A Scientific Approach Based on Multiple Intelligence Theory which implemented online: its effectiveness in terms of Mathematical Literacy and Student Self-Confidence

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**Abstract**. This study aims to examine whether the scientific approach based on the theory of multiple intelligence implemented online was effective in terms of mathematical literacy skills and students' self-confidence. The population in this study were 8th grade students at SMP Negeri 10 Yogyakarta in the 2019/2020 academic year, while the research sample was students in 8 B class. The research instruments were questions of mathematical literacy skills and a student self-confidence questionnaire. Both of these instruments are valid and reliable. There are 4 criteria for effectiveness. First, the average final score of the mathematical literacy test was more than 70 (out of a maximum score of 100). Second, the proportion of students who scored more than 70 was more than 75%. Third, the average final self-confidence score was greater than the average initial self-confidence score. Fourth, the mean final self-confidence score was more than 272 (this is the minimum score for the "good" category). Using a significant level of 0.05, it can be concluded that the scientific approach based on the multiple intelligence theory implemented online was effective in terms of the mathematical literacy skills of grade 8 students at SMP Negeri 10 Yogyakarta on the topic of Statistics. However, this approach is not effective in terms of student self-confidence. This ineffectiveness is due to interactions, time, and conditions. To be able to carry out an MI-based scientific approach in online mathematics learning, teachers need to pay attention to several things, such as student readiness, both in the technological aspect and in the psychological aspect.

1. Introduction

Since the implementation of the 2013 Curriculum, many teachers have used the scientific approach, including mathematics teachers. The scientific approach is a learning approach designed so that students are active in learning through observing, questioning, gathering information, associating, and communicating [1-3]. The five stages of the activity are a continuous process which is expected to develop students' attitudes, knowledge and skills [4-6]. There have been many research results that show the advantages of the scientific approach [7-9].

In order to obtain optimal learning outcomes, in addition to choosing the right learning approach, teachers need to also pay attention to factors from within students, namely the type of intelligence they have. According to Howard Gardner [10] every child has a unique combination of intelligence from nine types of intelligence, which is called multiple intelligence. Based on research conducted by Gardner, there are nine kinds of intelligence, namely linguistic, logic-mathematical, musical, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal, naturalist, and existentialist intelligence [11].

Noting the possibility of various types of student intelligence in one class, the teacher needs to design learning with an approach based on the theory of multiple intelligences. The teacher can choose a scientific approach that is carried out by paying attention to the types of multiple intelligences of students in their class. Learning using a scientific approach based on the theory of multiple intelligences is a learning activity with the steps of a scientific approach, but the teacher adds various activities, media, illustrations, contexts, and cases so that learning can be of interest to all students, regardless of the type of intelligence.

In 2020 there be a global pandemic caused by the corona virus around the world. This results in changes in the learning process in schools. Learning that is usually done face-to-face at school turns into learning from home with the help of the internet. This learning is known as online learning.

Online learning is a teaching-learning activity that utilizes information and communication technology [12, 13]. This online learning has several advantages, namely it can improve literacy and analysis, increase motivation, increase preparedness, and shorten learning time [14]. Especially during the Covid-19 pandemic like now. online learning is a solution so that students can continue to learn from their homes.

However, for most teachers, online learning is something new. There are still many problems and questions about this online learning [15]. One of these questions is whether the scientific approach based on the multiple intelligence theory implemented online can be effective when viewed from the mathematical literacy skills and self-confidence of students. Why are students' mathematical literacy skills and self-confidence a concern of mathematics teachers? This is because both were important and are still a problem.

Mathematical literacy skills are the ability of individuals to formulate, apply, and interpret mathematics in various contexts [16, 17]. Indonesian students' mathematical literacy skills are still a problem if you pay attention to the PISA results. Therefore, mathematics teachers must strive so that their students have adequate mathematical literacy skills.

Self-confidence is a feeling or attitude of being sure of one's own abilities. A person who has high self-confidence can generally be independent in acting, warm in interactions, and recognizes his strengths and weaknesses [18, 19]. Student self-confidence is a factor that determines student learning outcomes. Students' self-confidence in learning mathematics using a scientific approach based on the theory of multiple intelligences which is carried out online has not yet been researched.

