The analysis of students’ metacognition in solving local wisdom based mathematical problems and the application of murder strategy to increase their metacognition ability

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Abstract. Metacognition ability is very important nowadays, especially in solving the problems faced. This study aims to analyze the students’ level of metacognition in solving math problems based on local wisdom, and is continued with the effort to improve their metacognition ability by using Murder. This study is carried out by using Concurrent Triangulation mix method, started by having qualitative method, continued by analyzing quantitatively and finished by doing the qualitative analysis. The research subjects were 21 elementary students in the experimental class and 21 elementary students in the control class. The research findings show that there are various students' metacognition level varies weak, moderate and strong. There is a mean difference on students' metacognition ability and their achievement test. The description of each level of metacognition is presented in the portrait phase of metacognition. N-Gain shows that the use of Murder strategy in the experimental class is more effective than the use of demonstration strategies in control class. The increasing students' metacognition in Murder class were presented in a table. The result reveals that the application of Murder Strategy can increase students’ metacognition level in solving local wisdom based mathematical problems of elementary school students

1. Introduction
Learning in primary schools will be more meaningful if contextual approach is implemented and can be observed from the result of the students’ achievement and should emphasize the local and systematic principle [4]. Learning process aimed to give effect or impact on the application phase in the form of problem solving, merging, separation, and preparation between concepts. Students in primary schools are be able to solve the problem with guidance or support of others called as scaffolding. Scaffolding could be question, stimulus, reminder, and small step [11]. Knowledge and skills that occur within the students in their learning activities and affects the achievement of cognitive aspects is called as metacognition. Knowledge related to the translation of the meaning and application of things, the steps in doing something, and the combination of some sense and its application in solving something are the metacognition domain [5]. Meanwhile planning, arranging information, providing restrictions, improving the steps that are not appropriate, and assessing what has been done are the aspects area of the metacognition skill [14]. Metacognition skills comprise two related abilities:
an understanding of the abilities, strategies, and resources needed in a task; and the ability of how and when to use them to ensure that tasks can be completed perfectly [1].

Awareness of cognition is called metacognition, it can explained as an individual’s ability to think or the knowledge of an individual based on his operations, so that these processes affect the characteristics related to the information or data stored and stored in achieving the goal [7]. Metacognition controls the use of cognition strategies and guide on them. Main metacognition strategies have three categories, the first one is as programming strategies that include of determination, prediction, and analysis. The second is evaluation of learners and supervision themselves. The last one is regularize strategies that plasticity in learner’s behavior and help till change self-learning style and method when was needed [9].

Metacognition distinguished into two main components, namely knowledge of cognition and regulation of cognition [2]. Meanwhile, Schraw & Moshman (Deri, 2018) devides metacognition into 3 components, namely knowledge, regulation, and experiences. Individual knowledge about themselves and others called metacognition awareness. Regulation of metacognition is how individuals set about their learning. Meanwhile, experiences metacognition are related to experiences that have to do with cognitive endeavors and these experiences include feelings, estimates or judgement of learning task, processing and its outcome [8].

Education is the product of society itself [13]. It confirms that the values of local wisdom of a particular community also influence education in each area. Education in the broad sense includes a series of educational activities, while in a more narrow sense refers to the learning process. Local wisdom becomes important in terms of integrating local wisdom values of local people in learning with the expectation of improving the mood and bring it closer to the students. Indonesian society is a group with its heterogeneous characteristics consisting of various tribes spread from Sabang to Merauke and has more than 250 languages [3]. Local wisdom of each region in Indonesia needs to be developed and maintained.

