



## The Effect of Practicum Activities on Improving Data Literacy for High School Students

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### Abstract

The world change in the industrial revolution 4.0 is the state of the industry in the 21st century that combines automation and cyber technology. Education is one of the fields that is experiencing the impacts of the changes in the industrial revolution 4.0. The skills needed in this era was the literacy skills consisting of three new literacys, namely data, technological, and human literacy. The purpose of this study was to determine the effect of practicum activities on increasing data literacy of high school students. The method used in this study was a mix method with a concurrent embedded design, while the experimental design used was a one group pretest-posttest design. The instrument used was a written test with 10 numbers to get a pretest-posttest score. The pretest-posttest scores were used to measure the improvement of students' data literacy. The results of data analysis using the t-test paired samples t-test obtained the average value of the pretest and posttest scores significantly different with the value of  $t_{count} > t_{table}$  that is  $4.770 > 2.042$  with an effect size of 0.83. It can be concluded that there is an effect of practicum activities on increasing data literacy of high school students with high categories.

## INTRODUCTION

Indonesia is a developing country in the 21st century era with various demands. The 21st century has changed the world in the industrial revolution 4.0. The field of education is one of the fields that is experiencing the impacts of world changes in the era of the industrial revolution 4.0 or the era of disruption. In this era, it is not enough to have old literacy skills, but it is necessary to have new literacy skills, namely data literacy, technological literacy, and human literacy.

The impact of world changes in the era of disruption on education is that educators are required to participate in developing their abilities in new literacy. In the learning process, educators need to integrate learning outcomes, so that the world of education still has a high relevance (Fitriani & Aziz, 2019). The other competencies will be easy to master if they have good literacy skills.

Data literacy is one of the skills that individuals must have to live in the 21st century. According to Wolff *et al* (2019) data literacy is the ability to understand, find, collect, interpret, visualize, and communicate data. Research and advisory company in the United States, Gartner, explains data literacy is the ability to read, write, and communicate data in context. Data literacy is increasingly important as a general skill that must be possessed by all citizens as community empowerment. However, current student understanding of data is very limited, so it is possible that students do not get in-depth data literacy learning (Wolff *et al*, 2019).

One of the previous studies related to data literacy was carried out by Lusiyana *et al* (2020) which stated that Indonesian students were still considered low in having data literacy skills, so that in his research he developed a Mirecal learning model that was able to improve data literacy of physics students. It takes habituation of students in recognizing and understanding data to have competitiveness in achieving in the 21st century. In line with research conducted by Larasati *et al* (2020) that data literacy activities in physics learning can train students to be more pedagogically consistent and easy to understand the learning process.

Physics lessons are related to the discovery process so that physics is not only the mastery of facts, concepts or principles. Practicum is one of the main parts of physics. Learning physics using the practicum method is highly recommended because it can help students to understand physics, but it can also instill a scientific attitude and practice science process skills.

Based on the description about, the importance of data literacy in the industrial era 4.0, it is necessary to carry out a literacy analysis. The research that will be conducted focuses on analyzing student data literacy through temperature

measurement practicum activities which are expected to be able to improve high school physics data literacy in accordance with the demands of the industrial revolution 4.0 era. In addition, physics practicum activities are also expected to be used as a means to familiarize students in understanding, finding, collecting, interpreting, visualizing, and communicating the data presented in problems/questions.

## METHOD

The research method used was a mixed method (Mixed Methods) with a concurrent embedded design. The combination method of concurrent embedded design is a research method that combines qualitative and quantitative research methods by mixing the two methods unbalanced or in other words the weights of the two methods are different. The quantitative approach is the primary method while the qualitative method is the secondary method. Because the primary method was used a quantitative method, the weight of the method relies more on the experimental method which aims to measure whether there is an increase in physical data literacy of high school students. The experimental design used in this study was One-group pretest-posttest.

The research was carried out at the MA Negeri Pematang, in September 2021. The subjects in the study were students of class XI with a total of 33 students. In this study, the instrument used in data collection was in the form of a test instrument to measure students' data literacy and a non-test instrument in the form of an interview to find out students' obstacles in working on data literacy test questions. The data literacy test is made in the form of online-based description questions through a computer-based test (CBT). Data literacy analysis was obtained through answer scores. The answer score was calculated as a percentage through the following equation:

$$P = \frac{n}{N} \times 100\%$$

The categories of data literacy percentage are interpreted in Table 1.

