The influence of mobile instant messaging with scientific approach on students’ critical-thinking skills in physics learning during covid-19 pandemic

S Latifah¹, Koderi¹, R Firdaos¹, E T Khoeriyah¹, N Hidayah¹, M N F Ahmad¹

¹Universitas Islam Negeri Raden Intan Lampung, Indonesia

*corresponding author: meriananfa29@gmail.com

Abstract: The purpose of this study was to determine the influence of Mobile Instant Messaging with the scientific approach on critical-thinking skills on physics learning during the Covid-19 pandemic. The research method used was a quasi-experimental research with a non-equivalent control group design. The population of this study was all eleventh-grade science students Senior High School Bandar Sribawono. The sampling technique used the purposive sampling technique. The instrument used a test in the form of essay questions to measure students’ critical-thinking skills. Based on the critical-thinking skills, the experimental class and control class obtained 72.60% and 61.30% in the basic support indicator. In elementary clarification indicator, the experimental class and control class obtained 64.40% and 51.90%. In advanced clarification indicator, the experimental class and control class obtained 62.20% and 45.30%. Indicator of inference, the experimental class and control class obtained 67.90 and 46.40%. Indicator of strategy and tactics, the experimental class and control class obtained 66.40% and 46.09%. The score of students’ critical thinking skills in both classes was tested with the independent sample t-test with the obtained sig value of 0.001 <0.05. Thus, Ha was accepted which indicated that the students were able to think critically. In this study, it can be stated that there was an influence of mobile instant messaging with a scientific approach on students' critical-thinking skills.

Keywords: critical-thinking skills, mobile instant messaging, covid-19 pandemic, scientific approach

1. Introduction

The Covid-19 (Coronavirus disease-19) global pandemic affected every aspect of life, including education, economy, society, and culture in Indonesia. Particularly in the world of education, it limits access to face-to-face activities in schools, universities, and Islamic boarding schools. Globally, the results of monitoring by UNESCO (United Nations Educational, Scientific, and Cultural Organization) stated that, as of April 13, 2020, 191 countries had implemented a national closure which affected 1,575,270,054 students or 91.3% of the world's student population [1]. The health crisis caused by the spread of Covid-19 has spearheaded the implementation of online learning. The main element that plays a role in educational institutions, namely the teachers, should be able to utilize their abilities to create active,
effective, and fun learning activities because education is one of the activities and efforts to produce potential human resources [2]. Also, education is a human's lifelong need [3].

The rapid development of science and technology has brought changes in various aspects of human life [4]. It presents positive and negative impacts on the development of world civilization [5]. According to the survey results of the Indonesian Internet Service Providers Association in 2017, internet users in Indonesia reaches 143.26 million people [6]. This shows that almost everyone uses the internet in their daily life. The use of smartphones has been used in the world of education where social media technology offers modern and creative ways to build learning environments [7].

Online learning has occurred worldwide during the Covid-19 pandemic [8]. The use of e-learning can increase the intensity of interactive communication outside of the teaching and learning activities [9]. Learning using Mobile Instant Messaging is an example of the application of e-learning because this learning utilizes social media application features connected to the internet network. The WhatsApp Messenger application can increase students' learning motivation to accelerate the formation of study groups in building and developing science [10]. Studies on the use of Mobile Instant Messaging (MIM) to support teaching and learning show that WhatsApp is widely used because it is low-cost, capable of sending multimedia contents (text, images, audio, video, etc.), easy to use, free, and provides a simple, fun, and accessible communication service [11]. The components in the Mobile Instant Messaging applications can be used as supporting material in utilizing technology in the process of learning activities.

The web course is the use of the internet for educational purposes in which students and teachers are completely separated and a face-to-face meeting is not required. Also, a Web-centric course is the use of the internet that combines distance learning and face-to-face (conventional) learning where some of the material is delivered via the internet and partly through face-to-face [12].

Updates and improvements to educational performance can support the curriculum [13]. Implementation of the 2013 curriculum emphasizes modern pedagogical dimensions in learning, one of which is using the scientific approach [14, 15]. Learning through a scientific approach is learning where students can construct scientific cognitive concepts by paying attention to learning steps such as observing, questioning, applying, synthesizing, and communicating [16]. The scientific approach aims to encourage students to be more active when participating in the teaching and learning activities and to understand a variety of materials. In this case, students should realize that information can come from anywhere, anytime, and does not depend on one-way information from the teachers [17].

