Causalistic-learning model to improve reasoning-ability in learning physics in terms of student creativity during the covid-19 pandemic

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Abstract. This study aims to examining the effect of 1) the causalistic-learning model (CLM) on reasoning-ability (RA), 2) creativity on RA, and 3) the interaction between the CLM and creativity on RA. This research is quasi-experimental with a 2x2 factorial design. The population is all students of class X-IPA. Sampling uses purposive-technique with consideration of the ability and support of parents in facilitating students and obtained students of class X-IPA-3 (31-students) as an experimental class and class X-IPA-4 (30-students) as a control class. The data of RA and creativity were gathered by using four description-tests. The results show that the data is normally distributed and homogeneous as indicated by $\chi^2$ (10.87) < $\chi^2$ table (11.07), $F_{count}$ (1.57) < $F_{count}$ (1.85) (for RA) and $F_{count}$ (1.50) < $F_{count}$ (1.85) (for creativity). The hypothesis was tested using two-way ANOVA with the help of the SPSS 18 application. The conclusion is that in learning physics during the Covid-19 pandemic: 1) there is an influence of the CLM on RA, 2) there is an influence of creativity on RA, and 3) there is no interaction effect between the CLM and creativity on RA. Recommendation: In implementing a CLM to improve RA, it is better to use creativity-related phenomena in the form of pictures to facilitate students to do causality-thinking and argument formulation.

1. Introduction

1.1 Online Learning during the Covid-19 Pandemic

Currently, the development of information technology makes people think about how to make decisions quickly and correctly in all activities carried out, especially during the Corona Virus Disease (Covid-19) pandemic. Covid-19 is a disease that is endemic in 188 countries in the world [1]. This pandemic has an impact on all areas of life, one of which is the field of education such as closing schools and implementing learning from home policies. The learning policy from home is one of the steps to prevent the spread of Covid-19.
The existence of this condition does not mean learning is stopped but requires teachers to innovate in the learning process. One of these innovations is learning to use information technology or online. Online learning is a form of distance learning that utilizes telecommunications and information technology, for example, the internet, CD-ROOM (directly and indirectly) [2]. Online learning connects students with learning resources that are physically separate or even far apart but can communicate, interact, or collaborate directly and indirectly [3, 4], shows that online-based learning affects physics learning outcomes on the concept of impulse and momentum (student learning outcomes using online learning are higher than using conventional learning). However, online learning is inseparable from the problems that become obstacles in its implementation, such as being unfamiliar with online learning itself [5].

1.2 The ZOOM Cloud Meetings (ZOOM) Application as an Online Learning Media
This requires the selection and use of online learning media that can facilitate this condition. Through advances in information technology, there are currently many educational site facilities that provide learning platforms and applications that can be used so that online learning can be carried out such as learning in class. One such application is the ZOOM Cloud Meetings (ZOOM). ZOOM is an application that allows teachers to do face-to-face learning such as in-class and interact communicatively. This is because ZOOM provides features that can support the learning process like learning in class.

The features in question include Breakout Rooms for group discussions, Share Screen to display teaching materials in the form of videos and power points, Whiteboards to explain, Chats to send messages individually or classically, and Records to record activities carried out during learning. Learning using ZOOM makes teaching and learning activities more effective such as face-to-face teaching activities in the class [6]. ZOOM is listed as the number one application that is widely used with 257,853 users, followed by Skype in second place with 71,155 users [7]. The use of ZOOM as a learning medium is a form of creativity in combining previous, useful, and understandable things in solving problems faced to train and improve students' reasoning ability.

