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Improving Mathematical Connection Ability Through Discovery Link Map

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Abstract

This study aims to analyze the improvement of students' mathematical connection skills through the application of discovery link maps. This research is a quantitative descriptive study. Research with integral material. Data collection includes observations, questionnaires, and tests which are then analyzed descriptively. The results showed that the implementation of discovery link map learning can improve students' mathematical connection abilities. Students' connection skills in remembering mathematical concepts and linking mathematical concepts better through discovery link maps.

***Keyword**: Discovery link map; mathematical connections*

INTRODUCTION

Integral is a mathematical material that is full with counts so that it requires thinking ability, memory and high accuracy in solving problems in integral. However, many students have difficulty integral, including understanding the concept of integral, integral calculation, and solving integral problems. This can be seen when students are asked, for example, why and what are the reasons for using certain formulas or concepts, they cannot answer or do not know the answers. Many students say that integral is a material that is difficult to understand so that the impact on the results of the academic students who majority are still low (more than 70) around 37%.

One effort to overcome student difficulties is through the learning process, in accordance with the opinion (Lavine, 2012; Li, 2016) who states that the learning process makes students become more active learners in order to gain knowledge and develop thought processes through solving relevant problems. Integral Material in Calculus not only memorizes or only applies mathematical formulas or concepts but requires an understanding of mathematics and high-level mathematical thinking skills to be useful for students (Dewi & Kusumah, 2014; Haripersad, 2011). Mathematics learning can explore students' thinking abilities, encourage developing thinking power, evaluate work independently, have mathematical connection abilities to better understand mathematical concepts including implementing discovery link map.

Discovery link map is constructed by combining discovery learning and link map learning models. Discovery learning is used to foster students' understanding of mathematical concepts more easily and no longer abstract for students. The link map learning model is used to form conceptual relationships to make it easier to solve mathematical problems. Discovery learning includes stimulation, problem statements, data collection, data processing, verification, generalization (Alfieri et al., 2011; Byrnes, 2004; Kyriazis et al., 2009; Ramdhani et al., 2017). Discovery learning is one of learning that trains students on how to find mathematical concepts and trains students' ability to express student ideas or ideas (Tall, 2011; Tokada et al., 2017). Learning Discovery requires appropriate strategies for increasing understanding of mathematical concepts and fostering mathematical thinking skills through a link map. Link map is learning that can be packaged into map links that are easily processed and

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constructed in students' thinking. (Baroody & Bartels, 2000; Jin & Wong, 2015; Lindstrøm & Sharma, 2009).

Students are expected to develop mathematical thinking skills in themselves, by linking the relationship between concepts in solving mathematical problems. This is in accordance with several research results, including the results (Lindstrøm & Sharma, 2009) which concludes that the map arrangement explicitly shows key concepts discussed in learning and how these link concepts to help students build brand schemes.

Improving the quality of learning through discovery link map can develop students 'thinking processes better, according to the results of research conducted by (Marsitin, 2018) which conclude that discovery learning and link maps affect the mathematical connection and students are actively involved in learning mathematic. (Matic, 2014) that students have about mathematics thinking significantly influencing their learning, consequently on the retained knowledge and students showing better procedural knowledge than conceptual.

Students are expected to be able to improve their mathematical connection skills, so students can connect links between concepts in problem solving. Learning mathematics requires students to have the ability to think, communicate, reason, connect in solving mathematical problems. Mathematical connections play an important role in solving mathematical problems because in the mathematics connection requires students to have the ability to associate material with concepts previously understood both in mathematical concepts and concepts in other fields of science. If the ability of mathematical connections in students is still lacking, the ability to remember by themselves is still not optimal in solving mathematical problems. (Eli et al., 2013; Noto et al., 2016) states that students who have mathematical connection ability help students understand mathematical concepts in the form of images, symbols, and written words on mathematical problems.

Some abilities that students must possess in order to be able to solve mathematical problems are the ability to connect, communicate, reason, think students must have. One of them which plays an important role in solving mathematics is mathematical connection. Students who have the ability to associate the material with previously understood concepts, both in mathematical concepts and concepts in other fields of science, have high mathematical connection abilities so that memory is also high but if students with mathematical connection abilities are lacking then the memory in the low. (Marsitin, 2018) states that through mathematical connections, students can build new ideas or ideas to understand mathematical concepts and solve mathematical problems.

Mathematical connections used in research are the linkages between mathematical topics, linkages with other disciplines, and linkages with real life. Students are expected to have mathematical connection skills, with the aim that students use the linkages between mathematical ideas, understand interconnected mathematical ideas to produce a coherent whole, recognize and apply mathematics both inside and outside the mathematical context. Mathematical connections are very necessary to the integral material, especially in the completion of the application of integrals for calculations to determine the area and volume of objects. the difficulty of integral calculation that is experienced by many students. When students experience difficulties in mathematical connections when solving mathematical problems, it is necessary to innovate learning such as by applying a map of discovery links, for this purpose, this study aims to improve the ability of mathematical connections through map discovery links.

METODH

This research is a descriptive study with a qualitative approach. The research subjects were determined purposively. The study was conducted on mathematics education students in Malang, Indonesia. The selection of research locations is done through several considerations such as aspects of the number of students and aspects of mathematics lecturers. The subject of research is 35 mathematics education students who take calculus courses. The limitation of this study is the calculus course with a load of 3 credits taken by students in the second semester with integral material covering integral applications.

