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Using Toulmin's Argument Pattern on Problem Solving Model to Improve Problem-Solving Analysis Ability: Learning Alternatives During the Covid-19 Pandemic

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ABSTRACT

The lecture process even in the Covid-19 pandemic must continue. The right of students to obtain good teaching must still be fulfilled. Lectures are conducted online using the Zoom, WhatsApp, Google Drive, Google Form platforms. The platform is assembled in a problem solving model with Toulmin's Argument Pattern. Problem solving analytical skills are the main focus of the Statistics course. This study aims to improve students' analytical problem solving skills, describe their improvement and describe student responses with Toulmin's Argument Pattern in problem solving models. The research design used a one group pre-test and post-test design. The research subjects were 30 students of the Unesa Physics Department. The instruments used in collecting data include: (1) problem solving analysis ability test sheets, (2) student response questionnaires. The research data scores that have been collected after going through a series of prerequisite tests, normality tests and homogeneity tests are then analyzed using paired t-tests to find out if there are differences in pre-test scores and post-test scores for solving analytical skills. student problems. The mean level of improvement in pre-test scores and post-test scores was calculated using normalized gain. The results showed an increase in problem-solving analytical skills in the medium and high categories. Student responses in lectures were very positive.

INTRODUCTION

The lecture process even in the Covid-19 pandemic must continue. The right of students to obtain good teaching must still be fulfilled. Future lecture activities include developing skills needed in the 21st century. 21st century skills are considered capable of strengthening social capital and intellectual capital (Dorongin, 2017). Communication skills, collaboration, critical thinking and problem solving, creative and innovative. One of the fundamental abilities that must be achieved by students is problem solving ability (Bilgin, 2015). Statistics is a compulsory subject for students of the Department of Physics at Unesa. This course trains analytical skills and solving research cases for thesis completion (Faqih & Lukiyadi, 2014). The practical implications are used in Research Methods and Thesis. When working on a thesis there is a research method, here comes the use of statistics to answer the problem formulation presented. With regard to analytical and problem solving skills, each student has varying capacities in completing assignments, for that it is necessary to make efforts to improve analytical skills in problem solving with models or patterns that can help students complete their assignments (Tresnaningsih, 2013; Setyowati et al, 2019).

Problem solving is a process of applying previously acquired knowledge into new, unfamiliar situations (Nurlela, 2018). Problem solving as an attempt to find a way out of difficulties to achieve a goal (Rosbiono, 2017). Problems that need to be considered,

Namely: (1) the problem to find can be theoretical or practical, abstract or concrete, what to look for, how the data is known, and what are the conditions, all of which are the basis for being able to solve the problem, (2) the problem to prove is shows that a statement is true, false, or not both, in the form of a hypothesis and the conclusion of a theorem that must be proven true, then it is appropriate if it is used to solve problems from the statistical material itself. Students can solve problems in Statistics if they are able to analyze and propose arguments (Sugandi, 2015; Meghan, 2015), so that learning that involves the ability to argue can affect problem solving abilities. The form in lectures refers to the interaction process in the form of debate, explanation of the reasoning of a solution related to the substance of claims, data, evidence, and support that contributes to the content of the argument, while argumentation is related to the process of obtaining and compiling these components (Duschl & Osborne, 2003; Erduran, 2014). Six important elements in an argument are claims, grounds, warrants, qualifiers, backings, and rebuttals. Arguing can also improve student learning outcomes and performance (Acar, 2012). The learning outcome in question is an increase in student problem solving. Every student in a lesson really needs an argument that aims to strengthen a student's self-understanding (Enduran & Osborne, 2014).

Argumentation contains three aspects including claim, evidence, and reasoning. Claim is a statement that answers the problem (Akarsu, 2013; Sugandi, 2015). Evidence is scientific data that supports a statement. Reasoning is a reason or justification that connects a statement with evidence. The claim phase is a statement in the form of a problem from the thoughts of each student. In this phase, students make a list in the form of statements regarding problem identification, problem formulation, and problem analysis. In the second phase, Evidence is scientific data that supports a statement. Argumentation plays an important role in building an explanation, model and theory as used by scientists to connect the evidence that has been selected with the idea (claim) to be achieved and strengthened by justification (warrant) associated with the appropriate theory (Erduran, 2014).

Scientific argumentation involves scientific reasoning used to draw conclusions from available information and involves critical thinking skills in making a statement based on facts. Scientific argumentation plays an important role in instilling scientific concepts in students which are the core of reasoning ability and academic achievement. Scientific arguments can be used to increase students' understanding of scientific concepts. Increased understanding of concepts will have an impact on problem solving abilities. Analysis of the quality of the argument can be done using a method based on the Toulmin argumentation model (Handayani, 2015).

