Relationship Between Critical Thinking Skills and Metacognition Awareness with Learning Outcomes in Science Learning

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Abstract: This research is a quantitative research with correlational research design that aims to (1) analyze the relationship between critical thinking skills and knowledge learning outcomes in science learning, (2) analyze the relationship between metacognition awareness and knowledge learning outcomes in science learning, and (3) analyze the relationship between critical thinking skills and metacognition awareness simultaneously on knowledge learning outcomes in science learning. The sampling technique used was cluster random sampling and the sample consisted of 61 students of class VII E and VII H from one of public Junior High School in Surakarta. The research instrument used critical thinking skills test, metacognition awareness questionnaires, and documentation of knowledge learning outcomes. Analysis of the data used Pearson Product Moment Correlation and Multiple Correlations. Based on the data analysis, the results show that (1) there is relationship between critical thinking skills and knowledge learning outcomes in science learning with correlation coefficient of 0.689, (2) there is relationship between metacognition awareness and knowledge learning outcomes in science learning with correlation coefficient of 0.553, and (3) there is relationship between critical thinking skills and metacognition awareness on knowledge learning outcomes in science learning with correlation coefficient of 0.765 and simultaneously contributes 58.5% to knowledge learning outcomes.

Keywords: Critical Thinking Skills; Knowledge Learning Outcomes; Metacognition Awareness; Science Learning

Introduction

Indonesia is one of the many countries suffering from Covid-19 disease. Covid-19 has spread globally which affects the changes in various field. Education is one of the fields affected by Covid-19. Education is an important factor which could not be ignored because it aims to create high quality human resources. Therefore, education should be able to adapt with the condition so the output can fit with the current development. The rapid global development is in line with the demand of education in life as means to develop skills and positive behavior to fulfil the effective and efficient life purposes (Basar, 2021).

Dealing with current development demand, the execution of educational system should continue even though it undergoes transformation in various activities. The existence of changes in the learning implementation needs correct strategy composing to create optimal learning. Learning strategy should be structed and correct in order to reach the effectivity of learning purposes, so the learning activity is not disturbed even though it changes during the implementation (Fauzi, 2020). The indicator which proves how well the learning process was conducted is the activity which facilitates students in receiving their right to learn and fulfilling the learning competency (Danial & Sulastri, 2019). One of the student's competencies which needs to be supervised in science learning is the learning outcomes, especially in the cognitive (knowledge) domain. The cognitive (knowledge) learning outcomes is the character which fulfil cognitive scope resulting in

cognitive behavior changes (Pertiwi et al., 2019). Student learning outcomes in the cognitive (knowledge) domain become competencies that students need to have during the learning process (Wicaksono, 2014).

The reality shows that the learning quality during Covid-19 is not maximal enough which affects the effectivity level observed based on the student's knowledge learning outcomes. Achievement level between students in learning is different to each other. The different achievement level on the data report gained by the researcher is based on the result of daily tests which were conducted in the learning process during the pandemic. The student's learning outcomes is affected by various aspects. One of the aspects is the student's effort itself (Amanda et al., 2019). Student's achievement level in learning process may be affected by the student's internal factor (Dewi et al., 2019). The student's internal factor which affects the learning outcomes is the critical thinking skills and the metacognition awareness (Malahayati et al., 2015).

Critical thinking skills is one of the important and required aspects as a tool to build the future, either personal life or social life (Tenggarudin, 2016). Critical thinking are skills that need to be improved in order to compete with various development in the 21st Century. In line with the Partnership for 21st Century skills which explains that one of the 21st Century skills that must be possessed by student is critical thinking skills (Yanuarta et al., 2016). Critical thinking skills in Science learning becomes suitable thinking guidance for students in relating a phenomenon and understanding learning materials (Malahayati et al., 2015). Students having high critical thinking level will result in high knowledge learning outcomes, so student's critical thinking skills relates positively with the learning outcomes (Erikson & Erikson, 2019).