Murder strategy stands for Mood, Understand, Recall, Digest, Expand, Review. The description of Murder one by one are Mood refers to learning readiness; Understand interpreted to deep perception; Recall refers to remember and analysis; Digest related to get connectedness; Expand related new content to previous content; and Review refers to remove mistakes [9]. More profoundly, Murder consists of six (6) steps, namely : early conditioning of learning to let the students have positive atmosphere; the second step is classifying lesson materials into three criteria (easy, medium, and difficult) that should be understood by the students. The exclusive parts should really be understood as the basis for planning to be discussed again in the recall and review steps; the next step is repeating that is intended to make the students understand the parts to re-understand the parts that have not been understood by making them closer to the student's real life; exploring the material is conducted by integrating students’ initial ability with other relevant literacy; developing materials is done by developing things that the students can observe clearly; and a general should be thinking of the material that has been studied for a deeper understanding.

Based on explanations above, the researcher wants to bring it into a study because student’s metacognition ability is very useful in education and their future life. It can be improved with the use various learning models, among of them by using Murder. Even though, it needs more attentions to give relevant and deep research’s product, especially in the learning process with Murder. The researcher must also pay more attentions about the improvement of metacognition ability for all the students.

2. Methods
To analyze the students’ metacognition in solving local wisdom based mathematical problems and to improve the students’ ability by applying Murder strategy, this study is carried out by using combination method (mix method) with Concurrent Triangulation Strategy. Concurrent triangulation strategy uses both quantitative and qualitative data both in data collection and analysis, then compare the data obtained to find which data can be combined and differentiated [12]. Convergent parallel
research methods are a mixed-method design in which researcher collect or combine quantitative and qualitative data in order to provide comprehensive analysis [6]. This method is done by collecting both of qualitative and quantitative data, analyzing them separately, and then comparing the results to see whether the findings inform or not inform between both of the data.

The students’ metacognition potential is divided into three categories, namely: strong, moderate, and weak. Experiments were then conducted on two classes (experimental and control classes). At the end of the study both classes were given post test and the research was continued by seeing an increase in students’ metacognition after learning by using the Murder strategy. The learning in the experimental class was conducted by using Murder Demonstration strategy with the integration of local wisdom values, and the control class was taught by using the Conventional Demonstration strategy.

| Group     | Pre test | Treatment | Post test |
|-----------|----------|-----------|-----------|
| A (n = 21)| O1       | X         | O2        |
| B (n = 21)| O3       | –         | O4        |

The series of activities carried out to get maximum results of combination research in this study can be seen in the following figure.

![Trianggulation Research’s Model](image)

**Figure 1. Trianggulation Research’s Model**

The framework of thinking for this study analysis and application of Murder strategy to improve the result of students’ metacognition analysis can be seen in the following flowchart.
2.1. Subject
The subjects of this study were the students of class V SDN 1 Banyuglugur which consisted of 15 male students and 6 female students as experimental class. Meanwhile, the control consisted of 14 male students and 7 female students in SDN 2 Banyuglugur. The total number of research subjects were 42 students consisted of 29 males and 13 females. The samples for the guided interviews were 6 students from the experimental class and were taken from strong, moderate, and weak metacognition levels consisting of 2 students.

2.2. Instrument
The instrument in this research are questionnaire on metacognition given simultaneously with pre test tasks. In the next stage, the instruments used are learning tools and processing task for the experimental class and control class. At the end of the stages the partisipants were given questionnaire having the question on metacognition as a post test, then followed by guided interview to the 6 selected students representing three levels of metacognition with 2 students in each level.

The test in the form of a validated pre test and post test issue produces 0.58 consecutive differentiating power; 0.66; 0.72; and 0.87 (100% good). For the difficulty level of the problem in accordance with the grid (easy, easy, medium, easy) the obtained data was (0.92 / easy, 0.89 / easy, 0.56 / medium and 0.83 / easy). Meanwhile the validation of pre test task shows that all items are valid. The reliability level of the items were 0.62 (high reliability).

Questionnaire on metacognition in this study based on Junior Metacognitive Awareness by Sperling, namely : understanding the problem, determinating the final object, constructing the steps, believing the steps, implementing the steps, checking the steps, and believing the answers [10]. Instrument learning tools are validated by each teacher in both classes.