Taking into account the indicators of mathematical literacy skills and self-confidence, theoretically, a scientific approach based on the multiple intelligence theory implemented online will be effective in terms of mathematical literacy skills and students' self-confidence. The relationship between the multiple intelligence theory-based scientific approach in terms of mathematical literacy skills and students' self-confidence can be described as follows.

**Scientific Approach Based on Multiple Intelligence Theory**

**Self-Confidence**

**Observing**:Observing various problems or phenomena with the senses and with / without tools

**Communicating**: Presenting / presenting conclusions in oral or written form in the form of reports / charts / pictures / diagrams

Recognizes his strengths and weaknesses

Formulate

**Mathematical Literacy Skills**

Warm in interacting

Independent in action

**Gathering Information**: Conducting experiments / interviews / reading sources / observing various objects with heterogeneous groups

**Asking**: Creating and asking questions from a variety of problems

**Figure 1**. The Relationship of a Scientific Approach Based on Multiple Intelligence Theory in terms of Mathematical Literacy Skills and Students' Self-Confidence

Interpret

Apply

**Associating**: Working with heterogeneous groups in processing information to draw conclusions

For this reason, researchers are interested in conducting research with the aim of finding out the effectiveness of a scientific approach based on multiple intelligence theory which is implemented online in terms of mathematical literacy skills and students' self-confidence. The results of this study are expected to be taken into consideration by mathematics teachers in implementing learning

1. Method
	1. Research Design

This type of research is an experimental research (research experiment) with a pre-experimental design. The research design in this study is One-Shot Case Study to obtain mathematical data literacy skills and One-Group Pretest-Posttest to obtain student self-confidence data. The research design is shown in table 1 below.

**Table 1**.Pre-experimental Design

|  |  |  |  |
| --- | --- | --- | --- |
| **Dependent Variable** | **Pre-test** | **Treatment** | **Post-test** |
| Mathematical Literacy |  | X | O |
| Self-Confidence | O1 | X | O2 |

Information:

|  |  |  |
| --- | --- | --- |
| X | : | Treatment (learning with a scientific approach based on multiple intelligence theory). |
| O | : | Mathematical literacy skills test. |
| O1 | : | The first self-confidence questionnaire |
| O2 | : | The final self-confidence questionnaire. |

* 1. Population and Sample

The population of this study were five classes of eighth grade students of State Junior High School 10 Yogyakarta in the 2019/2020 academic year, while the sample was class VIII B consisting of 32 students. The researcher chose the sample randomly.

* 1. Instrument

Researchers used 2 instruments. The instrument for measuring mathematical literacy is in the form of description questions, consisting of seven questions. Meanwhile, the instrument for measuring self-confidence is in the form of a Likert scale, consisting of 80 statements. Both instruments are classified as valid and reliable.

* 1. Data Analysis Technique

Researchers set the following criteria for effectiveness. Learning using a multiple intelligence-based scientific approach is said to be effective in terms of students 'mathematical literacy skills if: (1) the average score of students' mathematical literacy skills is more than 75 (from a maximum score of 100); and (2) the proportion of students who obtained a minimum score of mathematical literacy skills in the good category, namely more than 70, more than 75%. The learning is also said to be effective in terms of students 'self-confidence if: (1) the average score of students' self-confidence at the end of the lesson is more than the average self-confidence score at the beginning of the lesson; and (2) the average final confidence score is at least good, which is more than 272). The statistical normality test uses the Shapiro-Wilk.

Using the Shapiro-Wilk test statistic with a significance level of α = 5%, it can be concluded that the data on mathematical literacy skills comes from a population that is not normally distributed. Meanwhile, the initial and final confidence score data came from a population that was normally distributed. Therefore, to test the effectiveness criteria in terms of students' mathematical literacy, researchers used the Wilcoxon Signed-Rank Test and One Sample Binomial Test. Meanwhile, to test the effectiveness in terms of student curiosity, researchers used the Paired Sample t-Test and One Sample t-Test*.*

1. Result and Discussion
	1. Result

The data described in this section is the data on the test scores for mathematical literacy skills. The summary of the results of the mathematical literacy skills test on the topic of Statistics for class VIII is presented in table 2 below.

