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The Effectiveness of Malcolm's Modeling Based on KWL Thinking Strategy towards The Problem Solving Skills

Keefektifan Model Pembelajaran Malcolm's Modelling Berdasarkan KWL Thinking Strategy terhadap Kemampuan Pemecahan Masalah Siswa

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Abstrak

Model pembelajaran yang bisa diimplementasikan untuk meningkatkan kemampuan pemecahan masalah adalah *Malcolm's Modeling*. Tujuan dari penelitian ini adalah: (1) mengukur kemampuan pemecahan masalah siswa yang diajar oleh Malcolm's Modeling berdasarkan *KWL thinking strategy* mencapai KKM; (2) membandingkan kemampuan pemecahan masalah siswa yang menerima *Malcolm's Modeling* berdasarkan KWL thinking strategy dalam bab notasi ilmiah dengan kemampuan pemecahan masalah siswa yang menerima model pembelajaran ekspositori. Populasi dalam penelitian ini adalah siswa kelas 7 SMP Negeri Jincheng, Tainan pada tahun akademik 2016/2017. Dengan teknik *simple random sampling*, kelas 705 dipilih sebagai kelas eksperimen dan 711 sebagai kelas kontrol. Metode dokumentasi, tes dan kuesioner yang digunakan dalam penelitian ini. Analisis data menggunakan software SPSS dan melalui uji t, uji proporsional dan perbandingan rata-rata. Hasil penelitian menunjukkan bahwa: (1) *Malcolm's Modeling* berdasarkan *KWL thinking strategy* memberikan hasil yang baik terhadap skor siswa; (2) kemampuan pemecahan masalah siswa yang menerima *Malcolm's Modeling* berdasarkan *KWL thinking strategy* lebih baik daripada kemampuan siswa yang menerima model pembelajaran ekspositori.

Abstract

The learning model that can be implemented to improve problem solving skills is Malcolm's Modeling. The objectives of this research were (1) to measure problem solving skill of the students who was taught by Malcom's modeling based on KWL thinking strategy towards the minimum criteria scores; (2) to compare the students on problem solving skill who received Malcom's Modeling based on KWL Thinking Strategy and expository learning model in the chapter of Scientific Notation. The population of this research were the students of seventh grade in Tainan Municipal Jincheng Junior High School in the academic year of 2016/2017. By simple random sampling technique, class 705 was selected as the experiment class and class 711 was selected as the control class. The data were collected by using some instruments, they were test and documentation. Data analysis used SPSS software and excel for t-test and proportion test. The results of the research showed that : (1) Malcom's modeling based on KWL thinking strategy gained good result to the scores of the students; (2) the problem solving skill of the students who received Malcom's Modeling using KWL Thinking Strategy was better than that skill of the students who received expository learning model.

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INTRODUCTION

Education is one of the rights for all the citizen. Every person needs education to increase their social life. By using education, the people can get a job and have prosperous life.

Knowledge can be obtained in many institutions. The institution can be obtained online by using internet or offline which can be obtained in formal school. Nowadays, education can be developed based on its situation and condition.

In formal education, studying indicates the changes into positive stage so that it can be obtained the skills, expertise and new knowledge. The results of the learning process are reflected on academic achievement. However, to get the best achievement, it needs maximum effort in the learning process. The learning process that occurs in individuals is an important thing, because by studying, individuals know their environment and adapt to the surrounding environment. According to Irwanto (1997) learning is a process of change and occur to a specified period.

One of the challenges to this century is to get good human resources. Good human resources are the human that can work in the under-pressure situation. In under-pressure situation, people must have the skills that can solve the problem properly. Because of that, skill of problem solving is indispensable. According to Wismath et al (2014), problem solving is a critical component of a comprehensive 21st century education, investigates the perceptions of the students of taking a university liberal education course designed to develop problem-solving skills.

