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A Case Study of Misconceptions Students in the Learning of Mathematics; The Concept Limit Function in High School

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Abstract

This study aims to find out how high the level and trends of student misconceptions experienced by high school students in Indonesia. The subject of research that is a class XI student of Natural Science (IPA) SMA Negeri 1 Anjatan with the subject matter limit function. Forms of research used in this study is a qualitative research, with a strategy that is descriptive qualitative research. The data analysis focused on the results of the students' answers on the test essay subject matter limit function with the number of students by 16 (sixteen). Data collection techniques used are shaped test methods essay, interview method to students who have misconceptions, and methods of documentation of the test answers. Examination of the validity of the data using a triangulation technique that compares the data written test results with data from interviews. The results of this study can be described as follows; (1) The level of misconceptions experienced by students belonging to the category of low, amounting to 12.18%. However, students who do not understand the concept quite high at 40.38%, and the others are students who understand the concept that is equal to 47.44%. (2) The misconception most experienced students lie in subconcepts explain the meaning of limit function at one point through the calculation of values around that point, that is equal to 20.51%. The tendency misconceptions experienced by students is located on errors and operating concepts that misconceptions students that there should be no limit in the completion of the writing of the emblem and misconceptions about the limit students to conclude if the limit value of 0 is no limit to the value of the function.

Keywords: misconception, limit function, mathematics learning

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INTRODUCTION

One of the important objectives of mathematics in this first year of higher education students who learn mathematics to understand and analyze the mathematical concepts and problems resolutions procedures (Rittle-Johnson, Siegler, & Alibali, 2001). The concept is one of the basic mathematical studies of objects and matter. In mathematics, the concept is presented using the definition, understanding of the important role definition holds in mastering mathematics completely. Through understanding the students to understand the concept of the material being taught. Understanding math also primary purpose of any material submitted by the teacher to Achieve desired concept (Isrotun, 2013).

But in fact, many student teachers consider an empty vessel to be filled and not be aware that students are human beings who have the potential to think and prejudice, as a result of the student mix prejudice occurred with a new concept. Students may be able to apply new concepts to problems with cognitive levels are low, but when it is a matter of understanding the cognitive levels already or even applications, and a higher level of the other, then Pre-concept would be devastating and can lead to students experiencing misconceptions (Inayah, 2003).

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The misconception stems from the student (preconceptions) which is already one will be continued and sustained. The success of each level of education influenced the success of students to master the competencies in previous levels. A good understanding will serve as a good base or foundation for the next level (Earl, 2004). Some information states that the low mastery of concepts and misconceptions on students affect the low value of Minimum Criteria exhaustiveness (KKM) on concepts and fields of study.

Similarly, the concept of limit function, the concept of limit function is new knowledge for students. The concept of limit function is an abstract concept and provides only a symbol lim"$\lim_{x \to a} f(x)$", so it can not be seen directly how the shape and purpose of the concept of limit function. Formal definitions limit function is taught in calculus lecture activities commonly known as the ε definition (read: epsilon) and δ (pronounced: delta) (Bahar et al, 2012).

One of the teachers in the high school-Indonesia stated that for students in the school, the math is still considered difficult subjects when national exams. He said this is because there are some materials that are less well understood by learners. One less mastered the subject matter is the limit function

Therefore, the solution of student difficulties in understanding the concept of the limit function must be found so as not to impact on the understanding of matter further. Based on this background, researchers interested in knowing how high the level of misconceptions experienced by students and student misconceptions tendency in the material limit function.

Literature Review

Direct objects in mathematics are facts, skills, concepts, and rules (Jordaan, 2009). The concept - a concept in mathematics is arranged in a hierarchical, structured, logical and systematic starts from the concept simple to complex concepts. Learning mathematics is like a chain of mutually sustainable and make it into a whole chain. The interrelated concepts in mathematics even simple concept has a role as a prerequisite for the concept toward understanding the most complex concept (Lestari, Triyono, & Joharman, 2012).