Arguments are very relevant to lectures since the purpose of inquiry is the development and justification of scientific ideas, actions taken to understand natural phenomena, and commitment to a goal or method that will cause debate among scientists (Sampson, 2016). Arguments attempt to validate or reject an idea or claim that is based on a scientific reason that reflects the behavior of scientists (Maya, 2016). The claim submitted must be in accordance with the evidence used to support the claim submitted. The evidence used is supported by a warrant that can explain the relationship between the evidence and the claim submitted. Claims in scientific arguments are interpreted by conjectures, conclusions, explanations, or statements descriptive research that answers the questions needed in the research. Meanwhile, evidence in scientific argumentation refers to the measurement of observations, or even

findings from previous research that have been collected, analyzed, and then interpreted by researchers (Khodijah, 2015; Sampson et al, 2016). Argumentation skills in lectures have the following contributions to support the existence of cognitive and metacognitive processes, support the development of competence and critical thinking, support the achievement of scientific literacy and train students to speak and write in the language of science, support culturation into scientific cultural practice and develop epistemic criteria for evaluating knowledge, supports the development of reasoning, especially in the selection of theories or determination of attitudes based on rational criteria (Erduran, 2014).

Problem solving is a form of learning based on the constructivism paradigm. In problem solving learning students are required to actively think, try out hypotheses and if they succeed in solving the problem, students learn and acquire new knowledge (Bambang, 2015). There are two meanings to the term problem solving, the first is defined as the process of solving problems, especially for questions involving numeric. Second, as a problem-solving strategy that is carried out in problem-based learning which is a form of active learning. Problem solving learning is very potential in the formation of creative thinking and critical thinking (Victor, 2016). Critical thinking describes an analysis and development of possibilities for contrasting ideas, thoughts that can be used as material in making effective judgments and decisions. Productive thinking is expressed in the form of creating variations of ideas, creating unusual ideas, providing opportunities to choose the best alternative activities, or providing arguments in determining a choice. Solving problems is the most complex type of learning because it is related to other types of learning, especially the use of existing rules accompanied by a process of analysis and inference. With this type of problem solving learning, children's reasoning abilities will develop (Sagala, 2014).

Problem Solving learning is learning that begins by exposing students to real problems or simulated problems, working together in a group to develop problem solving skills or Problem Solving, then students presenting so that students are expected to become individuals who are able to learn independently (Dahar, 2016).

The five steps of problem solving identify problems, define and represent problems, explore possible resolution strategies, execute resolution strategies, review and evaluate the effects of problem solving activities (Nitko & Brookhart, 2017; Mayer in Rosbiono, 2017; Arifin, 2015; Bambang, 2015). Problem solving is focused on three aspects, namely learning settings, learning structures, teacher behavior during the learning process (Rosbiono, 2017). Problem solving is most effective if the focus of problem solving is not only on intellectual abilities but as a collection of smaller component skills, such as problem solving skills and practice in the problem solving process (Tolga, 2010; Soekismo, 2015). Problem solving is a process that requires logic in order to find a solution to a problem. Students can have problem solving abilities if the tutor teaches them effectively. There are 4 stages of problem solving ability including; (1) Understood the Problem, (2) Device a Plan, (3) Carry Out the Plan, (4) Look Back (Tambunan, 2014). Students' analytical skills can be achieved by applying problem-solving steps that can be used to find a way out of a problem (Bilgin, 2015). So that students are expected to understand the relationship between facts and concepts in the case of classroom learning. The development of understanding and the ability to utilize facts becomes very important in solving cases, because they are useful in dealing with everyday problems (Josef, et al., 2015).

This research will (1) improve students' analytical problem solving skills in Statistics courses and describe their improvement (N-gain); (2) Describing student responses to lectures by applying Toulmin's Argument Pattern, a problem solving model. This research is urgent because it seeks to improve the competence of students' problem-solving abilities through the application of Toulmin's Argument Pattern. The results of the study will also show the response and condition of the competence of students majoring in physics before and after the implementation of the Toulmin's Argument Pattern, increasing problem-solving abilities which then if the results of the application are effective, it can be used to provide recommendations for application to other identical subjects.

RESEARCH METHOD

Place and time

The place of this research was carried out in the physics department of the Unesa FMIPA and the time of the research was during the 2021 registration period lectures. This type of research is descriptive-quantitative to answer the problems posed and solutions will be sought.

Research design

The design is to solve the problems faced by researchers using the One group pre-test-posttest design (Sugiyono, 2014) with the design in Figure 1.

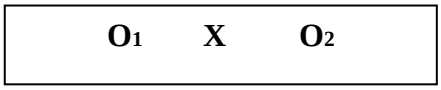

Figure 1. Research design.

