Enhancement of reasoning skills of 7th grade students using Malcolm’s modeling based on KWL thinking strategy

AJohan¹, ASuyitno², Mashuri² and ISayeki²

¹SMA Negeri 1 Pekalongan, Jl. RA Kartini No. 39, Pekalongan51128, Indonesia
²Mathematics Education Department, Universitas Negeri Semarang, Sekaran, Gunungpati, Semarang50229, Indonesia

*Corresponding author:arnojohan95@gmail.com

Abstract. One of the skills that need to be implemented in learning is reasoning skill and Malcolm’s Modelling is one of learning models to improve reasoning skills. This research aims to investigate students’ problem solving skills. The students were taught using Malcolm’s Modelling that was based on KWL thinking strategy to achieve the minimum criteria scores in the scientific notation. The participants of this study were 705 seventh grade students of Tainan Municipal Jincheng Junior High School Taiwan that were selected in random sampling techniques. The data were collected and analyzed using SPSS and Microsoft Excel® for t-test and proportion test. The results showed that the reasoning skills of students was classified as good and sufficient.

1. Introduction

One of the crucial skills for students is reasoning skill. Reasoning is defined as the process of manipulating and analyzing objects or giving statements in order to draw evidence-based conclusions [1]. The indicator for measuring the reasoning skills of the students are: (1) a problematic situation, (2) strategy choice, (3) strategy implementation, (4) conclusion [2]. The students need to complete all the indicator to meet the requirements in reasoning skills. The more complete students meet all the indicator, the better the reasoning skills of the students. Mathematical reasoning is considered as a crucial skill in problem solving processes [3].

Not only reasoning skill that the students need, but also the teaching model itself need to be improved. Effective mathematics teaching may be achieved by engaging students in solving and discussing tasks that promote mathematical reasoning and problem solving [4]. One of teaching model that can be implemented in reasoning skill is Malcolm's modeling. Malcolm’s modeling method in its implementation involves the students independently in all stages of learning and requires a long time because of all the activities carried out in groups [5]. Therefore, Malcolm's modeling methods can be modified into a learning model with procedural steps and systematically adapted to the characteristics of students who are not familiar implementing learning constructivism and the allocation of time available at school [6].

One of the method to understand and analyze the question is by using K-W-L strategy. The K-W-L strategy (what we know, what we want to know, what we learned) is a strategy to make the student list what they already know about a topic, to write what they would like to know about a topic, and to write what they learned and would still like to learn [7]. Teachers adapted and modified the K-W-L strategy to maximize its effectiveness with their students who, in turn, become more active learners.
and higher achievers. Using K-W-L strategy, the student will do better in understanding the question of the problem [8]. In this strategy, the students make an outline of the question in order to simplify the problem in a simple way. If the students can understand the question properly, they will easily finish their mathematical problems.

The PISA result on 2015 revealed that Taiwan students are amongst the top-performing students in mathematics. The students were able to handle tasks that require the ability to formulate complex situations mathematically [9]. Therefore, his study was carried out to investigate the factors behind the student’s performance.

2. Methods
This research used a quantitative approach with one-shot case study (Table 1). The population was all the students at seventh grade in Tainan Municipal Jincheng Junior High School on the academic year of 2016/2017 that were divided into 13 classes from 701-713. The sample was taken by using cluster random sampling technique based on the same material, same time allocation and not based on rank. Class 705 was chosen as experiment class by giving treatment for experiment class using Malcolm’s Modeling based on KWL Thinking Strategy.

| Table 1. Research Design One Shot Case Study Design |
|---------------------------------------------------|
| **Group** | **Treatment** | **Measurement** |
| Experiment | X | T2 |

Note:
X = Malcolm’s Modeling based on KWL Thinking Strategy
T1 = reasoning skills test

The variables of this research were Malcolm’s Modeling based on KWL Thinking Strategy and problem solving skills of the students. The variables were classified into two categories, which were independent variable and dependent variable. The independent variable for this research was Malcolm’s Modeling based on KWL Thinking Strategy on the material of scientific notation and the dependent variable for this research was the problem solving skills of the student.

The methods of collecting data for this research were documentation and test method. Documentation method has function to obtain the data of students’ names and the data of exam score before the test. Test method has function to obtain the data of problem solving skills of the students after giving the treatment for experiment class and control class.

3. Results and Discussion
Based on analysis of reasoning skill test, it was obtained that the data was in normal distribution and had the same variance or homogeneous. Normality test was used to know that data was in normal distribution or not [10]. This test is the most common test for parametric statistics because the data that is in normal distribution is one of the requirements in parametric statistics test. Meanwhile for the data that is not normal distribution, it uses nonparametric statistics [11]. This research used Kolmogorov-Smirnov test using SPSS 16.0.

