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The Impact of Discovery Learning with a Scientific Approach in Mathematics Learning

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Abstract. This study aimed to determine the impact of discovery learning with a scientific approach in mathematics learning on junior high school students in Makassar city. The research samples were students of class VIII MTs Negeri Model Makassar. Data collection methods in this research were test and interview. The test method was used to obtain learning outcome data. While interviews were conducted to obtain data about the impact of discovery learning with the scientific approach in student mathematics learning outcomes. The analysis techniques used were descriptive statistics and inferential statistics. The results of descriptive and inferential analysis showed that the average score of student mathematics learning outcomes in experimental class was 91.33 with classical completeness around 97%. It showed student learning outcomes increased after the discovery learning with the scientific approach was applied. Thus, discovery learning with the scientific approach was better than conventional learning.

Keywords: Discovery Learning, Scientific Approach, Mathematics Learning

1. Introduction

Currently the world in general, and Indonesia in particular, is entering a new industrial era in the 21st century which is marked by the era of digitization in various sectors of life. Experts call it the era of the industrial revolution 4.0 where information and technology has a massive impact on school activities. New information and knowledge is spread easily and accessible to anyone who needs it. Education is experiencing tremendous disruption. One of the disruptions that occur is that later education will be science-based (knowledge) no longer based on memorization [1]. Therefore, Indonesia has developed an educational curriculum designed to keep up with the industrial revolution. The curriculum is known as the 2013 curriculum. This curriculum is a development of the 2004 curriculum which is oriented towards achieving balanced competencies between attitudes, skills and knowledge, as well as a holistic and fun way of learning [1].

In implementing the 2013 Curriculum, one of the main subjects is Mathematics. As is well known, mathematics is one of the most dominant subjects in developing science and technology. Therefore, in the era of the industrial revolution 4.0, the role of the teacher as a guide is needed to improve the quality of learning mathematics so that students can build their own knowledge through concept discovery. The



use of appropriate learning models is considered to be able to support the achievement of maximum learning goals. Thus, it is not too much to say that the learning model used by the teacher is half of the spirit of learning, because this learning model is the flow of the process when learning in the classroom takes place.

However, in reality, there are still many teachers who carry out conventional teaching and learning processes that are teacher-centered, even though in this industrial revolution era, learning should no longer be teacher centered but student centered. The conventional method which is centered on the teacher (teacher centered), causes students to be bored and dislike mathematics. In a conventional approach, students are not given many opportunities to be involved in learning so that learning can kill students' enthusiasm and creativity. Students no longer have the opportunity to grow while learning (growth in learning) and do not have the opportunity to manifest their potential and all their abilities [2]. As a result, the knowledge obtained by students in learning mathematics will not become meaningful knowledge and this knowledge is only to be remembered temporarily, after it is forgotten.

According to [3] discovery learning is a model that allows students to be directly involved in teaching and learning activities, so that they are able to use their mental processes to find a concept or theory that is being studied. Not only that, learning by discovery helps students form effective collaborative ways of working, share information with one another, and listen to and use other people's ideas. Thus, learning using discovery learning models can improve student learning outcomes. This is in line with the results of research by [3] which states that the discovery learning model can improve student learning outcomes ranging from the lowest 9% to the highest 27% with an average of 17.8%.

In addition to using the right learning model, the use of the right learning approach can also support the achievement of learning objectives which will later have an impact on education in this industrial revolution era. In the 2013 Curriculum, it is clearly outlined that teachers, especially mathematics teachers, must carry out learning with the scientific approach. The scientific approach is a basic concept that inspires or provides the background for the formulation of teaching methods by applying scientific characteristics [4]. Based on the research results of [5] & [6], in general the application of the scientific approach can improve student learning outcomes.

Based on the description of the effectiveness of the discovery learning model and the scientific approach above, it is in line with the research results of [7] which shows that the mathematics learning outcomes of students who use the discovery learning model and the scientific approach are better than students who use conventional learning methods. Thus it can be understood that the discovery learning model with the scientific approach has an impact on mathematics education in the industrial revolution era for both primary and secondary school students. Therefore, researchers are interested in analyzing the impact of discovery learning with the scientific approach in mathematics education in the era of the industrial revolution on junior high school students in Makassar city.

2. Methodology

The research method used is quantitative research methods. Researchers used true experimental, namely pretest-posttest control design. The population in this study were students of class VIII MTs Negeri Model Makassar for the 2019/2020 school year. While the sampling used cluster random sampling technique by taking classes randomly in a homogeneous population. In the experimental class, students were taught with discovery learning model assisted by scientific approach, and in the control class students were taught using conventional learning models.

Data collection methods in this research are test and interview methods. The test method used is in the form of learning outcomes tests in the form of descriptions to obtain data on learning outcomes by applying the Discovery Learning model with a scientific approach for class VIII MTs Model Makassar. The test questions that will be given are tried out in the trial class and analyzed to determine the level of validity and validity of the test which includes validity, reliability, difficulty level and distinguishing power of each item. While interviews were conducted to obtain data about the impact of discovery learning with the scientific approach on student mathematics learning outcomes in the era of the industrial revolution 4.0.