Note: O1 = pre test
O2 = posttest
X = treatment toulmin's argument pattern model problem solving

The subjects of this study were 30 physics students in the Statistics program class. The reason for choosing students from this program is that most students have difficulty solving the problems that are their assignments. The research procedur in the Figure 2.

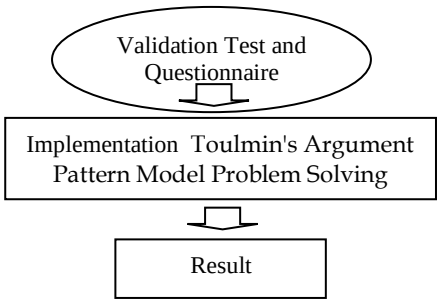

Figure 2. Research procedure.

Research Instruments

The instruments in this study were a test of problem solving analysis skills and student response questionnaires. In this study, a problem solving analysis ability test was used

by giving Toulmin's argument pattern problem solving model with a quasi-experimental approach. The questionnaire that will be used is a closed questionnaire related to the provision of Toulmin's argument pattern problem solving model in lectures. Test Instrument The ability to analyze problem solving before being used was tested for validity and reliability. This is intended to fulfill the requirements of a good test. Likewise, the response to the questionnaire was seen to fulfill its validity.

Data analysis technique

The analytical technique used to solve the problem is by using the success criteria and normalized N-gain. Observational data were analyzed to determine student activity based on the student activity observation sheet. The assessment is seen from the score on the observation sheet used. The percentage obtained from the score on the observation sheet is qualified to determine how much student activity is in participating in the learning process. The test is used to measure students' ability in problem solving.

Student learning outcomes were analyzed based on the scores obtained by students before and after lectures using Toulmin's argument pattern problem solving model. The value of learning outcomes from the pretest and posttest of students was analyzed by N-gain to show the degree of influence of increasing student learning outcomes before and after lectures with Toulmin's argument pattern problem solving model. Analysis of learning outcomes can be calculated using the following equation:

$$\text{Value of learning outcomes} = \frac{\text{Total score obtained}}{\text{Maksimum Score}} \times 100$$

The value of learning outcomes from the pretest and posttest of students was analyzed with N-gain to show the degree of influence of increasing student learning outcomes before and after learning with Toulmin's argument pattern problem solving model.

$$\langle g \rangle = \frac{Spost - Spre}{Smax - Spre}$$

With: $\langle g \rangle$: Score N-gain

Spost : Score *posttest*

Spre : Score *pretest*

Smax : Score max.

The results of the N-gain calculation are then converted to the criteria in Table 1.

Tabel 1. Normalized gain criteria.

N-Gain Score	N-Gain criteria
0.70 < N-Gain	High
0.30 ≤ N-Gain ≤ 0.70	Medium
N-Gain < 0.30	Low

(Arifin, 2015)

RESULTS AND DISCUSSION

1. Improving Student Problem Solving Analysis Ability Through Giving Toulmin's Argument Pattern in Problem Solving Model.

Problem solving analysis skills of the competencies taken are: (1) Understanding problems, Identifying problems; (2) Exploring problem solving strategies; (3) Implementing solving strategies; (4) Looking back and evaluating the effects of problem solving activities; (5) Students ask questions; (6) Irrelevant behavior (Demircioglu & Ucar, 2015). The results of the analysis of competency values before and after students take part in the lecture process are presented in Table 2.

Table 2. Results of competency analysis of the problem solving model.

Competence	Information	*Pretest*			*Posttest*		
		Σ Students	Completeness Indicator	$\bar{x}$	ΣStudents	Completeness Indicator	$\bar{x}$
Understanding the problem	Complete	4	13.33	49.17	28	93.33	86.67
	Not Complete	26			2		
Identify the problem	Complete	6	20.00	34.17	29	96.67	88.33
	Not Complete	24			1		
Explore problem solving strategies	Complete	4	13.3	22.50	28	93.33	80.00
	Not Complete	26			2		
Reviewing and evaluating the impact of problem solving activities	Complete	7	23.33	44.17	26	86.67	79.17
	Not Complete	23			4		
Students ask questions	Complete	6	20.00	32.50	25	83.33	75.50
	Not Complete	24			5		
Irrelevant behavior	Complete	9	30.00	26.67	27	90.00	80.83
	Not Complete	21			3		

Note: $\bar{x}$ = Average value , ΣMhs = sum of Students,

Table 2 shows the competence of students before taking part in the lecture process is generally still low. Most of the students have difficulty applying their skills in solving case study problems of learning in Statistics course. The application of Toulmin's Argument Pattern in problem solving models can improve the completeness of all competencies (Handayani, 2015), although some students still have difficulty in certain aspects (Akarsu, 2013). The value of N-gain and sensitivity in Statistics lectures can be seen in Table 3.