1.3 Observation Results at Madrasah Aliyah Negeri (MAN) 2 Mataram
In learning, the teacher is the subject of student creativity in training and improving students' reasoning ability, and vice versa [8] revealed that creativity in thinking is one of the main goals of all education in the world. This shows that the reasoning ability must be trained and improved in learning. However, the results of observations that have been made in MAN 2 Mataram illustrate that the students' reasoning ability is still very low. The low of students' reasoning ability can be seen from the low creativity of students, namely the absence of enthusiasm, willingness, awareness of students to ask questions, and express ideas which are a form of creativity as an understanding of material understanding. Besides, in the learning process, busy students become good recipients of information, as a result, students only imitate what the teacher does, without meaning and understanding so that when solving problems students feel that they are sufficient to do what is exemplified. This situation then makes it difficult for students to find other possible correct answers when solving a problem which is one indicator of creativity.

1.4 Research Focus
Low creativity will have an impact on students' reasoning ability which can not develop because creativity has an important role in students' reasoning ability [9] states that to succeed in reasoning at the right level, students need the right ways to get and have the opportunity to be creative. This can also be seen from the results of research conducted by [10], there is a significant and positive relationship between creativity and reasoning ability with mathematics learning achievement. In line with [11], states that there is an increase in student activity while studying physics and the level of reasoning is at the level of functional reasoning.

The reasoning ability in physics learning, among others, can be seen from its ability to formulate arguments from new ideas, solve problems in physics, arrive at conclusions by giving reasons. [12]
defines reasoning ability as the ability to think logically about the relationship between concepts and procedures that are generalized in a sensible way so that it can show the possibility of solving problems that must be constructed in a reasoned way. Through the reasoning ability of students will be able to provide solutions to problems using their intuitive application to prove the solution and use steps of analysis or justification [13], [14]. Furthermore, one way to improve reasoning ability is to present learning that encourages students to look for or solve problems.

1.5 Causalitic Learning Model As One of Learning Model That Can Improve Reasoning Ability

One of the learning models that is expected to help teachers, especially physics teachers at MAN 2 Mataram in improving students' reasoning ability, is the causalitic learning model. This is based on several kinds of research conducted by [15] and [16], that the causalitic learning model can increase student learning activities where students are trained to solve problems that are causalitic and require more than one answer. Research conducted by [17], revealed that the causalitic scaffolding approach to thinking affects improving students' problem-solving ability and creativity. The causalitic learning model is a learning model designed based on causalitic and analytic thinking approaches. This thinking approach directs students to be able to analyze (think causally) and arrange rationalizations (analytical thinking) in the form of arguments to explain physical phenomena [18]. The causalitic learning model consists of 4 learning phases, namely: (1) the orientation phase (2) the exploration phase and the development of the concept of causality (3) the argument preparation phase (4) the evaluation phase (ibid). The description of the problem then made researchers interested in discussing further the effect of the causalitic learning model on the ability to reason in physics in terms of student creativity during the Covid-19 pandemic.

2. Method

2.1 Type of Research

This quasi-experimental study used a 2x2 factorial design. A study has several research variables so that readers know the flow of the study. This study involved independent variables is the causalitic learning model, the dependent variable is the reasoning ability in physics learning, the moderator variable is creativity, and control variables is teaching materials, teachers, the ZOOM Cloud Meeting Application, and test instruments.

2.2 Population and Sample

The population in this study were all students of class X IPA MAN 2 Mataram. The sampling technique used purposive sampling with the consideration that the initial ability of the two classes was relatively the same, the teacher who taught the same, the learning time in both classes was the same, and the ability of both classes and the existence of the same facilities from parents during online learning. Based on the results of interviews with teachers at MAN 2 Mataram and communication with parents of students, it was obtained X IPA 3, which amounted to 31 students as the experimental class, and X IPA 4, which amounted to 30 students as the control class.