Other factors influencing the knowledge learning outcomes is metacognition awareness. Metacognition awareness deals with student's way of thinking about their mindset and ability to choose suitable learning tips to reach the expected goals (Muhali, 2015). Good metacognition awareness can help students in recognizing their abilities and realizing their strength and flaws during their learning process (Fitria et al., 2020). The implementation of metacognition awareness is related to the effectivity in improving student's learning activities, such as controlling learning behavior with various learning styles, controlling studying time, determining their learning partner, and supervising the learning achievements (Wicaksono, 2014). Hence, the developed metacognition awareness will contribute the learning outcomes (Bahri & Aloysius, 2015)

Based on the observation, it is found that student's critical thinking skills and metacognition awareness has not fully developed. Behavior that reflects student's critical thinking skills that are not fully developed seen from the ability to formulate and analyzing the problem, enthusiasm in finding sources of information to solve the problem, provide conclusion from learning that has been carried out, and the quality of questions asked by students during the learning process. The problems presented are in line with Yanuarta et al. (2016) that critical thinking skills in students not only be seen from the ability to answer or solve the problems, but also be seen from the ability and quality of questions asked by students. Regarding the aspect of critical thinking skills proposed by Ennis (1985) aspects that began to appear but had not developed well for all students was to give simple explanation and conclusion. There are some students who are starting to be able to focus and formulate the statement, and give conclusion from the problem and the material being studied. On the other hand, there is a need for more stimulation from teachers to be able to grow aspects of building basic skills related to student's consideration in obtaining credible source of information, providing further explanation, and student's abilities in managing strategies and tactics to solve the problem.

Another behavior that reflects student's metacognition awareness in relation to the aspects proposed by Schraw & Dennison (1994) is metacognitive knowledge (how students know about their cognition) seen from student's awareness in understanding their abilities, knowing appropriate learning strategies, and the right time to implement the learning strategies. Furthermore, related to the aspect of metacognitive regulation (how students use knowledge to regulate their cognition) it can be seen from the readiness of students before learning is carried out, involvement and activeness in learning, awareness of learning only when there are assignments or exams, and there are students who are not aware to complete the task. Based on the behavior that have been described, aspects of metacognition awareness that are starting to appear in some student are an understanding of the selection of learning strategies, procedures and time to implement the selected learning strategies, and student's preparation before learning takes place. Aspects that have not be seen in students are the ability of students to monitor their understanding in mastering a subject matter, evaluate the implementation of learning strategy, and awareness to improve and minimize the repetition of mistakes that occur during learning. Aspect of metacognition awareness that are not fully owned by students will be related to the student's learning outcomes (Purwanto et al., 2020).

Based on the problems, the research aims to (1) analyze the relationship between critical thinking skills and knowledge learning outcomes in science learning, (2) analyze the relationship between metacognition awareness and knowledge learning outcomes in science learning, and (3) analyze the relationship between

critical thinking skills and metacognition awareness simultaneously on knowledge learning outcomes in science learning.

Method

This research is categorized as quantitative research. The design of this research is correlational in order to analyze the relationship between variables of the research. The research variables consist of critical thinking skills and metacognition awareness as the independent variable, and the learning outcomes especially in the knowledge domain as the dependent variable. The research design can be seen in Figure 1.
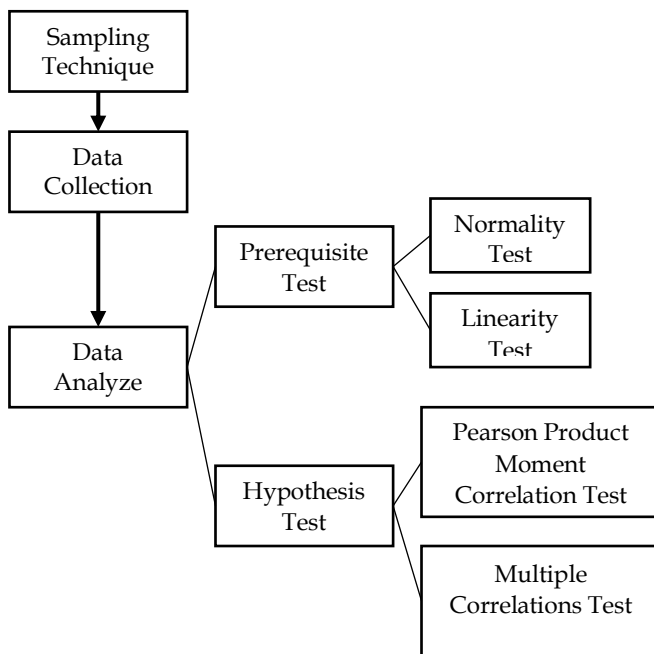

