The Influence of Index Card Match on Mathematics Learning Outcomes in Inverse Matrix Material in High School

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Abstract

Lack of interest in learning inverse matrix mathematics causes a lack of interest in learning mathematics and produces unsatisfactory results. Researchers tried to conduct experimental research on the application of the Index Card Match learning model to mathematics learning outcomes in Inverse Matrix material at SMA Negeri 21 Makassar. The approach used is a quantitative approach with a pre-experimental method with a One Group Pretest Posttest design. The data collection techniques used are tests, observation, interviews and documentation. Meanwhile, data analysis uses the normality test and the Simple Paired T-Test hypothesis test. The results of this research were hypothesis testing on the pretest and posttest which obtained results of $0.000 < 0.05$. H0 was rejected and Ha was accepted. From these results, it means that the application of the Index Card Match model has an influence on cognitive mathematics learning outcomes in inverse matrix material for class XI students at SMA Negeri 21 Makassar..

Keywords: Matrix Inverse; Index Card Matching; Learning outcomes.

INTRODUCTION

Mathematics is a basic science that discusses numbers and has benefits for everyday life so that it can support the process of developing other sciences and technologies. According to Haryani (2011) that mathematical problems which are called problems can be easily solved depending on the knowledge possessed by the answerer. Mathematics is taught to children from an early age so they can solve problems in everyday life. Meanwhile, according to Yulia Maftuhah Hidayati and Salsabila (2021), mathematics questions are able to develop students' abilities in mathematical literacy such as solving problems, using mathematical formulas and communicating answers when answering mathematics questions. Mathematics subjects in school learning are presented in the form of questions in the form of numbers, but there are several problems that are not only stated in the questions (Ulpa, 2021). This can be interpreted as that solving problems in mathematics is based on a person's knowledge in understanding basic mathematical concepts.

Mathematics has many basic concepts that students need to understand. One of the basic mathematical concepts that students consider difficult is matrix material. Based on experience in the field, economists who have a basic knowledge of mathematics or have a strong mathematical foundation will have no problems in studying econometrics, on the other hand, if the mathematical basis such as matrix topics, differentials, probability, etc. is not good, they will encounter significant obstacles. . The external factors that make it difficult for students to understand the matrix concept include 1) the

teacher does not make it a habit to memorize formulas from the scope of the matrix, 2) the teacher does not provide enough motivation for students to memorize the formulas used in the matrix material and 3) the lack of a learning process carried out with the peer tutoring method, making it easier for students to memorize matrix formulas. It is necessary to pay attention to the choice of learning model in order to encourage students to understand the material being studied, especially when presenting matrix material. If learning models are not used when delivering material, students will always experience difficulties.

An educator has a role in overcoming difficulties in learning mathematics in various ways, such as providing material and example questions, assisting students' learning personally, simplifying the form of mathematical formulas, using available learning media, providing learning evaluations to students in the form of practice questions or assignments at home. , using innovative learning models, and motivating students during learning (Abduh and Yuliyanti, 2020). The influence of students' difficulties is focused on one factor, namely that the learning model applied is less attractive, which is a big concern for teachers. Innovative and creative learning will provide new things experienced by teachers and students in the learning process (Uno and Mohamad 2022). Based on the opinion above, teachers need to apply learning models that are creative, interesting, motivating for students and in accordance with students' development and abilities in order to achieve predetermined learning goals..

The Index Card Match type learning model has learning rules by matching cards based on learning material which can make students understand the learning material by using these cards. The Index Card Match learning model is a learning process that has a fun learning flow for students (Hartiningrum and Ula, 2020). Fun learning is needed for students to be able to apply and experience various learning experiences in solving problems and to be motivated that learning can be done like playing without realizing that students are actually learning (Anugrahini and Y. Windrawanto 2017). So it can be understood that this learning model will have a good impact on students in the learning process.

The Index Card Match learning model has been widely applied in several previous studies. Based on the research results of Ismawati (2022), the results of the percentage of student activity through observation sheets showed an increase from 41.67% incompleteness in cycle I to 19.44% incompleteness in cycle II. Based on the research results, it can be concluded that the learning method using Index Card Match can improve the learning achievement of class XI IPA 3 students at SMAN 1 Cariu. The results of Duha's research (2023) show that the results of this research from all students' answers show that students made 15% factual errors, 49.7% conceptual errors, 30.7% principle errors, and 4.6% operational errors in this study. . So it can be concluded that class XI-MIA students at Teluk Dalam Campus Private High School made the highest number of mistakes, namely conceptual errors. Based on these results and conclusions, the researcher suggests that students do questions more often and understand the concepts in the matrix material so that they are used to and understand how to solve the questions given..