2.3 Instruments and Procedures

The data on reasoning ability and creativity were obtained through the essay test instrument with a total of 4 questions. The indicator of reasoning ability (IKB) that is used is ordering, namely the ability to sort the conditions that are the cause (IKB-1); predicting, namely the ability to predict various possible consequences (IKB-2); analyzing, namely the ability to analyze the causes which are a factor of each predicted effect (IKB-3); controlling, namely the ability to control by determining which concepts, principles, theories, and/or laws of physics can be used to support identifying several causes (IKB-4); and applying, namely the ability to apply concepts, principles, theories, and/or laws of physics represented in arguments for the occurrence of each predicted effect (IKB-5).
Meanwhile, the indicator of creativity (IK), namely fluency, shows that students can choose the possible consequences (IK-1); flexibility, showing students to provide arguments involving concepts, principles, theory, and/or law (IK-2); originality, showing students making arguments with a unique wording of their ideas, not from books and/or other sources (IK-3); and elaboration, showing students detailing and developing each element that causes the phenomenon to occur (IK-4) in the adaptation of [19]. The test instrument for reasoning ability and creativity before being used in this study must meet several requirements, namely the validity, reliability, difficulty level, and difference power test.

This research was conducted in five meetings, the first and fifth meetings were used for the pretest and posttest respectively, where all research activities were carried out online using the ZOOM application due to the Covid-19 pandemic which requires all learning activities to be carried out from home. The experimental class was treated with a causality learning model, while the control class was given conventional learning treatment. The two classes were then given learning for 3 meetings with a time allocation per meeting of 120 minutes or 3 hours of lessons on momentum and impulse material according to the schedule set by the school during Covid-19.

2.4 Data Analysis
The hypothesis in this study was tested using a two-way ANOVA with the SPSS 18 application. The criteria used were if $\text{sig} \leq 0.05$, then $H_{A0}$ is rejected, which means that there is an influence of the causality learning model (CLM) on reasoning ability (RA); $H_{B0}$ is rejected, meaning that there is an effect of creativity on RA; and $H_{AB0}$ is rejected, meaning that there is an interaction effect between CLM and creativity on RA.

3. Results and Discussion
Following with the objectives of this study, the presentation of the results of this study includes three things, first is the test of the causality learning model on reasoning ability in learning physics during the Covid-19 pandemic. Second, to test students’ creativity in reasoning ability in learning physics during the Covid-19 pandemic. Third, testing the interaction of the causality learning model with creativity on reasoning ability in learning physics during the Covid-19 pandemic. The research data obtained were analyzed using two-way ANOVA assisted by SPSS 18. The following are the results of the two-way ANOVA test with SPSS 18.

| Table 1. The results of creativity |
|---------------------------------|
| Class | Creativity group | N | Max value | Min value | Average |
|       | High | Low |          |          |         |
| Experiment | 14 | 17 | 31 | 75 | 10 | 68 |
| Control   | 11 | 19 | 30 | 73 | 4  | 46 |

Table 1 shows that the quantity of students with high and low creativity in the two classes is not much different. The data above indicate there are 14 and 11 students with high creativity and 17 and 19 students with low creativity. Furthermore, the effect of causality learning model on reasoning ability can be observed based on the results of the pre-test and post-test. The following is the test result data in the experimental class and control class.

| Table 2. The results of the pre-test reasoning ability |
|------------------------------------------------------|
| Class | N | Max value | Min value | Average | $F_{\text{count}}$ | $F_{\text{table}}$ | Information |
|-------|---|-----------|-----------|---------|-------------------|-------------------|-------------|
| Experiment | 31 | 80 | 10 | 33 | 1.57 | 1.85 | Homogenous |
| Control | 30 | 80 | 10 | 23 |        |                  |             |             |

4
Table 3. The results of the post-test reasoning ability

| Class      | N  | Max value | Min value | Average | $X^2_{count}$ | $X^2_{table}$ | Information |
|------------|----|-----------|-----------|---------|--------------|---------------|-------------|
| Experiment | 31 | 95        | 45        | 71      | 10.39        | 11.07         | Normal      |
| Control    | 30 | 90        | 25        | 52      | 10.87        |               |             |

Table 2 and Table 3 show that the increase in the average value of reasoning ability in the experimental class (38 points) is increased higher than the control class (29 points). From the two tables, we also know that the data is homogeneous and normally distributed, which means that the type of statistic used as a stage of hypothesis testing is a parametric statistical test.