**Table 2**. Summary of Mathematical Literacy Ability Test Results

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Interval** | **Total Students** | **Percentage** |
| Very Good | 85 $<X\leq $ 100 | 25 | 78,125% |
| Well | 70 $<X\leq $ 85 | 4 | 12,5% |
| Enough | 55 $<X\leq $ 70 | 2 | 6,25% |
| Less | $X\leq $ 55 | 1 | 3,125% |

From the table above, it can be seen that most of the students scored very well. From the summary, it can be seen that the percentage of students who got the minimum good category of mathematical literacy skills test score was 80.625%. The data on the results of the mathematical literacy test are presented in detail in Table 3 below.

**Table 3**. Description of the Score of the Mathematical Literacy Ability Test

|  |  |
| --- | --- |
| **Data** | **The Result of the Mathematical Literacy Ability Test** |
| Average | 86,16 |
| Variants | 183,62 |
| Standard Deviation | 13,55 |
| Maximum Value | 100 |
| Minimum Value | 31 |
| Reach | 69 |
| Maximum Possible Value | 100 |
| Minimum Possible Value | 0 |

Based on the table above, it can be seen that the average score of the mathematical literacy skills test is 86.16 which is included in the very good category. The standard deviation of 13.55 indicates that students' mathematical literacy skills do not spread too far from the average. In more detail, table 4 below presents the percentage of achievement for each mathematical literacy indicator.

**Table 4.** Percentage of Achievement of Each Indicator of Mathematical Literacy Ability

|  |  |
| --- | --- |
| **Indicator** | **The Result of Mathematical Literacy Test** |
| Formulate | 89,24% |
| Employ | 80,21% |
| Interpret | 87,5% |

From the table above, it can be seen that the achievement of students' mathematical literacy indicators is quite high. The highest percentage for formulating indicators was 89.24%. Meanwhile, the lowest percentage of the indicator apply was 80.21%. This is because some students can use the formula to get an answer. However, the final conclusions they wrote did not match the original problem. Thus, the percentage of achievement of using indicators is reduced.

Then, the summary of the results of the initial score and the final score of the student confidence questionnaire is presented in table 5 below.

**Table 5.** Summary of the Results of the Initial and Final Self-Confidence Questionnaires

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Interval** | **The Initial Questionnaires** | **The Final Questionnaires** |
| **Total** | **Persentage** | **Total** | **Persentage** |
| Very good |  $X>$ 336 | 2 | 6,25% | 6 | 18,75% |
| Well | $272 <X\leq $ 336 | 18 | 56,25% | 16 | 50% |
| Enough | 208$ <X\leq $ 272 | 12 | 37,5% | 10 | 31,25% |
| Less | 144$ <X\leq $ 208 | 0 | 0% | 0 | 0% |
| Very less | $X<$ 144 | 0 | 0% | 0 | 0% |

From the table above, it can be seen that there is an increase and decrease in the number of students in the very good, good, and sufficient categories. In the very good category there was an increase in the number of students by four students by 12.50%, in other words, the very good category experienced an increase of three times from the previous number. Meanwhile, in the good and moderate category, the number of students decreased. After being given treatment, in the good and sufficient categories, the percentage was 6.25% lower than the initial questionnaire. This indicates that there is an increase in students' self-confidence. Detailed descriptions of the initial and final questionnaire score data are presented in table 6 below.

**Table 6.** Description of the Initial and Final Questionnaire Score Students' Confidence

|  |  |  |
| --- | --- | --- |
| **Data** | **The Initial Questionnaires** | **The Final Questionnaires** |
| Average | 290,3 | 295,53 |
| Variants | 1260 | 1539,29 |
| Standard Deviation | 35,5 | 39,23 |
| Maximum Value | 345 | 377 |
| Minimum Value | 231 | 237 |
| Reach | 114 | 140 |
| Maximum Possible Value | 400 | 400 |
| Minimum Possible Value | 0 | 0 |

Based on the table above, it can be seen that the mean score of the initial questionnaire was 290.3 and the average score for the final questionnaire was 295.53. Both scores are in the good category. Judging from the standard deviation, the initial questionnaire has a standard deviation of 35.5 and the final questionnaire is 39.23, which means that the data does not spread too far from the average. In more detail, table 7 below presents the achievement of each student's self-confidence indicator.