**Table 1.** Interpretation of Data Literacy Percentage

Interval (%)	Category
66,6 < P ≤ 100	High
33,3 < P ≤ 66,6	Medium
0 < P ≤ 33,3	Low

Data analysis was carried out on the pretest and posttest scores obtained by students. The data were analyzed descriptively to describe the average value (mean) and standard deviation for the pretest and posttest, and analyzed the influence of

temperature measurement practicum activities, as well as analysis of the effect size using Cohen's formula. Effect size can be determined using the following equation:

$$d = \frac{\bar{x}_1 - \bar{x}_2}{S_{gab}}$$

$$S_{gab} = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

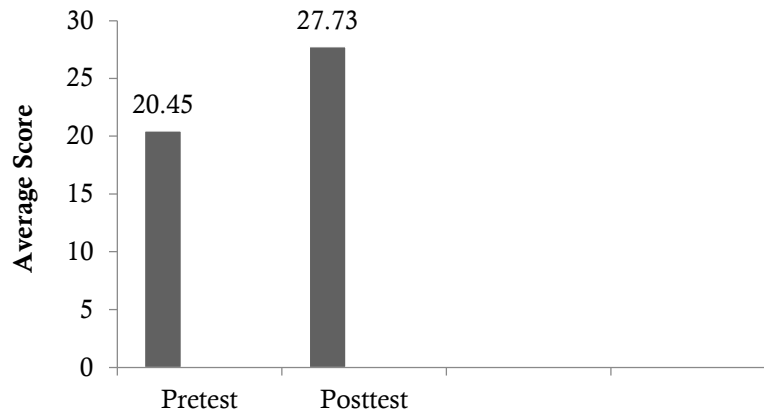
Classification of effect size calculation results was carried out using Cohen's formula according to (Handayani *et al.*, 2018) as follows.

**Table 2.** Classification of Effect Size

Value of d	Interpretation
$d > 0,8$	Great
$0,5 \leq d \leq 0,8$	Medium
$d < 0,5$	Small

**RESULTS AND DISCUSSION**

The temperature measurement practicum which is used as a treatment is carried out in the physics laboratory of the MA Negeri Pemalang in rotation and in groups due to limited tools and the place being renovated. In addition to practicum activities, another treatment that was used as an effort to improve data literacy is data literacy exercises. The data in this study are the results of the data literacy mastery test in the form of the students' average pretest and posttest results (mean), as well as the results of interviews from students' obstacles in mastering data literacy. The pretest data is used to determine the students' initial knowledge about data literacy, while the posttest results are given to determine the success of the treatment given. The treatment given is in the form of practical activities and data literacy questions. The results of the data from the average pretest and posttest can be seen in Figure 1.



**Figure 1.** Pretest and Posttest Scores

Figure 1 shows that the posttest average score is 27.73 so it can be concluded that students' mastery of data literacy has a low category. Based on the t-test using the paired sample t-test, it can be seen that  $t_{count} > t_{table}$  at a significance level of 5% with  $dk = 33$ , so it can be concluded that the average pretest and posttest scores are significantly different. This proves that there is an effect of temperature measurement practicum activities on increasing student data literacy. Based on the results of the calculation of effect size using Cohen's formula, the magnitude of the effect of temperature measurement practicum activities on increasing student data literacy is 0.83 with a large category. Although in general, there was an increase in the pretest-posttest scores, the average score was still in the low category.

At the time of giving treatment in the form of data literacy exercises, the indicators that students had not mastered well were the indicators of analyzing the uncertainty value of single/repeated measurements. The reason for the low mastery of these indicators, based on interviews with students, is that they have difficulty recalling the measurement material that has been delivered in class X. Because the material presented in class X is done online, they experience limitations in understanding the material. According to Rini *et al.* (2020), strong memory or retention makes the knowledge gained into memory that is stored in the long term, besides that a good memory will also make learning outcomes more optimal. The existence of habituation in working on data literacy questions will become proficient and skilled in

analyzing data. The process of habituation of students with optimal data will further improve students' mastery of data literacy, so that students can solve data literacy problems well.