Table 4. Hypothesis test results with SPSS 18

| Source                  | Type III Sum of Squares | df | Mean Square | F       | Sig.  |
|-------------------------|-------------------------|----|-------------|---------|-------|
| Corrected Model         | 6393.178                | 3  | 2131.059    | 9.180   | .000  |
| Intercept               | 224728.253              | 1  | 224728.253  | 968.054 | .000  |
| Learning (A)            | 3002.649                | 1  | 3002.649    | 12.934  | .001  |
| Creativity (B)          | 1557.609                | 1  | 1557.609    | 6.710   | .012  |
| Learning * Creativity (AB) | 769.666             | 1  | 769.666     | 3.315   | .074  |
| Error                   | 13232.232               | 57 | 232.144     |         |       |
| Total                   | 245875.000              | 61 |             |         |       |
| Corrected Total         | 19625.410               | 60 |             |         |       |

The hypothesis results in table 4 were tested using the SPSS 18 application with a significant value of 0.05. The results obtained are $H_A$ (sig-value 0.001) and $H_B$ (sig-value 0.012) so that $H_{A0}$ and $H_{B0}$ are rejected, while $H_{AB}$ (sig-value 0.074) so that $H_{AB0}$ is accepted. Several causes can be the reasons for the results obtained above. The following is a discussion of the causes and reasons.

3.1. The Reasoning Ability in Learning Physics with a Causalitic Learning Model

There is an effect of the causalitic learning model on the reasoning ability in learning physics during the Covid-19 pandemic. It can be seen from the calculated significance value that is smaller than the significance of 0.05 (0.012 <0.05). The factors that cause the causalitic learning model affect the reasoning ability in physics learning, because the learning stages of this model involve students optimally in learning so that students actively identify and describe the causes of phenomena through a series of activities that train their reasoning ability. This activity triggers and accustoms the development of students' reasoning ability. As stated by [20], for students' reasoning ability to develop optimally, students must have very open opportunities to think and be active in solving various problems.

The application of the causalitic learning model also directs and guides students in ordering, predicting, analyzing, controlling, and applying concepts, principles, theories, and/or laws to physical phenomena. The involvement of students to think actively in learning will stimulate their reasoning ability. This opinion is supported by research conducted by [21], emphasizing that to improve students' reasoning ability, students must be actively involved. The application of the learning model in the experimental class shows that there is a process to train students' reasoning ability, seen from the phenomena presented on the student worksheets (LKS) that students must complete. The ability to reason will develop if it continues to be trained and used. [22], emphasized that reasoning ability can be improved by training and getting used to presenting lessons that encourage students to look for and solve a problem.
This opinion of [22] is relating with the characteristics of the causalitic learning model, specifically a learning model that facilitates students to solve a problem or issue through causal and analytical thinking activities. This causal and analytic thinking activity has advantages, as expressed by Rokhmat [23], including 1) students will be trained to analyze physical phenomena, 2) understand the concept as a whole, 3) think critically and synthesize, 4) think divergent, and 5) answering problems based on the concept of physics. This thinking activity then triggers the development of each indicator of reasoning ability that is measured, especially sorting (students 'ability to sort the conditions that cause it) and applying (students' ability to provide arguments in applying concepts, principles, theories, and/or laws of physics). The results obtained are in line with research conducted by [16], that the application of a causalitic learning model appropriately can significantly improve students' problem-solving ability. The same thing was also expressed by [24], the causalitic approach to thinking is effective in learning physics which is shown by an increase in problem-solving ability. Furthermore [14], explaining about reasoning ability can be improved by practicing and getting used to presenting lessons by encouraging students to look for or solve a problem.

Another factor that results in the influence of the causalitic learning model on reasoning ability in learning physics during the Covid-19 pandemic is that student learning time in the experimental class is well managed. Students actively play a role in discussing solving the phenomena available on the LKS through Breakout Rooms to help and stimulate their reasoning ability. The existence of a Share Screen facility to display physical phenomena (momentum and impulse) in the form of videos and prepared test are also very helpful during the learning process. Through the facilities available at ZOOM, it is very helpful and easy to monitor student activities without having to be afraid of students doing unwanted things and cheating with their friends.

