Problem Solving: A Learning Model to Foster Argumentation and Critical Thinking Ability for Students with Different Academic Abilities

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Abstract: One of the efforts to improve students' argumentation and critical thinking skills in 21st century learning is to apply problem solving learning models by paying attention to students' academic abilities. The type of research used is quasi-experimental with a 2x2 factorial design. The study population was students of class VIII SMPN 18 Padang, while the research sample was students of class VIII.8 and class VIII.7 by taking samples based on certain criteria. The instrument is a data collection technique with a written test. Data analysis was performed by testing the two-way ANOVA hypothesis using SPSS. The results showed that: (1) the problem-solving learning model affected students' argumentative skills and critical thinking. (2) the problem-solving learning model affects the argumentative and critical thinking abilities of students with high and low academic abilities. (3) there is no interaction between the problem-solving learning model and the academic ability of students 'argumentation skills (4) there is an interaction between the problem-solving learning model and the academic ability of students' critical thinking skills. To sum up, problem solving learning model is able to realize students who have critical thinking skills and arguments that can compete in the era of globalization needed in this 21st century education.

Keywords: Problem-solving; Argumentation skills; Critical thinking; Academic skills.

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Introduction

Education in the 21st century requires students to have argumentation skills and critical thinking skills in producing quality graduates who can to compete in the era of globalization. Success in producing quality graduates will be obtained when students can argue and think critically, where students not only remember, memorize, and understand a concept, but students can analyze, evaluate, and create a concept as well as possible. The results of preliminary observations on students of SMPN 18 Padang using argumentation and critical thinking questions indicate that students' argumentation and critical thinking skills are still low. As many as 83.33% of students are in the less category and 16.66% in the sufficient category in critical thinking

skills. Furthermore, 90% of argumentation skills are in the less category and 10% in the sufficient category. This shows that the learning needed in the 21st-century has not been fully resolved. Saifulloh (2012) explain that argumentation and critical thinking skills are needed in increasing national competitiveness in producing quality future generations and being a determining factor for the success and progress of a nation in achieving the demands of 21st century learning.

The results of the observations show that the learning process is still less varied and still teacher-centered. This causes students to be less active in the learning process so that students are less able to develop critical thinking skills during the learning process. The implementation of the 2013 curriculum in schools requires the use of constructivist learning models that

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are able to empower the potential of students to be able to think critically (Mayasari & Adawiyah, 2015; Garad, 2021). Therefore, a learning model is needed that is able to encourage learning experiences and students' skills to be able to think actively (Alkhateeb, 2020; Rahmi et al., 2019; Syamsurizal, 2019; Suyitno, 2021).

Efforts were made to find a solution to the lack of argumentation and thinking skills of students by using problem-oriented learning. Problem-solving learning model is a model that can improve students' argumentation and critical thinking skills because the pattern of argumentation and critical thinking is problem solving. This is in line with the opinion of Kirmizi et al. (2016) that the problem-solving learning model can improve the ability to think critically, ask questions, identify, and solve existing problems. Research conducted by Alberida, (2019) explains that the problem-solving learning model is able to improve students' argumentation and critical thinking skills such as the ability to provide opinions that include evidence and facts, ask and answer in providing solutions and solve and analyze a problem. given problem. Research conducted by Hidjrawan, (2016) that the application of problem-solving learning models is effective in improving students' argumentation and critical thinking skills.

The problem-solving learning model is a model that can orient students to a problem to be solved, so that students can solve problems by searching for data and analyzing data, and can draw conclusions (Alberida, 2020). Argumentation and critical thinking skills are related to academic abilities which are seen in learning outcomes. The academic ability of students is divided into two, namely high academic ability and low academic ability. Students with high academic ability have higher learning outcomes than students with low academic abilities. In this case, the application of problem-solving learning models based on students' high and low academic abilities is expected to help overcome the challenges of 21st- century learning. So that in learning students can develop existing critical thinking skills. Based on these problems, the purpose of this study was to determine the effect of problem-solving learning models on argumentation skills and critical thinking skills based on the academic abilities of students at SMPN 18 Padang.

Method

The type of research is quasi-experimental using a 2x2 factorial design. Students were divided into two groups, namely experimental and control. The population of this research is all class VIII at SMP Negeri 18 Padang, totaling eleven classes. Sampling was based on certain criteria using SPSS so that class VIII.8 was obtained as an experiment using a problem-solving

learning model, while class VIII.7 was a control by applying a direct learning model. The scoring rubric and argumentation descriptors can be seen in Table 1.

