

# Analysis of Mathematical Concepts Understanding of College Students in the Form of Differential and Integral in Physical Mathematics Subject

Febriani Hastini Nasution<sup>1</sup> and Dedes Asriani Siregar<sup>2</sup>  
{febriani.hastini, ciregard2s}@gmail.com

*Physics Education Study Program, Education Institute of South Tapanuli, Sutan Mhd Arif Street, Padangsidimpuan, Zip Code 22716, Indonesia<sup>1,2</sup>*

**Abstract.** The purpose of this study was to analyze the mathematical concepts understanding of college students in the form of differential and integral in physical mathematics subject. The method of this research was mixed methods where the quantitative and qualitative research was combined. The model of the mixed methods was sequential explanatory design. The subject of this research was college students in fourth semester of physics education study program in Education Institute of South Tapanuli. The data were collected through using observation and interviewing sheet. Based on analysis data obtained the mean of mathematical concepts understanding of college students in the form of differential and integral was 77.61 in good category. The mean sequence of the indicators from high to the low level were: (1) restate the concepts; (2) apply the concepts or algorithms to physics problem solving; (3) classify objects according to the certain characteristics in accordance with concepts; (4) use, utilize and select certain procedures; (5) present concepts in various forms of mathematical and physical representations; (6) give examples and not examples; (7) develop the necessary or sufficient terms for a concept.

**Keywords:** Mathematical Concepts Understanding; Differential and Integral

## 1 Introduction

The concepts understanding are necessary in learning physics either in the form of an understanding of the concept, completion algebra or the acquisition of a quantity, equation and physical formula. In addition, physics is very closely related to mathematics where mathematics is used as a tool to learn physics. So that mathematics has an important role in learning physics.

One kind of physics subject in Physics Education Study Program, Education Institute of South Tapanuli is Physical Mathematics subject. Physical Mathematics subject is one of the compulsory subject which is consisted of four credits in Physics Education Study Program, Education Institute of South Tapanuli. In this subject, many mathematical concepts and methods are learnt such as Series, Complex Numbers, Vectors, Matrices, Differentiation, Integrals, and other concepts. In addition, not only learning about the mathematical concepts, but also learning about the application of this mathematical concepts to solve the physical problems whether it about concepts or problems. The example of concepts and methods that are often used in Physical Mathematics subject are differential and integral concept. The

example of the application of these concepts are found in some materials such as Rectilinear Motion, Decay, Oscillation, Work and Energy, Electricity Circuit, Thermodynamics, and the other concepts. So that in learning this subject, the mathematical concepts understanding is needed.

Based on the observation result and the experience of writer, college students in Physics Education Study Program occur some difficulties in learning Physical Mathematics subject. This is caused by lack of understanding the mathematical basic concepts of college students so that lecturer should re-teach it from the basis though in reality they have learnt it in Basic Mathematics I and Basic Mathematics II subject and even at the high school level. In addition, the difficulty of understanding the mathematical concepts is generally due to the nature of mathematics which has abstract object that are difficult for students to understand (Fauziyah and Budi, 2014).

The mathematical concepts understanding of students college in the form of differential and integral is the ability of students college in mastering a number of mathematical materials in the form of differential and integral where they are not only know or remember of learned concepts but also able to present these concepts to various forms of mathematical representation so they can solve the physical problems and apply the concepts and methods. This mathematical concepts understanding is very important because through this understanding make students college be easier to understand the materials in Physical Mathematics subject so that they can solve the physical problems. This is accordance with (Nurfarihin, 2010) which stated that there was a correlation between the ability of concepts understanding and the ability of solving problems. Some examples of these mathematical concepts are Differential and Integral. These two concepts are very important and be the basic concept in mathematics and in understanding of physics concepts especially in Mathematical Physics subject and in the other subjects such as Thermodynamics, Basic Nuclear Physics and Mechanics subject.

Differential equation is an equation containing derivatives (Boas M L, 1983). A great many applied problems involve rates, that is, derivatives. The integral equation is defined as inverse of derivative. Differential and integral have the wide application and interconnected each other especially in learning physics concepts. This is because the equations or formulas of physics are obtained through the application of the differential or integral concepts. Therefore, it is very important to understand the mathematical concepts in the form of differential and integral.

The purpose of this paper is to analyze the mathematical concepts understanding of college students in the form of differential and integral in Physical Mathematics subject.

## **2 Review Of Literature, Research Method And The Result Of Research**

This paper is also supported by some part, namely review of literature, research method and the result of research. These are will be explained as below parts:

### **2.1 Review of Literature**

#### **2.1.1 Mathematical Concepts Understanding**

A concept understanding is the ability of students in the form of mastering a number of learning study, where students not only know or remember the learned concepts, but also they

are able to re-disclosure in another form that is easy to understand, provides data interpretation and is able to apply concept that are in accordance with their cognitive structure (Sanjaya, 2000). So that a concept mastered by students is better if accompanied by its application.