**Figure 2.** Flowchart of Research Model
2.3. Data collection and process
Qualitative data is done by analyzing the questionnaire of metacognition that has been filled by the students after doing the pre test in which based on local wisdom. Then the students were categorized into three levels, namely: strong, moderate, weak.

The data process quantitatively was taken from the result of the pre test, the learning process with the Murder strategy, and the result from the post test. They were done by applying inferential statistics to results of the pre test and post test of the experimental class by using t-test paired sample to know how Murder's strategy can improve the students' metacognition ability.

In addition, the post test given to both the experimental and the control one were also tested by applying Anova (two ways) by considering the initial ability of metacognition (strong, moderate, and weak) and the strategy used (Murder and Conventional) to know the mean difference of achievement in each classes. Meanwhile, to know the effectiveness/improvement of metacognition ability in experimental class and control class, N-gain calculation shows relative effectiveness of Murder strategy compared with the conventional one and also shows the more effective strategy.

The findings of this research were presented in the form of qualitative analysis on the questionnaire of metacognition followed by guided interviews to 6 selected students representing three levels of metacognition with 2 students at each level to describe the patterns (portrait phases) of students’ metacognition in solving math problems based on local wisdom.

3. Findings and Results

3.1. Diversity of metacognition ability
From the result of the pre test used as the potential input to know the level of students’ metacognition, and based on the result of the questionnaire distributed to the students after completing the pre test problem by giving the rubric range of achievement of pre test value, the following data was obtained.

![Figure 3](image3.png)

Figure 3. The distribution of students’ metacognition in the experimental class

![Figure 4](image4.png)

Figure 4. The percentage of students’ metacognition in experimental class

![Figure 5](image5.png)

Figure 5. The distribution of students’ metacognition in the control class
Figure 6. The percentage of students’ metacognition in control class

3.2. Descriptive statistics of pre test and post test

Table 2. Pre test and post test in experimental class

|           | Pre Test | Post Test |
|-----------|----------|-----------|
| Mean      | 67,14    | 90,47     |
| Median    | 70       | 90        |
| Mode      | 70       | 100       |
| Standard Deviation | 25,52 | 9,21 |
| Sample Variance | 651,42 | 84,76 |
| Range     | 90       | 20        |
| Minimum   | 10       | 80        |
| Maximum   | 100      | 100       |
| Sum       | 1410     | 1900      |
| Count     | 21       | 21        |

Table 3. Pre test and post test in control class

|           | Pre Test | Post Test |
|-----------|----------|-----------|
| Mean      | 67,62    | 78,57     |
| Median    | 70       | 80        |
| Mode      | 70       | 80        |
| Standard Deviation | 26,44 | 15,58 |
| Sample Variance | 699,05 | 242,86 |
| Range     | 80       | 50        |
| Minimum   | 20       | 50        |
| Maximum   | 100      | 100       |
| Sum       | 1420     | 1650      |
| Count     | 21       | 21        |

3.3. Inferential statistics

Table 4. The result of t-test on pre test–post test in experimental class

| Paired Sample Test | Paired Differences | 95%            | T   | df | Sig. (2-tailed) |
|--------------------|--------------------|----------------|-----|----|-----------------|
|                    | Mean               | Std. Dev       | Std. Error Mean | Lower | Upper |       |     |    |
| Pair 1             | -23,33             | 19,32          | 4,22           | -32,13 | -14,54 | -5,53 | 20  | 0  |
Table 5. The result of Anova 2 ways on post test in two classes

| Source            | Type III Sum of Squares | df  | Mean Square | F     | Sig. |
|-------------------|-------------------------|-----|-------------|-------|------|
| Corrected Model   | 5183,333*               | 5   | 1036,667    | 13,062| .000 |
| Intercept         | 300059,524              | 1   | 300059,524  | 3780,750| .000 |
| Ability           | 3447,619                | 2   | 1723,810    | 21,720| .000 |
| Strategy          | 1488,095                | 1   | 1488,095    | 18,750| .000 |
| Ability* Strategy | 247,619                 | 2   | 123,810     | 1,560 | .224 |
| Error             | 2857,143                | 36  | 79,365      |       |      |
| Total             | 308100,000              | 42  |             |       |      |
| Corrected Total   | 8040,476                | 41  |             |       |      |

a. R Squared = .645 (Adjusted R Squared = .595)