Table 1. Assessment Rubric and Description of Critical Thinking

Scoring Guidelines	Score
Not answering, or making wrong claims	0
Making simple or inaccurate claims	1
Make a true claim	2
Provide true claims, with data or facts and evidence	3
Provide true claims, with data or facts and evidence and provide considerations	4

The research instrument for argumentation ability uses indicators, namely, claims, evidence, and considerations. While the instrument for critical thinking skills uses indicators, namely, analysis, evaluation, inference, deductive and inductive. Assessment rubrics and critical thinking descriptors can be seen in Table 2.

Table 2. Assessment Rubric and Description of Critical Thinking

Points	Description
5	The design and description of the answers are correct, clear, specific, supported by strong evidence, have a good frame of mind, are related and integrated, have good and correct equivalents, all aspects appear to be good and balanced.
4	The answers are correct, but not clear, most of the descriptions of the answers are correct, clear, but less specific, the frame of mind is good, interrelated and integrated, the equivalent words are appropriate, there are a few mistakes, all aspects are visible, but not balanced
3	A small part of the design is correct and clear, a small part of the description of the answer is correct and clear but the reasons are not clear, the frame of mind is adequate, a little related, the word equivalent is quite good, there are spelling errors, most of the aspects seem correct
2	The design is less focused or dubious, the description of the answers does not support, the frame of mind is sufficient, and not related to each other, the equivalent words are good, the sentences are incomplete, a few aspects that seem correct
1	All the designs are not correct, the reasons are not correct, the frame of mind and the equivalent words are not good, the overall aspects are not sufficient
0	No answer or wrong answer

Instruments about the ability of argumentation and critical thinking were carried out content validation and test questions to determine the empirical validity, reliability, and level of difficulty and discriminating power of the questions. The results of the calculation of the reliability of the argumentation ability test are 0.71

with high criteria, while for critical thinking skills are 0.60 with high criteria. Furthermore, the data analysis technique was carried out with normality test, homogeneity test, and 2-way ANOVA hypothesis testing, and continued with Bonferroni further test with the help of SPSS.

Result and Discussion

The results of research on the effect of problem-solving learning models on the argumentation of students with different academic abilities can be seen in Table 3, 4, and 5.

Table 3. Results of Problem-Solving Research on Argumentation Ability Based on Students' Academic Ability.

Average Argumentation Ability Based on Academic Ability				
Classes	Average	Academic Ability	Average	SD
Experiment	80.31	High	86.25	3.87
		Low	74.37	4.03
Control	75.00	High	81.00	3.87
		Low	69.00	3.87

Table 4. Normality and Homogeneity Test Results of Argumentation Ability

Parameter	Classes		Information
	Experiment	Control	
Normality	0.07	06	Normal
Homogeneity	0.99		Homogeneous

Table 5. Two-way ANOVA Test Results of Argumentation Ability and Academic Ability

Parameter	Mean square	F	Significance	Information
Class (Model)	436.99	28.51	0.00	Significant
Academic Ability	2.206.51	143.99	0.00	Significant
Class*Academic Ability	0.60	0.00	0.95	No Interaction

$\alpha = 0.05$

The results of the normality and homogeneity test for argumentation ability showed normal and homogeneous data with a value of > 0.05, then the results of the two-way ANOVA test showed significant results, namely with a value of < 0.05 except for the class parameter, academic ability for argumentation ability.

The argumentation ability of the experimental class students is better than the control class. It can be seen from the average, normality test and homogeneity test that the value of the argumentation ability of the experimental class is higher than the value of the argumentation ability of the control class students. This can be a reference that the problem-solving learning

model affects the argumentation ability of students. This is supported by research by Latif (2016) that the problem-solving learning model affects the argumentation ability and learning outcomes of students in understanding learning materials. Argumentation skills are important for students to have in building arguments and being active in discovering new knowledge. The application of the problem-solving learning model has a positive impact in improving the argumentation ability of students. This problem-solving learning model can help students to be skilled in analyzing various problems effectively and communicatively and can find alternative solutions in small groups so that students' argumentation skills will appear. Eskin and Bekiroglu, (2015) state that this argumentation ability is not easily obtained without continuous practice. Exercise for students can be continued with problem-oriented learning, so that in this learning it will bring up the argumentation ability of students. This problem-solving learning model encourages the success of students in solving problems by emphasizing reasoning that can train and be meaningful for students. The use of problem-solving models directs students to express their opinions in order to solve existing problems. As a result, it is easier for students to express their opinions during discussion activities, presentations, and when doing exercises.