According to MulyonoAbdurahman stated that the concept refers to a basic understanding (Jordaan, 2009). Students develop a concept when they were able to classify or categorize objects-objects or when they can associate a name with a certain group of objects, for example, between the concept of a triangle and the non-triangular.

Various studies have been conducted to identify the understanding of concepts with reference to the criteria established. Abraham et. al. has developed criteria for classifying understanding of concepts such as in Table 1 (Jordaan, 2009).

Misconceptions based grouping is done by Abraham et.al on one level of understanding of the concept of the show has not fulfilled all the components concept mastery (Jordaan, 2009). Therefore, the analysis from misconceptions that occur in students can be done through an analysis of the concept components that have not been mastered by students.

The misconception is a concept that is incompatible with the concept of which is recognized by experts (Suprapto, 2013). If a student is experiencing an error when receiving an understanding of learning concepts first, will have an impact not only at the time that students learn the concept. But it would also result in further learning is the development of the concept.

According to Soedjadi mathematical misconceptions can occur from several sources (Farida, 2016), (1) the meaning of the word, such as misconceptions about the term "high", (2) the practical aspects, such as the value then assume the same importance 2x5 and 5x2, (3) simplification, for example, understanding lineup that does not connect with the function or mapping, (4) singularity structure of mathematics, for example, there is a presumption in mathematics should be no contradiction without seeing a review of different systems, (5) images, for example by drawing the set of natural numbers as a subset of the set of integers that concluded integer more than the original number.

Based on the description and understanding of the above misconceptions in mathematics is defined as the use of the mathematical concepts that are inconsistent with the scientific understanding or definition accepted by scientists.

While the percentage of misconceptions level can be grouped into several categories as shown in the Table 2.

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Table 1. Grouping Degrees Concept Training

Criteria	The Degree of Understanding	Category
▪ No answer / empty, replied "I do not know"	No response	Nounderstand
▪ Repeating the statement, but the answer is not related to any questions or are unclear	Do not understand	
▪ Answered with an explanation illogical	Misconceptions	Misconceptions
▪ Answer showed no concept of controlled but no statement in reply which showed misconceptions	Understandpartly withmisconceptions	
▪ Answer showed only partially mastered concepts without any misconceptions	Understandpartially	Understand
▪ Answer demonstrated the concept understood by all true explanation	Understanding the concept	

Table 2 Category Misconception (Suwarna, 2013)

Percentage (%)	Category
0 – 30	Low
31 – 60	Moderate
61 – 100	High

Common mistakes done by children in doing the math, that is the lack of knowledge about the symbol, the lack of understanding of the value of the place, the use of the process wrong, miscalculations, and writing that can not be read so that the learner made a mistake because no longer able to read his own writing. The condition is caused by several factors. The factors that cause errors in the math homework covers the causes of fault location, cause this type of error factors, factors causing this type of error concept, factors causing this type of error-owned operations, factors causing this type of error principle (Lerner, 2003).

Misconceptions about the subject matter in some way limit function, namely misconceptions regarding the existence of the limit function and relation to limit the left and right limit, limit function misconceptions various forms, and misconceptions about the limit theorem (Jordaan, 2009).

Examples of misconceptions made by learners is when students were asked to give their perceptions of symbols $\lim_{x\to c} f(x) = 3$, by giving them the question _ whether a function should be defined at that point to have a limit on the time and what is the relationship between the value of the function at that time with the concept of limit, then from some learners will respond that it should be defined function in c and definitely value function is equal to 3 _ contrary with the definition of limit (Larson & Edwards, 2013).

METHODS

The target in this study is a class XI student of Natural Sciences (IPA) SMA Negeri 1 Anjatan in Indonesia who have misconceptions based on the analysis of the test results on the subject of mathematics learning limit function. Selection of this class is based on several considerations. The consideration was partly because a class XI student of Natural Science (IPA) SMA Negeri 1 Anjatan in Indonesia experienced enough problems as it is in the study of less mastering concepts particularly well in mathematics (limit function).