Mathematics is one of the subjects which is available in every school all over the world. Mathematics is considered as a difficult subject by many students. According to an investigation by the Ministry of Education's Department in Taiwan, 154,426 students in 866 elementary and junior high schools, it was concluded that, mathematics is the most disliked subject among elementary school, junior high school and senior high school students. This data also based on the results of international research named PISA or Program for International Student Assessment.

PISA is a program of cooperation in several countries belonging to the OECD (Organization for Economic Co-operation and Development) to compare the academic skills of students aged 15 years in various countries in the fields of mathematics, science, and reading. Research was done by testing (assessment) academic skills of students aged 15-16 years in the form of a written exam every 3 years for categories of subjects of mathematics, science, and reading. Recent research conducted in 2015 to include 510,000 students from 65 countries, including Indonesia. Meanwhile, Taiwan was in the best 5. Through this research, the researcher expects to find out how is the result of the problem solving skills of students in Taiwan and develop that learning method in Indonesia.

The PISA 2015 survey focused on science, with reading, mathematics and collaborative problem solving as minor areas of assessment. PISA 2015 also included an assessment of young people's financial literacy, which was optional for countries and economies.

Based on PISA result of 2015, more than one in four students in Beijing-Shanghai-Jiangsu-Guangdong (China), Hong Kong (China), Singapore and Taiwan were top-performing students in mathematics, meaning that they could handle tasks that require the ability to formulate complex situations mathematically, using symbolic representations. It could be concluded that Taiwan's student in solving mathematical problem was excellent. This data can be seen in table 1 below.

Table 1. PISA's Score 2015

Country	Mathematics Mean Score in PISA 2015
Singapore	564
Hongkong	548
Taiwan	542
B-S-J-G China	531

Source: PISA 2015; OECD

There are many things which cause the students can not do the problems associated with reasoning, one of which is the lack of problem solving skills in students (Fajariyah et al, 2012). Mathematical problem solving skills can be seen through: (1) understand the problem, students can identify the elements that are known, were asked, and the adequacy of the required elements, (2) plan the problems, students can formulate a mathematical problem or to develop a mathematical model. The students can implement strategies to solve various problems. (3) solve the problem, students are expected to perform well to complete the planning, (4) review and make conclusions.

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 in school (Wells et al, 1995). 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 (Syarifah, 2015).

One of the method to understand and analyze the question is by using K-W-L strategy. In reading, the K-W-L strategy helps all students, no matter the age or achievement level, activate their prior knowledge, develop a purpose for the reading, and make connections between new information and familiar ideas.

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. 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. In this strategy the students make an outline of the question in order to simplify the problem in simple way.

The objectives of this research were (1) to measure problem solving skills of the students who was taught by Malcom's modeling based on KWL thinking strategy towards the minimum criteria scores; (2) to compare the students on problem solving skills who received Malcom's Modeling based on KWL Thinking Strategy and expository learning model in the chapter of Scientific Notation..

METHOD

This research used true experimental design with posttest only control design that can be seen in Table 2 below.

Table 2. Research Design of Posttest Only Control Group Design

No	Group/Class	Treatment	Posttest
1	Experiment	X	T1
2	Control	Y	T2

Note :

X= Malcolm's Modeling based on KWL Thinking Strategy

Y= expository learning model

T1 = the test result of problem solving skills of experiment class

T2 = the test result of problem solving skills of control class

This research was conducted by giving treatment for experiment class using Malcolm's Modeling based on KWL Thnking Strategy and expository learning model for control class. The population for this research was all the students at seventh grade in Tainan Municipal Jincheng Junior High School on the academic year of 2016/2017 which was divided into 13 classes from 701-713. The sample was taken by using simple random sampling technique. It was chosen randomly two classes that have same condition. Class 705 was chosen as experiment class and class 711 was chosen as control class.

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 method 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.

RESULTS AND DISCUSSION

Research Results

Based on analysis of problem solving 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. 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. This research used Kolmogorov-Smirnov test using SPSS 16.0. The calculation used the data of problem solving skills test for experiment class and control class.