**Table 7.** Achievement of Each Student's Confidence Indicators

|  |  |  |
| --- | --- | --- |
| **Indicators** | **The Initial Questionnaires** | **The Final Questionnaires** |
| Independent in action | 115,56 | 118,95 |
| Warm in interaction | 125,94 | 118,67 |
| Get to know the advantages and disadvantages | 115,5 | 117,16 |

The data in Table 7 shows that the indicators of "being independent in action" and "recognizing the strengths and weaknesses" have increased. However, the indicator "Warm in interacting" decreased by 7.27. This is because learning is not done by interacting directly, but is done online.

Testing the effectiveness criteria in terms of mathematical literacy skills gives the following results..

**Table 8.** The Results of One Sample Wilcoxon Signed-Rank Test and One-Sample Binomial Test

|  |  |  |
| --- | --- | --- |
| **Type of Test** | **Test Statistics** | **Sig.** |
| Test 1 | One Sample Wilcoxon Signed-Rank Test | .000 |
| Test 2 | One-Sample Binomial Test | .000 |

The significance value of both of them is zero, it can be concluded that the average score of students' mathematical literacy skills is more than 75 and the proportion of students who score in the minimum category is good more than 75%. Thus the researchers concluded that the scientific approach based on multiple intelligence theory which was implemented online was classified as effective in terms of students' mathematical literacy skills.

The effectiveness test in terms of students' self-confidence gives the following results.

**Table 9.** The Results of Paired Sample t-Test and One Sample t-Test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Statistics** | **Data** | T | Df | Sig. (2-tailed) |
| Paired Sample t-Test | Questionnaires 2- Questionnaires 1 | 1.393 | 31 | .174 |
| One Sample t-Test | Questionnaires 2 | 3.393 | 31 | .002 |

From table above, based on the results of the Paired Sample t-Test, it is known that tcount = 1,393 $<$ t(0,05;31) = 1,697 and $\frac{sig. (2-tailed)}{2}$ = 0,087 $>$ 0,05 which causes H0 is accepted. Meanwhile, based on the results of the One Sample t-Test, it is known that tcount = 3,393 $>$ t(0,05;31) = 1,697 and $\frac{sig. (2-tailed)}{2}$ = 0,001 $<$ 0,05 which causes H0 to be rejected. Thus, it can be concluded that the average final self-esteem score is not greater than the average initial confidence score and the average self-confidence score is greater than 272. Thus the researchers concluded that the scientific approach based on the theory of multiple intelligences which was implemented online cannot be said to be effective in terms of students' self-confidence.

* 1. Discussion
		1. Effectiveness of Scientific Approach Based on Multiple Intelligence Theory in Term of Student’s Mathematics Literacy Skills

The effectiveness of the scientific approach based on the theory of multiple intelligence in terms of mathematical literacy skills is determined based on two criteria, namely: (1) the average score of students' mathematical literacy skills is more than 75; and (2) the proportion of students who obtained a minimum score of mathematical literacy skills was more than 75%. Hypothesis testing using the significance level α = 5% concludes that the scientific approach based on multiple-intelligence theory which is implemented online is classified as effective in terms of students' mathematical literacy skills.

This is in accordance with the researchers' expectations. The scientific learning process which includes activities to observe, ask questions, collect information, associate, and communicate is able to develop students' mathematical literacy skills. Moreover, learning is based on the theory of multiple intelligences. The teacher uses various media, illustrations, contexts, and case examples, enabling students to develop their mathematical literacy skills.

Literacy skills have three aspects, namely process, content, and context [16]. In learning using a scientific approach based on multiple intelligence theory, the aspects that are emphasized are aspects of content and context. This research was conducted on statistical materials which are included in uncertainty and data content. Meanwhile, the context aspect is shown on each Student Activity Sheet / Worksheet. 1st worksheet uses a scientific context, namely about the corona virus, 2nd worksheet uses a personal context, namely about conversations between students and teachers, and 3rd worksheet uses a work context, namely about employee salaries and production goods of an agency.

The results of this study are in line with the results of previous studies. Research by Fathani [20] concluded that if the variety of student intelligence is considered by the teacher in designing learning activities, the development of mathematical literacy will be successful. This is because the learning process respects the uniqueness of each individual.