3.2. The Effect of Creativity on the Reasoning Ability

Based on the results of the two-way ANOVA analysis using SPSS 18 (Table 4) the calculated significance value of creativity is smaller than the significance of 0.05 (0.012 <0.05). This means that there is an effect of student creativity on reasoning ability in learning physics during the Covid-19 pandemic. This shows that creativity has a role in students' reasoning ability. [20], stated that the opportunity for creativity makes students succeed in reasoning to the right level. Creativity is defined as an individual mental process that generates new ideas, processes, methods, or products that are effective in various fields to analyze and solve a phenomenon. The attachment of creativity to students can make it easier for students to analyze, identify and solve problems because the concepts obtained will be developed properly so that they can have a positive effect on their reasoning ability, for that creativity is an important thing that students must have.

Furthermore, [8] stated that the ability to think creatively is one of the main goals of all education in the world. The existence of creativity can help in solving problems because the creativity of students can generate new ideas that can be used in solving problems. In line with that [25], explains that as a process of creativity means the ability to make new combinations, as product creativity is defined as new work, used, and can be applied by society at a certain time, as one's creativity means inherent non-cognitive personality traits. in creative people, and as a determinant of the development of creativity it is determined by environmental factors both internal and external.

Students who have high creativity can reason better. This opinion is based on the average value of the reasoning ability in physics learning (momentum and impulse) of students in the experimental and control class with high creativity more than the average score of students with low creativity. As stated by [13] in his research, there is an effect of creativity on reasoning ability. The level of student creativity gives a real role in reasoning ability in learning physics. This causes a significant difference in the physics reasoning ability of students with high and low creativity.
3.3. The Effect of the Interaction between the Causalitic Learning Model and Creativity on Reasoning Ability

The results of the third hypothesis test with SPSS 18 showed that there was no interaction effect between the causalitic learning model and student creativity on reasoning ability in learning physics during the Covid-19 pandemic. It can be seen from the calculated significance value that is greater than the significance of 0.05 (0.074 > 0.05). Based on calculations using SPPS 18, the interaction between the causalitic learning model and students’ creativity in physics reasoning ability is obtained as shown in Figure 1.

Figure 1 shows the interaction of the learning model with creativity on the reasoning ability in learning physics during the Covid-19 pandemic. The interaction relationship lines on the two variables do not experience an intersection at one point, meaning that there is no interaction between the causalitic learning model and students' creativity on reasoning ability in learning physics during the Covid-19 pandemic. This is in line with the opinion of [26] and [27], which states that interactions can occur if the independent variables do not bring consequences separately and individually. Conversely, the interaction can also not occur if more than one independent variable brings significant separate consequences.

There is no interaction effect between the causalitic learning model and student creativity on reasoning ability in learning physics because students with high creativity tend to answer problems on worksheets and tests by choosing several possible correct answers and being able to provide explanations related to these answers using their own language and words which is in accordance with the concept of physics. Whereas students with low creativity tend to answer only by choosing one possible correct answer and provide an explanation related to that answer using book language. The results of this study are in line with the findings of previous studies conducted by [28] and [29], explaining that there is no interaction between learning models and student creativity. This is because the causalitic learning model and student creativity have a separate significant effect on reasoning ability in physics learning.

4. Conclusion

Based on the study, it can be concluded several things, namely the influence of the causalitic-learning model on the ability to reason in learning physics during the Covid-19 pandemic. The causalitic-learning model has a better effect than conventional learning models on reasoning ability in learning physics during the Covid-19 pandemic using the ZOOM application. Creativity also affects the ability to reason in learning physics during the Covid-19 pandemic. The ability to reason in physics learning for students who have high creativity will have a better effect than students with low creativity. However, the causalitic
learning model with creativity does not have the effect of interacting with each other in influencing reasoning ability in learning physics during the Covid-19 pandemic.

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