21st-century learning is one of the ideas adopted by the 2013 curriculum development in general and scientific learning in particular. The 21st-century competency frameworks include life and career skills, innovation, and learning skills or known as 4C (critical thinking, communication, collaboration, and creativity), and ICT (Information Communication and Technology) [18]. One of the innovations in learning is the critical-thinking skills that focus on cooperation, accuracy, willingness, and never give up attitude when facing difficult tasks. Critical-thinking skills are needed to analyze problems and finding solutions [19]. Critical-thinking skills are an important part of a person's life because they can create strong thinkers and reliable problem-solvers [20].

Other similar research has been conducted, one of which is the use of mobile instant messaging on WhatsApp group on self-efficacy and cognitive abilities on Newton’s law material at Senior High School 9 Bandar Lampung [21]. Other studies have shown that learning through the scientific approach can improve students' critical-thinking skills in vibrations and wave material [22]. Because of this, this study investigated the influence of a scientific approach with WhatsApp mobile instant messaging on critical thinking skills during the Covid-19 pandemic at Senior High School Bandar Sribhawono, East Lampung Regency.
2. Method
This study used quasi-experimental with a non-equivalent control group design. This research was conducted at Senior High School 1 Bandar Sribhawono. The data was obtained by administering pretests and posttests. In this study, the independent variable was the scientific approach and the dependent variable was the critical-thinking skills. This study has been conducted since April 6, 2020, in 4 face-to-face meetings.

Figure 1 is shown the stages of the research implementation process for the control and experimental classes.

| Creating WhatsApp groups as a media for the mobile instant messaging |
| Explaining the learning technique of using mobile instant messaging |
| Administering pretests to all research samples to determine the initial ability |
| Distributing the waves and the characteristics of mechanical waves learning material in the form of PowerPoint, Ms. Word file, web address, and image formats based on the stages of the scientific approach |
| Administering posttests to all samples to determine the level of abilities after implementing research treatments |

**The Learning Techniques**

1. Each meeting consists of three learning sessions. Each session lasts for 30 minutes.
2. Question and answer session is opened at the end after delivering the learning material.
3. Each student may only ask one question
4. The questions asked are in written form while the answer may be in written or oral form

**Figure 1. The Procedure of Research**
The populations of this study were all eleventh-grade science students of Senior High School Bandar Sribhawono which consisted of 156 students. The sample consisted of two classes, namely class XI IPA 1 as the control class which consisted of 32 students, and class XI Science 3 which consisted of 32 students as the experimental class. The sampling technique used was purposive sampling with the consideration that the experimental class was a class with a low physics ability and the control class was the class with the moderate physics ability. The sample selection also considered the directions from the physics teacher at the school. Data collection techniques in the research were tests and documentation.

The sample of students' answers is seen figure 2:

![Image of student answers](image-url)

**Figure 2. The Sample of Students’ Answer**

The research data were analyzed using the normality test and homogeneity test. The hypothesis test was performed using the independent sample t-test to determine whether or not there was a difference in the mean between two unrelated sample groups. The independent sample t-test in this study was calculated using the SPSS (Statistical Package for the Social Sciences) program version 17.00 with a significance level of 5%. The calculation using SPSS 17.00 was done by clicking Analyze → Compare Means → Independent sample t-test → inputting the method into the test variable and inputting the test results into the Grouping Variable→ ok [23].

3. Result and Discussion
The data of this study were obtained by administering tests in the form of essay questions to students according to indicators of critical-thinking skills. A deeper treatment was carried out in the experimental class than in the control class to find out how the treatments increased critical-thinking skills in physics learning. A person can be said to think critically if he has met several indicators. Table 1 is shown the indicators of critical-thinking skills [24].
Table 1. The Indicators of Critical-Thinking Skills According to Ennis

| No. | Critical Indicators | Critical Thinking Sub Indicator |
|-----|---------------------|--------------------------------|
| 1   | Give simple explanation (elementary clarification) | 1.1 Focusing the problems  
1.2 Analyzing Arguments  
1.3 Clarifying questions or challenging questions |
| 2   | Building basic skills (basic support) | 1.4 Considering the credibility of a source  
1.5 Observing and considering the results of observations |
| 3   | Inferencing | 1.6 Deducing and considering deduction or Inducing and considering the result of induction  
1.7 Deciding and considering the results |
| 4   | Providing further explanation (advanced clarification) | 1.8 Defining terms and considering definitions  
1.9 Identifying assumptions |
| 5   | Setting strategy and tactics (strategy and tactics) | 1.10 Formulating and defining an action  
1.11 Conveying written and oral arguments |

The score obtained in each indicator of critical-thinking skills after the treatments can be seen in Figure 3.