Based on the results of data analysis obtained from treatment in the form of temperature measurement practicum activities can improve data literacy because in the learning process students are directly involved. Learning with the practicum method is also able to improve science process skills. according to Ergül *et al* (2011) the use of science process skills will provide permanent learning outcomes, because students are freed by problems solving, thinking critically, making decisions, obtaining answers, and satisfying their curiosity. Worth saying Usmeldi (2016) that practicum activities are able to improve students' skills in using equipment, problem solving, and logical thinking.

The purpose of learning with the practicum method is to provide opportunities for students to get real experience in increasing understanding of physics theories, and to familiarize students with being close to data so that students have good data literacy skills. However, it is still found that physics learning in high school is carried out theoretically only through the lecture method (teacher center) without being accompanied by practicum. In line with Atnur *et al* (2015) the implementation of practicum in schools is still not running well. This was caused by various problems, including the laboratory space being used as a classroom, the absence of laboratory staff, and the limited number of practical tools.

In this study, practically each group was able to work well together. Each group is also able to carry out practical steps according to the existing

guidelines. During the practicum activities, students collect and understand data to analyze the measurement results related to the uncertainty value. Aspects of indicators in practicum activities are all achieved, namely understanding and finding data. This is in accordance with the indicators that have been set (Wolff *et al*, 2019).

During the activity, the obstacles that occurred were the lack of availability of practical tools and the condition of the equipment that was not functioning properly, such as a stopwatch. In addition, due to the renovation of the building, some tools are difficult to find. The implementation of the practicum does not run efficiently due to the condition of the students who are not serious in carrying out the practicum. In line with Rahmah *et al* (2021) Factors constraining practicum implementation include inadequate supporting facilities, lack of completeness of practicum materials, insufficient time allocation for practicum, and lack of readiness of laboratory assistants in helping prepare tools and materials.

The causes of the low mastery of data literacy include students having minimal experience in analyzing data from practical activities. Each practicum activity is measured and will produce data that must be analyzed for measurement uncertainty to get a conclusion (Fauzi *et al*, 2013). In addition, based on the results of the FGD of students causing low data literacy, they admitted that it was the first time they had received a question of data literacy from the measurement results or it could be concluded that they were not familiar with data literacy questions. The results of the FGDs are shown in Table 3.

**Table 3.** Results of FGD Student Difficulties

FGD Questions	Student Answer	
What difficulties did you experience in doing this question?	Student A:	Confused about the answer, where to start?.
	Student B:	It's hard to answer because it's an essay.
	Student C:	Confused about where to start.
	Student D:	Usually always get questions in multiple choice form, but this is an essay. Because it's difficult.
	Student E:	The material is difficult, about measurement. Can be when class X and even then less clear because it is online.
	Student F:	The problem is that some are easy and some are difficult, but what is difficult is that they do not understand the material and the formulas
	Student G:	It's hard to understand the story, know what it means but it's hard and confused to write it
	Student H:	The theory seems easy, but when you come across a question that is difficult to reason, for example, you only know the table in a question, then you don't know how to draw a graph

Table 3 is the result of the student focus group discussion on students' problems in solving data literacy problems. Most of the students answered confused, because the questions were in the form of essays which were done through CBT. This shows that the student's mindset is still on the conventional test for essay type questions. This means that teachers need to provide more online practice essay questions. One of the advantages of applying online questions is that they are time effective. Rohayati *et al* (2018) revealed that the computer-assisted essay test has two functions, namely to make essay questions and to assess the answers to essay questions. Many experts say the frequency of answering essay questions will have advantages, including the potential to bring up higher-level cognitive skills more easily (Safari, 2019).

Factors causing the low mastery of student data literacy, among others, the lack of student experience in analyzing data from practicum activities. According to Fauzi *et al* (2013) every practicum activity is measured and will produce data that must be analyzed for measurement uncertainty to get a conclusion. Therefore the analysis of measurement uncertainty becomes very important.

## CONCLUSION

Based on the results of the study, it can be concluded that the data literacy of students of MA Negeri Pematang class XI increased through temperature measurement practicum activities. The percentage score of data literacy obtained was 27.72% in the low category. The effect size of the treatment in the form of temperature measurement practicum in increasing data literacy is 0.83 so it is

categorized as having a great effect. This means that the use of this treatment has a great effect on increasing data literacy students for MA Negeri Pematang.

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