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The influence of the Knisley mathematics learning model on the mathematical connection ability and self-confidence of high school students

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Abstract

This research aims to conduct a study that focuses on the effect of applying the Knisley mathematics learning model on students' mathematical connection abilities and self-confidence.This research is research using a quasi-experimental method with a research design in the form of a pretest-posttest control group design. The sampling technique used was cluster random sampling. The population in this study were all class XI students at SMAN 1 Tirtayasa, with a sample of 2 classes to be used as experimental classes, namely class The instruments used in this research were mathematical connection ability tests, self-confidence questionnaires, observation sheets and interviews. Based on data analysis, it was concluded that (1) Learning using the Knisley mathematics learning model had a positive effect on students' mathematical connection abilities, (2)Learning using the Knisley mathematics learning model has a positive effect on students' self-confidence.

Keywords: Educational Research; Influence; Mathematical Connection Ability; Confidence; Knisley Mathematics Learning Model

1. Introduction

Learning mathematics aims not only to understand mathematics lessons conceptually, but students are required to be able to develop mathematical ideas with other sciences and be able to relate them to everyday life. This is based on the fact that as students' ability to connect mathematical concepts and ideas increases, their understanding ability will also increase. Understanding is closely related to mathematical connections,Negoro and Wijaya (2011)interprets that mathematical connection as a connection between mathematical concepts internally, namely relating to mathematics itself or external connections, namely mathematics with other fields, both other fields of study and with everyday life, so that students are required to understand more than one concept.According toAviyanti and Setianingsih (2021), mathematical connections can develop students' knowledge which includes concept linkages, understanding and creativity. Mathematical connections are developed so that students are able to think and communicate by connecting relationships between mathematical concepts. Besides that, mathematical connections are developed so that students can have knowledge and skills in using words, forms of representation, materials, tools, techniques and knowledge from other disciplines to define and solve problems with reasoning, insight and technical abilities. The goal is for students to have mathematical connection abilities according toSiagian (2016), so that students are able to recognize and use connections between mathematical ideas, understand how mathematical ideas are interconnected and based on each other to produce a coherent (integrated) whole, and recognize and apply mathematics both in and out of context mathematics.

Sumarno(in Fauzan, 2012)states that activities that are classified as mathematical connections include "...Finding relationships between various representations of concepts and procedures and applying relationships between

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mathematical topics and between mathematical topics and topics outside mathematics". Mathematical connection skills are very necessary for students in learning mathematics, without connections students will experience difficulties in learning mathematics. One of the factors that influences mathematical connection abilities is the lack of variety of models applied in learning. Described in Process Standards (National Education Standards Agency, 2007) that the implementation of the learning process to achieve basic competencies is carried out in an interactive, inspiring, fun and challenging manner, thereby motivating students to participate actively. The implementation of the learning process uses methods that are adapted to the characteristics of students and subjects through a process of exploration, elaboration and confirmation.

One learning model that has the potential to meet the Process Standards is the learning model developed byJeff Knisley, (2003)namely the Knisley mathematics learning model. The Knisley mathematics learning model (MPMK) is a mathematics learning model developed based on Kolb's learning style theory which is interpreted into four stages of mathematics learning. Each of Knisley's learning stages corresponds to each of Kolb's learning styles. Correspondence between Kolb's learning style and learning activities according to Knisley's interpretation(in Mulyana, 2009)namely, the concrete-reflective learning style corresponds to the student's activities as an allegorizer, the concrete-active learning style corresponds to the student's activities as an integrator, the abstract-reflective learning style corresponds to the student's activities as an analyzer, and the active abstract learning style corresponds to the student's activities as a synthesizer.

According to Mulyana (2009), this learning begins with inviting students to recall concepts that have been studied previously and are related to the concepts they will learn, which is called the concrete-reflective stage, then in the concrete-active stage students are given questions on simple application of new concepts with exploration tasks the properties of the new concept. Students at this stage will differentiate new concepts from old concepts that they already know by formulating a solution which will later be used as a logical reason that can explain the allegations of these two concepts. In the abstract-active stage, students will use the results of the formulations they have created which are applied in practice. In the abstract-reflective stage, students look for logical reasons that can explain the allegations about the relationships between mathematical concepts that they have made in the first two stages. The abstract-active stage facilitates students to relate the use of mathematical concepts to problems in other fields of study or everyday life. In this way, MPMK provides space for students to understand a mathematical concept and see the relationship between these concepts internally and externally. Based on this explanation, the Knisley learning model provides space for students to be able to explore all ideas and understand a concept and its relationship with other concepts. So the Knisley mathematics learning model has the potential to influence students' mathematical connection abilities

Self-confidence according to Lautser(in Hendriana, 2017)is an attitude or feeling of confidence in one's own abilities so that the person does not feel anxious about his actions, feels free to do things he likes, and is responsible for his actions, is polite in interacting with other people, can accept and respect others, has encouragement to achieve and recognize one's strengths and weaknesses. This statement is supported byYates (2002)that self-confidence is very important for students to be successful in learning mathematics. With self-confidence, students will be more motivated and prefer to study mathematics, so it is hoped that students' mathematics learning achievements will also be more optimal. So, students will have difficulty learning or understanding mathematical concepts if students are not confident in their own abilities.