The first stage of learning the problem-solving model is the introduction, at this stage students' know the learning material, here students begin to be trained to prepare their own arguments so that they can develop indicators of claims, evidence, and considerations. This is supported by research by Surif et al. (2012), and Kirmizi (2014) that, in the early stages of learning, students are able to prepare ideas, arguments, investigate, and seek the truth of the problems given. The next stage is observation, at this stage students are given a picture or a discourse about the material of the human digestive system, which is able to form the curiosity of students, then at the initial problem stage, at this stage students are able to give a question of what have been seen, and are able to provide hypotheses or temporary answers from the images or discourses provided, this makes students active in building their arguments, students are able to make claims or provide an answer or identify a given problem. This is supported by research (Eskin and Bekiroglu, 2013), the use of problem-solving models can improve argumentation skills because it can train students' abilities in problems related to real life.

Next is the stage of collecting data and information, students carry out discussion activities with their group friends and continue with the stage of organizing data and analyzing data, at this stage students are able to present and analyze data about learning material for the human digestive system, here students are able to

develop argument indicators, namely claims, evidence, and considerations, where students are able to identify, find evidence or facts and provide explanations regarding the arguments given by students on a problem. This is supported by the research of Osborne et al. (2016), Wang and Buck, (2016), and Eskin and Bekiroglu, (2013) that, at each stage of learning the problem-solving learning model students are able to build their arguments well in building explanations to generate new knowledge, and can make decisions related to problems in science. The next stage is communication, this stage is a question-and-answer discussion through the WA group, at this stage it is able to build the activeness of students in giving and answering questions related to a problem. At this stage, students actively provide their respective arguments on an available problem, this makes students able to solve problems by providing their respective arguments or opinions. This is in line with Ruci's opinion (2020) that the use of problem-solving learning stages in learning activities can develop students' abilities to find a new concept from the problem-solving activities carried out.

Furthermore, based on the research results obtained, in the experimental class and control class, students are equally divided into students with high academic ability and low academic ability on argumentation skills. Academic ability affects the intellectual development of students. Students with high academic abilities tend to think systematically in conveying arguments that are supported by provable data and knowledge, so that these students also have high argumentation skills. Students who have high academic abilities have better arguments than students with low academic abilities. This is in line with Noviyanti's research (2019), Prayitno (2017), and Crowel (2014) that academic and intellectual abilities affect the argumentation ability of students, where students with high academic abilities are easier to construct their thoughts in providing an argument related to problem solving and easier to understand learning material than students with low academic abilities. According to Razali, (2017) that students with high academic abilities get higher learning outcomes than students who have low academics after being given the same treatment.

Based on the results of the two-way ANOVA test, it states that there is no interaction between the learning model and the academic ability of the argumentation ability. It can be seen in the curve (Figure 1), that there is no effect between the learning model and the students' academic ability on the argumentation ability.
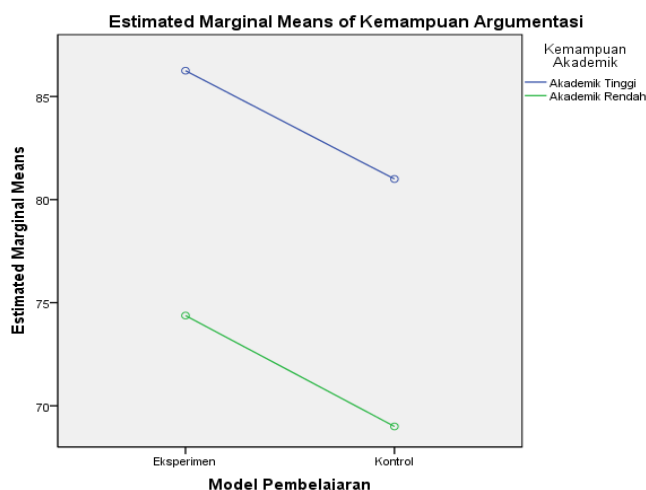