Based on the results of interviews with the homeroom teacher of class This can be seen from the ability of class Students in understanding the matrix concept only rely on rote memorization methods and not all students have good memory. Another problem that arises in mathematics learning is that teachers still use a one-way learning paradigm, so teachers prefer the rote method so that students understand the concept of matrices quickly. Pohan (2021) revealed that if teachers are more active in explaining the material, so that learning is difficult for students to understand, then in the learning process teachers will tend to use lecture and memorization methods. Another problem is related to unsatisfactory learning outcomes. In accordance with the opinion of Kharomah and Abduh (2023) the

success of students depends on their attitude towards learning, so if students have low mathematics learning outcomes then the mathematics learning process needs to be optimized.

Based on the data that has been obtained, to solve the problems that occur in this research, researchers will carry out experiments in applying the Index Card Match learning model which has been carried out by previous researchers in certain lessons and this learning model has never been applied by teachers in improving cognitive learning outcomes. mathematics subjects, especially matrix material.

The formulation of the problem in this research is how is the influence of cognitive learning outcomes in matrix mathematics in Class XI SMA Negeri 21 Makassar?

The aim of this research is to determine the influence of cognitive mathematics learning outcomes on matrix material using the Index Card Match learning model in Class XI SMA Negeri 21 Makassar.

METHOD

The research method used in this research is a pre-experimental type quantitative method which uses a "one group pretest-posttest" design, namely research using only one experimental class without a comparison class or control class. The reason the researcher used this research was because the researcher wanted to compare cognitive mathematics learning outcomes with accurate Inverse Matrix material through tests carried out, namely by having a pretest (before treatment) and posttest (after treatment). An overview of the One Group Pretest-Posttest design is presented in table 1.1 as follows:

Table 1. 1 *One Group Pretest-Postest Design*

Group	Pre-Test	Action	Post-Test
Experiment	O_1	X	O_2

The research was conducted at SMA Negeri 21 Makassar which is located at Jl. Tamalanrea Raya No. 1A BTP Makassar, Tamalanrea, Kec. Tamalanrea, Makassar City Prov. South Sulawesi. The population used was class XI students of SMA Negeri 21 Makassar. The sample was obtained from a population of 36 students. The sampling technique used is purposive sampling, namely a technique for determining samples with several considerations so that the data obtained is more representative of the research process (Sugiyono 2019). Data collection techniques in this research are observation, interviews, tests and documentation.

The procedure for collecting research data uses a test in the form of multiple choice questions and consists of 20 questions. The test was carried out to determine students' cognitive learning outcomes in matrix mathematics learning before and after implementing the Index Card Match model. Research instruments need to go through validity and reliability tests before being given to students. If the research instrument is valid and reliable, then the test instrument can be used in research. Validity test uses Point Biserial and reliability test uses the Rolan formula. The data analysis technique used is the normality test with the Shapiro Wilk formula and the Simple Paired T-test with SPSS Statistics 25.

RESULT AND DISCUSSION

Result

The results of research instrument analysis tests that have gone through validity and reliability tests can be used as Pretest and Posttest questions. Researchers conducted a validity test with Point Biserial. The research instrument is declared valid if the correlation value is more than 0.3, which is presented in table 1.2 as follows:

Table 1. 2 Question Instrument Validity Test

Comparison	Total	Test Item
Valid	17	1,2,3,5,6,7,8,9,10,11,12,13,14,16 17,18,20
Invalid	3	4,15,19

After carrying out a validity test, then carry out a reliability test. Reliability test using the Rolan formula. The research instrument is declared to have a very high level of reliability if $0.80 < r count < 1.00$ is presented in table 1.3 as follows:

Table 1. 3 Question Instrument Reliability Test

Rumus Rulon	Results
$r_{11} = 1 - \dfrac{S_d^2}{S_t^2}$	$r_{11} = 1 - S_d^2 / S_{ts}^2$ $r_{11} = 1 - 6{,}06 / 16{,}45$ $r_{11} = 1 - 0{,}368 = 0{,}632$ (High Reliability)

Table 1. 4 Normality Test

Class	Shapiro-Wilk		
	Statistic	Df	Sig.
Student Cognitive Learning Outcomes	Pretest .969	36	.367
	Postest .947	36	.079

The results of cognitive mathematics learning in Inverse Matrix material for class The basis for decision making in the instrument normality test has been determined, namely with a significance level of 5% or 0.05. Based on the normality test results in table 1.4, the Pretest result is 0.367 more than 0.05, so the data is normally distributed. Meanwhile, the Posttest results obtained 0.079 which is greater than 0.05, so the data is also normally distributed.