This is in line with research conducted byArisanti (2021), stated that the self-confidence of students who received Knisley learning was better than the self-confidence of students using the conventional model. This is because mathematics learning using the Knisley learning model facilitates students to be more active and interactive, helps create a conducive learning atmosphere because students rely on individual discovery, creates excitement in the teaching and learning process because students are dynamic and open from various directions, so it can be concluded that the application The Knisley learning model is effective on the self-confidence of class VII students at SMP NU 03 Islam Kaliwungu. The same is true of research conducted byTrisnawati (2015), explained that the use of the Knisley mathematics learning model can help improve mathematical connection skills and improve students' self-confidence, through discussions in small groups and presentations, students are given the opportunity to explore their mathematical abilities which are triggered by problems given by the teacher, which is able to grow interaction, sharing information between one student and another, students and teachers in solving problems, as well as fostering self-confidence and mutual respect in learning, the need to pay attention to students' self-confidence before and after the learning process. This implies that students with good self-confidence will help these students in solving mathematical problems, and avoid giving up and cheating on friends.

2. Material and methods

The purpose of this research is to determine the effect of Knisley mathematics learning on students' mathematical connection abilities and self-confidence. Research that is suitable for this research objective is experimental research. This is in accordance with the opinion of Arikunto (2010) that experimental research is carried out with the aim of seeing the effects of a treatment. In this study the author did not choose students randomly to be in the experimental and control classes, but the author used existing classes at the school where the research was conducted. Thus, this research is more suitable to the type of quasi-experimental research. As stated byRuseffendi (2010), subjects are not randomly grouped in quasi-experimental research, but researchers accept the conditions of the subjects as they are.

The research design used in this research is a pretest-posttest control group design or group design, then selecting two classes that are equivalent in terms of academic ability. The first class received learning using the Knisley Mathematics learning model (experimental class) and the second class received scientific learning (control class). Before implementing the learning, both classes were given a pretest in the form of mathematics questions with the aim of determining students' initial abilities in mathematical connections. After being given treatment, students were given a posttest with the same questions as the posttest to determine their final ability in mathematical connection abilities. The materials and tools used in this research are teaching materials/LKPD, RPP and LTS (Student Assignment Sheet). The instruments used consist of test and non-test instruments. The test instrument is designed to measure students' mathematical connection abilities. The test instrument in this research is called the mathematical connection test.The non-test instrument used is the self-confidence questionnaire.

The data presented are the results of data analysis of tests given before learning (pretest), tests after learning (posttest), N-gain and scales given after learning (final scale). The data was analyzed quantitatively with descriptive and inferential statistics assisted by SPSS 24.0 for Windows and Microsoft Excel 2019 software. The self-confidence scale is on an ordinal scale. Therefore, before the data is calculated using SPSS 24.0 for windows, the research data is first transformed into interval scale data to fulfill some of the requirements for parametric analysis using the Method of Successful Interval (MSI)..

3. Result

Data on students' mathematical connection abilities was obtained from the test and post-test scores. This data was obtained from the results of students' answers in working on mathematical connection questions which consisted of 6 description questions according to indicators of mathematical connection ability. Pretest and posttest questions are similar questions that have been tested for validity and reliability.

Table 1 Descriptive Statistics of Pretest Data on Mathematical Connection Ability

Class	Pretest				
	N	x_{min}	x_{max}	$(\overline{x})$	sd
Experiment	31	12	25	18.65	4.05
Control	31	6	30	19.13	6.12

Based on Table 1, it can be seen that the mathematical connection ability scores of students in classes using the Knisley mathematics learning model and classes using scientific learning before learning show differences, where classes with scientific learning are 0.48 superior to classes using the Knisley mathematics learning model. This means that the initial ability of the control class is better than the experimental class.

Table 1 Descriptive Statistics of Mathematical Connection Ability Post-Test Data

Class	Postest				
	N	x_{min}	x_{max}	$(\overline{x})$	sd
Experiment	31	20	40	30.29	5.581
Control	31	17	35	26.13	5.305

Based on Table 2 above, the averages of the two classes are different, increasing the average value in the classusing the Knisley mathematics learning model experienced a significant increase, namely 30.29 when compared to classes with scientific learning, namely 26.13. Post-test valuein classusing the Knisley mathematics learning model4.16 higher than classwith scientific learning. This means that the final ability of the experimental class is better than the control class.