Descriptive Statistic of Final Data

After doing research on the experiment class and control class and evaluating the test instrument which had 5 numbers, it was obtained the final data of problem solving skills on the chapter Scientific Notation. The data was the score of problem solving skills on chapter scientific notation. Analysis of final data consist of normality test, homogeneity test, hypothesis test 1, and hypothesis test 2.

Based on the test of problem solving skill, experiment class had mean 76,72 with the highest score was 100 and the lowest score was 50. That result was good even though there were 4 students who get the score below the minimum criteria scores. Meanwhile for the control class had mean 62,24 with the highest score was 90 and the lowest score was 30. This result was not good because there were 15 students who got the score below the minimum criteria scores. This data can be seen in table 3 below.

Table 3. The Data of Problem Solving Skill Test

No.	Class	Mean	Highest Score	Lowest Score
1	Experiment	76,72	100	50
2	Control	62,24	90	30

Hypothesis Test I

After knowing that the data was normal and homogeneous, it was continued to use t-test. Meanwhile for the data that were not normally distributed, it used non parametric test. 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.

The classical criteria scores is the percentage of the students which pass individual score standard must be greater than 75% by calculating from the data it was obtained : z=1,904. For α=5%, it can be obtained $z_{table}=z_{0,5-\alpha}$=1,64.

Since z_{cal}=1,904 ≥ z_{table}=1,64, then H_0 was rejected. Statistically, the percentage of problem solving skills students who get the score greater than 65 was greater than 75%.

From the calculation, it can be concluded that the problem solving skills students of 7th grader using Malcolm's Modeling Based on KWL Thinking Strategy was passing the minimum criteria scores.

Hypothesis Test II

Hypothesis test II was used to test equality mean the result of two samples. Hypothesis test II had a function to know if the samples had the same average or not. Equality mean used t-test.

Based on calculation, t_{cal} = 3,71 and t_{table} = 1,99 with α=5%, it means that H_0 was rejected. It was concluded that the problem solving skills of the students on the chapter scientific notation by using Malcolms Modeling Based on KWL Thinking Strategy was better than using expository learning model. It also can be seen from the average value that the score was greater than that score of expository learning model.

Discussion

This research was designed to measure the problem solving skills of the students using Malcolm's Modeling Based on KWL Thinking Strategy. The first step on this research was taking the score mid term test in semester 1 of seventh grade at Jincheng Junior High School on the mathematics subject. The mid term test score was used as the initial data. Based on the analysis of two classes, it was obtained that the data were in normal distribution and homogeneous and also they had the same average. Thus, two classes had the same initial condition or same ability. Then, it was chosen class 711 as control class which used expository learning model and 705 as experiment class which used Malcolm's Modeling Based KWL Thinking Strategy.

The result of problem solving test showed that score of problem solving skill of the students in experiment class pass the minimum criteria score which is 65. Based on proportion test, experiment group also achieved learning completeness classically in problem solving test which was 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 solving problems. 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 solving problems and could train problem-solving skills through problems in the worksheet. Students were also accustomed to problem-solving 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.

The results were also supported by the results of hypothesis II test which stated that the mean of problem solving skill from Malcolm's Modeling based on KWL Thinking Strategy was higher than the average problem-solving skill with expository learning model. Therefore, it could be concluded that the quality of the problem solving ability of the experiment class was higher than the control class. This happened because in the implementation stage, the students were more faced with real or concrete problem reasoning that made students become more interested in learning. Understanding problems based on real-world problems allows the students to analyze and understand problem solving questions.