Figure 1. The Research Design

The population in this study were all students of class VII from one of the public Junior High School in Surakarta. The sampling technique used is Cluster Random Sampling. Random group selected as research sample were 61 students of VII E and VII H from 2021/2022 academic year. Data collection techniques used in this study include test, questionnaires, and documentation. The test technique is used to measure student's critical thinking skills, totaling 11 essay questions developed based on aspects by Ennis (1985). The questionnaire technique to measure metacognition awareness, which consisted of 19 items adapted from Schraw & Dennison (1994). Then the documentation sourced from the examination score on solar system material as the parameter of student's knowledge learning outcomes. Critical thinking test in this study was tested for validity, reliability, discriminating power, and difficulty of the questions. Then for the

metacognition awareness questionnaire, the validity and reliability have been tested. The instrument was not only tested, but it was also validated by experts.

The data were analyzed using prerequisite test and hypothesis test. Prerequisite test was conducted using normality and linearity tests. Then the hypothesis test consists of Pearson Product Moment correlation test to find out the relationship between each independent variable towards the dependent variables and Multiple Correlations test was applied to reveal the relationship between critical thinking skills and metacognition awareness towards knowledge learning outcomes.

Result and Discussion

The collected data were examined to answer the hypothesis by conducting prerequisite test. Prerequisite test in this research consists of normality test and linearity test. The result of normality test on Table 1.

Table 1. The Results of Normality Test

Variable	Sig. value	Sig. level	Conclusion
X1	0.089	0.05	Normal
X2	0.200	0.05	Normal
Y	0.072	0.05	Normal

Kolmogorov-Smirnov test was used to examine the normality with 5% significance using the help of SPSS 25. Based on the test, the significance level on three variables is bigger than 0.05 (0.089, 0.200, 0.072 > 0.05). Therefore, it can be concluded that the data on three variables were spread normally. The next prerequisite is linearity test, which were presented on Table 2.

Table 2. The Results of Linearity Test

Variable	Sig. value	Sig. level	Conclusion
X1 with Y	0.187	0.05	Linear
X2 with Y	0.938	0.05	Linear

The linearity was tested using the help of SPSS 25 based on significance value on 5% significance level deviation from linearity. The calculation on each independent variable, namely critical thinking skills (X_1) and metacognition awareness (X_2) towards knowledge learning outcomes (Y) has ($\alpha > 0.05$) significance value, which shows the linear relationship between X_1 with Y and X_2 with Y. After fulfilling prerequisite test, the hypothesis was tested using Pearson Product Moment correlation test and Multiple Correlation test. The explanation of the hypothesis test results is as follows:

Relationship between Critical Thinking Skills (X_1) and Knowledge Learning Outcomes (Y)

The result of Pearson Product Moment correlation test, which functions to find out the existence of the relationship between critical thinking skills towards

knowledge learning outcomes on Sciences learning, was presented on Table 3.

Table 3. The Results of Relationship between Critical Thinking Skills (X_1) and Knowledge Learning Outcomes (Y)

Variable	N	Sig. (2-tailed)	Pearson Correlation
X_1 with Y	61	0.000	0.689

Based on the test in Table 3, the significance value was 0.000 which shows that score α (0.000 < 0.05). Hence, it can be concluded that there is relationship between critical thinking skills and knowledge learning outcomes. Furthermore, correlation coefficient (R) is 0.689 positive, which shows the positive relationship between each variable in strong level (Sugiyono, 2016). The strong relationship between both variables shows that students having complex and clear thinking skills will easily find the answer of a problem and choose learning strategy, which resulting in a good learning outcomes (Barka et al., 2020).