The design used in this research is descriptive qualitative research that describes an event in the present. This descriptive qualitative study aimed to describe, summarize a variety of conditions, different situations or phenomena that exist in the community that the object of research (Bowen, 2009).

According to Miles and Huberman suggests that activity in the qualitative data analysis performed interactively and runs continuously until complete, so that the data is already saturated (Miles, Huberman, & Saldaña, 2014). Activities in the analysis of the data, that is data reduction, data display, and conclusion drawing/verification.

RESULTS AND DISCUSSION

Result Test Description

Based on the results of the research shows that the students who have misconceptions far less when compared with students who understand and do not understand the concept, meaning that misconceptions that occur in XIclasses in Natural Sciences(IPA) by category misconceptions (Suwarna, 2013) in Table 2 are low. As shown in Table 3.

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Based on the results of data analysis, the average students who experience misconception is lower when compared with the categories of students who understand the concept and students who do not understand the concept of limit. The distribution of values from the Six sub-concepts is as follows.

First, it can be seen on the sub-concept describes the function limit function at one point through the calculation of value around the point, the students who experienced misconception average of 20.51%, students who understand the concept of 56.41%, and do not understand the concept of 23.08%. **Secondly**, the sub-concept predicts the value of f(x) if x goes through the graph and calculation, the students experiencing misconception on average are 12.82%, the students who understand the concept of 66.67%, and the students who do not understand the concept of 20.51%. **Thirdly**, the sub-concept determines the limit value of algebraic functions based on the nature of the limit, the students experiencing misconception average of 12.82%, students who understand the concept of 30.77%, and students who do not understand the concept of 56.41%. **Fourth**, the sub-concept determines the limit value of the indefinite function based on the limit properties, the students who have a misconception on average are 10.25%, the students who understand the concept of 66.67%, and the students who do not understand the concept of 23.08 %. **Fifth**, the sub-concept determines the limit value of the root shape function based on the limit properties, the students experiencing misconception on average - 7.69%, the students who understand the concept of 12.82%, and the students who do not understand the concept of 79.49%. While the latter, the sub-concept determines the limit value of the trigonometric function based on the limit properties, the students experiencing misconception average of 8.98%, the students who understand the concept of 51.28%, and students who do not understand the concept of 39.74 %.

Subconcepts with the highest percentage misconception are subconcepts explain the meaning of limit function at one point through the calculation of value -value around that point, that is equal to 20.51%. This error occurs because the majority of students believe that if the results obtained $\lim_{x \to c} f(x) = 0$ means that the value *f(x)* does not exist. This is because of misconceptions students understand the concept of the presence or absence of a function when the limit load factor of zero makers.

In general, misconception experienced by students the high school in Indonesia there on subconcepts explain the meaning of limit function at one point through the calculation of value around the point, namely (1) misconceptions concluded if the limit value of 0 is no limit value for the function. (2) misconception that there should be no limit in the completion of writing the symbol of matter limit.

Table 3 Percentage of Students Understand Concepts, Misconceptions and Not Understand Concepts

SubConcept	Question	Category Answers Students		
		PK	MK	TPK
Explaining the meaning of limit function at one point by calculating values around the point	1	51,28%	23,08%	25,64%
	2	61,54%	17,95%	20,51%
	$\bar{x}$	56,41%	20,51%	23,08%
Predicting the value of *f(x)* if *x* towards infinity through graphs and calculations.	3	66,67%	12,82%	20,51%
Determining the value of the limit functional algebra based on the nature of limit	4	30,77%	12,82%	56,41%
Determining the value of the limit function indeterminate forms based on nature - the nature of limit	5	66,67%	10,25%	23,08%
Determining the value of the limit function of the root by nature - the nature of limit	6	12,82%	7,69%	79,49%
Determining the value of the limit of trigonometric functions by nature - the nature of limit	7	38,46%	7,69%	53,85%
	8	64,10%	10,26%	25,64%
	$\bar{x}$	51,28%	8,98%	39,74%
Total average		**47,44%**	**12,18%**	**40,38%**