* + 1. Effectiveness of Scientific Approach Based on Multiple Intelligence Theory in Term of Student’s Self-Confidence

The effectiveness of the scientific approach based on multiple intelligence theory in terms of student self-confidence is determined based on two criteria, namely; (1) the average self-confidence score at the end of the lesson is more than the average self-confidence score at the beginning of the lesson; and (2) the average final confidence score at least reaches the good category, namely 272. Hypothesis testing using the significance level α = 5% concludes that the multi-intelligence theory-based scientific approach implemented online cannot be classified as effective in terms of student self-confidence.

The results of this study are different from the results of previous studies which state that the scientific approach is effective in terms of student self-confidence [21]. The factor that is thought to be the cause of the scientific approach based on the multiple intelligence theory is not effective in terms of student self-confidence is because it is implemented online.

To corroborate the findings of this study, researchers have provided questionnaires to students. This questionnaire consists of two questions related to obstacles in taking online learning. The researcher asked: (1) whether the students had difficulty participating in online learning; and (2) what obstacles students experience during online learning. From the questionnaire, the results are shown in tables 10 and 11 below.

**Table 10.** Answers to the 1st Question of the Online Learning Difficulties Questionnaire

|  |  |
| --- | --- |
| **1st Question** | **The Answers** |
| **Yes** | **Ordinary** | **No** |
| Do you find it difficult during online learning? | 6 students(18,75%) | 21 students(65,625%) | 5 students(15,625) |

**Tabel 11.** Answers to the 2nd Question of the Online Learning Difficulties Questionnaire

|  |  |  |
| --- | --- | --- |
| **No.** | **Statements** | **Total Students** |
| 1. | Inadequate communication tools (cell phones). | 0 |
| 2. | The signal in the area where you live is less supportive. | 6 |
| 3. | Limited internet quota. | 10 |
| 4. | Not good at technology. | 3 |
| 5. | Instructions / learning instructions from the teacher are less clear. | 8 |
| 6. | The delivery of the material is not clear. | 10 |
| 7. | Student Worksheets (LKS) are difficult to understand. | 10 |
| 8. | Difficult to discuss with friends in the group. | 12 |
| 9. | Less interested in learning mathematics. | 2 |
| 10 | Difficult to understand the material. | 13 |
| 11. | Not ready for online learning. | 6 |
| 12. | Not motivated to study at home. | 9 |
| 13. | Others: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 2 |

From the results of the questionnaire, it is known that 18.75% of students find it difficult with online learning, 65.625% of students are normal with online learning, and 15.625% of students do not find it difficult with online learning. The highest percentage is that students feel normal with online learning. Here students are not sure whether to answer yes or no. So, there are several factors that cause students to feel comfortable with online learning and there are also several factors that become obstacles to student learning in online learning. For this reason, the factors that become obstacles for students in online learning are detailed in the second question.

In table 11, it can be seen that a communication tool in the form of a cellphone is not an obstacle during learning. However, six students experienced signal difficulties in their area of ​​residence and ten students did not have sufficient internet quotas. This affects online learning which requires a good network so that students can participate in learning smoothly.

Eight students felt the instructional instructions from the teacher were less clear, 10 students felt the material was unclear, 12 students had difficulty in discussing with their group friends, 10 students felt the worksheets used were difficult to understand, and 13 students found it difficult to understand the material. This is related to interaction. In online learning, the interaction between teachers and students and between students is very limited. This is also in accordance with the student's self-confidence questionnaire which shows the indicator “warm in interaction” has decreased by 7.27, even though other indicators of self-confidence have increased..

A person's self-confidence requires habituation. Self-confidence must be developed from the age of five. Environment affects a person's self-confidence [22]. Therefore, it is reasonable to suspect that online learning which has not been too long has caused the increase in student self-confidence not yet significant.

1. Conclusion

Using a significant level of 0.05, it can be concluded that the scientific approach based on the multiple intelligence theory implemented online was effective in terms of the mathematical literacy skills of grade 8 students at SMP Negeri 10 Yogyakarta on the topic of Statistics. However, this approach is not effective in terms of student self-confidence. This ineffectiveness is due to interactions, time, and conditions. To be able to carry out an MI-based scientific approach in online mathematics learning, teachers need to pay attention to several things, such as student readiness, both in the technological aspect and in the psychological aspect.

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