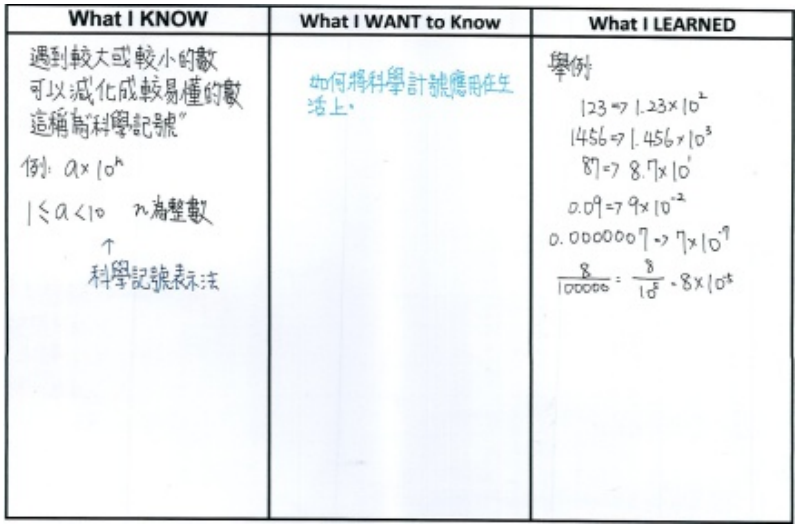
Problem Solving Skills of the Students Using Malcolm's Modeling Based on KWL Thinking Strategy on Chapter Scientific Notation

The connection between Malcolm's Modeling and problem solving skills is on the orientation stage, the students gave questions to the teacher based on the problem. This stage made the students wanted to asked and developed their motivation because of the interesting problem was showed (Syarifah & Yosaphat, 2015). The students are more active in discussion because they are interested with the given problem.

In this research, the researcher wanted to measure the problem solving skills of the students by using KWL table. 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 (Ogle, 1986).

The table 4 below shows the problem solving skills using KWL chart. In column of What I Know or K column the result of the student above described that this student knew

Table 4. KWL Strategy Student 1



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 students 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. As students take time to think about what they already know about the topic and the general categories of information that should be anticipated, questions emerge. Not all students agree on the same pieces of information, some information was conflicting, some of the categories have had no particular information provided. All this 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 (Ogle, 1986). The teacher's role in this stage was central. The teacher highlighted their disagreements and helped the students raise questions that focus their attention and energize 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 that he/she was most interested in having answered as a result of the discussion.

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 the table 5 above the student just knew about the material only a few. This student could not write in K column what he/she knew deeply in this material. In addition, this student also could not describe what he/she wanted to know because it was just written one question. In L column, this student understood about the material because the teacher had explained it.

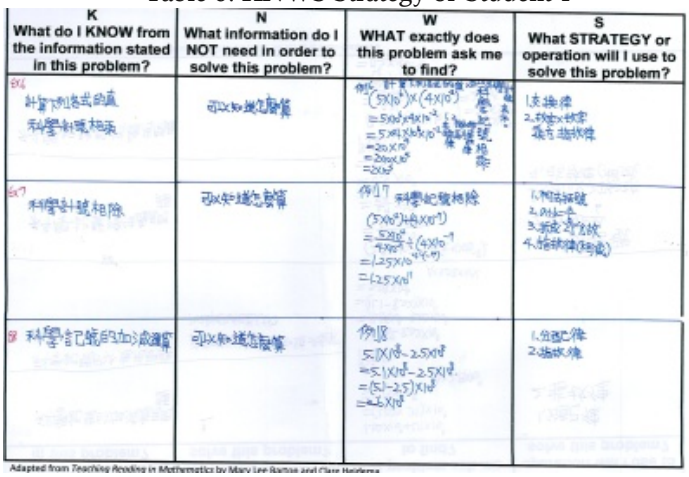
In reading, the KWL strategy helps all students, activate their prior knowledge, develop a purpose for the reading, and make connection between new information and familiar ideas. KWL is good for the students when the teacher has explained about the material.

The development method of KWL Thinking Stategy is KNWS. In similar pattern, KNWS allows students to use word problem to answer what facts they know (K); what information is not relevant (N); what the problem wants them to find out (W); and what strategy can be used to solve the problem (S) (RMC Research Corporation, 2005). This method is good for the students in solving the mathematics problem. It can improve the problem solving skills of the students because in this method, allows students to plan, organize, and analyze how to solve word problems, while teachers can evaluate students' understanding and possible misconceptions about mathematics problem (RMC Research Corporation, 2005). This following table is example of students task about scientific notation.