The hypothesis in this study is to determine the results of learning mathematics, classical completeness, and improving student learning outcomes after applying discovery learning with the scientific approach or by applying conventional learning, as well as how the impact of discovery learning with the scientific approach in the era of the industrial revolution 4.0. The analysis technique used is descriptive statistics and inferential statistics. Descriptive statistical analysis aims to determine the understanding of the material through describing the characteristics of the distribution of student mathematics learning outcomes through discovery learning with a scientific approach. Meanwhile, inferential statistics are used to test the research hypotheses that have been formulated.

3. Results and Discussion

This research was conducted at MTs Negeri Model Makassar with a population of class VIII students in the 2019/2020 school year and took two classes as samples. Class VIII 2 students as an experimental class were treated with discovery learning models with a scientific approach. Meanwhile, class VIII 4 students as the control class were treated with conventional learning models. The material chosen in this study is a two-variable system of linear equations.

3.1 Descriptive Analysis

Results The results of the research and discussion in this case are in the form of learning outcomes tests by applying the discovery learning model with a scientific approach to the experimental class and the control class after being given different treatments.

Table 1. Recapitulation of Student Learning Outcomes Class VIII.2 MTs Model Makassar

Statistics	PRETEST_EX	POSTTEST_EX
Samples	33	33
Mean	40.9697	91.3333
Median	40.0000	92.0000
Modus	25.00 ^a	95.00
Std. Deviation	11.88614	5.59948
Variance	141.280	31.354
Skewness	0.223	-0.318
Range	35.00	20.00
Min	25.00	80.00
Max	60.00	100.00

Based on table 1, it can be seen that the mean posttest of student learning outcomes is 91.33. This shows that in general the posttest scores are in the very high category, thus there is an increase in the mean value of students from pretest to posttest (from very low to very high categories). The posttest median score of the students was 92.00 indicating that there were about 50% of the students who obtained the highest score of 92.00 or the lowest score of 92.00. The mode value of 95.00 indicates that the posttest of student learning outcomes with the greatest frequency is 95.00. Based on the slope coefficient of -0.31 and paying attention to the mean, median and mode values, it can be said that in general the posttest results of student learning outcomes are above the average with a very high category.

From Table 2 it can be seen that the pretest scores of all students are in the very low category. On the other hand, for the posttest score, 1 student scored in the low category, 14 students scored in the high category, and 18 students scored in the very high category. This gives an indication that there is an increase in student learning outcomes after the discovery learning model is applied with a scientific approach in class VIII.2 MTs Model Makassar.

Table 2. Frequency Distribution of Student Learning Outcomes for Class VIII.2 MTs Model Makassar

Interval	Category of student understanding	Pretest		Posttest	
		Frekuensi	Percentage (%)	Frekuensi	Percentage (%)
$90 < x \leq 100$	Very High	0	0	18	55
$80 < x \leq 90$	High	0	0	14	42
$60 < x \leq 80$	Low	0	0	1	3
$0 \leq x \leq 60$	Very Low	33	100	0	0
Total		33	100	33	100

Based on the description above, it can be concluded that descriptively there was an increase in student learning outcomes after the discovery learning model approach was applied with a scientific approach to mathematics subjects in the subject of two-variable linear equation systems in class VIII.2 MTs Model Makassar.

Table 3. Recapitulation of Class VIII.4 Student Learning Outcomes at MTs Makassar Model

Statistics	POSTTEST_KT
Samples	33
Mean	79.2121
Median	78.0000
Modus	78.00
Std. Deviation	6.22875
Variance	38.797
Skewness	-0.023
Range	20.00
Min	65.00
Max	85.00

Based on table 3, it can be seen that the mean student learning outcomes are 79.21. This shows that in general student learning outcomes are in the medium category. The median value of 78.00 shows that there are about 50% of students who get the highest score of 78.00 or the lowest score of 78.00. The mode value of 20.00 indicates that the acquisition of student learning outcomes with the greatest frequency is 78.00. Based on the slope coefficient of -0.02 and paying attention to the mean, median and mode values, it can be said that in general the learning outcomes of students taught by conventional learning are in the medium category.

Table 4. Frequency Distribution of Student Learning Outcomes for Class VIII.4 MTs Model Makassar

Interval	Category of student understanding	Pretest		Posttest	
		Frekuensi	Percentage (%)	Frekuensi	Percentage (%)
$90 < x \leq 100$	Very High	0	0	12	37
$80 < x \leq 90$	High	0	0	16	48
$60 < x \leq 80$	Low	0	0	5	15
$0 \leq x \leq 60$	Very Low	33	100	0	0
Total		33	100	33	100

From table 4 it can be seen that the pretest scores of all students are in the very low category. On the other hand, for the posttest score, 5 students scored in the low category, 16 students scored in the high category, and 12 students scored in the very high category. This gives an indication that there is an increase in student learning outcomes after the application of discovery learning with the scientific approach to class VIII.4 students of MTs Model Makassar. Based on the description above, it can be concluded that there has been a descriptive increase in student learning outcomes after the application of discovery learning with the scientific approach in mathematics subjects of the two-variable linear equation system in class VIII.2 MTs Model Makassar.