![Figure 3. The Scores of Each Indicator of Critical-Thinking Skills](image)

Based on Figure 3, the basic support indicator in the experimental class obtained a value of 72.60% and the control class obtained a value of 61.30%, the elementary clarification indicator in the experimental class obtained a value of 64.40% and the control class obtained a value of 51.90%, the advanced clarification indicator in the class the experimental class obtained a value of 62.20% and the control class obtained a value of 45.30%, the inference indicator in the experimental class obtained a value of 67.90% and the control class obtained a value of 46.40% and the strategy and tactics indicator in the experimental class obtained a value of 66.40% and the control class obtained a value of 46.09%. Based on the data, the
experimental class obtained a higher value compared to the control class. It was influenced by several factors, namely the treatments given to the experimental class were more detailed by allowing private chat between students to discuss the material. The treatments aimed to foster self-confidence and to express opinions in online and offline learning activities.

3.1 Prerequisite Test

The prerequisite tests performed were the normality and homogeneity tests. The normality test had been carried out to see whether the research sample was normally distributed or not. This test used the Liliefors test on the SPSS (Statistical Package for the Social Sciences) version 17.00. The obtained significance value by the control class in the pretest was 0.128 and the posttest was 0.122. The obtained significance value of the experimental class in the pretest was 0.10 and the posttest was 0.200. If the value obtained is more than the significance level (5%), then the samples came from a normally distributed population or the data have a symmetrical distribution pattern. The homogeneity test was performed after the sample had been known to be normally distributed. The homogeneity test had been carried out to see whether the sample was homogeneous or not by using the homogeneity test of two-variance. The result of the homogeneity test was interpreted with the following references; $\text{Sig} > 0.05 =$ the data was homogeneous; $\text{Sig} < 0.05 =$ the data was not homogeneous. After the homogeneity test had been performed, the pretest data obtained a value of 0.639 and the posttest data obtained a value of 0.802. It can be concluded that the pretest and posttest significance values were greater than the significance level, thus the two samples came from a homogeneous population. A homogeneous population indicated that the students possessed the same or equivalent abilities.

3.2 The Hypothesis Test (Independent Sample T-test)

The t-test can be performed after the prerequisite tests had been performed. The t-test was aimed to see the influence of mobile instant messaging with the scientific approach on students’ critical-thinking skills. The results are described in Table 2:

| Data   | Sign | Criteria | Conclusion          |
|--------|------|----------|---------------------|
| Pretest| 0.949| $H_0$ was accepted, $H_1$ was rejected | There was no difference |
| Posttest| 0.001| $H_0$ was rejected, $H_1$ was accepted | There was a difference |

Based on Table 2, the value of the pretest data was $\geq 0.05$ which indicated that $H_0$ was accepted and $H_1$ was rejected. It meant that there was no difference between the two samples. On the other hand, the value of the Posttest data was $\leq 0.05$ which indicated that $H_0$ was rejected and $H_1$ was accepted. This indicated that there was a difference between the two samples after receiving treatments. In this study, the experimental class obtained higher results than the control class. Considering that this research was conducted during the Covid-19 pandemic which implemented social distancing, the researchers had difficulty analyzing the learning process carried, especially in solving problems. The students’ internet packages availability and inadequate networks to access the materials acted as problems in conducting the research treatments. This was caused by the economic factors due to the Covid-19 pandemic and the non-existence supports from schools and central and local governments to deal with these problems. Conducting online learning, especially during the pandemic, produced many problems for teachers. It was difficult to directly monitor
the learning processes and there was no guarantee that students fully paid attention to the teachers’ explanation. Many students found it difficult to understand the online material. Besides learning difficulties, it also affected the mental health and the psychological state of students.

Students should be aware of their environment in which they live daily [25]. Besides preventing the spread of the Covid-19 virus, distance learning also makes students feel fewer peer pressures that are usually felt when studying face-to-face. Online distance learning can foster learning independence where individual students can easily access a wider range of materials and tasks through other developed platforms. It shows that online learning can eliminate awkward feelings so that students can express their thoughts and ask freely [26].

4. Conclusion
The learning activities through mobile instant messaging that utilized WhatsApp groups on learning waves and the characteristics of mechanical waves based on the critical-thinking skills during the Covid-19 pandemic have not been fully influential and cannot be accounted for even though the results of the pretest and posttest showed that there was a significant influence. So, it can be concluded that students' critical-thinking skills cannot be analyzed only by problem-solving or objective assessment. Critical-thinking skills must also be assessed subjectively and directly by reviewing students' critical thinking skills.

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