The thinking abilities possessed by the students are used as a process of concepts mastering, with the intention that the more critical thinking ability of the students will be able to increase their understanding that could give concrete benefits in influencing the learning outcomes (Malahayati et al, 2015). The critical thinking skills affect student learning processes because learning outcomes are a reflection the student abilities, especially abilities on the knowledge aspects according to Bloom who states that cognitive learning outcomes are related to intellectual aspects, starting from the level of knowledge (C1), understanding (C2), application (C3), analysis (C4), synthesis (C5), and evaluation (C6), where the level of knowledge and understanding becomes an aspect that must be focused on as a basis for thinking because it refers to the process of remembering and understanding concepts which will lead to critical thinking processes including aspects analysis, synthesis, focusing on problem solving, conclusion, and evaluation (Nur'azizah et al., 2021). Indicators of critical thinking skills are interrelated with knowledge learning outcomes which involve student abilities to remember, understanding, application, analysis, synthesis, and evaluation (Saparuddin et al., 2021).

Positive relationship between both variables is in line with the conducted research Hamdani, Baskoro, & Puguh (2020) stated that the students with high critical thinking will correlate with better learning outcomes compared to students with low critical thinking skills. Moreover, similar research was conducted by Akpur (2020) which examined critical thinking skills on reasoning aspect, problem solving based on proof, problem introduction, and significant information finding related to learning outcomes.

Relationship between Metacognition Awareness (X_2) and Knowledge Learning Outcomes (Y)

The testing result in order to analyze the relationship between metacognition awareness towards knowledge learning outcomes on sciences learning was presented on Table 4.

Table 4. The Results of Relationship between Metacognition Awareness (X_2) and Knowledge Learning Outcomes (Y)

Variable	N	Sig. (2-tailed)	Pearson Correlation
X2 with Y	61	0.000	0.553

The result based on Table 4 shows that score α (0.000 < 0.05) proves that there is relationship between variable X_2 towards Y. The correlation coefficient is 0.553 and affected positively. Therefore, it can be concluded that there is positive relationship between metacognition awareness towards knowledge learning outcomes in moderate level (Sugiyono, 2016).

The positive relationship happened because of the high level of student's metacognition awareness, which affect their mindsets in preparing, arranging, and considering aspects needed to follow the learning process optimally, so they can receive good learning outcomes. The metacognition abilities encourage students to learn more about their role as a learner, factors that can improve performance, such as planning, information management, monitoring and evaluation in learning, as well as instilling awareness of how to design, monitor and control what they know, what is needed to do and how to do it, so as to provide an overview for planning what best for himself in advancing learning outcomes (Asmawati et al., 2022).

Research on relationship between metacognition awareness and learning outcomes has been done by Chikmiyah & Sugiarto (2012), which found that metacognition awareness is correlated significantly towards learning outcomes. Students having high metacognition ability understand more on planning management towards metacognitive behavior, which affected on the learning competency. Students who have understood their abilities in learning process can choose suitable learning strategy and understand correct process and time in implementing it, which affects their learning outcomes (Helendra, Rahmawati, & fauzan., 2015). About the metacognitive regulation, students having well metacognition awareness will start to plan their purposes, decide learning sources which support their learning process, and understand in evaluating the effectivity of the chosen learning strategy (Fauziah, et al., 2018). Awareness in evaluating strength and flaws on themselves will train students to become their own evaluators. Therefore, students can develop their strength and solve the flaws.

Relationship between Critical Thinking Skills (X_1) and Metacognition Awareness (X_2) Towards Knowledge Learning Outcomes (Y)

Moreover, in order to find out the relationship between critical thinking skills and metacognition awareness towards knowledge learning outcomes, the researcher applied multiple correlation test with the help of SPSS 25. The result on Table 5.