3.1 Reasoning Skill Test
After doing research on the experiment class and evaluating the test instrument which had 5 numbers, the final data of reasoning skills on the chapter Scientific Notation were obtained. The data were the score of reasoning skills on chapter scientific notation. Analysis of final data consisted of normality test, homogeneity test, hypothesis test.

Based on the test of reasoning skill, experiment class had an mean value of 76.72 with the highest score was 100 and the lowest score was 50. Those results were categorized as good even though there were 4 students who get the score below the minimum criteria scores.
3.2 Hypothesis Test

The data resulted in this study were normal and homogeneous. This test was held to know that the Malcolm’s Modeling Learning Based on KWL Thinking Strategy in the material of Scientific Notation passed the minimum criteria scores or not.

From the calculation, it can be concluded that the reasoning skills students of 7th grade using Malcolm’s Modeling Based on KWL Thinking Strategy passed the minimum criteria scores. The result of problem solving test showed that score of reasoning skill of the students in experimental class pass the minimum criteria score of 70. Based on proportion test, experimental group also achieved learning completeness classically in problem solving test (86%).

The learning using Malcolm’s Modeling Based on KWL Thinking Strategy could help students in understanding the contextual problems so that it could help students in reasoning. In addition to the Malcolm’s Modeling based on KWL Thinking Strategy, students were required to be able to understand the problems by themselves and the teacher only acted as a facilitator so that it could help students in the process of reasoning and could train reasoning skills through problems in the worksheet. Students were also accustomed to reasoning activities through formative/quiz tests given by the researcher at the end of the lesson and through homework assignments. At the time of the group discussion the students looked so enthusiastic in asking and doing. In addition, discussions conducted by students provide opportunities for students to interact, exchange ideas, and help each other in solving problems. At the end of the discussion, one of the students confidently dared to explain the results of their group answers in front of the class and the other students responded to the student’s exposure.

3.3 Reasoning Skills of the Students Using Malcolm’s Modeling Based on KWL Thinking Strategy on Chapter Scientific Notation

The correlation between Malcolm’s Modeling and reasoning skills is on the orientation stage, of which the students gave questions to the teacher based on the problem. This stage encouraged students to ask and develop their motivation because of the interesting problem showed [6]. The students weremore active in discussion due to the interested problem given.

To measure the reasoning skills of the students, this study used the KWL chart. This KWL table is an active reading strategy to help students build content knowledge by focusing on the topic and setting the purpose for the upcoming reading [7]. In column of What I Know or K column the result of the student above described that this student knew about what he/she wanted to do. He/she wrote about what he/she knew in Scientific Notation. In this column, the teacher provided specific questions to focus on the student’s thinking. In column of What I WANT to Know or W column, the student had to wrote about what they want to know. The teacher did not give any instructions, the teacher wanted the students to find by themselves about what they want to know. The prereading activity developed the students’ own reasons for reading, reading to find answer to questions that will increase their reservoir of knowledge in this topic [7]. The teacher’s role in this stage was to highlight students’ disagreements, to help the students raising questions, and to focus students’ attention to their reading. The majority of W column was done as a group activity, but before students begin to analyze, each student wrote down on his/her own worksheet for the specific questions. In column of What I LEARNED or L column, the students summarize what they learned. The students can write the answers from their questions in W column into L column.

In reading, the KWL strategy promotes the activation of students’ prior knowledge and the connection between new information and familiar ideas. KWL is good for the students when the teacher has explained about the material.

The development method of KWL Thinking Stategy is KNWS. In similar pattern, KNWS allows students to dig the facts they know (K); to search for information is not relevant (N); to find the problem they want them to find out (W); and to explore the strategy can be used to solve the problem (S) [12]. This method is good for the students in solving the mathematics problem. It can improve the
reasoning skills such as planning, organizing, analyzing and solving problems. Additionally, teachers can evaluate students’ understanding and gather the misconceptions that occurred [12].

In one case, the student could interpret what was in the mathematics problem. This student could write what he/she knew in the problem. He/she wrote the important information the K column. It would make the student get easier in solving the problem. This student also filled the N column. He/she could distinguish what was the important information and not. In W column, this student wrote what he/she must find about the problem. In this column, he/she also wrote the solution for this problem.

Meanwhile, another student could interpret what he/she knew about the problem, but he/she could not write the information completely. He/she could not write in N column like the previous student. This thing showed that this student felt that all the information in the problem was needed. In W column, he/she did not write the solution of the problem. Even though, he/she did not write the solution, but he/she wrote the correct strategy to answer the problem. It showed that this student understood enough about the material.

4. Conclusion

It was concluded that Malcolm’s Modeling based on KWL Thinking Strategy may improve students’ mathematics score. It can be seen that the proportion of the students in experimental class who passed the minimum standard was higher than 70%.

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