, J., M., Donk, T. (2007). Models of teaching: Connecting student learning with standartds. London: SAGE Publication.

[22] Becker, J., P., & Shimada, S. (2005). The open ended approach: A new proposal for teaching mathematics. Virginia: National Council of Teachers of Mathematics.

[23] Yumiati & Noviyanti, M. (2017). Abilities of Reasoning and Mathematics Representation on Guided Inquiry Learning. Journal of Education and Learning. 11 (3), 283-290.

[24] Putra, F. G., et al. (2018). The implementation of advance organizer models on mathematical communication skills in terms of learning motivation. Tadris: Journal of Education and Teaching Training, 3 (1), 41-46.

[25] Baig, S & Halai, A. (2006). Learning mathematical rules with reasoning. Eurasia Journal of Mathematics, Science and Technology Education, 2 (2), 15-33.

[26] Priatna, N. (2003). Reasoning Ability and Understanding of Mathematics in Class 3 Students of State Junior High School Bandung. Unpublished Dissertation. Bandung: UPI Postgraduate Program.

[27] Napitupulu, E., E., Suryadi, D., & Yaya, S. Kusumah. (2016). Cultivating Upper Secondary Students' Mathematical Reasoning-Ability and Attitude Towards Mathematics Through Problem-Based Learning. Journal on Mathematics Education, 7 (2), 117-128.

[28] Huda, S., Kharisma, H., N., Qoma, I., & Jermsittiparsert, K. (2020). How can Mathematical Reasoning Abilities be improved ?: A Study Case at Islamic Boarding School. Decimal: Journal of Mathematics, 3 (1), 1-6.

[29] Rasmussen, C., & Marrongelle, K. (2006). Pedagogical Content Tool: Integrating Student Reasoning and Mathematics in Instruction. Journal of Research in Mathematics Education, 37 (5), 388-420.

[30] Rahayu, S., Widodo, A., T, & Supartono. (2010). Development of an Advance Organizer Learning Model to Increase Student Activities and Learning Outcomes. Journal of Chemical Education Innovation, 4 (1), 497-505.

[31] Tasiwan, Nugroho, S., E., & Hartono. (2010). Analysis of the level of Student Motivation in Science-Based Advance Organizer Model Project-based Learning. Indonesian Natural Sciences Education Journal, 3 (1), 43-50.

[32] Alamsyah, T., P., & Turmudi. (2016). Critical and Creative Thinking Abilities and Student's Mathematical Self-Esteem through the Advance Organizer Model. Journal of Mathematics Education, 1 (2), 119-128.

[33] Yusuf, M., Zulkardi., & Saleh, T. (2009). Development of Open-Ended Problems in the Subjects of Triangle and Quadrilateral in Middle School. Journal of Mathematics Education, 3 (2), 48-56.