Table 5. KWL Strategy of Student 2

What I KNOW	What I WANT to Know	What I LEARNED
遇到較大或較小的數 可以減化成較易懂的數 這稱為"科學記號" 例: $a\times10^n$ $1\le a<10$ n為整數 ↑ 科學記號表示法	如何將科學計號應用在生活上.	舉例 $123=1.23\times10^2$ $1456=1.456\times10^3$ $87=8.7\times10^1$ $0.09=9\times10^{-2}$ $0.0000007=7\times10^{-7}$ $\frac{8}{100000}=\frac{8}{10^5}=8\times10^{-5}$

Table 6. KNWS Strategy of Student 1



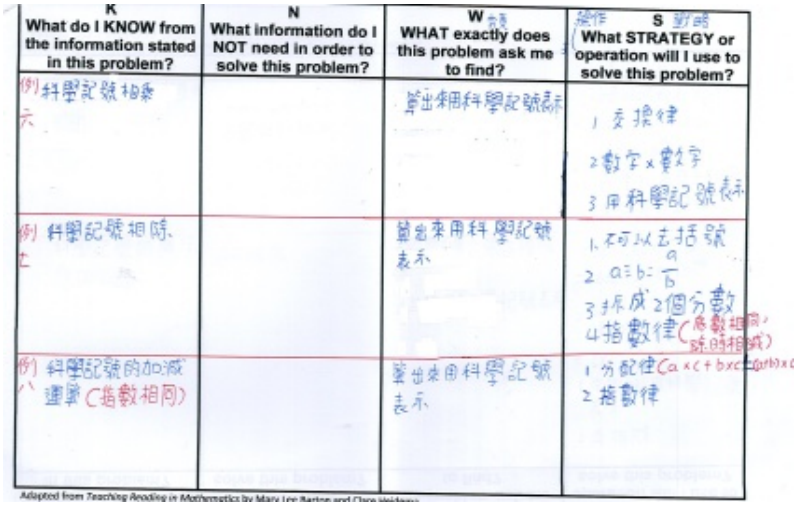
In the table 6 above, the student could interpret what was in the mathematics problem. This student could write what he/she knew in the problem. He/she wrote the important information the K column. It would make the student get easier in solving the problem. This student also filled the N column. He/she 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, for the table 7 below, this 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 the correct strategy to answer the problem. It showed that this student understood enough about the material.

The Difference between The Students who Received Malcolm's Modeling Based on KWL Thinking Strategy and The Students who Received Expository Learning Model

Based on the thinking strategy of KWL and KNWS in problem solving skills, it could be concluded there were different result in the end. The average score of the result problem solving skill test for experiment class was 76,72 and control class was 62,64. In the hypothesis test I and II also showed that result of the students who received Malcolm's Modeling based on KWL Thinking Strategy was better than that students who received expository learning model. The factors why there were differences of problem solving skills between two classes

Table 7. KNWS Strategy of Student 2



are explained as: (1) The Malcolm's modeling based on KWL Thinking Strategy made the students interested to ask about the material because the teacher gave KWL table to students and the students had to ask about what they did not understand yet; (2) Malcolm's Modeling based on KWL Thinking strategy could improve the problem solving skills of the students because the students with their groups used scientific method to solve the problem in the construction stage.

CONCLUSIONS

Based on research results and discussion, it was obtained the conclusion as follows (1) the results of the research showed that Malcolm's Modeling based on KWL Thinking Strategy gained good result to the score of the students. It was seen from the proportion test that score of the students in experiment class was passing the minimum standard with the proportion greater than 75%; (2) the problem solving skill of the students who received Malcom's Modeling using KWL Thinking Strategy was better than that skill of the students who received expository learning model.

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