There are seven indicators of concepts understanding, namely the ability to restate the concepts, classify objects according to certain characteristics in accordance with concepts, give examples and not examples, present concepts in various forms of mathematical and physical representations, develop the necessary or sufficient terms for a concept, use, utilize and select certain procedures, apply the concepts or algorithms to mathematical problem solving (Hamzah B Uno, 2012).

### 2.1.2 Differential Concepts

Differential equation is an equation containing derivatives (Boas, M L, 1983). A great many applied problems involve rates, that is, derivatives notated as

$$y' = \frac{dy}{dx} \quad (1)$$

The classifications of differential equations are (Anugraha, 2011):

- Ordinary Differential Equations;  
A great many applied problems involve rates, that is, derivatives. An equation containing derivatives is called a differential equation. If it does not contain the partial derivatives, it is called as ordinary differential equation. Ordinary differential equation is a form of equation that contains derivatives of one or more non-independent variable on a function of independent variable. Determining the order of a differential equation depends on the derivative function in the differential equation. An order or level of a differential equation is the highest rank derivative in a differential equation.
- Partial Differentiation;  
Partial differentiation is an equation that contains partial derivative of one or more non independent variable on more than one independent variable of a function.
- Linear and non Linear Ordinary Differential Equations.

### 2.1.3 Integral Concepts

The integral equation is defined as inverse of derivative. The Integral is consisted of:

- Definite Integral;

The function integration  $f(x)$  which is written as  $\int f(x) dx$  is called as definite integral of  $f(x)$ . If  $F(x)$  is anti-derivative of  $f(x)$ , so

$$\int f(x)dx = f(x) + c \quad (2)$$

- Indefinite Integral;

If the function of  $y = f(x)$  is continue to the interval  $a \leq x \leq b$ , so

$$\int_a^b f(x)dx = F(x)\Big|_a^b = F(b) - F(a) \quad (3)$$

Then, the integration techniques, namely:

- Substitution Integral
- Partial Integral

Partial integration rule is the rule that are related to the rule of product for derivatives (Stewart J, 2002). The formula is:

$$\int u \, dv = uv - \int v \, du \quad (4)$$

## 2.2 Research Method

The research method is consisted of:

### 2.2.1 Stages of Research

The research method used is a combination research or mixed methods. This research combines between quantitative research steps and qualitative research steps to obtain more comprehensive, valid, reliable and objective data (Sugiyono, 2012).

### 2.2.2 The Location of Research

This research was conducted in Education Institute of South Tapanuli, Sutan Mhd Arif street, Padangsidempuan, North Sumatera. This research was conducted to fourth semester of college students in even semester Academic Year 2017/2018.

### 2.2.3 The Model of Research

The combination research used in this research is sequential explanatory design. This model of research uses quantitative method at first and the second use qualitative method (Sugiyono, 2012).

### 2.2.4 The Techniques of Data Collecting and Data Analysis

Data collecting used were observation and interview.

Data analysis used by two steps, namely:

- Quantitative Data Analysis;  
Analysis of mathematical concepts understanding in the form of differential and integral calculated by:

$$value = \frac{\textit{obtained score}}{\textit{max imum score}} \times 100 \quad (5)$$

- Qualitative Data Analysis.

The steps of analysis are data reduction, data presentation, and drawing conclusions or verification.

### 2.3 The Result of Research

The purpose of this research was to analyse mathematical concepts understanding in the form of differential and integral of college students in the form of differential and integral in Physical Mathematics subject.

#### 2.3.1 Mathematical Concepts Understanding in the Form of Differential and Integral

The mathematical concepts understanding in the form of differential and integral was analysed using test instrument in the form of observation which was consisted of seven indicators, namely: (1) restate the concepts; (2) classify objects according to certain characteristics in accordance with concepts; (3) give examples and not examples; (4) present concepts in various forms of mathematical and physical representations; (5) develop the necessary or sufficient terms for a concept; (6) use, utilize and select certain procedures; (7) apply the concepts or algorithms to physical problem solving. This understanding was observed and assessed by two observers. The observation result of the first and second observer was:

**Table 1.** Mathematical concepts understanding in the form of differential and integral by observer.

	Mean Value	Category
Observer I	<b>78</b>	<b>Good</b>
Observer II	78	Good

The mean value of each indicator of mathematical concepts understanding in the form of differential and integral was described as below:

**Table 1.** Table title. Table captions should always be positioned *above* the tables.

Indicators	Mean	Category
Indicator I	<b>80</b>	<b>Very Good</b>
Indicator II	<b>78</b>	<b>Good</b>
Indicator III	<b>75</b>	<b>Good</b>
Indicator IV	<b>75</b>	<b>Good</b>
Indicator V	71	Good
Indicator VI	76	Good
Indicator VII	79	Good

The descriptions of indicators are:

Indicator I = Restate the concepts

Indicator II = Classify objects according to certain characteristics in accordance with concepts

Indicator III = Give examples and not examples

Indicator IV = Present concepts in various forms of mathematical and physical representations