Table 1. 5 Hypothesis Test

Simple Paired T-Test

Student Cognitive Learning	Mean		Df	Std Deviation	T	Sig. (2 Tailed)
	Pretest	62.64	36	17,177	-7.888	.000

Outcomes	Postest	82.22	36	10,919

Test the hypothesis with the Simple Paired T-test to find out whether there is an influence or not when applying the Index Card Match learning model to the cognitive mathematics learning outcomes of class XI students at SMA Negeri 21 Makassar. The criteria for determining the value are the significance level (2 tailed) < 0.05, then H0 is rejected and Ha is accepted. Based on the hypothesis testing data obtained from this research, it proves that the significance (2 tailed) is 0.000 < 0.05 which shows that Ha is accepted and the application of the Index Card Match learning model shows that there is a significant difference between the initial variable and the final variable. This means that there is an influence in the application of the Index Card Match learning model on the cognitive learning outcomes of class XI students in the Inverse Matrix material.

Discussion

Based on the research results, the application of the Index Card Match learning model during the learning process makes students motivated, active and easy to understand the material provided. This is because this learning model has never been applied by teachers, so what teachers need to do is apply a learning model that can provide a good response to students. In accordance with the opinion of Fathurrohman (2015) that teachers must understand that in choosing a learning model they must pay attention to the condition of the students, the nature of the teaching materials, the facilities available and the condition of the teacher himself.

The Index Card Match learning model has an impact on students being active in learning and not only learning in one direction or between teachers and students but students and other friends. This can build communication between students and teachers as well as communication between one student and another. In accordance with the opinion of Fitri Puji, Magrifiani and Noviati (2016) that active learning will stimulate stimulus and response from students, so that the learning process becomes fun and learning does not seem boring.

The increase in cognitive learning outcomes obtained from implementing the Index Card Match model occurs because students are enthusiastic about participating in learning from start to finish and gain new experiences in learning that are fun. The average increase in the Pretest and Posttest results shows that students experienced a significant increase of 19.58 with a Pretest average of 62.64 and a Posttest average of 82.22. This can be seen in Figure 1.1 as follows:
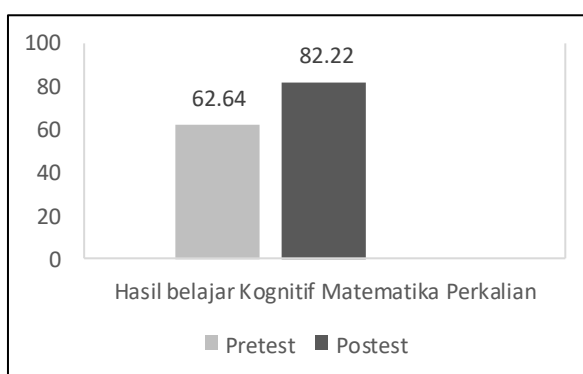

Figure 1. 1 Graph of Cognitive Learning Results

The percentage of students' completion in the Pretest results was 39% and 22 students did not achieve the complete score and the percentage in the Posttest results was 89% and there were only 4 students who did not complete. Based on the research results, if learning is carried out without any learning

preparation such as reviewing previously obtained material and the difficulties experienced by students and not applying the learning model then learning will not go well. Learning will be boring and students' understanding of the material provided is still lacking. Therefore, the application of the Index Card Match learning model is applied to students with the enthusiasm of students during learning.

During learning, students are active in asking questions, answering questions and establishing communication with other students. Students are eager to complete the challenge by matching the question and answer cards that have been given. A sense of responsibility, cooperation and self-confidence during group work also shapes the character of students. Students who are motivated and enthusiastic about studying mathematics will be active and directly involved in the learning process (Muflihah, 2021). During the implementation of the Index Card Match learning model, there were shortcomings experienced by researchers which were in accordance with the opinion of Damayanti (2022), including 1) the preparation time was quite long, 2) the class atmosphere became noisy and disturbed the learning of other classes, 3) it took quite a long time to discussions and presentations.

Based on the research results, Index Card Match can be applied by teachers in mathematics learning. Index Card Match can help students to solve a problem by matching the question cards and answers that have been given. In accordance with Polya's theory, effective learning in mathematics is by solving a problem stated in a mathematics problem or from problems faced in everyday life. The application of the Index Card Match model to the cognitive learning outcomes of mathematics matrices in class Inverse matrix mathematics material and attracts students' attention to be active in learning.

CONCLUSIONS AND SUGGESTIONS

Based on the results of research carried out in class Using Index Card Match really helps students to be active and motivated in the learning process. There are suggestions from researchers that the Index Card Match learning model can also be applied and tested between classes so that they can find out differences in cognitive mathematics learning outcomes regarding inverse matrix material as well as knowing the psychomotor learning outcomes of students in the matrix.

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