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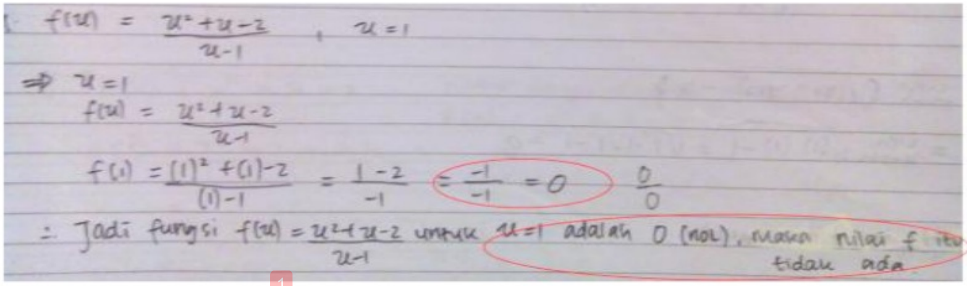

Figure 1. Answer Subject 18 Problem No. 1

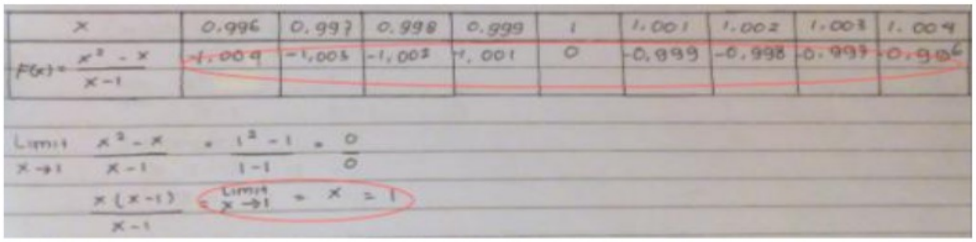

Figure 2. Answer Subject 3 Problem Number 2

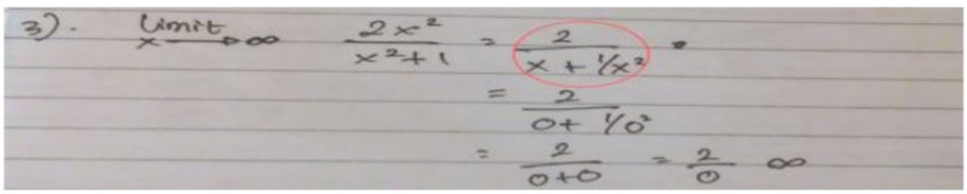

Figure 3. Answer Subject 6 Problem Number 3

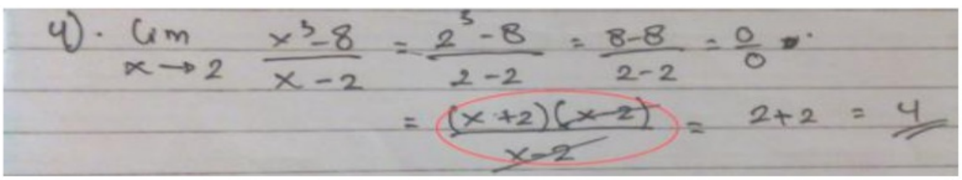

Figure 4. Answers Subjects 6 Problem Number 4

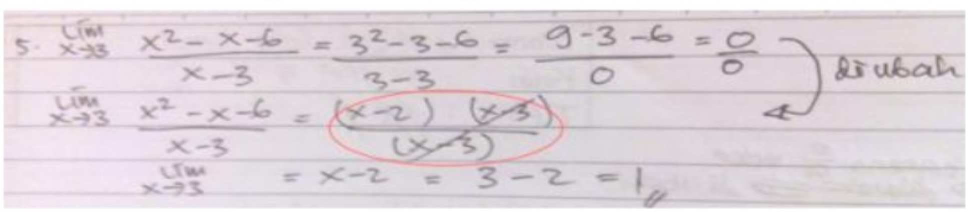

Figure 5. Answer Subject 1 Question Number 5

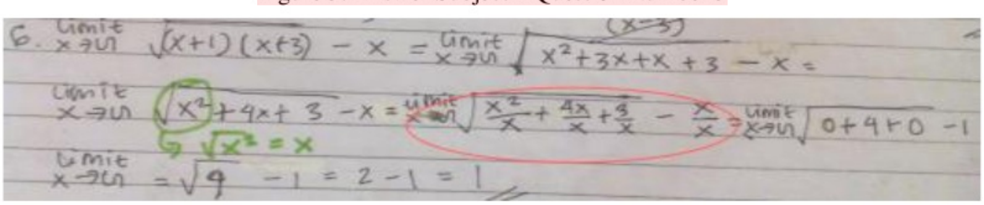

Figure 6. Answer Subject 2 Problem Number 6

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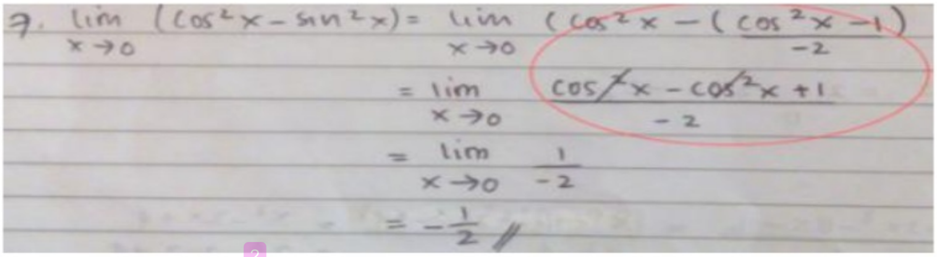

Figure 7 Answers Subjects 37 Problem No. 7

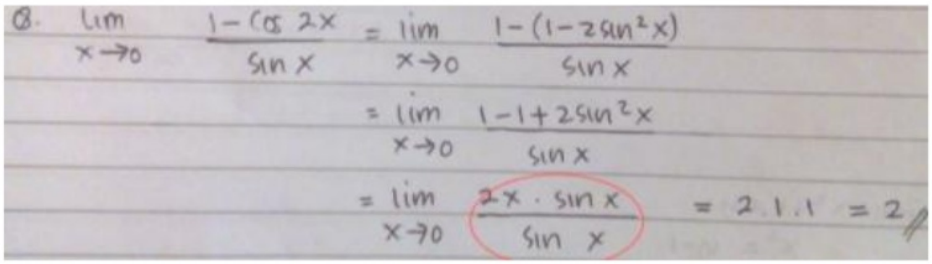

Figure 8. Answers Subjek 37 Problem No. 7

Data Analysis

The following analysis is presented misconception of the study subjects with the possible causes of these misconceptions.

Figure 1 shows that according to Zulfa-Amrina errors made by the subjects 18 is a misconception that students' mistakes because they do not write emblem limit function "$\lim_{x \to 3}$"when using the procedure count limit (Abidin, 2012). Students also make mistakes in understanding the concept of the presence or absence of a limit of a function when the result is 0.

Possible cause of the misconception is the lack of understanding of the definition of the concept of limit function and a lack of under-standing of the value and place (Lerner, 2003).

Figure 2 shows that according to ZulfaAmrina errors made by the subject 3 is operating errors that students make mistakes count at the time of filling the table, and misconceptions by writing "$\lim_{x \to 1} = x = 1$"when using the procedure count limit (Abidin, 2012).