Indicator V = Develop the necessary or sufficient terms for a concept

Indicator VI = Use, utilize and select certain procedures

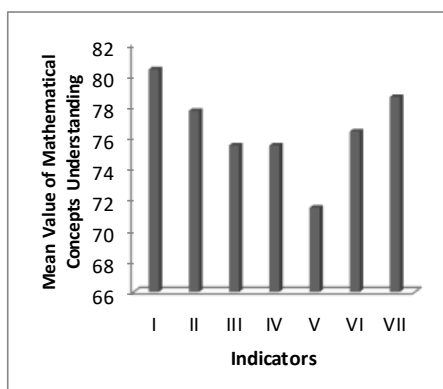
Indicator VII = Apply the concepts or algorithms to physical problem solving

### 3 DISCUSSION

The mean value of mathematical concepts understanding of college students in the form of differential and integral by observer I was 78 in “Good” category and by Observer II was 78 in “Good” category too, so obtained the mean value of the observers was 78 in “Good” category.

The mean value of indicators the mathematical concepts understanding of college students in the form of differential and integral were, indicator “restate the concepts” was 80 in “Very good” category, indicator “classify objects according to certain characteristics in accordance with concepts”

was 78 in “Good” category, indicator “give examples and not examples” was 75 in “Good” category, indicator “present concepts in various forms of mathematical and physical representations” was 75 in “Good” category, indicator “develop the necessary or sufficient terms for a concept” was 71 in “Good” category, indicator “use, utilize and select certain procedures” was 76 in “Good” category, indicator “apply the concepts or algorithms to physical problem solving” was 79 in “Good” category. These mean value described as figure below:



**Fig 1.** Mathematical concepts understanding of college students in the form of differential and integral in each indicator.

If the indicators are sorted from the high mean value to the low mean value are restate the concepts, apply the concepts or algorithms to mathematical problem solving, classify objects according to certain characteristics in accordance with concepts, use, utilize and select certain procedures, present concepts in various forms of mathematical and physical representations, give examples and not examples, develop the necessary or sufficient terms for a concept.

Based on the initial interview result before learning begins, found that college students feel difficult to understand the differential and integral method/concept. They only know the definition of these two methods/concepts, namely differential is derivative while integral is the opposite of the derivative. When given several examples, they still cannot distinguish which one included the example of differential and which one included the example of integral. In addition, they also forget about the formula and how to use it both differential and integral. This causes them to not be able to distinguish the use of the methods/concept in solving physical problems contained in Physical Mathematics subject.

However, after the next meeting the mathematical concept understanding of college students in the form of differential and integral is increasing. This is evidenced by the mean value of mathematical concept understanding of college students that increase at each meeting. Therefore, concluded that they have the ability to restate the concepts, classify objects according to certain characteristics in accordance with concepts, give examples and not examples, present concepts in various forms of mathematical and physical representations, develop the necessary or sufficient terms for a concept, use, utilize and select certain procedures, apply the concepts or algorithms to physical problem solving.

## 4 Conclusions

Based on the result of research and data analysis obtained conclusion, namely the mean value of mathematical concept understanding of college student in the form of differential and integral analysed through seven indicators was 78 and was in "Good" category. Where the highest mean value was in the indicator "restate the concepts" with a mean value of 80 and was in "Very good" category while the lowest mean value was in the indicator "develop the necessary or sufficient terms for a concept" with a mean value of 71 and was in "Good" category.

## References

- [1]Anugraha, R.: Pengantar Fisika Matematik.FMIPA UGM, Yogyakarta (2011)
- [2]Boas., M, L.: Mathematical Methods in The Physical Science.John Wiley & Sons Inc, Singapore(1983)
- [3]Fauziah & Budi.:Peningkatan Kemampuan Pemahaman Konsep Matematika Melalui Pendekatan Open-Ended bagi Siswa Kelas VIII Semester Genap SMP Muhammadiyah 10 Surakarta Tahun 2013/2014.FKIP Universitas Muhammadiyah, Surakarta (2014)
- [4]Nurfarihin, F.: Hubungan Kemampuan Pemahaman Konsep dan Kemampuan Penalaran dengan Kemampuan Pemecahan Masalah pada Materi Bangun Ruang Sisi Lengkung Peserta Didik Kelas IX MTs Nu 24 Darul Ulum Pidodo Kulon Patebon Kendal.Fakultas Tarbiyah Institut Agama Islam Negeri Walisongo Semarang, Semarang (2010)
- [5]Sanjaya, W.: Strategi Pembelajaran Berorientasi Standar Proses Pendidikan. Kencana Prenada Media Group, Jakarta (2009)
- [6]Stewart, J.: Kalkulus Edisi Keempat. Terjemahan oleh Nyoman Susila dan Hendra Gunawan, Penerbit Erlangga. Jakarta (2002)
- [7]Sugiyono.: Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D) Alfabeta, Bandung (2012)
- [8]Uno, H., B.:Belajar dengan Pendekatan PAIKEM. PT Bumi Aksara, Jakarta (2012)