Table 5. The Results of Relationship between Critical Thinking Skills and Metacognition Awareness Towards Knowledge Learning Outcomes

R	R Square	F Change	Sig
0.765	0.585	40.806	0.000

Based on multiple correlation test about the relationship between critical thinking skills and metacognition awareness towards knowledge learning outcomes showed F count bigger than F table (40.806 > 3.156) and the correlation coefficient value is 0.765. The F count value which is bigger than F table shows that there is relationship between research variables. Meanwhile, the correlation coefficient is 0.765 shows the positive relationship between critical thinking skills and metacognition awareness towards knowledge learning outcomes followed by strong related level (Sugiyono, 2016). Furthermore, the determining coefficient (R square) shows that critical thinking skills and metacognition awareness contribute 58.5% towards knowledge learning outcomes. Meanwhile, 41.1% comes from other variable relation. The result of this research is in line with the previous research which shows the relationship between student's critical thinking skills and metacognition awareness towards the knowledge learning outcomes (Malahayati et al., 2015; Miharja et al., 2019; Wicaksono, 2014).

Based on the research, it can be proven that critical thinking skills and metacognition awareness are related towards the student's knowledge learning outcomes. The relationship between research variables can be seen in Figure 2.
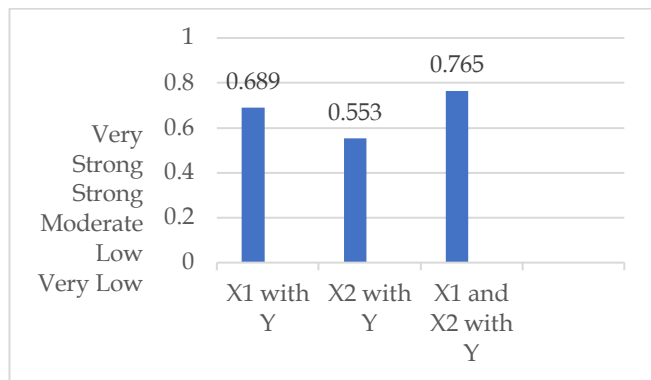

Figure 2. Diagram of the Relationship between Variables

Students who have analyzing mindset in finishing a problem will have higher learning outcomes compared to the students having undeveloped analyzing mindset (Husnah, 2017). On the other hand, the more developed the student's awareness on their mindsets starting from making study plan, using learning strategy, and evaluating the learning goals achievements, the higher student's academic achievement especially on the knowledge learning outcomes (Kristiani, 2015). Someone who is a critical thinker is a person who is responsible for his thinking process, while metacognitive awareness allows control to occur (Sadeghi et al., 2014). The relationship between critical thinking skills and metacognition awareness towards student's knowledge learning outcomes can be seen from the different perspective that aspects of critical thinking skills are included in the scope of the learning cycle that can improve students' abilities, while metacognition awareness aspects are able to solve difficulties encountered during learning, so both contribute to improving knowledge learning outcomes (Wicaksono, 2014). Thus, the integration of aspects of critical thinking skills and metacognition awareness into learning activities can contribute to knowledge learning outcomes.

Conclusion

Based on research, it can be concluded that (1) there is relationship between critical thinking skills and knowledge learning outcomes in science learning with a correlation coefficient of 0.689 which indicates a strong relationship, (2) there is relationship between metacognition awareness and knowledge learning outcomes in science learning with a correlation coefficient of 0.553 which indicates moderate relationship, and (3) there is relationship between critical thinking skills and metacognition awareness on knowledge learning outcomes in science learning with correlation coefficient of 0.765 which indicates a strong relationship and simultaneously contributes 58.5% to knowledge learning outcomes.

Author Contributions
Conceptualization, Rissa Khairinaa; Methodology, Rissa Khairinaa; Normal analysis, Rissa Khairinaa and Daru Wahyuningsih; Supervision, Daru Wahyuningsih and Annisa Nur Khasanah; All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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