Table 3. N-Gain and sensitivity values in lectures.

No	Competence	*N-Gain*		Sensitivity	
		Coeficien	Information	Coeficien	Information
1	Understanding the problem	0.93	High	0.46	sensitive
2	Identify the problem	0.82	High	0.60	sensitive
3	Explore problem solving strategies	0.74	High	0.62	sensitive
4	Execute the settlement strategy	0.63	Medium	0.34	sensitive
5	Reviewing and evaluating the impact of problem solving activities	0.64	Medium	0.12	not sensitive
6	Students ask questions	0.85	High	0.56	sensitive
7	Irrelevant behavior	0.40	Low	0.36	sensitive

Table 3 shows that increasing competence in understanding problems, identifying problems, exploring problem solving strategies, students asking questions, in high criteria, irrelevant behavior, in low criteria. The student competencies used are generally good and sensitive to the lecture process, except for looking back and evaluating the effect of problem solving activities not yet sensitive to the lecture process (Herlianti, 2012).

2. Student responses after giving Toulmin's Argument Pattern, in the Problem Solving model

The results of student responses during lectures by applying Toulmin's Argument Pattern, problem solving models are presented briefly in Table 4.

Table 4. Results of student response analysis in lectures.

Student Response Component	Response Yes		Response No	
	Sum	%	Sum	%
1. The novelty of the learning process:				
a. How lecturers teach	28	93.0	2	6.7
b. Language of instruction	27	90.0	3	10.0
c. Language and content of case study sheets	27	90.0	3	10.0
d. Learning atmosphere in class	29	96.7	1	3.3
2. Clarity of delivery of Toulmin's Argument Pattern in Problem Solving Model by lecturers:				
a. Use clear and concise questions.	29	96.7	1	3.3
b. Give a reference	29	96.7	1	3.3
c. Focusing	29	96.7	1	3.3
d. Spread the question	29	6.7	1	3.3
e. Shifting turn	29	96.7	1	3.3
f. Give time to think	29	96.7	1	3.3
a. Using tracker questions	27	90.0	3	10.0
b. Increase interaction	27	90.0	3	10.0
3. Clarity of problem solving stages to measure competence by lecturers:				
a. Understanding the problem	29	96.7	1	3.3
b. Identify the problem	29	96.7	1	3.3
c. Explore problem solving strategies	25	83.3	5	16.7
d. Execute the settlement strategy	23	76.7	7	23.3
e. Reviewing and evaluating the impact of problem solving activities	23	76.7	7	23.3
f. Students ask questions	25	83.3	5	16.7
g. Irrelevant behavior	24	80.0	6	20.0
h. Drawing conclusions	29	96.7	1	3.3
4. Ease of working on the assessment sheet:				
a. Pedagogic ability	24	80.0	6	20.0
b. Professional ability	20	66.7	10	33.3
5. Interested if the Toulmin's Argument Pattern model is applied to:				
a. Next material	28	93.3	2	6.7
b. Other courses	24	80.0	6	20.0

Table 4 shows that most of the students feel new with the learning process that has been carried out, feel clear with the information conveyed by the lecturer, find it easy to learn and work on learning case studies (Junianto, 2015), and are interested in giving Toulmin's Argument Pattern, problem model solving is applied to other subjects. With the emergence of novelty in teaching given by lecturers, it will increase student curiosity and a new learning atmosphere. As a result, students are more active in discussing and solving the problems presented will be better.

CONCLUSION

The conclusions obtained after conducting research on improving analytical problem solving skills in Statistics courses through the provision of Toulmin's Argument Pattern problem solving model for undergraduate physics education students are as follows. Increasing students' problem solving analysis skills for Statistics courses in the aspects of: (1) understanding the problem of high and sensitive increments, (2) Identifying high and sensitive increment problems, (3) Exploring strategies for solving high and sensitive increment problems, (4) Carrying out the settlement strategy the increase is moderate and sensitive, (5) Looking back and evaluating the effect of problem solving activities, the increase is moderate and insensitive, (6) Students ask questions with high and sensitive increases, (7) Irrelevant behavior, the increase is low and sensitive. 2. Student responses after giving Toulmin's Argument Pattern in the Problem Solving model of Statistics lecture activities are very positive. Students feel new with the learning process that has been carried out, feel clear about the information conveyed by the lecturer, find it easy to learn and work on learning case studies, and are interested if it is applied to other subjects. Toulmin's Argument Pattern, with problem solving that received a very positive response by students programming Statistics courses, can be applied to other courses to see the consistency of good research results. This research is limited to only one class, so necessary to examine the number of classes that are more than one and in other study programs in universities in Surabaya.

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