3.4. Relative effectiveness

Table 6. Relative effectiveness of Murder’s Strategy

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| Murder | $\frac{1900 - 1410}{2100 - 1410} = \frac{490}{690} = 0.7101 = 71.01\%$ |
| Convens| $\frac{1650 - 1420}{2100 - 1420} = \frac{230}{680} = 0.3382 = 33.82\%$ |
| N-Gain | $\frac{0.7101}{0.3382} = 2.099$ Murder is more effective |

3.5. The result on guided interview

The researcher want to prove more about the achievement of each student's pre test by selecting 2 students representing the metacognition level to be explored more deeply by conducting guided interview consisting clarification on understanding the intent of the problem, determining of the final goal, the step planning, believing the steps, checking the steps, and believing the correct answer. (P = researcher; T = selected students).

The selected question 1: "The data of Banyuglugur White Beach visitors: on Monday, there are 20 people. On Tuesday, the number of visitor is minus 8 from the visitor on Monday. On Wednesday, there are 2 more people than the number of the visitor on Tuesday. On Thursday, the number of the visitor is the same as the one on Monday. On Friday, there were 13 people. On Saturday, there were 35 people. And on Sunday, the visitor is as twice as the visitor on Monday. On what day do we have the least visitor?".

1. Strong metacognition ability in solving Mathematics problems based on local wisdom
   
   $P_{1.1}:$ Do you understand the point of problem #1?
   
   $T_{1.1}:$ Yes Sir, I know what that means.
   
   $P_{1.2}:$ Try to explain, what kind of answer does the question ask?
   
   $T_{1.2}:$ I was asked to decide on what day the White Beach had the least number of visitor.
   
   $P_{1.3}:$ What are the steps to solve the problem?
   
   $T_{1.3}:$ I read the phrase carefully, then I arranged the number of visitors in each day.
   
   $P_{1.4}:$ Okay, … please put in.
   
   $P_{1.5}:$ Why are the numbers circled by you?
So that I can compare correctly Sir. So I circle the final number of each day.

Okay, … Good. What will you do next?

To make me sure that it is right, I will read the question once again and I recalculate the number of visitors every day (the student recalculate carefully and more throughly). It’s done Sir, the least number of visitors coming to White Beach is 12 people, on Tuesday.

Done? … Are you sure that your answer is correct?

Yes, but I want to recalculate once again Sir (after a few minutes). Yes Sir, I have recalculate the calculation. I am sure that my answer is correct.

Figure 7. The result of guided interview conducted to the student having strong metacognition

From the guided interviews above, it means that the students with fully understood the final purpose and objectives required by the problem, planned the completion steps, and attempted to repeat the completion steps so that the students really believed that the answers were correct.

From the pattern formed, it appears that this students do not rush to take the decision to believe that the answer is true before doing a recalculation. Multiple repetitions at the end of the problem resolution or at certain points affecting the completion result are performed by the student as part of getting the correct answer, minimizing the error, and building confidence in the plan, step, and result.