Figure 1. Interaction between learning model, academic ability and argumentation ability

The existence of equality of argumentation abilities of students based on academic level in problem solving learning is influenced by internal and external factors such as learning materials, time, environment and students' learning experiences. This is supported by research by Nurabadi (2021), and Hasanah, (2020) which states that, the absence of interaction between learning models and academic abilities is influenced by external and internal factors of students that cannot be controlled, external factors such as the learning environment, and preparation and length of teacher experience. in teaching. In addition, because of the strong influence of each independent variable and moderator on the dependent variable. Furthermore, the results of the Bonferroni further test in Table 5. show that there are significant differences between groups of students with high academic ability and low academic ability in the experimental class and control class. The significance value between groups of academic ability is less than (alpha), so there are significant differences in all groups.

The results of research on the effect of problem-solving learning models on critical thinking skills of students with different academic abilities can be seen in Table 6, 7, and 8.

Table 6. Results of Problem-Solving Research on Critical Thinking Ability Based on Students' Academic Ability.

Average Critical Thinking Ability Based on Academic Ability				
Classes	Average	Academic Ability	Average	SD
Experiment	78.62	High	84.75	3.92
		Low	72.50	3.83
Control	72.53	High	81.33	5.16
		Low	63.73	5.54

Table 7. Normality and Homogeneity Test Results of Critical Thinking Ability

Parameter	Classes		Information
	Experiment	Control	
Normality	0.18	0.20	Normality
Homogenity	0.21		Homogeneous

Table 8. Two-way Anova Test Results Critical Thinking Ability and Academic Ability

Parameter	Mean square	F	Signifikance	Information
Class (Model)	574.58	26.54	0.00	Significant
Academic Ability	3.449.11	159.36	0.00	Significant
Class* Academic Ability	110.79	5.11	0.03	No Interaction

α = 0. 05

The results of the normality and homogeneity test for critical thinking skills showed normal and homogeneous data with a value > 0.05, then the results of the two-way ANOVA test showed significant results with a value of < 0.05. Furthermore, further Bonferroni test was carried out to determine significantly different groups, which can be seen in Table 9, and 10. The results of the analysis show significant differences in academic ability in the two sample classes. This can be seen from the asterisk (*) on the average value between groups of academic ability of the two sample classes.

Table 9. Bonferoni Advanced Test Results of Students' Academic Ability (Argumentation Ability)

Ability	Experiment KAT	Experiment KAR	Control KAT	Control KAR
Experiment KAT				
Experiment KAR	11.87*			
Control KAT	5.25*	11.87*		
Control KAR	17.25*	5.37*	12.00*	

Information.
KAT: High academic ability
KAR: Low academic ability.
* Significant value

Table 10. Bonferoni Advanced Test Results of Students' Academic Ability (Critical Thinking Ability)

Ability	Experiment KAT	Experiment KAR	Control KAT	Control KAR
Experiment KAT				
Experiment KAR	12.25*			
Control KAT	3.41	12.25*		
Control KAR	21.01*	8.76*	17.60*	

Information.
KAT: High academic ability
KAR: Low academic ability.
* Significant value

The critical thinking ability of the experimental class students was better than the control class. This can be seen from the average, normality test and homogeneity test. This is a reference that the problem-solving learning model affects students' critical thinking skills. This is supported by research by Alberida (2019), and Ruci (2020) explained that problem solving can improve students' critical thinking both in solving problems in the learning process. According to Listiani et al. (2006) research explained that the problem-solving learning model has an effect on students' critical thinking skills. Rumi, (2017) that problem solving can improve critical thinking skills, ask questions, identify, and solve existing problems. The problem-solving model consists of seven syntaxes, where in the first stage, namely the introduction, at this stage students' know the learning material, namely the human digestive system, at this stage students have begun to be trained in analyzing a given problem. This is supported by research by Setiawati, and Corebima, (2017) that problem solving models make students able to think critically on a given concept.

The next stage is observation, at this stage students are given a picture or a discourse about the learning material, with the aim of stimulating the curiosity of students, then at the initial problem stage, at this stage students are able to give a question from what they have seen as well as being able to provide hypotheses or temporary answers from the images or discourses provided, this makes students active in solving real problems regarding learning materials. Students begin to analyze a given problem critically. According to Permana et al. (2019), the problem-solving model involves students in solving problems in order to develop higher ways of thinking. In addition, the learning experience of students, both direct experience and indirect experience, can also build students' attitudes to have critical thinking skills.