Furthermore, the results of student interviews show that through discovery learning with the scientific approach in the era of the industrial revolution 4.0 by utilizing computerization or digitalization with discovery learning learning with the scientific approach are: 1) Helping students to improve and improve cognitive skills and processes, 2) The knowledge obtained through this model is very personal and powerful because it strengthens understanding, memory, and transfer, 3) It creates joy in students, because it grows a sense of investigation and success, 4) It causes students to direct their own learning activities by involving their own intellect and motivation, 5) Student-centered and the teacher plays an active role in issuing ideas, 6) Encourages students to think and work on their own initiative, 7) Encourages students to think intuition and formulate their own hypotheses, 8) Provides intrinsic decisions, 9) Pros situation ice learning becomes more aroused, 10) The possibility of students learning by utilizing various types of learning resources, and 11) Can develop individual talents and skills.

3.2 Inferential Analysis Results

3.2.1 Learning Outcomes

Based on the one sample test, the value obtained by $t_{\text{count}} = 11.63 > t_{\text{table}} = 1.70$ then $H_0: \mu_1 \leq 75$ is rejected and $H_1: \mu_1 > 75$ is accepted in other words for the 95% confidence level the average student learning outcomes after applied learning discovery learning with a scientific approach is more than 75. Thus it can be concluded that the average student learning outcomes by applying discovery learning learning with a scientific approach in class VIII MTs Negeri Makassar meet the minimum completeness criteria which is more than 75

3.2.2. Completeness Learning

Based on the analysis using the proportion test/z-test using a significant level of 5% and the test proportion = 0.75, the value of $z_{\text{count}} = 2.14$ was obtained. Because the value of $z_{\text{hitung}} = 2.14 > z_{\text{tabel}} = 1.64$ then $H_0: \pi \leq 75\%$ is rejected and $H_1: \pi > 75\%$ is accepted. In other words, the proportion of students who reach the completeness criteria is 75% of the total students who take the learning outcome test Thus mathematics learning by applying discovery learning with a scientific approach in class VIII MTs Negeri Makassar fulfills classical completeness, namely 75%.

3.2.3 Improved Learning Outcomes

Based on the analysis results of the one sample test, it was obtained with the value $t_{\text{count}} = 43.77 > t_{\text{table}} = 1.70$, then $H_0: \mu_g < 0.3$ was rejected and $H_1: \mu_g \geq 0.3$ was accepted in other words, the 95% confidence level was The average increase in student learning outcomes after the application of discovery learning with a scientific approach is 0.3. Thus the average increase in student learning outcomes is verified, so it can be concluded that discovery learning learning with a scientific approach in class VIII MTs Negeri Makassar meets the criteria for a gain value of 0.3.

4. Conclusions

The conclusion of this study is the application of discovery learning with a scientific approach has an impact on the mathematics learning outcomes of class VIII students of MTs Model Makassar. Student mathematics learning outcomes after the application of discovery learning with the scientific approach in class VIII.2 (Experiment class) Makassar Model State MTs achieved an average posttest score of

91.33; average normalized gain of 0.86; classical completeness of 97%; standard deviation of 5.60; and the highest score reached 100. Meanwhile, students' mathematics learning outcomes after the application of conventional learning in class VIII.4 (control class) MTs Negeri Model Makassar achieved an average posttest score of 79.21; the average normalized gain is 0.76; classical completeness by 85%; standard deviation of 6.22; and the highest score reached 85. The results of interviews conducted with students showed that through discovery learning with the scientific approach in the era of the industrial revolution 4.0 by utilizing computerization or digitalization, it could help students to improve and improve cognitive skills and processes. In addition, this model is able to provide reinforcement to students in understanding the material. Students can also have good learning awareness and independence and can take advantage of various learning resources that can support student understanding.

Based on the impact of discovery learning with the scientific approach, it is expected that teachers must reduce the dominance of knowledge in education and learning in the hope that students will be able to outperform machine intelligence. Education that is balanced with character and literacy makes students very wise in using machines for the benefit of society. Teacher 4.0 has a greater responsibility in educating students to face the Industrial Revolution 4.0. Teacher 4.0 is a teacher who is able to master and utilize digital technology in learning. The industrial revolution 4.0 is marked by the presence of four things, namely super computers, artificial intelligence, cyber system, and manufacturing collaboration. Thus a competency is needed that is able to keep up with the presence of these four things in the era of Education 4.0.

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