Next, the pretest and posttest scores are used to calculate the normalized gain (n-gain) of mathematical connection abilities in the experimental class and control class. The average n-gain results obtained from this calculation are an illustration of the increase in students' mathematical connection abilities with the Knisley mathematics learning model and scientific learning. Table 3 shows descriptive statistics of n-gain scores.

Table 2 Mathematical Connection Capability Normalized Gain Descriptive Statistics

Class	**Normalized Gain**				
	N	x_{min}	x_{max}	$(\overline{x})$	sd
Experiment	31	0.15	0.71	0.3988	0.158
Control	31	0.08	0.51	0.2652	0.107

Based on table 3, the average normalized gain for the MPMK class and the Scientific class is different, the difference is 0.1336. The average gain for classes with the Knisley mathematics learning model (0.3988) is higher than for classes with scientific learning (0.2652). To see whether the increase is significant or not, the second stage is carried out, namely parametric analysis, including tests for normality and homogeneity of the data. To test the normality of the N-gain data in the experimental class and control class, a normality test was used*Shapiro-Wilk*

Table 4 Normality Test Results of Normalized Gain Data Mathematical Connection Ability

	Class	**Shapiro-Wilk**		
		Statistics	df	Sig.
N-Gain	Experiment	0.956	31	0.234
	Control	0.969	31	0.497

The significance values for the experimental class and control class are 0.234 and 0.497 respectively. Both significance values are ≥ 0.05 so Ho is accepted, meaningThis means that the normalized gain data for the experimental class and control class are normally distributed.The next step is to test the homogeneity of variance. To test the homogeneity of variance, a test is used*Levene.*

Table 5 Normalized Gain Data Homogeneity Test Results Mathematical Connection Ability

Levene Statistics	**df1**	**df2**	**Sig.**
5,846	1	60	0.019

The significance value obtained is 0.019> 0.05, so Ha is accepted, soThe normalized gain data for both classes is not homogeneous.Because the data is normal and not homogeneous, the next step taken was to analyze the differences in the means of the two classes using the t-test

From table 6, it can be seen that the sig (2-tailed) value for Gain Equal Variances not Assumed is 0.000, so the value$\frac{sig\ (2-tailed}{2}$ =0,000< 0.05, then Ho is rejected, so H1 is accepted. This means that the average gain in mathematical connection ability in the experimental class is greater than in the control class. So it can be concluded that at α = 0.05, the increase in the mathematical connection abilities of students who receive the Knisley Mathematics Learning model is better than the mathematical connection abilities of students who receive the learning.

Table 6 T Test Results for Normalized Gain Data Mathematical Connection Ability

		t-test for Equality of Means						
							95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
N-Gain	Equal variances not assumed	3.890	52.769	0.000	0.13357	0.03434	0.06469	0.20246

To answer the problem formulationIs the self-confidence of students who use the Knisley mathematics learning model better than students who use a scientific approach in their learning?So self-confidence data was collected through a self-confidence questionnaire given to the experimental class and control class. Each statement on the results of the self-confidence scale is given a score based on the scoring of the results of the self-confidence scale trial. Description of the self-confidence scores of the experimental class and control class is as follows.

Table 7 Descriptive Statistics of Self-Confidence Data

Class	**Confidence**				
	N	x_{min}	x_{max}	$(\overline{x})$	sd
Experiment	31	76	108	93.61	7.055
Control	31	69	98	84.10	7.476

Based on Table 7 above, the average of the two classes is different, the experimental class is 9.51 higher than the control class. This means that the self-confidence of the experimental class is better than the control class.To test the normality of self-confidence data in the experimental class and control class, a normality test was used*Shapiro-Wilk.*

Table 8 Normality Test Results of Self-Confidence Data

	Class	**Shapiro-Wilk**		
		Statistics	df	Sig.
N-Gain	Experiment	0.966	31	0.418
	Control	0.980	31	0.811

Based on the calculation results, the significance values obtained for the experimental class and control class were 0.418 and 0.811 respectively. Both significance values are ≥ 0.05 so Ho is accepted, meaning that the self-confidence data for the experimental class and control class are normally distributed.The next step is to test the homogeneity of variance. To test the homogeneity of variance, a test is used *Levene.*

Table 9 Homogeneity Test ResultsSelf-Confidence Data

Levene Statistics	**df1**	**df2**	**Sig.**
0.429	1	60	0.515

Based on the calculation results, information was obtained that the significance value obtained was 0.515, which was more than 0.05, so Ho was accepted, so that the data for the two classes were homogeneous.So the next step is to analyze the differences in the means of the two classes using the t-test

Table 10 T Test Results for Self-Confidence Data

		t-test for Equality of Means						
							95% Confidence Interval of the Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
N-Gain	Equal variances not assumed	5.154	59.800	0.000	9.516	1.846	5.823	13.209

From table 10. it can be seen that the sig (2-tailed) value is 0.000, so that the value < 0.05 means Ha is accepted and Ho is rejected.