Next is the stage of collecting data and information, students carry out discussion activities with their group friends and continue with the stage of organizing data and analyzing data, at this stage students' are able to present and analyze data about learning materials, here students are able to develop all critical thinking indicators such as analyzing, inference, evaluate, deductive or inductive. Students can analyze and re-evaluate the hypotheses given at the beginning of learning. so that at this stage the participants are able to think critically scientifically by applying the problem-solving model. This is supported by research by Rumi (2017), Komariah (2011), and Listiani (2017) that the problem-solving model forms students to think systematically, trains students to find an invention in finding a way out of the situation at hand. The next stage is communication, this stage is a question-and-answer discussion through the WA group, at this stage it is able

to build the activeness of students in giving and answering questions related to a problem. At this stage, students are able to develop their respective critical thinking indicators on an available problem, such as students being able to analyze questions from their friends and be able to provide conclusions from a problem regarding the material of the human digestive system. This is in line with Ruci's opinion (2020) that the use of problem-solving stages in learning activities can develop students' abilities to find new concepts, and develop students' critical thinking from problem solving activities carried out.

Furthermore, based on the research results obtained, in the experimental class and control class students are divided into students with high and low academic abilities, where the results show that students with high academics get good results compared to students who have low academics. Academic ability affects the intellectual development of students (Madjid, 2021). Students with high academics tend to think systematically, the achievement of critical thinking skills will also be better than students with low academic abilities. According to Latif's research (2016), Setiawati and Corebima, (2017), and Permana et al. (2019) explains that, students who have high abilities can solve problems better than students who have low abilities. In this case the learning model affects students' critical thinking. As the opinion of Rasyid, (2015) which states that groups of students who have high academic abilities get better results than groups of students with low academic abilities.

Based on the results of the two-way ANOVA test that there is an interaction between the learning model and academic ability on students' critical thinking skills (Fig. 2) with a correlation coefficient value of 0.60 the criteria are sufficient. From the curve, it can be seen that there is an influence between the problem solving model and academic ability on students' critical thinking skills.
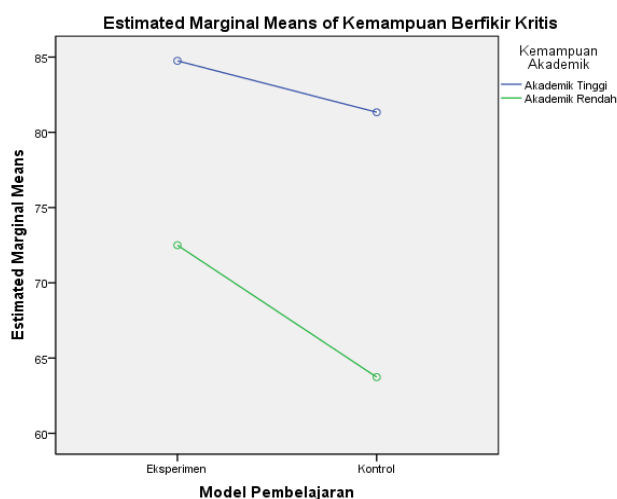

Figure 2. Interaction Between Learning Model, Academic Ability And Critical Thinking Ability.

Furthermore, the results of the Bonferroni further test in Table 10 show that there are significant differences between groups of students with high and low academic abilities. The significance value between groups of academic ability is smaller than except in the control class with high academic ability and the experimental class with high academic ability. There is no high academic difference between experimental and control class students because students in the two sample classes have almost the same or equivalent academic abilities. Suhandri, (2017) explains that, the connection ability is uniform (not varied), and is in the very good category. that is, all students can answer the test questions correctly and completely and show an understanding of concepts and the right learning process.

Conclusion

Problem solving learning models on argumentation skills and critical thinking skills with different academic abilities of students obtained: (1) problem solving learning models affect students' argumentation and critical thinking skills (2) problem solving learning models affect students' argumentation and critical thinking abilities students with high and low academic abilities. (3) there is no interaction of problem-solving learning model with academic ability on students' argumentation skills (4) there is interaction of problem-solving learning model with academic ability on students' critical thinking ability. In this case, problem solving learning is able to realize students who have critical thinking skills and arguments that can compete in the era of globalization needed in this 21st century education.

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