Figure 8. Structural patterns (portrait phases) of the student having strong metacognition
2. Moderate metacognition ability in solving Mathematics problems based on local wisdom

\begin{tabular}{|l|l|l|}
\hline
\textbf{a} & The point of the matter is to compare & flowcharts \\
& the number of White Beach visitors & activity \\
each day and determine the fewest & \\
\hline
\textbf{b} & Determining the steps to get answers & repeat process \\
\hline
\textbf{c} & Recording / numbering of White & work process \\
& Beach visitors every day & \\
\hline
\textbf{d} & Marking the results of data collection & analysis process \\
& calculate the number of White & \\
& Beach visitors every day & \\
\hline
\textbf{e} & Comparing the calculations & object \\
& of White Beach visitors and determine the & \\
& fewest one & \\
\hline
\textbf{f} & Re-examining the process and the & scheme \\
& overall steps thoroughly & \\
\hline
\textbf{g} & Believing in the answers & begin/final \\
\hline
\textbf{h} & Done & \\
\hline
\end{tabular}

\begin{enumerate}
\item Do you understand the point of problem #1?
\item Yes, I do Sir.
\item Try to explain, what kind of answer does the question ask?
\item The least number of visitor coming to White Beach.
\item What are the steps will you do to solve the problem?
\item (student directly explain), Monday 20; Tuesday 20+8=12; \textbf{Wednesday 20+2=22}; Thursday 20; Friday 13; Saturday 35; and Sunday 2x20=40.
\item Okay … It would be better if you write it down. \textit{(the researcher deliberately didn’t tell the student know that Wednesday 20+2=22 was error)}.
\end{enumerate}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure9.png}
\caption{The result of guided interview conducted to the student having moderat metacognition}
\end{figure}

\begin{enumerate}
\item Are you sure that they are correct and is in line with the sentences?
\item (the student tried to repeat, but still made an error). Yes Sir, I have recalculated the counting.
\item Okay … What will you do next ?
\item The answer of the fewest White Beach visitors is 12 people, on Tuesday.
\item Are you sure that your answer is correct ? Would you like to repeat it once again ?
\item (the student tried to repeat). I am sure Sir.
\end{enumerate}

The students have understood the purpose and goal of the problem, plans the steps, and repeats the settlement steps, but the students have not shown serious concern in implementing the problem-solving steps. The final answer given by the students is true, but the steps that are done with "less
through" will give effect (to be wrong) if the matter is continued to be presented in other forms such as tables and diagrams.

The student made a mistake when he counted the number of visitors on Wednesday. It will give the wrong effect in doing follow-up. In the early recalculation phase, this student used it but did not find the mistake. The student actually did the recalculation at the end of the settlement, but unfortunately he did not find the correct answer.

3. Weak metacognition ability in solving Mathematics problems based on local wisdom

\begin{align*}
P_{3,1} : & \quad \text{Do you understand the point of problem #1?} \\
T_{3,1} : & \quad \text{I understand Sir (slowly but not sure).} \\
P_{3,2} : & \quad \text{Try to explain, what kind of answer does the question ask?} \\
T_{3,2} : & \quad \text{The least number of visitor coming to White Beach.} \\
P_{3,3} : & \quad \text{What steps do you plan to solve the problem?} \\
T_{3,3} : & \quad \text{(student did not give any answer).} \\
P_{3,4} : & \quad \text{If we are going to search for the fewest visitors, we must know the number of visitors every day before, then we choose the least.} \\
T_{3,4} : & \quad \text{Yes Sir. (the student started to write on the provided paper).}
\end{align*}

\textbf{Figure 10.} The result of guided interview conducted to the student having weak metacognition

\begin{align*}
P_{3,5} : & \quad \text{Are you sure these are correct and is in line the sentence in the item?} \\
T_{3,5} : & \quad \text{(the student hesitated and tried to repeat, but still did not change the writing).} \\
P_{3,6} : & \quad \text{Yes. What will you do next?} \\
T_{3,6} : & \quad \text{On Wednesday, there were only 2 visitors.} \\
P_{3,7} : & \quad \text{Are you sure that your answer is correct?, I give you an opportunity to change if you want to repeat it.} \\
T_{3,7} : & \quad \text{Done Sir.}
\end{align*}

The student with weak metacognition understood the purpose and the goal of the problem. Planning steps must be triggered by the researcher. Repetition of the problemsolving steps is not done so that the researcher take the conclusion that the student is also not sure of the answer.