Thus p$\frac{\text{sig }(2-tailed)}{2} = 0{,}000$

Learning using the Knisley mathematics learning model has a positive effect on students' self-confidence

4. Discussion

Based on the results of the research analysis of the results before the research in classes that received the Knisley mathematics learning model and the scientific approach, it can be concluded that, there is no difference in students' mathematical connection abilitiesKnisley mathematics learning modelwith students' mathematical connection abilities who receive learning using a scientific approach. This confirms that before treatment (Knisley mathematics learning model), the academic abilities of the research subjects are relatively homogeneous.

Based on the analysis of the results after research in classes that received the Knisley mathematics learning model and scientific learning, it can be concluded that, there are differences in the mathematical connection abilities students obtainKnisley mathematics learning modelwith students' mathematical connection abilities who receive learning using a scientific approach.Based on the normalized gain analysis of the mathematical connection abilities of experimental class and control class students, it was concluded that there was an increase in the mathematical connection abilities of students who received the Knisley mathematics learning model compared to students who received learning using a scientific approach. If seen from the average normalized gain, the average gain of the experimental class is greater than the control class. This condition shows that the mathematical connection abilities of students who receive the Knisley mathematics learning model are better than the mathematical connection abilities of students who receive learning using a scientific approach.

This is possible because there is a compatibility between the activities carried out by students in implementing learning with the characteristics of the mathematical connection questions given, the compatibility between teaching materials and learning facilities available at school such as learning packaged in power point form so that students make the learning process enjoyable. . Apart from that, it is also possible because the Knisley mathematics learning model contains several important components in learning that support students to be more active in learning, students are more able to explore their opinions, thereby creating a conducive and meaningful learning atmosphere. Some of these components are that students can formulate new concepts, compare and contrast new concepts with old concepts, solve problems using logic with concepts that have been formed. With this component, it provides students with the opportunity to recall concepts they have learned or new concepts they have learned using their own abilities. Students are directed to be able to analyze and discover the concepts of the material being studied by studying problems in everyday life. So that the learning that takes place will be more meaningful.

Figure 7 Student activities in Knisley Mathematics Learning

The results obtained from distributing the self-confidence scale questionnaire show that confidencestudents who earnKnisley's model of mathematics learning is better than self-confidencestudents who receive learning with a scientific approach.Based on the data, it was found that there was a significant difference between the average valuesconfidencestudentexperimental class andaverage valueconfidencestudentclasscontrol that obtains learning with a scientific approach

In general it can be said that, using the Knisley mathematics learning model influencesstudent self-confidence. This situation illustrates that using the Knisley mathematics learning model has a great influence on students' self-confidence. One of the reasons this is possible is because there is a match between learning activities and the problems faced by students in everyday life, so that mathematics is more useful for students in their lives, so that students are more motivated in learning mathematics. In addition, the Knisley mathematics learning process is carried out by dividing students into several groups, so that learning becomes an activity that makes students more communicative with their friends. Then in group work activities to find solutions to the problems faced, students exchange ideas with each other, after finding solutions students are required to present the results of their discussion.

At the stage of finding solutions and presenting the results of their discussions, students are trained to have the courage to express their opinions, so that gradually students will have good self-confidence. This is in accordance with the opinion of Saranson (Daam Siregar, 2012) who says that self-confidence is formed and developed through individual and social learning processes, so it can be said that self-confidence can be increased through activities that contain social interaction.

The results obtained from distributing the self-confidence scale questionnaire show that self-confidencestudents who earnKnisley's model of mathematics learning is better than self-confidence high and low students who receive learning with a scientific approach.

5. Conclusion

Based on the results of data processing and the findings obtained in this research, several conclusions are: Learning using the Knisley mathematics learning model has a positive effect on students' mathematical connection abilities. Learning using the Knisley mathematics learning model has a positive effect on students' self-confidence.The application of the Knisley mathematics learning model in mathematics learning at SMAN 1 Tirtayasa has had a positive influence, namely increasing mathematical connection abilities and increasing self-confidence (*Self-confidence)*students with the Knisley mathematics learning model are better than students who receive learning with a scientific approach.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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