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The research data includes observations, questionnaires, and tests which were then analyzed descriptively. Research instruments include observation sheets, questionnaire sheets, test for mathematical connection abilities. Prior to the research data collection, validation is done, and including validation of planning for learning implementation, observation validation, validation of the questionnaire, validation of test questions about mathematical connection ability. Research data includes observation, questionnaires, and tests of mathematical connection ability. The study uses observations to collect data during learning. The learning process with a discovery learning link map that includes stimulation, problem statements, data collection, data processing with link map, verification with link map, generalization (Marsitin, 2018). The questionnaire is used to confirm data and to measure student responses in learning.

This test is used to measure the ability of mathematical connections. In working on test questions, students are given a 90-minute time limit with three problem descriptions. The mathematical connections used in the research are the connections between mathematical topics (using the association of mathematical concepts with various mathematical topics in solving mathematical problems), connections with other scientific disciplines (using the association of mathematical concepts with various other scientific disciplines in solving mathematical problems), and connections with the real world (using the association of mathematical concepts with reality in solving mathematical problems) (Marsitin, 2016).

Data analysis used in this study includes reduction, presentation, descriptive statistical calculations, and conclusion drawing. The test result data are grouped according to indicators of mathematical connection ability, then calculated in descriptive statistics, analyzed descriptively, and concluded. Scores from the test results are converted to values in the range of 0-100, with the formula that is value = (score obtained / total score) x 100%. Student mathematics connection ability test results are grouped in the criteria in table 1.

Table 1. Mathematical Connection Ability Criteria

Value Range	Criteria
$80 < x \leq 100$	Very high
$60 < x \leq 80$	High
$40 < x \leq 60$	Medium
$20 < x \leq 40$	Low
$0 \leq x \leq 20$	Very low

RESULT AND DISCUSSION

Implementation of research by applying maps of discovery links that include stimulation by providing stimuli, statement of problems by identifying problems, collecting data by collecting data, processing data by processing data and applying map links, namely the relationship between concepts, verification with evidence, generalization by attracting conclusion, then continue working on problems in mathematical connection ability. Students work on three breakdown questions of integral application problems according to the specified allocation, then analyzed using a frequency distribution. Data about the frequency distribution of students' mathematical connection ability test results can be seen in table 2.

Tabel 2. Frequency Distribution of Mathematical Connection Ability Test Results

Value Range	Frequency distribution		Criteria
	f	f (%)	
$80.9 - 100$	3	8.57	Very high
$60.9 - 80$	18	51.43	High
$40.9 - 60$	12	34.29	Medium
$20.9 - 40$	2	5.71	Low
$0 - 20$	0	0	Very Low

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In addition, the results of students' mathematical connection ability tests can be expressed in descriptive statistics, this can be seen in table 3.

Table 3. Mathematical Connection Ability Test Results

Description	Statistics
Maximum Value	83
Minimum Value	40
Average Value	67.17
Standard Deviation	10.49
Mode	72

The value of the test results of mathematical connection ability in the implementation of the discovery link map obtained an average of 67.17 with high criteria. The highest score of 83 is 3 students (8.57%), and the highest 72 scores are obtained by students, 11 students (31.43%). The lowest score of 40 is 2 students (5.71%). In addition, there were 23 students (65.71%) with a value of more than 70 so it can be said that the implementation of Discovery Link Map Learning can improve mathematical connection skills. Interaction in learning makes students feel interested so that the learning process is fun. This is in line with the opinion (Ramdhani et al., 2017) states that the learning process using discovery learning can improve student learning outcomes. In addition, (Yang et al., 2010) states that students who have better concept retention will have good performance with discovery learning.

In addition, the results of students' math connection test answers from three integral material questions were analyzed descriptively according to mathematical connection indicators and classified in criteria. This can be seen in table 4.

Table 4. The Average Value of Each Student's Mathematical Connection Test for Each Indicator

Description	Average Value	Criteria
Connection between mathematical topics	63	High
Connection with other disciplines	51.33	Medium
Connections with the real world	37.67	Low

The results of tests of mathematical connection ability of students with high criteria on connection indicators between mathematical topics that are using the association of mathematical concepts with various mathematical topics in solving mathematical problems. Students with the correct answer on the connection indicator between mathematical topics are 23 students (65.71%). Students are still not right in linking mathematical topics or concepts to solve mathematical problems. In addition, the criterion is being an indicator of connections with other disciplines that are using the association of mathematical concepts with various other scientific disciplines in solving mathematical problems. Students with the right answer on the connection indicator with other disciplines are 19 students (54.29%). Students still do not understand in linking mathematical concepts with other concepts to solve mathematical problems. The low criterion in connection with real-life is to use the association of mathematical concepts with reality in solving mathematical problems. Students with the right answer on the connection indicator with real-life are 11 students (31.43%). Students still lack understanding in associating mathematical concepts with reality to solve mathematical problems because students still experience obstacles in solving integral problems, especially integral applications, including obstacles when connecting between various representations and mathematical concepts, obstacles when connecting with other fields of study and the realities of life. This is in line with opinion (Baki et al., 2009; Dumalia & Surya, 2017; Saminanto & Kartono, 2015) that average score of mathematical connection ability between concepts in high materials, mathematical connection between medium topic, ability to connect mathematics with other lesson is lower.

CONCLUSION

Implementing mathematics learning using discovery link map improve students' mathematical connection skills. Improved connection on connection indicators between mathematical tropic with criteria, connection with other disciplines with moderate criteria and connections with low criteria.

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