The student is still not able to plan the problem solving independently. Furthermore, in running the plan he still did mistakes, and he did not understand the meaning of the sentence in the item, so that he did not seem to believe have done the problem solving well and correctly. Finally, when given the opportunity to recalculate the problem resolution, he did not do it. The following figure illustrates the student having weak metacognition ability.
3.6. The improvement of metacognition on post test-pre test

Table 7. Students’ improvement on metacognition

| Metacognition Potential | Pre Test | Post Test |
|-------------------------|----------|-----------|
|                         | n        | Percentage| n        | Percentage|
| Control Class with Conventional Strategy |          |           |          |           |
| Weak                    | 12       | 57,14%    | 8        | 38,10%    |
| Moderate                | 6        | 28,57%    | 9        | 42,86%    |
| Strong                  | 3        | 14,29%    | 4        | 19,05%    |
| Experimental Class with Murder Strategy |          |           |          |           |
| Weak                    | 13       | 61,90%    | 0        | 00,00%    |
| Moderate                | 6        | 28,57%    | 12       | 57,14%    |
| Strong                  | 3        | 9,52%     | 9        | 42,86%    |

4. Discussion

The result on the pre test illustrates that the two classes do not have much difference on their metacognitive capabilities. The selection of experimental class by the researcher to the class with the smaller mean value reveals that the researcher really wants to prove that Murder strategy is able to improve students' metacognition ability.

The students are not affected by external factor such as fear of being said to be less intelligent. It happened because before the students did the pre test, the researcher told them that the test and the questionnaire should be filled in based on what they thought and it had nothing to do with their academic score.

The descriptive statistics of pre test and post test of each class indicates that there is an increase in post test over the average of pre test both in class with Murder strategy and conventional strategy with relatively large difference. The finding supports the researcher's assumptions about the effectiveness of Murder's strategy in improving the students' metacognition skills in solving math problems based on local wisdom.

T-test paired sample (pre test-post test) in the experimental class previously tested levene’s homogeneity and kolmogorov-smirnov normality test gave homogeneous and normal distributed results. SPSS 25 application showing sig value. (2 tailed) of 0.000<0.05. It means that the Murder Strategy can improve the students' metacognition skills in solving local-based wisdom-based mathematics problems.

Anova two ways test (pre test-post test) of the experimental and control class shows that there was an average difference based on the students' metacognition ability / 0.000<0.05, and there was an average difference based on the strategy applied / 0.000<0.05. However the two classes do not interact / 0.224>0.05. It happened because the two classes did efforts to increase metacognition skills with different strategies, meaning learning experiences, learning process, and instructional techniques.

For relative effectiveness of Murder strategy, the experimental class contributed 71.01%, while the conventional strategy in the control class contributed 33.82% effectiveness. N-Gain combination...
obtained that $2.09 > 1$, so it can be concluded that the implementation of the Murder strategy is More Effective than the conventional strategy.

Finally, the increase of students’ metacognition (pre test-post test) in the Murder class, the weak metacognition level decreased from 13 students (61.90%) into 0 (0%). The moderate metacognition level increased from 6 students (28.57%) into 12 students (57.14%), and the number of students having strong metacognition level increased from 2 students (9.52%) into 9 students (42.86%). We conclude that the application of Murder Strategy is able to increase the ability of metacognition in solving local wisdom-based mathematical problems of an elementary school students.

5. Conclusion

This study concludes that the diversity of students’ metacognition ability in solving problems based on local wisdom-based math is divided into weak, moderate, and strong metacognition. Students with strong metacognition ability are able to transcend the metacognition phases by themselves. The moderate ones should be more carefully especially on re-examining phase. And the weak ones should be given trigger to arise their planning steps until believing the answer.

This study provides evidence that the Murder strategy is able to improve students' metacognition ability in solving math problems based on local wisdom. The ability of students’ metacognition is very important for the students not only to solve math problems but also to support their life.

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