This condition can occur due to teacher factor in teaching mathematics. Not a few teachers give less attention to the achievement of students' understanding of the mastery of the concept of limit. So students can experience misconceptions. The possible causes of miscon-ceptions are the lack of teachers' emphasis on limit function theorems and the lack of understanding of the concept of existence of function limits and their relation to the left and right limits (Jordaan, 2009).

Figure 3 shows that according to ZulfaAmrina errors made by the subject 6 is a misconception that students do not write emblem limit "$\lim_{x \to 1}$"when using the procedure count limit, and operation errors that students make mistakes arithmetic operation division of the highest rank (Abidin, 2012).

Possible causes are a weak factor misconception practical aspects that students only pay attention to the practical aspect without regard to the concept (Irawan, Riyadi, & Triyanto, 2012). Miscalculation, as well as the lack of understanding of the value and place (Lerner, 2003).

Figure 4 shows that according to ZulfaAmrina errors made by the subject 6 is a misconception that students do not write emblem limit "$\lim_{x \to 2}$"when using the procedure count limit, and operation errors that students make mistakes factoring arithmetic algebraic function in order to obtain these results (Abidin, 2012).

Possible causes are a factor miscon-ception practical aspects that students only pay attention to the practical aspect without regard to the concept (Irawan et al., 2012). Miscal-culation, as well as the lack of understanding of the value and place (Lerner, 2003).

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Figure 5 shows that according to ZulfaAmrina errors made by the subject 1 is a misconception that students misunderstood the concept of limit theorem function by writing "$\lim_{x\to 3} = x - 2 = 3 - 2 = 1$"when using the procedure count limit, and miscalculation that students perform arithmetic operation error factoring algebraic function in order to obtain these results (Abidin, 2012).

Possible causes of misconception are the lack of understanding about value And points, as well as calculation errors (Lerner, 2003).

Figure 6 shows that according to ZulfaAmrina errors made by the subject 2 is the systematic errors that students make mistakes in taking steps to resolve problems in order to obtain such a result and the misconceptions that students misunderstood the concept of limit theorem function by writing "$\lim_{x\to\infty} = \sqrt{4} - 1 = 2 - 1 = 1$"when using the procedure count limit (Abidin, 2012).

The possible cause of the misconception is the use of the wrong process, as well as a lack of understanding about the value and place of (Lerner, 2003).

Figure 7 shows that according to ZulfaAmrina errors made by the subjects 37 is the systematic errors that students make the mistake of changing the shape of trigonometric functions towards resolving the matter in order to obtain these results (Abidin, 2012).

Possible causes misconception is the wrong use of the process (Lerner, 2003).

Figure 8 shows that according to ZulfaAmrina errors made by the subject 37 is an operation error that one student in performing arithmetic operations division trigonometric functions, and misconceptions that students misunderstood the concept of limit theorem function by writing "$\lim_{x\to 0} \frac{2x.\sin x}{\sin x} = 2.1.1 = 2$"when determining the value of the limit of a function (Abidin, 2012).

Possible cause of the misconception is the lack of understanding of the value and place, as well as calculation errors (Lerner, 2003).

CONCLUSION

Based on the research result, it can be concluded that; (1) Based on the analysis written tests and interviews were conducted to class XI student of Natural Sciences (IPA) 5SMA Negeri 1 Anjatan in Indonesia. Level experienced misconceptions belong to the category of low, amounting to 12.18%. However, students who do not understand the concept quite high at 40.38% and the rest are students who understand the concept that is equal to 47.44%. (2) Based on the analysis written tests and interviews were conducted to 16 students of class XI Natural Sciences (IPA) 5 SMA Negeri 1 Anjatan in Indonesia who have misconceptions. The misconception of the most widely experienced by students lies in subconcepts explain the meaning of limit function at one point through the calculation of value-value around that point, that is equal to 20.51%. It can be seen from the results of the answers to a written test limit function, most of them do not write emblem limit "$\lim_{x\to a}$" when using the procedure count limit, it is due to ignorance of the definition of the concept of limit function intuitively.

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